APPENDIX A

FLAT PANEL DISPLAY TECHNOLOGIES

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FLAT PANEL DISPLAY TECHNOLOGIES

1. Background

Flat panel displays (FPDs) are increasingly gaining a presence in the computer display market. They provide, for example, a more compact display as used in laptop computers and are viable substitutes for cathode ray tube (CRT) displays. Other advantages over the CRT are higher contrast, sunlight readable, more reliable, and more durable (i.e., require much less maintenance) Koch and Keoleian, 1995). In general, the major disadvantages have been that the resolution and quality of the image did not match that of CRTs. Several different types of FPD technologies have been demonstrated and are in use to varying degrees. The major categories are liquid crystal displays (LCD), plasma display panels (PDP), electroluminescent (EL), field emission displays (FED), vacuum fluorescent displays (VFD), digital micromirror devices (DMD), and light emitting diodes (LED). Table A-1 briefly describes each FPD technology. Although each technology has its own performance characteristics and is manufactured using different materials and processes, most are generally comprised of two glass plates surrounding a material that filters external light or emits its own light. These technologies use manufacturing techniques more similar to the production of semiconductor chips than televisions. Most FPDs control the color and brightness of each pixel (picture element) individually, rather than from one source, such as the electron gun in the CRT. The different types of electronic information display devices and how they are categorized are depicted in Fig. A-1.

1.1 Elimination of FPD Technologies from this Study

While there are several types of FPDs, two LCD technologies will be included in this LCA, based on their applicability to be used as substitutes in the computer display market. LCDs comprise approximately 87% of the FPD market (OTA, 1995). Currently, the largest market for FPDs is in notebook computers and CRTs monopolize the desktop computer market. However, FPDs are already moving into the desktop computer market. The LCD technology that best meets the purpose and needs of this study is the amorphous-silicon thin film-transitor (a:Si TFT) active matrix LCD (AMLCD). There are two variations of the a:Si TFT AMLCD that are expected to dominate the desktop monitor market for LCDs: the traditional twisted nematic (TN) mode and the in-plane switching (IPS) mode. Table A-1 describes these technologies. Various subtechnologies of LCDs are presented in Fig. A-2. The IPS mode is a non-nematic amorphous silicon AMLCD. Note that all the subtechnologies listed in Fig A-2 are not described here; the purpose is simply to show the complexity of different types of LCDs.

The PDP technology could be incorporated into the desktop computer market, especially if computers and televisions begin to merge. However, plasma technology is generally designed for large screens, and does not meet the specifications (e.g., diagonal size) of the functional unit defined for this project. Therefore, PDP technology will not be included in the scope of this project. FED and EL technologies are targeted toward military, medical, and high-end commercial products because they possess particular characteristics (such as size, durability, and high image quality) for those niche markets. Because these other FPD technologies are a small fraction of the market, not targeted toward the desktop computer market, and/or do not meet the

specifications of our functional unit, they are not included within the scope of this project. Table A-1 presents brief descriptions of various FPD technologies and whether or not they are included in this LCA.

Table A-1. Flat panel display technologies

Technology	Description	Applicability to Project
Liquid Crystal Displays (LCD)	A liquid crystal material, acting like a shutter, blocks, dims, or passes light unobstructed, depending on the magnitude of the electric field across the material (OTA, 1995). A backlight provides the light source.	Included in this study. Descriptions of the subtechnologies and whether or not they are included in the study are presented below.
(1) Passive matrix (PMLCD)	Liquid crystal (LC) material is sandwiched between two glass plates, which contain parallel sets of transparent electrical lines (electrodes) in a row and column configuration to form a matrix. Every intersection forms a pixel, and the voltage across the pixel causes the LC molecules to align and determines the shade of that pixel (OTA, 1995).	Traditionally for low-end applications (e.g., calculators, wrist watches). Higher end applications use a super-twisted nematic (STN)[1] construction. The liquid crystal material is twisted between 180 and 270 degrees which improves the contrast between the "on" and "off" states, resulting in a clearer display than with the twisted nematic (twisted only 90 degrees) (OTA, 1995; MCC, 1997). However, cost and performance issues limit this technology from wide application in the desktop market and therefore, it will not be evaluated in this study.
(2) Active matrix (AMLCD)	Similar to the PMLCD except an electronic switch at every pixel provides faster switching and more shades. The addressing mechanism eliminates the viewing angle and brightness problems suffered by PMLCD. Requires more backlight than PMLCD due to the additional switching devices on the glass (at each pixel). Various switching types are listed below:	Provides vivid color graphics in portable computer and television screens (OTA, 1995). This technology meets the functional unit specifications in this study. Specific subcategories are described below.

[1] Traditional light modulating methods for LCD technologies include twisted nematic (TN), super-twisted nematic (STN), double STN, triple STN, and film-compensated STN (OTA, 1995). The STN is the current standard for high-end PMLCD applications.

Table A-1. Flat panel display technologies

Technology	Description	Applicability to Project
	AMLCD Switch Types:	
	(2a) Thin-film transistor (TFT): The transistor acts as a valve allowing current to flow to the pixel when a signal is applied. The transistors are made of various materials including: amorphous silicon (a:Si), polycrystalline silicon (p:Si), non-Si[CdSe] (Castellano, 1992). Two different TFT light modulating modes are twisted nematic (TN) and in-plane switching (IPS) (DisplaySearch 1998). In comparison to the TN mode, the IPS mode requires more backlight but fewer manufacturing steps.	The current standard AMLCD switching mechanism for computer displays is a:Si TFT. Polycrystalline Si is not suitable for larger than about 5" displays. Both the TN and IPS a:Si TFT AMLCD technologies are analyzed in this project.
	(2b) Diode matrix: The diode acts as a check valve. When closed, it allows current to flow to the pixel charging it. When opened, the pixel is disconnected and the charge is maintained until the next frame (Castellano, 1992).	The diodes are found to short easily and must be connected in series to achieve long life usability. The diode displays are also limited in size smaller than that of the functional unit.
	(2c) Metal-insulator metal (MIM): The MIM is a diode type switch using metal-insulated-metal fabrication techniques (OTA, 1995).	Temperature sensitive, which creates gray scale nonuniformities. They are also size limited like other diode type displays and therefore not included in this study.
(3) Active addressed LCD	Hybrid of passive and active matrix. The pixels are addressed using signals sent to the column and row as determined using an algorithm encoded into an integrated circuit (IC). The IC drives each row of pixels more or less continuously and drives multiple rows at one time (OTA, 1995)	Employed in notebook and desktop monitors >12.1". However, they need special drivers (OTA, 1995), have slow response times, and their contrast worsens as panel size increases (Young, 1998). Therefore, this technology does not meet the specifications of the functional unit and is excluded from evaluation in this study.
(4) Plasma-addressed liquid crystal (PALC)	The pixel is addressed using row electrodes, which send the signal, and column gas channels, which conduct a current when ionized (OTA, 1995).	PALC displays are in development to be used as large low cost displays. Production of the displays have not yet occurred and they are not included in this study.
(5) Ferroelectric LCDs (FLCD or FELCD)	The pixel is addressed using positive or negatives pulses to orient the crystals. The positive pulse allows light to pass (light state) and the negative pulse causes the blockage of light (dark state) (Castellano, 1992). A ferroelectric liquid crystal is bistable and holds it polarization when an electric field is applied and removed (Peddie, 1994). They are also called surface stabilized ferroelectric (SSF) LCD.	Has high resolution with very good brightness, but limited color palette (Peddie, 1994). Limited color palette does not meet color specification of functional unit.

Table A-1. Flat panel display technologies

Technology	Description	Applicability to Project
Plasma Display Panels (PDP)	An inert gas (e.g., He, Ne, Ar) trapped between the glass plates emits light when an electric current is passed through the matrix of lines on the glass. Glow discharge occurs when ionized gas undergoes recombination. Ionization of atoms occurs (electrons are removed), then electrons are recombined to release energy in the form of light. Full color plasma displays use phosphors that glow when illuminated by the gas (OTA, 1995).	Established technology. Good for large screens (e.g., wall-mounted televisions), but are heavier and require more power than LCDs (OTA, 1995). Designed for large screens and are larger displays than specified for desktop applications. Therefore, not included in this study.
Electroluminescent Displays (EL)	A phosphor film between glass plates emits light when an electric field is created across the film (OTA, 1995). EL uses a polycrystalline phosphor (similar to LED technology which is also an electroluminescent emitter, but uses a single crystal semi-conductor). ELs are doped (as a semiconductor) with specific impurities to provide energy states that lie slightly below those of mobile electrons and slightly above those of electrons bound to atoms. Impurity states are used to provide initial and final states in emitting transitions (Peddie, 1994). Also referred to as thin-film EL (TFEL). Variations: AC thin-film EL (AC-TFEL), active matrix EL (AMEL), DC EL, organic EL.	Lightweight and durable. Used in emergency rooms, on factory floors, and in commercial transportation vehicles (OTA, 1995). Problems found in the power consumption and controlling of gray levels. Targeted toward military, medical, and high-end commercial products, therefore not included in the scope of this project.
Field Emission Displays (FED)	Flat CRT with hundreds of cathodes (emitters) per pixel (form of cathodeluminescent display); eliminates single scanning electron beam of the CRT. Uses a flat cold (i.e., room temperature) cathode to emit electrons. Electrons are emitted from one side of the display and energize colored phosphors on the other side (OTA, 1995; Peddie, 1994).	Not commercially available, but anticipated to fill many display needs (OTA, 1995). Could potentially apply in all LCD and CRT applications. High image quality as with CRT, but less bulky and less power use than with CRT. A number of roadblocks to this technology taking over the AMLCD market include proven manufacturing processes (problems found in the reliability and reproducibility of the devices), efficient low-voltage phosphors, and high voltage drivers. The technology is targeted toward military, medical and high-end commercial products and not included in current study.
Vacuum Fluorescent Displays (VFD)	Form of cathodeluminescent display that employs a flat vacuum tube, a filament wire, a control grid structure, and a phosphor-coated anode. Can operate at low voltages since very thin layers of highly efficient phosphors are coated directly onto each transparent anode (Peddie, 1994).	VFDs offer high brightness, wide viewing angle, multi-color capability and mechanical reliability. Used in low information content applications (e.g., VCRs, microwaves, audio equipment, automobile instrument panels, etc.). No significant uses seen for computer displays (Peddie, 1994).

Table A-1. Flat panel display technologies

Technology	Description	Applicability to Project
Digital Micromirror Devices (DMD)	Miniature array of tiny mirrors built on a semiconductor chip. The DMD is used in a projector that shines light on the mirror array. Depending on the position of a given mirror, that pixel in the display reflects light either onto a lens that projects it onto a screen (resulting in a light pixel) or away from the lens (resulting in a dark pixel) (OTA, 1995).	Just beginning to be used mainly as projection devices and has not been developed for use that would match the functional unit (OTA, 1995).
Light Emitting Diodes (LED)	The LED device is essentially a semiconductor diode, emitting light when a forward bias voltage is applied to a p-n junction. The light intensity is proportional to the bias current and the color dependent on the material used. The p-n junction is formed in a III-V group material, such as aluminum, gallium, indium, phosphorous, antimony, or arsenic.	For low information display applications, which makes it not capable of meeting the requirements of the functional unit. Color, power, and cost limitations prevent the emergence into the high information display market (Castellano, 1992).
Electrochromic display	Open-circuit memory using liquid electrolytes (Peddie, 1994, p. 214). Non-emitter (as LCDs), as opposed to emitters (e.g., EL, FED, PDP).	Outstanding contrast and normal and wide viewing angles; open-circuit memory. Complex and costly involving liquid electrolytes, poor resolution, poor cycle life, lack of multicolor capability, etc. Not suitable for computer displays in past; however, new technology may be promising (Peddie, 1994).
Light Emitting Polymers	Developing technology (Holton, 1997).	Developing technology.

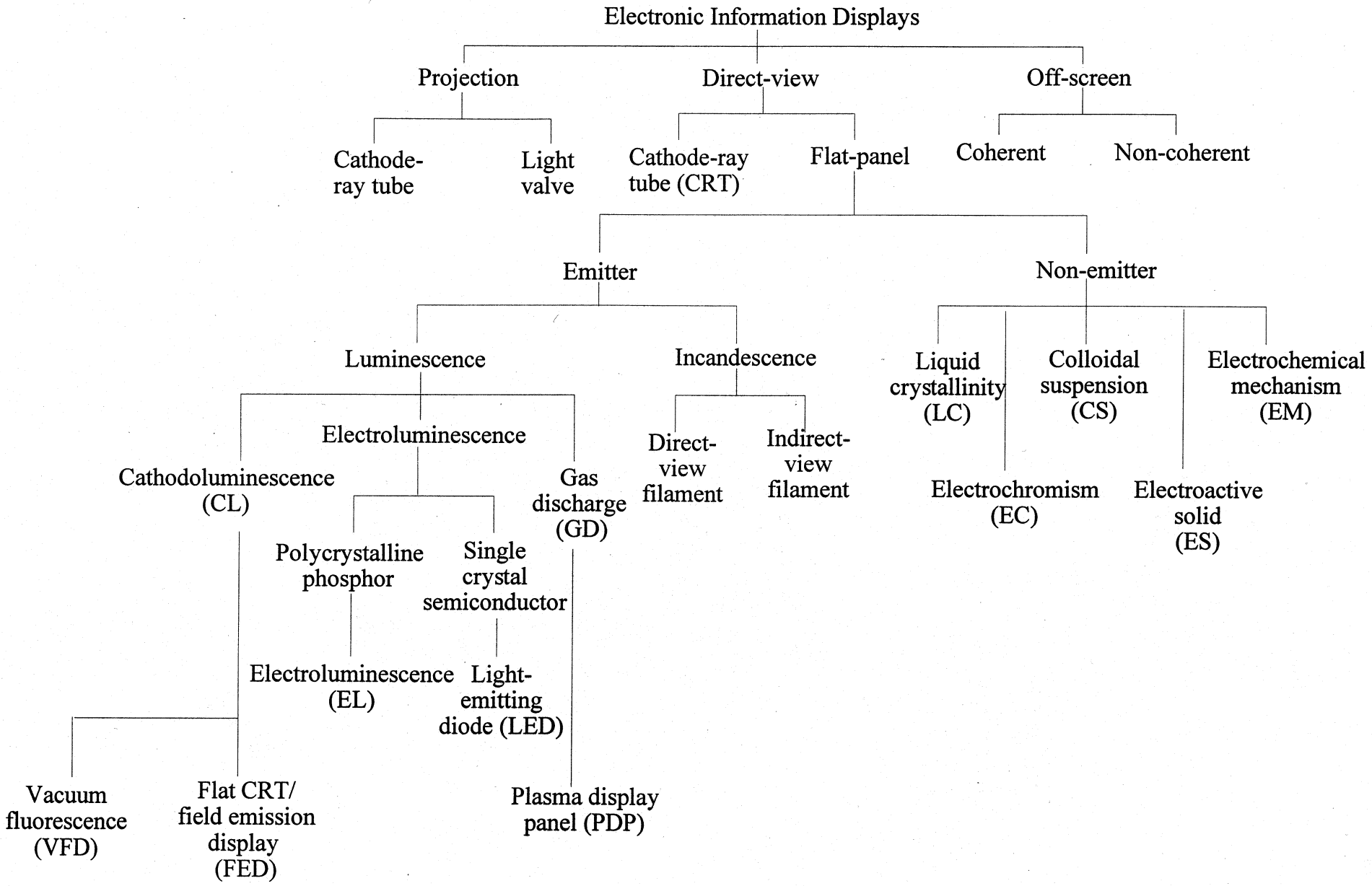

Figure A-1. Classification of Electronic Information Displays. ***Source:*** **Adapted from Tannas 1985.**

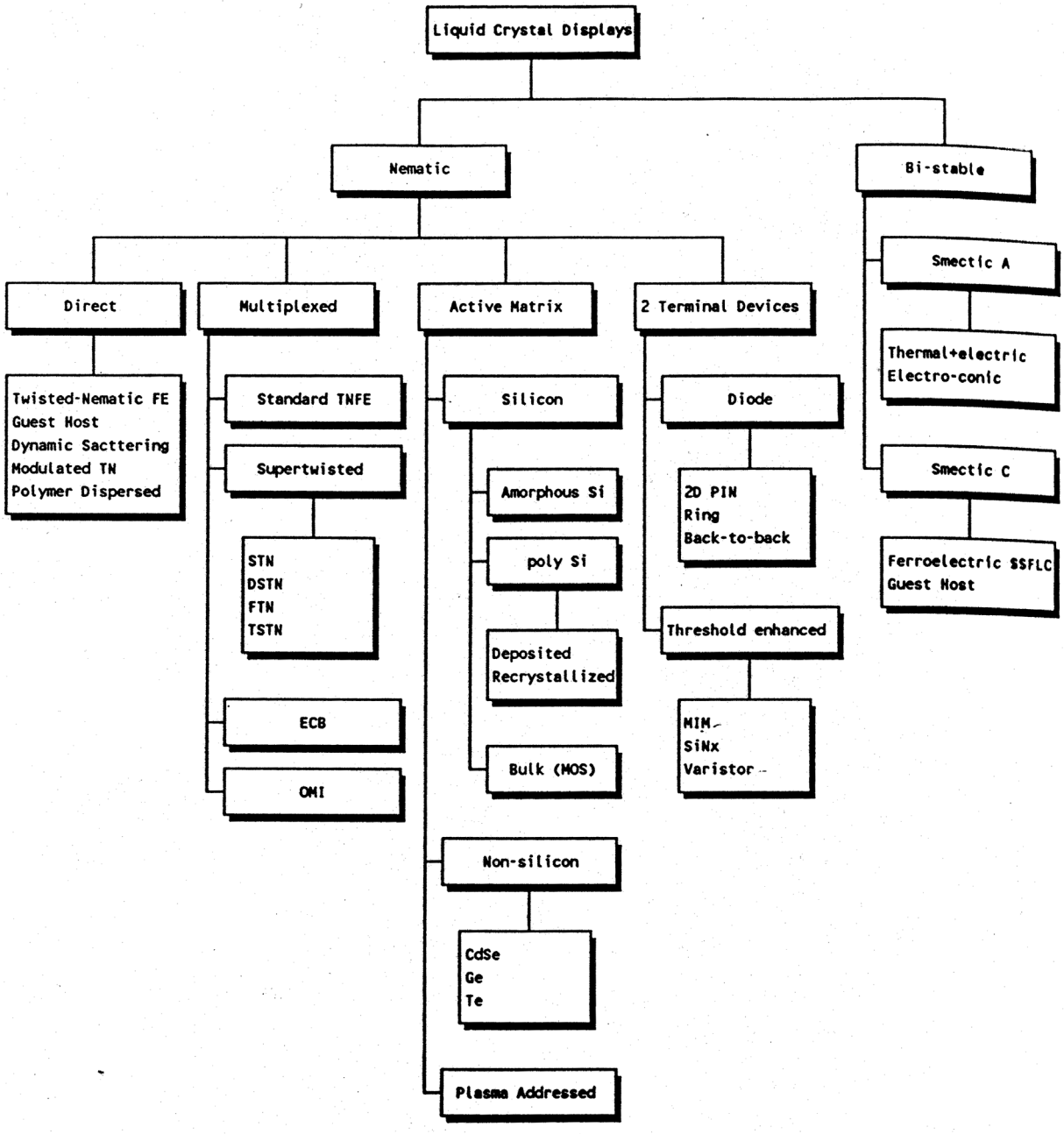

Figure A-2. LCD subtechnologies. Source: Catellano 1992.

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APPENDIX B

DESCRIPTIONS OF LIQUID CRYSTAL DISPLAY (LCD) TECHNOLOGY AND AMORPHOUS SILICON THIN-FILM TRANSISTOR (a:Si TFT) TECHNOLOGY

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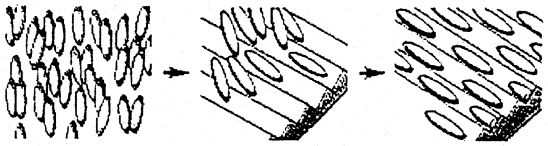
PRINCIPLES OF LCD TECHNOLOGY

In this section, we will explain everything ranging from the properties of liquid crystal molecules to the basic principle of display technology by using TN type liquid crystals as an example.

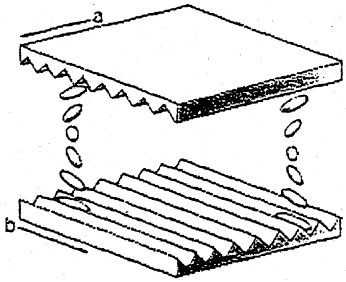
The parallel arrangement of liquid crystal molecules along grooves

When coming into contact with grooved surface in a fixed direction, liquid crystal molecules line up parallel along the grooves.



Natural State	When coming into contact with a finely grooved surface (alignment layer).	Molecules line up parallel along grooves.
Molecules are arranged in a loosely ordered fashion with their long axes parallel.		

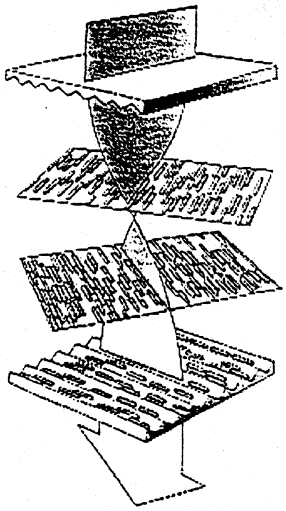
When liquid crystals are sandwiched between upper and lower plates, they line-up with grooves pointing in directions 'a' and 'b,' respectively



The molecules along the upper plate point in direction 'a' and those along the lower plate in direction 'b,' thus forcing the liquid crystals into a twisted structural arrangement.
(figure shows a 90-degree twist)
(TN type liquid crystal)

Light travels through the spacing of the molecular arrangement

The light also "twists" as it passes through the twisted liquid crystals

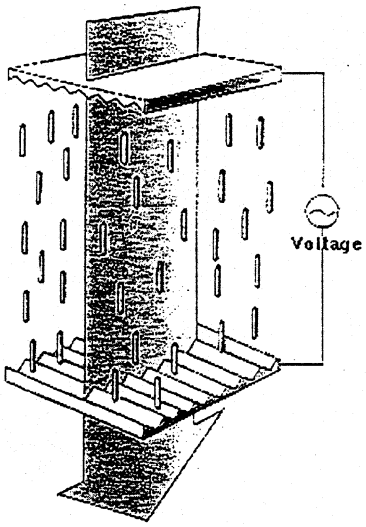


Light passes through liquid crystals, following the direction in which the molecules are arranged. When the molecule arrangement is twisted 90 degrees as shown in the figure, the light also twists 90 degrees as it passes through the liquid crystals.

Light bends 90 degrees as it follows the twist of the molecules

Molecules rearrange themselves when voltage is applied

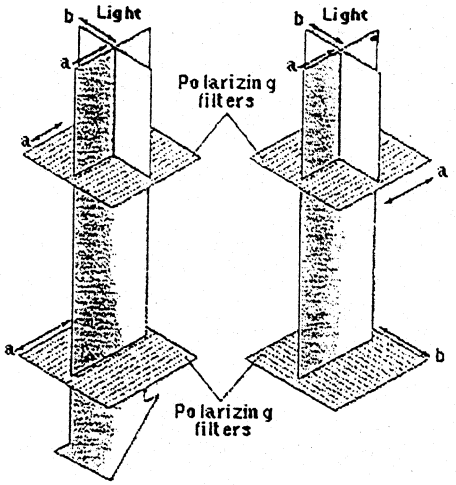
When voltage is applied to the liquid crystal structure, the twisted light passes straight through.



The molecules in liquid crystals are easily rearranged by applying voltage or another external force. When voltage is applied, molecules rearrange themselves vertically (along with the electric field) and light passes straight through along the arrangement of molecules.

Blocking light with two polarizing filters

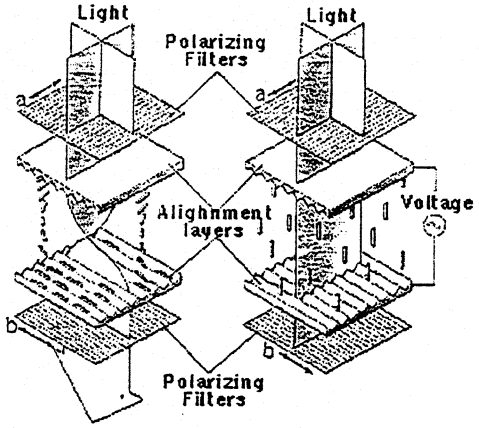
When voltage is applied to a combination of two polarizing filters and twisted liquid crystal, it becomes a LCD display.



Light passes when two polarizing filters are arranged with polarizing axes as shown above, left.
Light is blocked when two polarizing filters are arranged with polarizing axes as shown above, right.

TN type LCDs

A combination of polarizing filters and twisted liquid crystal creates a liquid crystal display.



When two polarizing filters are arranged along perpendicular polarizing axes, light entering from above is re-directed 90 degrees along the helix arrangement of the liquid crystal molecules so that it passes through the lower filter.	When voltage is applied, the liquid crystal molecules straighten out of their helix pattern and stop redirecting the angle of the light, thereby preventing light from passing through the lower filter.

This figure depicts the principle behind typical twisted nematic (TN) liquid crystal displays. In a TN type LCD, liquid crystals in which the molecules form a 90-degree twisted helix, are sandwiched between two polarizing filters. When no voltage is applied, light passes; when voltage is applied, light is blocked and the screen appears black. In other words, the voltage acts as a trigger causing the liquid crystals to function like the shutter of a camera.

AMORPHUS-SI TFT TECHNOLOGY

Active matrix LCDs, which are typically used in products such as LCD projectors, are controlled by a switching element known as a thin-film transistor or thin-film diode placed at each pixel.

The fundamental concept was revealed in 1961 by RCA of America, a U.S. company, but basic research only began in the 1970's. Amorphous Si TFT LCDs introduced in 1979 and 1980 have become the mainstream for today's active matrix displays. These units place an active element at each pixel, and taking advantage of the non-linearity of the active element, are able to apply sufficient drive-voltage margin to the liquid crystal itself, even with the increase in the number of scan lines.

As shown in Figure 1, TFT LCDs that use amorphous Si thin-film transistors (TFTs) as the active elements are becoming the mainstream today, and full-color displays achieving contrast ratios of 100:1 and which compare favorably to CRTs are being developed.

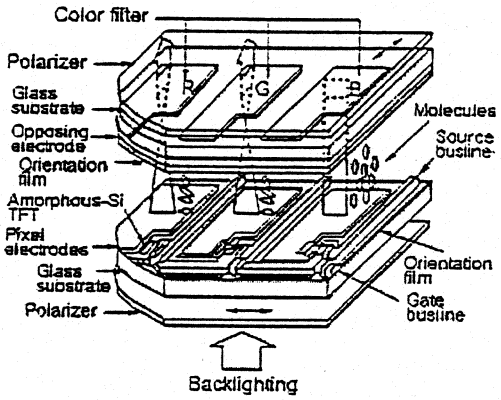


Figure 1 Construction of TFT LCD

The driver electronics for TFT LCDs consist of data-line drive circuitry that applies display signals to the data lines (source drivers) and scanning line drive circuitry that applies scanning signals to the gate lines (gate drivers). A signal control circuit to control these operations and a power supply circuit complete the system.

Liquid crystal materials used in TFT LCDs are TN (twisted nematic) liquid crystals, but despite the fact that pixel counts have increased and a drive element is placed at each pixel, we have still been able to rapidly increase the contrast, viewing angle, and image quality of these displays.

However, manufacturing technologies to fabricate several hundred thousand such elements onto the surface of a large screen are extremely problematic, and the fundamental approach developed in 1987 is still being used today.

In 1988, Sharp developed a 14-inch TFT color TV, and with this development of a futuristic wall-mount TV, TFT LCDs created the foundation for manufacture and introduction of large-screen color displays.

Reinitzer discovered liquid crystals almost 100 years ago, and today, bolstered by customer needs and the new and special technologies and materials that a manufacturer can offer to meet those needs, liquid crystals have made huge strides.

At this opportunity, we would to make the whole world aware of the potential of LCDs, and as new manufacturers enter the market, become the trigger that raises this awareness to new levels.

In the evolution of LCD display manufacturing, the burden of undertaking aggressive development of application products has been considerable. In addition to notebook and sub-notebook PCs that have been the mainstream applications for LCDs in the past, there has been significant growth in areas which take advantage of the unique characteristics of LCD displays, such as compact size, thin profile, and low power consumption to create products which could not be produced using CRTs, such as LCD TVs, ViewCams, new portable information tools, etc. In addition, for large projection TVs, it has now become possible to develop products that are more compact and lighter in weight than conventional CRT-based models, and LCDs are rapidly becoming the mainstream display device in this field.

In this way, LCD displays have expanded into application areas that were once niches belonging solely to CRTs, and the development of numerous key technologies that have the potential to further expand their application product areas continues.

Thanks to the development of TFT LCD displays and the synergistic evolution (spiral evolution) with LCD application devices and equipment, such as PC notebooks and computer monitors, A/V equipment, car navigation systems, game devices, etc., we can anticipate the growth of new demand-generating products. LCDs have emerged as the likely winner among flat-panel displays for the new information-oriented society. As we approach the dawn of the multimedia era which will see the convergence of video, computers, and communications, a critical need is emerging for innovations in displays that link man and machine through our sense of sight.

The driving force behind LCD manufacturing are recently developed amorphous-Si TFT LCD technologies which represent breakthroughs in the areas of 1) higher aperture ratios, 2) wider viewing angles, and 3) EMI (electromagnetic interference) reduction, as well as low-temperature polycrystalline Si TFT LCD display technologies. Thanks to these

breakthroughs, a new direction has emerged in 1996 which will make the best use of these key technologies in LCD applications. For example, higher aperture ratio technologies are being used in LCD displays intended for PC notebooks, wider viewing angle and lower EMI technologies are being used in LCDs destined for LCD monitors, and low-temperature polycrystalline Si TFT LCD technologies are being used as super-fine dot-pitch light valves for high-definition projection TV systems.

In the future, promising new technologies can be expected to spawn the next generation of new LCD application products based on high-performance LCD display systems ("systems-on-panel") that takes full advantage of integrated drive and control circuitry.

References

Sharp. 1998. Information found on a Web page from Sharp USA. Web site available at: <http://www.sharp-usa.com/products/pro/tech/>.

APPENDIX C

CRITICAL REVIEW

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APPENDIX C

CRITICAL REVIEW

Table C-1. Computer Display Project Core Group* and Technical Work Group Members

Contact	Organization	Location
Salla Ahonen	Environmental Issues, Nokia Research Center, Nokia	Helsinki, Finland
Heather Bowman	Electronics Industry Alliance	Arlington, VA
Reggie Caudill	New Jersey Inst. of Tech. Research Center	Newark, NJ
Bob Donofrio	Display Device Consultants	Ann Arbor, MI
Holly Evans Co-Chair, Core Group	Electronics Industry Alliance	Arlington, VA
Bruce Gnade	DARPA	Arlington, VA
Tony Hainault	Minnesota Office of Environmental Assistance	St. Paul, MN
Kathy Hart* Co-Chair, Core Group	US EPA, Office of Prevention Pesticides and Toxic Substances	Washington, DC
Edwin Henderson*	US EPA, Office of Prevention Pesticides and Toxic Substances [a]	Washington, DC
David Isaacs* former Co-Chair, Core Group	Electronics Industry Alliance [a]	Arlington, VA
Mikko Jalas	Environmental Issues, Nokia Research Center, Nokia	Helsinki, Finland
Tim Jarvis	The SemiCycle Foundation	Austin, TX
Greg Keoleian	U. of Michigan, School of Natural Resources and the Env.	Ann Arbor, MI
Lori Kincaid*	Univ. of TN Center for Clean Products and Clean Technologies	Knoxville, TN
J. Ray Kirby	IBM	Research Triangle Park, NC
Jonathan Koch	GE Power Systems	Schenectady, NY
David Lear	Compaq Computer Corp.	Houston, TX
Clare Lindsay	U.S. EPA, Office of Solid Waste	Arlington, VA
John Lott	DuPont Electronic Materials	Research Triangle Park, NC
Jeff Lowry	Techneglas	Columbus, OH
Carole McCarthy	McCarthy Environmental Consulting	Duxbury, MA
Timothy Mann	IBM	Loganville, GA

Table C-1. Computer Display Project Core Group* and Technical Work Group Members

Contact	Organization	Location
Frank Marella Co-Chair, Technical Work Group	Sharp Electronics Corporation	Mahwah, NJ
John Mathews	Envirocycle	Hallstead, PA
Jay Mathewson	Eastman Kodak Co.	Rochester, NY
Colleen Mizuki*	Microelectronic & Computer Technology Corporation [a]	Austin, TX
Amanda Monchamp	Electronics Industry Alliance [a]	Arlington, VA
Rick Nolan	Motorola	Austin, TX
Bob Pinnel*	U.S. Display Consortium	San Jose, CA
Greg Pitts*	Microelectronic & Computer Technology Corporation [a]	Austin, TX
Gene Proch	Corning Asahi	
Gloria Schuldt	Microelectronic & Computer Technology Corporation [a]	Austin, TX
Eileen Sheehan	U.S. EPA, P2 Team, Region 9	San Francisco, CA
Dipti Singh* Co-chair, Technical Work Group	US EPA, Office of Prevention Pesticides and Toxic Substances	Washington, DC
Doug Smith	Sony Electronics Inc.	San Diego, CA
Ted Smith*	Silicon Valley Toxics Coalition	San Jose, CA
David Spengler*	Digital Equipment Corporation	Maynard, MA
Maria Socolof*	Univ. of Tennessee Center for Clean Products & Clean Technologies	Knoxville, TN
Dan Steele	Motorola MD FPD 10 ESIH and Chemical Operations Flat Panel Display Division	Tempe, AZ
Larry Stone	Compaq Computer Corp.	Houston, TX
Butch Teglas (Delmer F.)	Philips Consumer Electronics	Knoxville, TN
Valerie Thomas	Princeton Univ. Ctr. For Energy & Env. Studies	Princeton, NJ
David Thompson	Matsushita Electronic Corporation of America	Secaucus, NJ
Donna Timmons	Eastman Kodak Co.	Rochester, NY
Dani Tsuda*	Apple Computer Inc.	Cupertino, CA
Lucian Turk	Dell Computer	Austin, TX
Laura Turbini	Georgia Institute of Technology	Atlanta, GA
Victoria Wheeler	Eastman Kodak Co.	Rochester, NY

Table C-1. Computer Display Project Core Group* and Technical Work Group Members

Contact	Organization	Location
Ross Young former Co-Chair, Technical Work Group	Display Search	Austin, TX

* Core Group members (subset of Technical Work Group)
[a] Affiliation at time of involvement in project.

Table C-2. U.S. EPA Design for the Environment Workgroup Members for the Computer Display Project

Name	Division/Branch
Andrea Blaschka	Risk Assessment Division/Existing Chemicals Assessment Branch
Susan Dillman	National Program Chemicals Division/Technical Branch
Franklyn Hall	Economic, Exposure, and Technology Division/Chemical Engineering Branch
Kathy Hart	Economics, Exposure, and Technology Division/Design for the Environment
Karen Hogan	Risk Assessment Division/Science Support Branch
Susan Krueger	Economics, Exposure, and Technology Division/Economic and Policy Analysis Branch
Fred Metz	Economics, Exposure, and Technology Division/Industrial Chemistry Branch
Dipti Singh	Economics, Exposure, and Technology Division/Design for the Environment
Jerry Smrchek	Risk Assessment Division/Existing Chemicals Assessment Branch

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APPENDIX D

TECHNICAL MEMORANDUM:
Life-Cycle Inventory Approach for Materials Extraction and Materials Processing Life-Cycle Stages

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APPENDIX D

TECHNICAL MEMORANDUM: Life-Cycle Inventory Approach for Materials Extraction and Materials Processing Life-Cycle Stages

1. INTRODUCTION

1.1 Background

The U.S. Environmental Protection Agency's Design for the Environment Program Computer Display Project (CDP) is conducting an environmental life-cycle assessment (LCA) that will evaluate the relative environmental impacts of cathode ray tubes (CRT) and liquid crystal display (LCD) computer monitors. The major life-cycle stages of a product system include materials extraction, materials processing, product manufacturing, product use, and final product disposition (end-of-life). An LCA evaluates the relative environmental impacts of a product system and is defined in greater detail in Chapter 1 of the main report. An LCA generally consists of four phases: goal definition and scoping, life-cycle inventory (LCI), life-cycle impact assessment (LCIA), and life-cycle improvement assessment.

The activity of quantifying the inputs (e.g., materials, utilities) and outputs (e.g., emissions, wastes) of a product system is the LCI phase of an LCA. A product system is made up of the multiple processes that help produce, use, or dispose of the product. Each process typically has an inventory that consists of inputs and outputs for each process. Therefore, an LCI of a product system consists of several inventories for processes throughout the life-cycle of the product. This technical memorandum (TM) addresses the LCIs related to two major life-cycle stages: materials extraction and materials processing, which together will be referred to as the life-cycle stages that are "upstream" of the product manufacturing stage. Ideally, transportation associated with those stages is also included. This TM will describe the approach to choosing the upstream data from secondary sources that will be included in the CDP analysis.

1.2 Purpose and Scope of this Technical Memorandum

The purpose of this TM is to present the approach for obtaining process-specific inventory data related to extraction and processing of the materials needed to produce a CRT and LCD computer monitor. Collecting these upstream inventory data can involve dozens of upstream processes because there are dozens of materials used to produce CRTs and LCDs. Therefore, decision rules are typically used to limit which materials to include in the scope of the LCA, and existing data from secondary sources are generally relied upon. For inventories related to materials extraction and materials processing, various databases with input and output LCI data exist for materials commonly used in industry. The existence of these inventories, and the limited resources available for collecting primary inventory data for the entire life cycle, result in the use of secondary data for upstream processes. In the CDP, more emphasis will be given to collecting primary data for product manufacturing and end-of-life processes. This TM identifies initial materials considered for inclusion in the upstream life-cycle stages. Actual material lists from the inventories collected from the primary data collection efforts were not available until

after data collection had to begin for the upstream processes. Therefore, initial materials were identified to help determine which secondary data to obtain. Once actual materials from the manufacturing stage inventory were identified, the selected secondary data source was checked for the appropriate data sets to be included in the study. This TM addresses the initial steps for choosing which upstream data source to use, by identifying and prioritizing several data sources. The remainder of this TM will present a brief summary of results, the methodology for selecting secondary upstream data for the CDP, detailed results in terms of preferred data sources, and the limitations to using the upstream data for the CDP.

2. RESULTS SUMMARY

Based on initial material lists and project decision rules, approximately 40 materials (including some material groups) were initially identified as materials for which upstream data inventories should be included in the CDP LCA. Nine data sources (i.e., studies and/or databases) were evaluated to determine which upstream data would be used for these and other materials that might be identified in the CDP. Two databases were disregarded because the data are not or will not be available to the public. The remaining seven were reviewed for their applicability to the CDP. Complete inventory data for all currently identified CDP materials were not available from any one of the databases/studies alone. Therefore, a hierarchy of preferred data has been chosen for upstream data from secondary sources. The most preferred data is that from the Environmental Information and Management Explorer (EIME) database developed by *Ecobilan* (Ecobalance), a company based in France.

EIME is an LCA software package that specializes in electronics and the electronics industry and currently includes 18, with forthcoming updates expected to bring it to 21 materials specific to the CDP. The database is immediately available, and although it is relatively expensive, it may be attainable at a negotiated price (Glazebrook 1999). The EIME data do not fulfill all the CDP's upstream data requirements and therefore, other databases will be needed. Twelve materials were not found in any of the databases and may require additional research from secondary or primary sources to complete the CDP product system inventories. It appears, however, that EIME, supplemented with Ecobalance's Database for Environmental Analysis and Management (DEAM) will cover most materials needed in the CDP.

3. METHODOLOGY

The method for determining the upstream data that will be used for the CDP depends on which materials need to be included in the upstream evaluation and what existing databases are currently available for those materials. This section consists of three subsections that present the following: (1) how the preliminary list of materials were identified; (2) which data sources were considered for use as CDP upstream inventory data; and (3) the selection criteria for choosing which upstream data to include in the CDP.

3.1 Materials Selection

The first step to selecting upstream data sources is to identify what materials are of interest to the project. Primary data collected from manufacturing facilities will provide a list of upstream materials to consider in the upstream stages. However, the materials inventory from

the CDP product manufacturing stage was not yet complete when upstream data collection needed to begin to meet project time and budget constraints. Therefore, a preliminary list of materials used to manufacture the monitors was identified by disassembling a CRT and LCD and by reviewing the literature on manufacturing processes. The list was then slightly reduced based on decision rules to limit the scope of the project. This preliminary list is then used to help choose preferred sources of upstream data for materials of interest in the CDP. The following subsections describe the bills of materials of the LCD and CRT, the decision rules applied to the bills of materials, and the list of selected materials for upstream data collection.

3.1.1 Bills of Materials

A 15" CRT and a 15" LCD desktop monitor were disassembled, to the extent they could be manually separated, into their component parts/materials and each of these parts was weighed using Mettler analytical balances. A 17" CRT (the CDP functional unit) was not available for disassembly and therefore it is assumed that the percent contribution of materials in the 15" CRT and the 17" CRT are equivalent, which is an adequate assumption for the purposes of identifying major product materials.

Primary (also referred to as "product") materials are defined as those that become part of the final assembled monitor. Bills of materials of the CRT and LCD monitors were compiled to quantify the mass contribution of each primary material and component in each monitor. Where individual materials could not be discerned, component parts consisting of multiple materials were identified and weighed. These bills of materials are presented in the CDP's Industry and Technology Profile Document (MCC 1998). The material makeup of some component parts [e.g., thin-film transistors (TFTs) on LCD glass substrate or phosphors on CRT glass substrate] were identified from published literature (i.e., secondary sources) (O'Mara 1993, DisplaySearch 1998, FCR 1996, MCC 1993, ECT 1980). Simultaneous and subsequent work on the CDP involved obtaining more details on the makeup of certain component parts from manufacturers (i.e., primary sources) through data collection questionnaires.

The next step was to identify common ancillary (also referred to as "process") materials used in product manufacturing, which were found from secondary sources (O'Mara 1993, DisplaySearch 1998, FCR 1996, MCC 1993, ECT 1980) and reviewed by industry experts. These ancillary materials were added to the primary bills of materials for consideration in the LCA (MCC 1998). Additional ancillary materials were identified from primary sources during concurrent manufacturing data collection activities.

3.1.2 Decision Rules

Due to the complexity of the CRT and LCD monitors, and for any LCA, the boundaries of the analysis must be clearly defined. Thus, the following decision rules for choosing the materials to be evaluated were developed and applied to the primary and ancillary bills of materials. Three major categories of decision criteria were used to select materials for detailed analysis in the LCA: (1) mass contribution; (2) potential environmental and/or energy significance; and (3) technological importance. A priority hierarchy was developed (Figure 1) using a combination of these criteria.

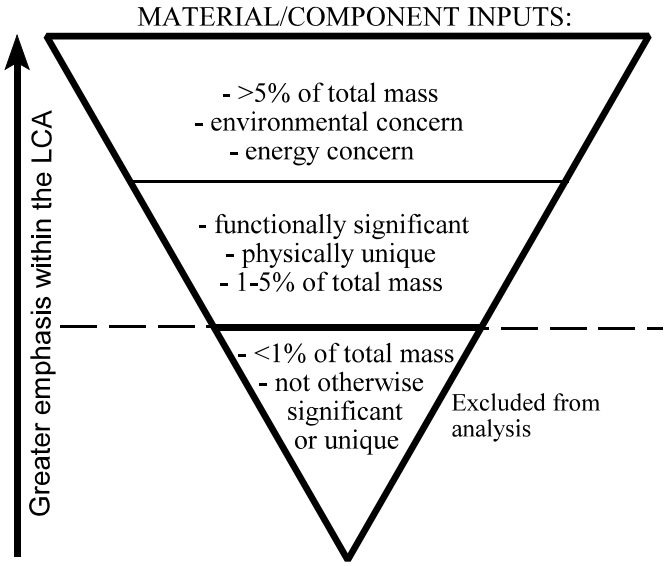

Figure 1. Decision rule hierarchy

The first criterion is applied by including materials that constitute greater than or equal to 1% of the monitor by mass. Materials constituting more than 5% will be given greater emphasis in the LCA. Mass is a simple measure by which to select important materials for consideration in the LCA because in many cases, the larger the material, the greater the impact. This is true for resource consumption impacts which are equivalent to the amount of material used. However, other impact categories may not be equivalent to the amount of material consumed, and simply eliminating materials based on mass alone may exclude important impacts from an environmental life-cycle perspective. Therefore, under the second criterion, materials were also included if they have a potential environmental/health impact (e.g., they may be toxic) or use large amounts of energy to produce. The environmental criterion decision rule refers to materials that may pose risks to the public, occupational workers, or the ecosystem from manufacturing, use, or disposal of the material. The primary and ancillary materials were reviewed by a team of experts at the University of Tennessee and were compared to regulatory lists and other sources (Klaassen et al. 1986, EPA 1998, ChemFinder 1998, SRC 1998) to identify materials with known or potential environmental concerns. When impacts are calculated in the LCIA, a more rigorous review of toxicity data and environmental parameters will be conducted to provide quantitative impact measures.

The third decision rule criterion applies to materials that are critical to the technology (e.g., LCD TFT materials or the CRT phosphors). This is intended to ensure that other materials of potential importance are not overlooked in the LCA. Furthermore, because the LCA will be comparative in nature, greater emphasis will be placed on materials that are physically unique to a display technology.

For the materials meeting the top tier of the decision rule hierarchy (Figure 1) in the CDP, attempts are made to obtain secondary data for those upstream material processes. Materials in the middle segment of the triangular hierarchy scheme are given lower priority, but included, if

available. Finally, the last segment of the triangle would contain materials excluded from the analysis.

3.1.3 Material Selection Results

The materials identified here are for selecting which materials require the collection of input and output inventory data from materials extraction, materials processing, and associated transportation, collectively referred to as the "upstream" life-cycle stages. The inventories from each of these life-cycle stages are then used to calculate impacts of the various impact categories considered in the analysis.

The total masses of the CRT and LCD that were disassembled were approximately 12.8 kg and 5.15 kg, respectively. The printed wiring boards (PWBs) and their components were excluded from these weights and from the following materials analysis because they are treated as complex display components not broken down by individual materials. The CRT consists of approximately 17 primary materials and the LCD is comprised of about 23 primary materials (MCC 1998). The major primary materials by weight (≥1%) in the CRT and LCD are listed in Table 1 with their corresponding components. Figures 2 and 3 depict the percent contribution of each of those materials to the overall monitor. For the CRT, eight materials were greater than or equal to 1% and only three [glass, steel, and high impact polystyrene (HIPS)] were greater than 5% of the weight of the monitor. The LCD had seven materials greater than or equal to 1%, five of which were greater than 5% [steel, polycarbonate, acrylonitrile butadiene styrene (ABS), polyester, and glass]. The items in bold in Table 1 represent the materials that are >5% for both the CRT and LCD. Other primary materials to be included in the LCA, based on the environment and technology decision rules, are presented in Table 2. The primary materials that were excluded due to mass are presented in Table 3.

Ancillary materials, such as those required for photolithography, are used in greater quantities for LCDs than CRTs. Preliminary literature searches (O'Mara 1993, DisplaySearch 1998, FCR 1996, MCC 1993, ECT 1980) found four ancillary materials for CRTs and 12 for LCDs (MCC 1998). The latter portion of Table 2 presents the ancillary materials that are included for either technological or environmental importance. The mass criterion for ancillary materials will be identified through responses to data collection questionnaires distributed to manufacturers participating in the project. Table 3 shows the ancillary materials that were preliminarily excluded based on environmental and technical criteria because mass data for ancillary materials are not yet available.

Table 1. Primary materials comprising ≥1% by mass of a CRT or LCD monitor and associated components [a]

Material	Associated component(s)	
	CRT	LCD
ABS	-----	Base/stand
Aluminum (Al)	Aluminum shielding, power board heat sink, connectors	Power supply heat sink, TFT metal
Copper (Cu)	Deflection yoke	-----
Ferrite-magnet	Deflection yoke	-----

Table 1. Primary materials comprising ≥1% by mass of a CRT or LCD monitor and associated components [a]

Material	Associated component(s)	
	CRT	LCD
Glass (e.g., borosilicate) [b]	-----	LCP panel
Glass (lead oxide)	Panel, funnel, neck, frit	-----
Lead (Pb) [c]	Funnel & neck glass, frit	-----
Plexiglas	-----	Backlight clear protector
Polycarbonate	-----	Backlight light pipe
Polyester	-----	Power supply & rear cover insulators
Polystyrene, high-impact (HIPS)	Casing	-----
Silicone	Potting material in flyback transformer	-----
Steel	Base, right, left & back shields; shadow mask	Base/stand weight & brackets, backlight plates, rear cover metal plate, power supply housing

[a] See Figures 2 and 3 for material percent contributions to total mass of monitor, excluding PWBs.
[b] Includes materials that could not be easily separated from the glass (e.g., frit, phosphors, transistors) and subtracts the estimated lead content of the glass for the CRT.
[c] The mass of lead was estimated from the total mass of the different glass components and approximate lead levels in the CRT glass components (MCC 1994). On average, approximately 10% of the total mass of CRT glass was assumed to be lead.
NOTE: Materials in bold are >5% of the monitor by weight.

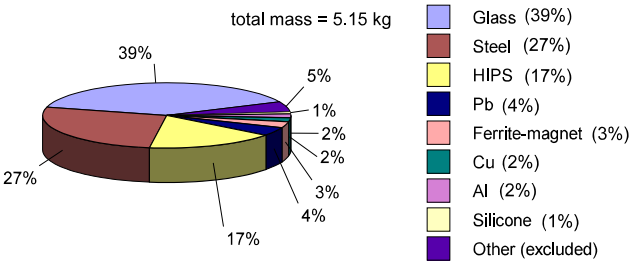

Fig. 2. CRT product materials meeting mass decision rule

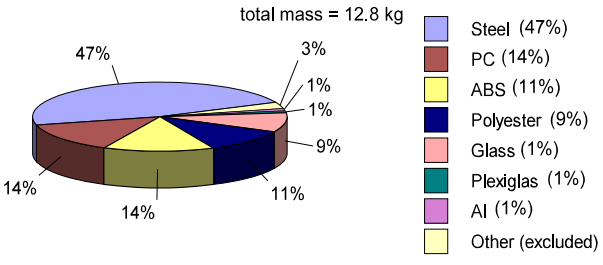

Fig. 3. LCD product materials meeting mass decision rule

Table 2. Primary and ancillary materials or components meeting technology (T), environment (Env), or energy (E) criteria

Materials	Associated components or process		Decision criteria	
	CRT	LCD	CRT	LCD
Primary materials				
Aluminum oxide (Al_2O_3)	Electron gun wire heater	-----	Env	-----
Aquadag	Faceplate black matrix coating	-----	T	-----
Beryllium (Be)	-----	Be-Cu metal clips	-----	Env
Bismuth oxide	Shadow mask back coating	-----	Env	-----
Color filters (acryl epoxy resins)	-----	Front panel glass color filters	-----	T
Divinylbenzene resin	-----	Spacers in AMLCD cell	-----	Env
Frit (lead solder glass)	Glass solder joints	-----	Env, E	-----
Indium-tin oxide (ITO)	-----	Electrode	------	T
Liquid crystals (e.g., polycyclic aromatic halogenated hydrocarbons, cyanobiphenyl, phenylcyclohexane compounds)	-----	Light-modulating material	-----	T, Env
Mercury	-----	Cold cathode fluorescent tube in backlight	-----	Env
Nickel	Electron gun cathodes	-----	T, Env	-----
Phosphors (e.g., ZnS, Y_2O_2)	Illuminating material	-----	T, Env	-----
Polyimide	-----	AMLCD cell alignment layer	-----	T
TFT metals (e.g., Al, Cr, Mo, W)	-----	Transistor	-----	T, Env
TFT silicon materials (e.g., SiO_2, SiNx, doped Si)	-----	Transistor	-----	T
Tungsten (W)	Electron gun wire heater	Transistor	T, Env	T, Env
Ancillary materials				
Boron trichloride (BCl_3)	-----	Photolithographic etchant	-----	Env
Carbon tetrafluoride (CF_4)	-----	Photolithographic etchant	-----	Env
Carbon trifluoride (CHF_3)	-----	Photolithographic etchant	-----	Env
Chloride (Cl_2)	-----	Photolithographic etchant	-----	Env
Ferric chloride ($FeCl_3$)	Photolithographic etchant (shadow mask)	-----	Env	-----
Hydrochloric acid (HCl)	-----	Photolithographic etchant	-----	Env
Isopropyl alcohol (IPA)	-----	Glass cleaner	-----	Env
N-methyl pyrrolidone (NMP)	-----	Photolithographic developer	-----	Env
Polyvinyl alcohol	Photolithographic application of phosphors	-----	Env	-----
Sulfur hexafluoride (SF_6)	-----	Photolithographic etchant	-----	Env

Table 2. Primary and ancillary materials or components meeting technology (T), environment (Env), or energy (E) criteria

Materials	Associated components or process		Decision criteria	
	CRT	LCD	CRT	LCD
Tetramethyl ammonium hydroxide (TMAH)	-----	Photolithographic developer	-----	Env

The materials identified for inclusion in the CDP (Tables 1 and 2) are then prioritized based on the decision rule hierarchy triangle. Those materials that are either: (1) >5% by mass; or (2) of environmental/energy concern, fit into the top priority of the upstream data collection effort. Those materials that are either: (1) between 1-5% by mass; or (2) functionally important and/or physically unique, fit into a lower priority of upstream data collection, but are still included in the project. Those materials that are less than 1% by mass and do not meet the other criteria listed above are excluded from the analysis. Currently, the materials falling into each segment of the decision rule hierarchy are listed in Table 4.

Table 3. Materials excluded from analysis

Material	Associated component/application	
	CRT	LCD
Primary materials		
Aluminized mylar		Corner tape on backlight assembly
Brass	Brass ring on neck assembly	Brass threaded standoff in backlight assembly
Foam rubber		Foam gasket in backlight assembly
Nylon		Cable clamp, strain relief in backlight assembly, clamp in backlight, bushing in base/stand assembly
Paper		Caution label on rear plate assembly
Polysulphone	Insulating rings on neck assembly	
Silicone rubber		Gaskets in LCD panel assembly, shock cushion in light assembly, rubber feet in base/stand assembly
Ancillary materials		
Nitrocellulose binder	For frit application	
Amyl acetate	For frit application	
O_2		Metal etchant
N_2		Metal etchant
Iodine		Polarizer coating

For the top priority materials, we obtained upstream inventory data from secondary sources where available. If no secondary sources were available, we attempted to collect primary data or conduct further research from the literature. For materials in the middle tier, we attempted to collect secondary data but gave less emphasis on including them if too many resources were required. The top tier consists of materials greater than 5% by mass and all the materials in Table 2. Each material in Table 2 was added to the list of materials for either environmental or technological reasons and all except tungsten (W) were unique to a technology. However, tungsten is also included in the top tier for potential environmental concern. As a result, all the materials in Table 2 are of potential environmental concern and/or are both functionally important and physically unique (see Figure 1).

Table 4. Summary table of preliminary CDP materials in priority hierarchy

Top tier	Middle tier	Lowest tier (excluded)
Steel, CRT glass, HIPS, Polycarbonate, ABS, Polyester, LCD glass, lead, Al_2O_3, Aquadag, Be, Bismuth oxide, Acryl epoxy resins (color filters), Divinylbenzene resin, Frit, ITO, Liquid crystals, Hg, Ni, Phosphors, Polyimide, TFT metals, TFT silicon materials, W, BCl_3, CF_4, CHF_3, Cl_2, $FeCl_3$, HCl, IPA, NMP, Polyvinyl alcohol, SF_6, TMAH	Ferrite-magnet, Silicone, Plexiglas, Al, Cu	Aluminized mylar, Brass, Foam rubber, Nylon, Paper, Polysulphone, Silicone rubber, Nitrocellulose binder, Amyl acetate, N_2, O_2, Iodine

3.2 Data Sources Evaluated

In order to identify upstream inventory data to be used for the CDP, nine different data sources (databases or studies) were evaluated. The following nine were chosen based on UT's experience in LCA, which included a comprehensive review of LCA databases (Menke et al. 1996), and from the scoping process for this project:

- American Plastics Council (APC)
  The APC is a major trade association for the U.S. plastics industry. APC is comprised of 24 of the leading plastics manufacturers in the United States with many members having a strong global market presence. APC's membership represents 80% of the U.S. resin production capacity (APC 1999). APC has collected LCI data that are expected to be released in 1999 for polyethylene (PE), polypropylene (PP), high impact polystyrene (HIPS), polyethylene terephthalate (PET), and polyvinyl chloride (PVC) resins and polyurethane precursors (Hentges 1999). Data are mostly vintage 1991 or 1993 and cover production in North America (Hentges 1999). Additional inventories from APC have not yet been identified, although they are presumed to exist.

- Association of Plastics Manufacturers in Europe (APME)
  APME is an industry body that has published inventory data on olefins, polystyrene (PS), PE, PP, PVC, PET and polymethanes (APME 1999), as well as ABS, Plexiglas, polycarbonate, polyester, and polyimide (Karlsson 1999).
- Boustead
  Dr. Ian Boustead is a well known LCA practitioner who developed the Boustead model and database that allows users to produce LCIs of complete systems. Boustead's focus areas are aerosols, automotive products, beverage containers, building materials, and the plastics industry. The organization is based in the United Kingdom (Boustead 1999).
- BUWAL
  BUWAL is the Swiss Agency for the Environment, Forests and Landscape (BUWAL 1999). They have several published reports on LCA. BUWAL 250 is an English version of their LCI database of several common industrial materials.
- Environmental Information and Management Explorer (EIME)
  This software design tool was developed by the *Ecobilan* group in conjunction with IBM, Alcatel, Legrand, Schneider, and Thompson. *Ecobilan* was founded in 1990 and has offices in Europe and in the United States (*Ecobilan* 1999). Version 1.4 of EIME has been released and the embedded database contains 170 modules on the most commonly used materials and subcomponents of the electronic and electric industry (EIME 1999).
- Industrial DEsign MATerials (IDEMAT)
  Dr. J.A.M. Remmerswaal and J. Rombouts of the Delft University of Technology's Section for Environmental Product Development produced this software with a database of LCI data for various industrial materials. There is a student version that was released in 1995 that is available to the public at no cost, but the availability and cost of the complete version is yet undetermined by UT. This evaluation focuses on the student version that was available to UT.
- New Jersey Institute of Technology (NJIT) Report
  NJIT's "Lifecycle Assessment of Television CRTs," (Caudill 1998) report is not a database of upstream inventory data *per se*, however, it is a preliminary LCA that includes LCI data for a CRT and therefore it was considered for use in the CDP as an upstream data source.
- Personal Computer (PC) Ecolabel Report
  This study was developed by Atlantic Consulting and IPU (Institute for Product Development of the Technical University of Denmark) for the Ecolabel Unit of the European Commission (AC and IPU 1998). The purpose of the report was to study personal computers so that an ecolabel could possibly be established. Similar to the NJIT report, this is an LCA with inventory data applicable to the CDP, but it is not a traditional database of upstream inventory data. Analysis of the inventory in the PC Ecolabel Report for the purposes of the CDP was based on Version 1.11 of the report downloaded from their website in January of 1998.
- United States Automotive Materials Partnership (USAMP)
  Formed in June 1993, this partnership set out to conduct vehicle-oriented research and development in materials and materials processing to improve the competitiveness of the U.S. auto industry (USAMP 1999). The USAMP is conducting joint research to further the development of lightweight materials for improved automotive fuel economy. The major technology groups being studied are polymer composites, light metals (including

aluminum, magnesium, etc.), engineered plastics, cast iron, steel and ceramics (USAMP 1999). The aluminum, plastics, steel and automotive industries are participating in a collaborative LCI project to produce a quantitative database of information regarding all the resources used to make, operate and dispose of a generic 3200-pound vehicle (USAMP 1999).

3.3 Selection Criteria

For choosing which upstream data to use for the CDP, the following 11 criteria were considered. Descriptions of each criterion and what is preferred for that category are presented below:

1. Geographic boundaries – Describes whether the data are representative of Europe and/or the United States. In general, U.S. data are preferred for this project, assuming most of the materials for the monitors are extracted and processed in the U.S. However, because some of the CDP manufacturing is in Asia, materials may originate from non-U.S. locations/countries.

2. Origin of data – Describes whether or not the data originate from primary or secondary sources. Primary sources that are clearly identified are preferred.

3. Currency of data – This refers to the dates that represent the actual inventory data. More recent data are preferred. If the date of the inventory data is not known, the date the database was released is considered.

4. Public availability – Data are categorized as either public or private. Publicly available data can be considered for the CDP.

5. When available – This describes whether or not the data are currently available and if not, when they are expected to be available. Immediately available means the data are available from the appropriate company or individual; however, more time may be required for UT to obtain the data. Also provided under this criterion will be whether UT currently has some of the data applicable to the CDP. Immediately available is preferred and further consideration is given to data that UT already has in house.

6. Cost – Due to limited resources, cost is an important factor for determining which upstream data should be obtained for the CDP. However, if possible, negotiations for or donations of data can be pursued as this is a collaborative project with industry and other stakeholders. Least costly data are preferred.

7. Upstream life-cycle stages – Which upstream life-cycle stages are included from each data source are identified, if possible. In some cases, the databases or reports address more than only upstream stages and other stages included will also be noted under this criterion. In the results of this analysis, we will present the names of the life-cycle stages as they are labeled in each respective data source. However, such labels may not be consistent with the specific

terminology used in this report. For use in the CDP, we prefer data sources that include materials extraction, materials processing, and associated transportation.

8. Aggregation of data – This describes whether or not the data from the various life-cycle stages are aggregated into one set of inventory numbers or how the data are aggregated. With less aggregation, the CDP will better be able to predict impacts particular to a specific life-cycle stage. Therefore, less aggregation is preferred. For some of the reports considered in this analysis, processes may also be aggregated for an entire product or component and therefore it is difficult to separate out the inventory for one particular material. The advantage of material-specific LCI databases is that the data are not aggregated into a larger component or product.

9. Input/output categories – This lists which categories of inputs and outputs are included in the database or report (e.g., non-renewable resources, fuel and energy inputs, water use, air emissions, water effluents, solid/hazardous wastes). Ideally, the input and output categories would match those defined for the CDP that will be used to calculate the impacts. The LCIA TM (Socolof 1999) describes the impact categories and how the inventory data will be used to calculate impacts. Also of interest is whether the outputs within each category are chemical specific. The more speciated the chemicals, the more desirable the data. In some cases, chemical groups or categories of chemicals are provided. The CDP LCIA methodology requires chemical-speciated data to calculate most impacts.

10. Data quality indicators – If the data source provides an indication of its data quality, this will help determine the data quality of the CDP. In several cases, we were not able to discern whether there were data quality indicators for a particular data set. If the data source provides some indication of data quality, this can then be incorporated into the CDP's data quality indicators for the upstream data.

11. CDP materials included – These are the materials that have been identified in Set. 3.1.3, which constitute the initial list of materials of interest in the CDP. They were cross-referenced with each data source under consideration. Preferred data sources are those with the greatest number of materials of interest to the CDP.

Each database or report was reviewed based on available information, and in some cases, limited information was available. This exercise was not intended to be a comprehensive review of each database, because we were not able to purchase each source. It was intended to be a cursory review of available data sources to assist in the decision of which inventory data to obtain and include in the CDP for the upstream life-cycle stages. When we could not obtain a database, our review was based on information available on company websites, other available literature on the database, personal contacts with company representatives, or third parties who have had experience with using a particular database.

Based on all this information, preferred data sources were identified. All factors were considered, including expected data quality and cost. The first most important criterion was whether the data source included many of the materials of interest to the CDP. Although additional materials may be identified during the concurrent CDP data collection efforts, we expect that the majority of materials of interest have already been identified.

4. RESULTS

Using the CDP decision rules, we initially identified approximately 40 materials (including some material groups) for which upstream data inventories should be included in the CDP LCA (Sect. 3.1.3). Nine data sources were evaluated to determine which upstream data would be used for these and other materials that might be identified. Tables 5 and 6 present a comparison of the data sources evaluated. Table 5 lists the first ten criteria presented in Sect. 3.3, which are related to the type of data provided, availability of the data, and cost. Table 6 cross-references the materials of interest in the CDP to the materials found in the various data sources (the 11th criterion in Sect. 3.3). Together this information was used to identify which data are preferred for use in the CDP as upstream inventory data. Brief discussions of each data source and a final conclusion are presented below.

Referring to Table 5, APC data are not yet available and it is uncertain if they will be available as scheduled, as they were expected to be released in previous years but were not. Therefore, APC is not considered further in this analysis. USAMP inventory data, which were intended only for participating organizations is not a publicly available data set. Therefore, USAMP as a source of upstream data for the CDP is also excluded from further analysis. The remaining seven data sources are evaluated by analyzing Tables 5 and 6.

The eleven criteria described above (Sect. 3.3) can be condensed into three major areas:

- Cost;
- Data quality; and
- Applicability to CDP.

Each source will be described in terms of these criteria, without giving a particular weight to any one over another. Note that the "data quality" criterion is a combination of the origin of the data, the currency of the data, the upstream life-cycle stages included, data quality indicators, and to some extent, the geographic boundaries of the data (see Table 5). The "applicability to the CDP" criterion depends on which upstream life-cycle stages are included, how the data are aggregated, what input and output categories are included (including whether or not the output data are speciated), whether data quality indicators are provided, and which materials of interest to the CDP are included.

Table 5. Selected criteria of upstream data sources

	APC	APME	Boustead	BUWAL 250	EIME	IDEMAT	NJIT LCA	PC Ecolabel	UPAMP
Geographic boundaries	U.S.	Europe	Europe	Europe	U.S. & Europe	Netherlands & Europe	U.S.	Europe	U.S.
Origin of data	Unknown	Primary	Primary	Secondary	Majority is primary, some secondary	Unknown	Secondary	Secondary	Unknown
Currency of data	1990s	1990s (varies per material)	Unknown	1996	1990s (varies)	Second Student version, released in 1995	1970s - 1990s	Not completely determined, but most appear to be 1990s	1990s
Public availability	Public	Public	Public	Public	Public	Public (student version); unknown for complete version	Public	Public	Public
When available	Expected to be released in 1999	Immediate (UT has 2 applicable materials)	Immediate	Immediate (UT has 6 applicable materials)	Immediate	Immediate (UT has 9 applicable materials; unknown if complete version can be obtained)	Interim report immediately available (UT has copy)	Version 1.11 immediately available (UT has copy)	Not available to public
Cost	No cost	No cost	~$10,000	~$250	~$7,500; > $5,700 for universities (Negotiable)	No cost, unknown for complete version	No cost	Version 1.11 no cost; ~$75 for final report	Not available to public
Upstream life-cycle stages	Unknown	Raw material extraction, material processing, transport	Process operations (including fuel production) and transport operations	Pre-combustion, combustion + processes, transports	Extraction, processing, transportation	Production, which includes transportation when noted, and not clear if extraction included	Material extraction and material synthesis	Material production, manufacturing, transport, use, EOL	Unknown

APPENDIX D

Table 5. Selected criteria of upstream data sources

	APC	APME	Boustead	BUWAL 250	EIME	IDEMAT	NJIT LCA	PC Ecolabel	UPAMP
Aggregation of data	Unknown	Some data presented as process-specific e.g., fuel production, transport, process)	Often classified into several processes: fuel production, fuel use, transport operations, process operations	Aggregated as "LCI" or "energy consumption," latter subclassified (e.g., final energy source, energy supply, final process energy, transport)	Aggregated over all upstream life-cycle stages for each module (material) into impact categories, system administration can access LCI data separately	Each material aggregated for all life-cycle stages for the following categories: processes, thermal energy, electrical energy, and transports	Process specific; sometimes a few subprocesses are aggregated	Aggregated by major computer components (e.g., monitor) for each life-cycle stage, not process or material specific	Unknown
Input/ Output categories	Unknown	Energy, primary fuels, and raw material inputs; air, water, and solid waste emissions; outputs mostly unspecified	Gross energy, primary fuels & feedstocks: raw materials; water use; air, water solid waste emissions; outputs provided as chemical categories and several speciated chemicals	Commercial fuels resources, feedstock resources, materials used in final stage, main product, co-products, usable wastes, waste treatment; outputs provided as chemical categories and as some speciated chemicals	Natural resources, energy, water inputs; air, water, hazardous waste outputs; outputs relatively well speciated	Material inputs (including water), energy inputs; air, water, and solid outputs; mostly unspeciated outputs	Raw material and energy inputs; solid, air, and waterborne waste outputs; outputs as chemical categories and some speciation	Resource consumption (raw materials), air emissions, water emissions, and waste; includes chemical categories, but also very well speciated	Unknown

Table 5. Selected criteria of upstream data sources

	APC	APME	Boustead	BUWAL 250	EIME	IDEMAT	NJIT LCA	PC Ecolabel	UPAMP
Data quality indicators	Unknown	All calculations were referred back to participating companies before being used	Not provided, but data quality believed to be moderately good (above average as compared to other available sources)	Unknown	Provides high, medium, and low measures of reliability of the data	Unknown	Data were gathered on each material, carefully citing notes and references which document the original sources	Unknown	Unknown

Key:
APC = American Plastics Council
APME = Association of Plastics Manufacturers in Europe
EIME = Environmental Information and Management Explorer
IDEMAT = Industrial DEsign MATerials
NJIT = New Jersey Institute of Technology
USAMP = U.S. Automotive Materials Partnership

4.1 Data Source Reviews

APME data are European-based, of moderate quality, and available for free. However, the data are mostly limited to materials of interest to the plastics industry and therefore only apply to 7 materials of interest to the CDP. The materials covered by APME constitute 17% of the product weight of the CRT described in Figure 2 and 49% of weight of the LCD in Figure 3.

The Boustead data are very expensive, of moderate quality, and include several materials of interest for the CDP, including most of the major product materials by weight of the CRTs and LCDs (55% and 85%, respectively, see Table 6). The significant material missing for the CRT is the leaded glass, which is approximately 39% of the mass of the monitor. The Boustead data include two of the ancillary materials that have been identified for the CDP, but do not include several of the other materials identified for potential environmental concern. The Boustead data are moderately equipped with speciated chemical data as required for the CDP. Data are aggregated for all upstream stages, but are also available as some individual upstream inventories (e.g., transport operations, process operations). Although data quality indicators are not provided by Boustead for the data, the Center for Clean Products and Clean Technologies assesses it as above average based on comparisons with other databases reviewed.

Table 6. Cross-reference of preliminary CDP materials and potential upstream data sources

		APME	Boustead	BUWAL 250	EIME [4]	IDEMAT [8]	NJIT	PC Ecolabel
Primary Materials								
1	ABS	Y	Y		Y (APME)	Y	Y	Y
2	Aluminum		Y	Y	Y	Y	Y	Y
3	Aluminum oxide		Y	Y	Y (BUWAL)			
4	Aquadag							
5	Beryllium					Y		
6	Bismuth oxide					Y (C) [9]		
7	Color filters (acryl epoxy resins)				Y [5]			
8	Copper		Y		Y	Y	Y	Y
9	Chromium (TFT metal)		mining chromite ore		(Y)	Y		
10	Divinylbenzene resin							
11	Ferrite-magnet		Y [2]		Y [6]			Y
12	Frit							Y
13	Glass, borosilicate (LCD)	Y	Y	Y	(Y)	Y		
14	Glass, lead oxide (CRT)						Y	Y
15	Indium-tin oxide - ITO							
16	Lead		Y		Y	Y	Y	Y
17	Liquid crystals				Y			
18	Mercury					Y (C)		
19	Molybdenum (TFT metal)				(Y)	Y		
20	Nickel				Y	Y		Y

Table 6. Cross-reference of preliminary CDP materials and potential upstream data sources

		APME	Boustead	BUWAL 250	EIME [4]	IDEMAT [8]	NJIT	PC Ecolabel
21	Phosphors: e.g., ZnS, Y_2O_2							
22	Plexiglas [polymerization of methyl ester (methyl methacrylate)]	Y			Y (APME)			
23	Polyimide	Y			Y (APME)			
24	Polycarbonate	Y	Y		Y (APME)	Y	Y	Y
25	Polyester	Y			Y (APME)	Y (C)		
26	Polystyrene-HIPS	Y	Y	Y	Y (APME)	Y	Y	Y [11]
27	Silicon TFT materials: e.g., SiNx, SiO2				Y	Y (C)		
28	Silicone				Y			
29	Steel		Y	Y	Y(BUWAL)	Y (C)	Y	Y
30	Tungsten (TFT metal)					Y		Y
Ancillary Materials								
31	Boron trichloride							
32	Carbon tetrafluoride							
33	Chlorine		Y	Y				
34	Ferric chloride							
35	Hydrochloric acid		Y		Y			
36	Isopropyl alcohol							
37	N-methyl pyrrolidone							
38	Polyvinyl alcohol							
39	Surfur hexafluoride							
40	Tetramethyl ammonium hydroxide							
Totals		7	12 [3]	6	18 (21) [7]	12 (17) [10]	8	12
% contribution of CRT primary materials >= 1% by mass [1]		17	55	46	56	25 (52) [10]	91	94
% contribution of LCD primary materials >= by mass [1]		49	85	57	88 (97) [7]	38 (96) [10]	76	76

1. The percent mass contribution of the primary materials were summed to identify the total percent of the monitor by mass that is covered by each data source.
2. Inventory data are available for iron, which is assumed to represent ferrite-magnet.
3. The tally of chemicals for Boustead excludes mining chromite ore for chromium.
4. Cells with a Y and the name of a data source [e.g., "Y (APME)"] indicate the data source that EIME obtained that particular inventory from, if that source is included elsewhere in this table. "(Y)" represents materials that are expected in EIME's forthcoming update.
5. "Epoxy resins" assumed to be for color filters (acryl epoxy resins).
6. The EIME database does not have ferrite-magnet listed, but it does have ferrites MnZn as a mateiral inventory.
7. The first value represents the current EIME dataset and the value in parenthesis indicates materials expected in the forthcoming update.
8. The student version of IDEMAT was the source investigated. "C" (for "complete") indicates cases where IDEMAT has the inventory on a given material only in the complete version.
9. Bismuth
10. The first value is for the student version and the value in parthenthesis is for the complete version.
11. The study only listed polystyrene (PS) and did not indicate if it was high-impact polystyrene (HIPS).

BUWAL 250 is a relatively inexpensive database that is also European data and believed to be from secondary sources. Therefore, the data quality is marginal and its applicability to the CDP is also relatively low as it only appears to cover the least number of materials of interest. Some chemical speciation is provided as output data and the inventories are aggregated over the upstream processes.

EIME appears to be the best candidate for the purposes of the CDP as it is targeted specifically for the electronics industry and includes many of the materials of interest to the CDP (Table 6). The current version includes 18 materials and, with forthcoming updates to the database, there are expected to be 21 materials covered (Karlsson 1999), representing 56% of the materials by mass of the CRT and 97% of the LCD. The low CRT percent is again due to the lack of leaded glass, which is 39% of the CRT. These data also include important materials not included in the weight criterion such as liquid crystals, lead, silicon materials, and color filters. Each of these, with the exception of lead are not found in any other data sources reviewed. The EIME inventory output data appear to be relatively well speciated, but the inventory data in general cannot be separated into each upstream life-cycle stage. The data quality is adequate as some data are from the U.S. and from primary sources. The data specific to the electronics components are from the five industrial partners and their suppliers, while some of the other common industrial materials were obtained from other LCI databases (EIME 1999). The cost is relatively high; however it covers the cost of the entire life-cycle software tool. Discussions with *Ecobilan* representatives have revealed their willingness to negotiate for the use of some material inventory data, provided we supply our results to them in a desirable format. Alternatively, we would be required to purchase the entire software package to obtain the desired inventory data.

The student version of IDEMAT is another free set of data that is European-based. The true quality of the data is not yet well determined by UT. Several (12) CDP materials are included in the student version, and it is believed that 17 would be covered with the complete version. IDEMAT has a few materials, metals in particular, that are not found in any of the other data sources reviewed.

The NJIT LCA report provides only eight material inventories relevant to the CDP; however, because it is an LCA of a television with a CRT, it includes leaded glass, which is not commonly found in existing databases. Some of the inventory data, which are U.S.-based, are from relatively old secondary sources (*circa* 1970). Furthermore, not all outputs are quantified. The report includes two upstream life-cycle stages: materials extraction and "materials synthesis" (referred to as "materials processing" in the CDP). Transportation within these upstream stages is not included. Data are easily identified per material, and some chemical speciation is included. This report does not provide sufficient amount of upstream data to be used exclusively, but given that it is available at no cost, it may supplement missing data (e.g., leaded glass).

The PC Ecolabel LCA is a report that includes 12 of the materials of interest in the CDP in its study and has very well speciated output data. UT has obtained a copy of Version 1.11 at no charge. It is based on European data and of undetermined quality. This was a study that was intended to present results of the life-cycle impacts of a PC and is not intended to be a database of material inventories. UT chose to evaluate this as a potential source for upstream data because of the relevant subject matter of the LCA. And although it covers several materials of interest, the inventory data cannot be separated into individual material inventories. Data are presented for different life-cycle stages, but not provided on a material basis. Therefore, this report could be helpful for checking our final results of the LCA, but not for providing upstream inventories of specific materials.

4.2 Conclusion

To identify the priorities for using upstream data, we would prefer to use as much data from one source as possible to help ensure consistency and thus improve the data quality of the results of the CDP. We have selected to target EIME as the primary source of upstream data. However, what is seen from the information in Table 6 is that no one data source will completely encompass the product materials of the CDP. Twelve of the 40 materials were not covered by any data source. EIME includes the greatest number, yet even including the expected updates to EIME, ten primary materials and nine ancillary materials are not covered by EIME. Four of the ten primary materials and eight of the nine ancillary materials were not covered by any other data sources. Six materials that are not in EIME are believed to be in other data sources. These include the following: beryllium, bismuth oxide, frit, leaded glass, mercury, and tungsten. Beryllium and tungsten are in the student version of IDEMAT and bismuth and mercury are in the complete version of IDEMAT. The NJIT and PC Ecolabel studies include leaded glass and the PC Ecolabel study also includes frit. The NJIT report, however, does not quantify the outputs from leaded glass production. Furthermore, because the PC Ecolabel study's inventory is aggregated over the whole monitor, individual inventory data cannot be produced for the specific materials. Therefore, IDEMAT data and the quantified inputs from the NJIT report may help supplement the EIME data.

Subsequent work for the CDP revealed that Ecobalance also had DEAM data available that supplemented the EIME data, both of which were listed as upstream data sources for this project. Procuring EIME requires negotiations with *Ecobilan* for a reduced price. This will begin subsequent to the final approval of this TM by EPA and the CDP Core and Technical Work Groups. In the event we cannot procure the EIME data for a reduced price, we will try to rely on the no cost options of APME, IDEMAT and NJIT data. Together, these three data sources cover 17 materials with the IDEMAT student version or 20 with the complete version. Relying on several material inventories from each of the three sources will reduce consistency in our upstream data and thus reduce the data quality in the CDP. For materials not included in the data sources obtained, UT will attempt to find the data from primary or secondary sources.

5. LIMITATIONS AND UNCERTAINTIES

Information on the different databases were from personal communications, websites, and in some cases, review of selected inventories obtained for a database. Copies of the NJIT and Ecolabel reports were available for review. This evaluation of upstream sources was not intended to be a comprehensive assessment of each data source, but instead a cursory review to evaluate which data to pursue. Therefore, there remain uncertainties to the information presented in this TM, but it is believed that adequate information was available to make recommendations in this report.

Using secondary data will also have an effect on the limitations of the CDP results. Using secondary data that are not tailored to the specific goals and boundaries of a project limits the quality of the data. However, due to the large data collection efforts in the LCA, priorities are given to collecting data. Thus, secondary sources have been chosen for upstream inventories and primary sources will be approached for monitor and component manufacturing data, as well as some end-of-life processes.

Once the upstream data are incorporated into the CDP, limitations in those databases will be transferred to limitations in the CDP. Furthermore, the use of more than one database (e.g., EIME supplemented by NJIT and IDEMAT) will reduce consistency in our upstream data and thus somewhat reduce the data quality in the CDP. However, it should be noted that the upstream data are only one portion of the overall inventory of the product systems being evaluated.

ACRONYMS/ABBREVIATIONS

ABS	=	Acrylonitrile butadiene styrene
APC	=	American Plastics Council
APME	=	Association of Plastics Manufacturers in Europe
BUWAL	=	The Swiss Agency for the Environment, Forests and Landscape
CDP	=	Computer Display Project
CRT	=	Cathode ray tube
DEAM	=	Database for environmental Analysis and Management
EIME	=	Environmental Information and Management Explorer
IDEMAT	=	Industrial DEsign MATerials
IPA	=	Isopropyl alcohol
IPU	=	Institute for Product Development of the Technical University of Denmark
HIPS	=	High impact polystyrene
LCA	=	Life-cycle assessment
LCD	=	Liquid crystal display
LCI	=	Life-cycle inventory
LCIA	=	Life-cycle impact assessment
LDPE	=	Low density polyethylene
NJIT	=	New Jersey Institute of Technology
NMP	=	N-methyl pyrrolidone
PC	=	Personal computer
PS	=	Polystyrene
PE	=	Polyethylene
PET	=	Polyethylene terephthalate
PP	=	Polypropylene
PVC	=	Polyvinyl chloride
PWB	=	Printed wiring board
TFT	=	Thin-film transistor
TM	=	Technical memorandum
TMAH	=	Tetramethyl ammonium hydroxide
USAMP	=	United States Automotive Materials Partnership

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APPENDIX E

TECHNICAL MEMORANDUM:
Electrical Energy Grid Life-Cycle Inventories for the CDP

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APPENDIX E

TECHNICAL MEMORANDUM:
Electrical Energy Grid Life-Cycle Inventories for the CDP

1. INTRODUCTION

1.1 Background

The U.S. Environmental Protection Agency's (EPA) Design for the Environment (DfE) Program Computer Display Project (CDP) is conducting a combined Cleaner Technologies Substitutes Assessment (CTSA) and life-cycle assessment (LCA) to evaluate the relative environmental impacts, cost, and performance of cathode ray tube (CRT) and active matrix liquid crystal display (AMLCD) desktop computer monitors. Initially the project is conducting an LCA to determine the relative potential environmental impacts of the monitors, including impacts from materials extraction, materials processing, manufacturing (monitor and components), use, and end-of-life disposition. Transportation information is also included within and between each stage.

LCA has four major components:

1. goal definition and scoping,
2. life-cycle inventory (LCI),
3. life-cycle impact assessment (LCIA), and
4. improvement assessment.

The LCI is a collection of inputs (materials, energy, and other resources) and outputs (products, wastes and emissions) for processes throughout the product's life cycle. The LCIA characterizes the potential relative impacts of these inputs and outputs per functional unit, where the functional unit is defined in this project as one monitor over its lifetime. Improvement assessment is the component where those who are in the position to make changes in either the design or manufacture of the product review the results and decide on ways to implement environmental improvements.

The focus of this technical memorandum (TM) is on the LCI component of the LCA. Established LCI methodology accounts for electricity requirements throughout the life cycle of a product system. Wherever electricity is used in a process in the product system, the LCI typically includes the inputs and outputs from the generation of that electricity. This TM presents the input and output inventory data that are used to calculate the impacts from electricity generation for the CDP. The inventory data were developed by the University of Tennessee Center for Clean Products and Clean Technologies (CCPCT) from existing data for the various fuels (e.g., coal, petroleum) used by electric utilities around the United States. Two inventories illustrate the amount of materials consumed (inputs) and pollutants released (outputs) to generate one kilowatthour (kWh) of electricity, based on the average U.S. and the average Japanese electrical grids. The data are presented in units of grams of material input or emission output per kWh (g/kWh) in almost all cases, excluding radioactive emissions which are presented in Becquerels

per kWh [Bq/kWh, where a Becquerel is the Système Internationale (SI) unit for radioactivity]. All of the inputs and outputs in the electric grid inventories have been multiplied by the electricity consumption rate for each process in the product system where electricity is used. These input and output data are not used with LCI data collected from secondary sources that already include inputs and outputs from electricity generation. The two electric grid inventory data sets presented in this TM are for the average U.S. electrical grid and the average Japanese electric grid.

1.2 Boundaries of the Analysis

In addition to the geographic boundary (i.e., U.S. and Japanese data only), the boundaries of the data presented in this TM are defined by the generation categories included in the analysis (e.g., coal, nuclear) and the life-cycle stages evaluated for the various generation categories (e.g., extraction, generation). A U.S. electric grid inventory was developed first and the Japanese grid inventory is simply a modification of the U.S. inventory, which applies the average Japanese electric grid to the input and output data found for the United States. This will not account for any effects of different control technologies used in Japan compared to the United States. The majority of this TM focuses on collecting U.S. data, and mentions when the Japanese grid is applied.

Table 1 presents the electricity generation categories, associated fuels types, percent breakdown for U.S. electricity generation in 1997 and whether or not that category is included in this inventory. (While 1998 is the target year for the overall CDP, this TM was targeted for 1997 as almost no data could be obtained that was relative to 1998.) Coal is the dominant generation category and fuel type in the U.S., accounting for over 55 percent of 1997 electricity production. Non-renewable fuels (coal, gas, petroleum, and uranium) plus water (for hydroelectric plants) together provide greater than 99 percent of U.S. electricity. Table 1 also lists the average Japanese breakdown of fuels.

Table 1. Fuel Types Used to Generate Electricity in U.S. and Japan in 1997

Generation Category	Fuel	U.S. Generation % Breakdown	Japanese % Breakdown	Included in Electric Grid Analysis?
Coal	Coal	57.23%	18%	Yes
Gas	Gas	9.07%	20%	Yes
Petroleum	Petroleum	2.53%	21%	Yes
Nuclear	Uranium	20.14%	31%	Yes
Hydro	Water	10.79%	9%	No
Renewables	Wind, biomass, heat from sun, heat from earth	0.24%	1%	No
Total		100%	100%	

Sources: EIA 1999a, EIA 1997.

Individual input and output inventories were developed for each of the generation categories listed in Table 1, except hydro and renewables. Hydroelectric facilities, which constitute nearly 11% of the U.S. electric grid, were excluded due to the scarcity of data on hydroelectric inputs and outputs. Known impacts of hydroelectric facilities primarily relate to

reservoir formation, which includes habitat destruction and its concurrent effects on biodiversity, and the generation of the greenhouse gases methane and carbon dioxide from the flooding of wetlands during and after reservoir formation. Habitat destruction is not included as an impact category *per se* within the CDP LCIA methodology (see Chapter 3 of main report), but global warming is included. Furthermore, EPA has concluded there is currently no adequate basis for estimating the emissions and sinks from the flooding of wetlands (EPA 1998a).

Renewables were excluded because they accounted for only a small fraction (0.24%) of total U.S. electricity production in 1997. In addition, little or no data exist on material inputs and pollutant outputs for renewable electricity generation processes.

The following life-cycle stages are associated with electricity generation:

- Extraction of ores and fluids from the earth and any necessary transportation to the initial processing point (Materials Extraction);
- Initial and secondary processing of those ores/fluids into usable fuels, and the associated transportation between processing points and to the generating stations (Materials Processing);
- Combustion or use of the fuel and the onsite control of pollutants, and transmission and distribution of the generated electricity to the points of use (Manufacturing);

NOTE: This description excludes the process flows of renewable energy sources.

Little or no data were available for the extraction and initial and secondary processing of ores and fluids into fuels, except for some data for coal extraction and processing. Therefore, most of the electrical grid input and output data presented in this TM only include the manufacturing life-cycle stage (generation and transmission and distribution of electricity) as shown in Table 2.

Table 2. Fuel Life-Cycle Substages Captured in Electric Grid LCI Data

Life-Cycle Substages	Coal	Gas	Petroleum	Uranium
Extraction	P	N	N	N
Transport to Initial Processing	N	N	N	N
Initial Processing	P	N	N	N
Transport to secondary processing	NA	NA	NA	N
Secondary processing	NA	NA	NA	N
Transport to generating stations	N	N	N	N
Electricity generation	I	I	I	I
Transmission and Distribution	I	I	I	I

I = Included in inventory; P = Partially included in inventory; N = Not included in inventory; NA = Not applicable.

It should also be noted that this electric grid inventory relates only to *utility*-based generation. Electric power generation in the Unites States can be broken down into two main categories: utility and nonutility. In simplified terms, most electricity generating entities that are not classified as utilities fall in the nonutility category, and include many cogeneration facilities and small and independent power producers. About 65% of nonutility production is attributed to

the manufacturing sector (EIA 1998a), and nonutility production as a whole constitutes just over 10% of the total power produced by the electric power industry. The inputs and outputs of nonutility electricity production are excluded here due to a lack of detailed data on the associated emissions and wastes.

1.3 Organization of the TM

The remainder of this document provides supporting information on the development of the electric grid data. It is organized into six sections: results summary, methodology, fuel-specific results, data sources and quality, limitations and conclusions. Supporting tables are presented as necessary in the Appendices.

2. RESULTS SUMMARY

Table 3a presents the primary and ancillary materials consumed and products and environmental burdens produced during the generation of 1 kilowatthour (kWh) in the United States, based on the national 1997 generation percent breakdown (see Table 1). Similarly, Table 3b presents the inventory for the Japanese grid. All inputs and outputs listed in Tables 3a and b are presented on a per kWh basis.

Section 3 of this TM discusses the methods used to calculate the nationwide U.S. electric grid inventory data. Spreadsheets were used to organize and manipulate all of the inventory data, and those spreadsheets are shown in Attachments A through E and contain supporting data source, assumptions, and limitations information.

Table 3a. U.S. Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
PRIMARY INPUTS					
Coal, avg. (in ground)	2.83E+02	G	Input	Primary material	
Natural gas	2.20E+01	G	Input	Primary material	
Petroleum (in ground)	5.99E+00	G	Input	Primary material	
Uranium, yellowcake	7.64E-03	G	Input	Primary material	
ANCILLARY INPUTS					
Lime	1.67E+00	G	Input	Ancillary material	
Limestone	3.79E+00	G	Input	Ancillary material	
Water	1.79E+03	G	Input	Water	
PRODUCT					
Electricity	1.00E+00	KWH	Output	Energy	
AIR EMISSIONS					
1,1,1-Trichloroethane	3.02E-06	G	Output	Airborne	air
1,2-Dichloroethane	5.65E-06	G	Output	Airborne	air
2,3,7,8-TCDD	2.02E-12	G	Output	Airborne	air
2,3,7,8-TCDF	7.20E-12	G	Output	Airborne	air
2,4-Dinitrotoluene	3.96E-08	G	Output	Airborne	air
2-Chloroacetophenone	9.89E-07	G	Output	Airborne	air
2-Methylnaphthalene	4.20E-09	G	Output	Airborne	air
5-Methyl chrysene	3.11E-09	G	Output	Airborne	air
Acenaphthene	8.94E-08	G	Output	Airborne	air
Acenaphthylene	3.55E-08	G	Output	Airborne	air
Acetaldehyde	8.05E-05	G	Output	Airborne	air
Acetophenone	2.12E-06	G	Output	Airborne	air
Acrolein	4.10E-05	G	Output	Airborne	air
Anthracene	3.07E-08	G	Output	Airborne	air
Antimony	6.87E-06	G	Output	Airborne	air
Arsenic	5.91E-05	G	Output	Airborne	air
Barium	3.24E-06	G	Output	Airborne	air
Benzene	1.84E-04	G	Output	Airborne	air
Benzo[a]anthracene	1.46E-08	G	Output	Airborne	air
Benzo[a]pyrene	5.37E-09	G	Output	Airborne	air
Benzo[b,j,k]fluoranthene	1.68E-08	G	Output	Airborne	air
Benzo[g,h,i]perylene	5.68E-09	G	Output	Airborne	air
Benzyl chloride	9.89E-05	G	Output	Airborne	air
Beryllium	3.01E-06	G	Output	Airborne	air
Biphenyl	2.40E-07	G	Output	Airborne	air
Bromoform	5.51E-06	G	Output	Airborne	air
Bromomethane	2.26E-05	G	Output	Airborne	air
Cadmium	7.59E-06	G	Output	Airborne	air

Table 3a. U.S. Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
Carbon dioxide	7.00E+02	G	Output	Airborne	air
Carbon disulfide	1.84E-05	G	Output	Airborne	air
Carbon monoxide	1.27E-01	G	Output	Airborne	air
Chloride ions	2.86E-04	G	Output	Airborne	air
Chlorobenzene	3.11E-06	G	Output	Airborne	air
Chloroform	8.33E-06	G	Output	Airborne	air
Chromium (III)	3.83E-05	G	Output	Airborne	air
Chromium (VI)	1.14E-05	G	Output	Airborne	air
Chrysene	1.61E-08	G	Output	Airborne	air
Cobalt	1.91E-05	G	Output	Airborne	air
Copper	1.57E-06	G	Output	Airborne	air
Cumene	7.49E-07	G	Output	Airborne	air
Cyanide (-1)	3.53E-04	G	Output	Airborne	air
Di(2-ethylhexyl)phthalate	1.03E-05	G	Output	Airborne	air
Dibenzo[a,h]anthracene	1.38E-09	G	Output	Airborne	air
Dichloromethane	4.10E-05	G	Output	Airborne	air
Dimethyl sulfate	6.78E-06	G	Output	Airborne	air
Dioxins, remaining unspeciated	9.21E-11	G	Output	Airborne	air
Ethyl Chloride	5.93E-06	G	Output	Airborne	air
Ethylbenzene	1.33E-05	G	Output	Airborne	air
Ethylene dibromide	1.70E-07	G	Output	Airborne	air
Fluoranthene	1.06E-07	G	Output	Airborne	air
Fluorene	1.32E-07	G	Output	Airborne	air
Fluoride	3.08E-05	G	Output	Airborne	air
Formaldehyde	1.33E-04	G	Output	Airborne	air
Furans, remaining unspeciated	1.47E-10	G	Output	Airborne	air
Hexane	9.46E-06	G	Output	Airborne	air
Hydrochloric acid	1.70E-01	G	Output	Airborne	air
Hydrofluoric acid	2.12E-02	G	Output	Airborne	air
Indeno(1,2,3-cd)pyrene	1.04E-08	G	Output	Airborne	air
Isophorone	8.19E-05	G	Output	Airborne	air
Lead	2.01E-05	G	Output	Airborne	air
Magnesium	1.55E-03	G	Output	Airborne	air
Manganese	7.18E-05	G	Output	Airborne	air
Mercury	1.18E-05	G	Output	Airborne	air
Methane	1.02E+00	G	Output	Airborne	air
Methyl chloride	7.49E-05	G	Output	Airborne	air
Methyl ethyl ketone	5.51E-05	G	Output	Airborne	air
Methyl hydrazine	2.40E-05	G	Output	Airborne	air
Methyl methacrylate	2.83E-06	G	Output	Airborne	air

Table 3a. U.S. Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
Methyl tert-butyl ether	4.94E-06	G	Output	Airborne	air
Molybdenum	9.20E-07	G	Output	Airborne	air
Naphthalene	2.88E-06	G	Output	Airborne	air
Nickel	1.08E-04	G	Output	Airborne	air
Nitrogen oxides	1.85E+00	G	Output	Airborne	air
Nitrous oxide	5.35E-03	G	Output	Airborne	air
o-xylene	8.99E-08	G	Output	Airborne	air
PM-10	9.10E-02	G	Output	Airborne	air
Phenanthrene	3.95E-07	G	Output	Airborne	air
Phenol	2.26E-06	G	Output	Airborne	air
Phosphorus (yellow or white)	7.80E-06	G	Output	Airborne	air
Propionaldehyde	5.37E-05	G	Output	Airborne	air
Pyrene	5.25E-08	G	Output	Airborne	air
Selenium	1.84E-04	G	Output	Airborne	air
Styrene	3.53E-06	G	Output	Airborne	air
Sulfur dioxide	3.93E+00	G	Output	Airborne	air
TOCs, remaining unspeciated	9.07E-03	G	Output	Airborne	air
Tetrachloroethylene	6.07E-06	G	Output	Airborne	air
Toluene	4.00E-05	G	Output	Airborne	air
Vanadium	2.77E-05	G	Output	Airborne	air
Vinyl acetate	1.07E-06	G	Output	Airborne	air
Xylene (mixed isomers)	5.23E-06	G	Output	Airborne	air
Zinc (elemental)	2.40E-05	G	Output	Airborne	air
WATER RELEASES					
Sulfate ion (-4)	1.08E-01	G	Output	Waterborne	surface water
Suspended solids	2.80E-03	G	Output	Waterborne	surface water

Table 3a. U.S. Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
WASTE					
Coal waste	8.01E+01	G	Output	Solid waste	landfill
Dust/sludge	3.10E+01	G	Output	Solid waste	landfill
Fly/bottom ash	2.00E+01	G	Output	Solid waste	landfill
Low-level radioactive waste	2.77E-03	G	Output	Radioactive waste	landfill
Uranium, depleted	8.30E-04	G	Output	Radioactive waste	landfill
RADIOACTIVE AIR EMISSIONS					
Argon-41 (isotope)	2.51E+01	Bq	Output	Radioactivity	air
Bromine-89 (isotope)	2.91E-06	Bq	Output	Radioactivity	air
Bromine-90 (isotope)	1.18E-06	Bq	Output	Radioactivity	air
Cesium-134 (isotope)	7.99E-05	Bq	Output	Radioactivity	air
Cesium-137 (isotope)	6.02E-04	Bq	Output	Radioactivity	air
Chromium-51 (isotope)	1.58E-03	Bq	Output	Radioactivity	air
Cobalt-57 (isotope)	4.24E-06	Bq	Output	Radioactivity	air
Cobalt-58 (isotope)	5.41E+00	Bq	Output	Radioactivity	air
Cobalt-60 (isotope)	4.07E-04	Bq	Output	Radioactivity	air
Iodine-131 (isotope)	1.90E-03	Bq	Output	Radioactivity	air
Iodine-132 (isotope)	3.86E-04	Bq	Output	Radioactivity	air
Iodine-133 (isotope)	1.76E+00	Bq	Output	Radioactivity	air
Iodine-134 (isotope)	2.00E-03	Bq	Output	Radioactivity	air
Iodine-135 (isotope)	1.01E-04	Bq	Output	Radioactivity	air
Krypton-85 (isotope)	4.17E+01	Bq	Output	Radioactivity	air
Krypton-85M (isotope)	2.02E+00	Bq	Output	Radioactivity	air
Krypton-87 (isotope)	7.52E-01	Bq	Output	Radioactivity	air
Krypton-88 (isotope)	3.53E+00	Bq	Output	Radioactivity	air
Manganese-54 (isotope)	2.24E-05	Bq	Output	Radioactivity	air
Niobium-95 (isotope)	8.89E-07	Bq	Output	Radioactivity	air
Rubidium-88 (isotope)	8.26E-03	Bq	Output	Radioactivity	air
Silver-110M (isotope)	2.65E-08	Bq	Output	Radioactivity	air
Technetium-99M (isotope)	1.19E-07	Bq	Output	Radioactivity	air
Tritium-3 (isotope)	5.90E+01	Bq	Output	Radioactivity	air
Xenon-131M (isotope)	3.40E+00	Bq	Output	Radioactivity	air
Xenon-133 (isotope)	4.91E+02	Bq	Output	Radioactivity	air
Xenon-133M (isotope)	3.26E+01	Bq	Output	Radioactivity	air
Xenon-135 (isotope)	1.85E+01	Bq	Output	Radioactivity	air
Xenon-135M (isotope)	3.54E-01	Bq	Output	Radioactivity	air
Xenon-138 (isotope)	1.17E+00	Bq	Output	Radioactivity	air

Table 3a. U.S. Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
Zirconium-95 (isotope)	2.30E-06	Bq	Output	Radioactivity	air
RADIOACTIVE WATER RELEASES					
Antimony-124 (isotope)	1.24E-02	Bq	Output	Radioactivity	surface water
Antimony-125 (isotope)	4.95E-02	Bq	Output	Radioactivity	surface water
Barium-140 (isotope)	9.21E-04	Bq	Output	Radioactivity	surface water
Cesium-134 (isotope)	3.32E-02	Bq	Output	Radioactivity	surface water
Cesium-136 (isotope)	3.84E-14	Bq	Output	Radioactivity	surface water
Cesium-137 (isotope)	4.99E-02	Bq	Output	Radioactivity	surface water
Chromium-51 (isotope)	5.98E-02	Bq	Output	Radioactivity	surface water
Cobalt-57 (isotope)	1.45E-03	Bq	Output	Radioactivity	surface water
Cobalt-58 (isotope)	5.90E-01	Bq	Output	Radioactivity	surface water
Cobalt-80 (isotope)	1.55E-01	Bq	Output	Radioactivity	surface water
Iodine-131 (isotope)	2.76E-02	Bq	Output	Radioactivity	surface water
Iodine-132 (isotope)	1.05E-02	Bq	Output	Radioactivity	surface water
Iodine-133 (isotope)	1.18E-02	Bq	Output	Radioactivity	surface water
Iodine-135 (isotope)	8.49E-03	Bq	Output	Radioactivity	surface water
Iron-55 (isotope)	1.41E-01	Bq	Output	Radioactivity	surface water
Iron-59 (isotope)	7.24E-03	Bq	Output	Radioactivity	surface water
Krypton-85M (isotope)	3.73E-02	Bq	Output	Radioactivity	surface water
Lanthanum-140 (isotope)	9.86E-04	Bq	Output	Radioactivity	surface water
Manganese-54 (isotope)	3.94E-02	Bq	Output	Radioactivity	surface water
Molybdenum-99 (isotope)	7.44E+04	Bq	Output	Radioactivity	surface water
Niobium-95 (isotope)	1.02E-02	Bq	Output	Radioactivity	surface water
Ruthenium-103 (isotope)	1.24E-03	Bq	Output	Radioactivity	surface water
Silver-110M (isotope)	1.45E-02	Bq	Output	Radioactivity	surface water
Sodium-24 (isotope)	2.21E-03	Bq	Output	Radioactivity	surface water
Strontium-89 (isotope)	2.39E-03	Bq	Output	Radioactivity	surface water
Strontium-90 (isotope)	5.61E-04	Bq	Output	Radioactivity	surface water
Strontium-95 (isotope)	6.18E-03	Bq	Output	Radioactivity	surface water
Sulfur-136 (isotope)	1.33E-03	Bq	Output	Radioactivity	surface water
Technetium-99M (isotope)	8.66E-04	Bq	Output	Radioactivity	surface water
Tin-113 (isotope)	1.37E-03	Bq	Output	Radioactivity	surface water
Tritium-3 (isotope)	4.41E+02	Bq	Output	Radioactivity	surface water
Xenon-131M (isotope)	4.54E-01	Bq	Output	Radioactivity	surface water
Xenon-133 (isotope)	6.97E+01	Bq	Output	Radioactivity	surface water
Xenon-133M (isotope)	5.71E-01	Bq	Output	Radioactivity	surface water
Xenon-135 (isotope)	5.20E-01	Bq	Output	Radioactivity	surface water

Table 3a. U.S. Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
Zinc-85 (isotope)	6.65E-04	Bq	Output	Radioactivity	surface water

Table 3b. Japanese Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
PRIMARY INPUTS					
Coal, avg. (in ground)	8.88E+01	G	Input	Primary material	
Natural gas	4.85E+01	G	Input	Primary material	
Petroleum (in ground)	5.00E+01	G	Input	Primary material	
Uranium, yellowcake	1.18E-02	G	Input	Primary material	
ANCILLARY INPUTS					
Lime	5.24E-01	G	Input	Ancillary material	
Limestone	1.19E+00	G	Input	Ancillary material	
Water	1.72E+03	G	Input	Water	
PRODUCT					
Electricity	1.00E+00	KWH	Output	Energy	
AIR EMISSIONS					
1,1,1-Trichloroethane	2.51E-06	G	Output	Airborne	air
1,2-Dichloroethane	1.78E-06	G	Output	Airborne	air
2,3,7,8-TCDD	6.53E-13	G	Output	Airborne	air
2,3,7,8-TCDF	2.27E-12	G	Output	Airborne	air
2,4-Dinitrotoluene	1.24E-08	G	Output	Airborne	air
2-Chloroacetophenone	3.11E-07	G	Output	Airborne	air
2-Methylnaphthalene	9.24E-09	G	Output	Airborne	air
5-Methyl chrysene	9.77E-10	G	Output	Airborne	air
Acenaphthene	1.68E-07	G	Output	Airborne	air
Acenaphthylene	1.28E-08	G	Output	Airborne	air
Acetaldehyde	2.53E-05	G	Output	Airborne	air
Acetophenone	6.66E-07	G	Output	Airborne	air
Acrolein	1.29E-05	G	Output	Airborne	air
Anthracene	1.77E-08	G	Output	Airborne	air
Antimony	3.69E-05	G	Output	Airborne	air
Arsenic	2.72E-05	G	Output	Airborne	air
Barium	2.01E-05	G	Output	Airborne	air
Benzene	5.92E-05	G	Output	Airborne	air
Benzo[a]anthracene	3.11E-08	G	Output	Airborne	air
Benzo[a]pyrene	1.69E-09	G	Output	Airborne	air
Benzo[b,j,k]fluoranthene	1.51E-08	G	Output	Airborne	air
Benzo[g,h,i]perylene	1.67E-08	G	Output	Airborne	air
Benzyl chloride	3.11E-05	G	Output	Airborne	air
Beryllium	1.26E-06	G	Output	Airborne	air

Table 3b. Japanese Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
Biphenyl	7.55E-08	G	Output	Airborne	air
Bromoform	1.73E-06	G	Output	Airborne	air
Bromomethane	7.11E-06	G	Output	Airborne	air
Cadmium	5.48E-06	G	Output	Airborne	air
Carbon dioxide	5.98E+02	G	Output	Airborne	air
Carbon disulfide	5.78E-06	G	Output	Airborne	air
Carbon monoxide	1.09E-01	G	Output	Airborne	air
Chloride ions	2.39E-03	G	Output	Airborne	air
Chlorobenzene	9.77E-07	G	Output	Airborne	air
Chloroform	2.62E-06	G	Output	Airborne	air
Chromium (III)	2.15E-05	G	Output	Airborne	air
Chromium (VI)	5.22E-06	G	Output	Airborne	air
Chrysene	2.08E-08	G	Output	Airborne	air
Cobalt	4.60E-05	G	Output	Airborne	air
Copper	1.24E-05	G	Output	Airborne	air
Cumene hydroperoxide	2.35E-07	G	Output	Airborne	air
Cyanide (-1)	1.11E-04	G	Output	Airborne	air
Di(2-ethylhexyl)phthalate	3.24E-06	G	Output	Airborne	air
Dibenzo[a,h]anthracene	1.15E-08	G	Output	Airborne	air
Dichloromethane	1.29E-05	G	Output	Airborne	air
Dimethyl sulfate	2.13E-06	G	Output	Airborne	air
Dioxins, remaining unspeciated	2.90E-11	G	Output	Airborne	air
Ethyl Chloride	1.87E-06	G	Output	Airborne	air
Ethylbenzene	4.61E-06	G	Output	Airborne	air
Ethylene dibromide	5.33E-08	G	Output	Airborne	air
Fluoranthene	6.79E-08	G	Output	Airborne	air
Fluorene	7.11E-08	G	Output	Airborne	air
Fluorides (F-)	2.57E-04	G	Output	Airborne	air
Formaldehyde	3.97E-04	G	Output	Airborne	air
Furans, remaining unspeciated	4.62E-11	G	Output	Airborne	air
Hexane	2.98E-06	G	Output	Airborne	air
Hydrochloric acid	5.33E-02	G	Output	Airborne	air
Hydrofluoric acid	6.66E-03	G	Output	Airborne	air
Indeno(1,2,3-cd)pyrene	1.74E-08	G	Output	Airborne	air
Isophorone	2.58E-05	G	Output	Airborne	air
Lead (Pb, ore)	1.71E-05	G	Output	Airborne	air
Magnesium	4.89E-04	G	Output	Airborne	air
Manganese (Mn, ore)	4.24E-05	G	Output	Airborne	air
Mercury	4.59E-06	G	Output	Airborne	air

Table 3b. Japanese Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
Methane	3.16E-03	G	Output	Airborne	air
Methyl chloride	2.35E-05	G	Output	Airborne	air
Methyl ethyl ketone	1.73E-05	G	Output	Airborne	air
Methyl hydrazine	7.55E-06	G	Output	Airborne	air
Methyl methacrylate	8.88E-07	G	Output	Airborne	air
Methyl tert-butyl ether	1.55E-06	G	Output	Airborne	air
Molybdenum	6.01E-06	G	Output	Airborne	air
Naphthalene	8.60E-06	G	Output	Airborne	air
Nickel	5.72E-04	G	Output	Airborne	air
Nitrogen oxides	1.58E+00	G	Output	Airborne	air
Nitrous oxide	4.34E-03	G	Output	Airborne	air
o-xylene	7.50E-07	G	Output	Airborne	air
Phenanthrene	2.02E-07	G	Output	Airborne	air
Phenol	7.11E-07	G	Output	Airborne	air
PM-10	7.77E-02	G	Output	Airborne	air
Propionaldehyde	1.69E-05	G	Output	Airborne	air
Pyrene	4.90E-08	G	Output	Airborne	air
Selenium	6.25E-05	G	Output	Airborne	air
Styrene	1.11E-06	G	Output	Airborne	air
Sulfur dioxide	3.35E+00	G	Output	Airborne	air
Tetrachloroethylene	1.91E-06	G	Output	Airborne	air
TOCs, remaining unspeciated	7.66E-03	G	Output	Airborne	air
Toluene	5.56E-05	G	Output	Airborne	air
Vanadium	2.22E-04	G	Output	Airborne	air
Vinyl acetate	3.37E-07	G	Output	Airborne	air
Xylene (mixed isomers)	1.64E-06	G	Output	Airborne	air
Zinc (elemental)	2.00E-04	G	Output	Airborne	air
WATER RELEASES					
Sulfate ion (-4)	3.39E-02	G	Output	Waterborne	surface water
Suspended solids	8.82E-04	G	Output	Waterborne	surface water
WASTE					
Coal waste	2.52E+01	G	Output	Solid waste	landfill
Dust/sludge	9.73E+00	G	Output	Solid waste	landfill
Fly/bottom ash	6.30E+00	G	Output	Solid waste	landfill
Low-level radioactive waste	4.29E-03	G	Output	Radioactive waste	landfill
Uranium, depleted	1.29E-03	G	Output	Radioactive waste	landfill
RADIOACTIVE AIR EMISSIONS					
Argon-41 (isotope)	3.89E+01	Bq	Output	Radioactivity	air
Bromine-89 (isotope)	4.50E-06	Bq	Output	Radioactivity	air

Table 3b. Japanese Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
Bromine-90 (isotope)	1.83E-06	Bq	Output	Radioactivity	air
Cesium-134 (isotope)	1.24E-04	Bq	Output	Radioactivity	air
Cesium-137 (isotope)	9.33E-04	Bq	Output	Radioactivity	air
Chromium-51 (isotope)	2.44E-03	Bq	Output	Radioactivity	air
Cobalt-57 (isotope)	6.57E-06	Bq	Output	Radioactivity	air
Cobalt-58 (isotope)	8.38E-05	Bq	Output	Radioactivity	air
Cobalt-60 (isotope)	6.31E-04	Bq	Output	Radioactivity	air
Iodine-131 (isotope)	2.95E-03	Bq	Output	Radioactivity	air
Iodine-132 (isotope)	5.99E-04	Bq	Output	Radioactivity	air
Iodine-133 (isotope)	2.73E+00	Bq	Output	Radioactivity	air
Iodine-134 (isotope)	3.10E-03	Bq	Output	Radioactivity	air
Iodine-135 (isotope)	1.56E-04	Bq	Output	Radioactivity	air
Krypton-85 (isotope)	6.46E+01	Bq	Output	Radioactivity	air
Krypton-85M (isotope)	3.13E+00	Bq	Output	Radioactivity	air
Krypton-87 (isotope)	1.17E+00	Bq	Output	Radioactivity	air
Krypton-88 (isotope)	5.47E+00	Bq	Output	Radioactivity	air
Manganese-54 (isotope)	3.47E-05	Bq	Output	Radioactivity	air
Niobium-95 (isotope)	1.38E-06	Bq	Output	Radioactivity	air
Rubidium-88 (isotope)	1.28E-02	Bq	Output	Radioactivity	air
Silver-110M (isotope)	4.11E-08	Bq	Output	Radioactivity	air
Technetium-99M (isotope)	1.85E-07	Bq	Output	Radioactivity	air
Tritium-3 (isotope)	9.13E+01	Bq	Output	Radioactivity	air
Xenon-131M (isotope)	5.27E+00	Bq	Output	Radioactivity	air
Xenon-133 (isotope)	5.05E+01	Bq	Output	Radioactivity	air
Xenon-133 (isotope)	5.05E+01	Bq	Output	Radioactivity	air
Xenon-133M (isotope)	7.60E+02	Bq	Output	Radioactivity	air
Xenon-135 (isotope)	2.87E+01	Bq	Output	Radioactivity	air
Xenon-135M (isotope)	5.48E-01	Bq	Output	Radioactivity	air
Xenon-138 (isotope)	1.82E+00	Bq	Output	Radioactivity	air
Zirconium-95 (isotope)	3.56E-06	Bq	Output	Radioactivity	air
RADIOACTIVE WATER RELEASES					
Antimony-124 (isotope)	1.92E-02	Bq	Output	Radioactivity	surface water
Antimony-125 (isotope)	7.67E-02	Bq	Output	Radioactivity	surface water
Barium-140 (isotope)	1.43E-03	Bq	Output	Radioactivity	surface water
Cesium-134 (isotope)	5.15E-02	Bq	Output	Radioactivity	surface water
Cessium-137 (isotope	7.73E-02	Bq	Output	Radioactivity	surface water
Chromium-51 (isotope)	9.27E-02	Bq	Output	Radioactivity	surface water
Cobalt-57 (isotope)	2.24E-03	Bq	Output	Radioactivity	surface water
Cobalt-58 (isotope)	9.13E-01	Bq	Output	Radioactivity	surface water

Table 3b. Japanese Electricity Generation Inventory [inputs and outputs per kWh (3.6 MJ)]

Material	Quantity	Units	Input/output	Input/output type	Disposition
Cobalt-80 (isotope)	2.40E-01	Bq	Output	Radioactivity	surface water
Iodine-131 (isotope)	4.28E-02	Bq	Output	Radioactivity	surface water
Iodine-132 (isotope)	1.62E-02	Bq	Output	Radioactivity	surface water
Iodine-133 (isotope)	1.83E-02	Bq	Output	Radioactivity	surface water
Iodine-135 (isotope)	1.31E-02	Bq	Output	Radioactivity	surface water
Iron-55 (isotope)	2.18E-01	Bq	Output	Radioactivity	surface water
Iron-59 (isotope)	1.12E-02	Bq	Output	Radioactivity	surface water
Krypton-85M (isotope)	5.77E-02	Bq	Output	Radioactivity	surface water
Lanthanum-140 (isotope)	1.53E-03	Bq	Output	Radioactivity	surface water
Manganese-54 (isotope)	6.11E-02	Bq	Output	Radioactivity	surface water
Molybdenum-99 (isotope)	1.15E+05	Bq	Output	Radioactivity	surface water
Niobium-95 (isotope)	1.57E-02	Bq	Output	Radioactivity	surface water
Ruthenium-103 (isotope)	1.92E-03	Bq	Output	Radioactivity	surface water
Silver-110M (isotope)	2.24E-02	Bq	Output	Radioactivity	surface water
Sodium-24 (isotope)	3.42E-03	Bq	Output	Radioactivity	surface water
Strontium-89 (isotope)	3.70E-03	Bq	Output	Radioactivity	surface water
Strontium-90 (isotope)	8.69E-04	Bq	Output	Radioactivity	surface water
Strontium-95 (isotope)	9.57E-03	Bq	Output	Radioactivity	surface water
Sulfur-136 (isotope)	2.06E-03	Bq	Output	Radioactivity	surface water
Technetium-99M (isotope)	1.34E-03	Bq	Output	Radioactivity	surface water
Tin-113 (isotope)	2.12E-03	Bq	Output	Radioactivity	surface water
Tritium-3 (isotope)	6.83E+02	Bq	Output	Radioactivity	surface water
Xenon-131M (isotope)	7.02E-01	Bq	Output	Radioactivity	surface water
Xenon-133M (isotope)	8.84E-01	Bq	Output	Radioactivity	surface water
Xenon-135 (isotope)	8.05E-01	Bq	Output	Radioactivity	surface water
Zinc-85 (isotope)	1.03E-03	Bq	Output	Radioactivity	surface water

3. METHODOLOGY

The U.S.-wide inventory was developed by first compiling inventory data for each of the major generation (fuel-specific) categories used to produce electricity in the U.S., and then creating the U.S.-wide inventory from the fuel-specific inventories. The creation of the U.S.-wide data from the fuel-specific inventories required two particular sets of information: 1997 fuel consumption data and 1997 fuel-specific net electricity generation data (see Table 4). In the majority of cases, one or more pieces of information from these two data sets was needed to convert each input or output into the units of grams per kWh (excluding the radionuclides which were converted to Becquerels per kWh).

Table 4. 1997 U.S. Electricity Utility Summary Statistics

Fuel [a]	1997 Fuel Consumption	Units	1997 Net Electricity Generation	1997 Generation % Breakdown
Coal	900,361,000	short tons/yr	1,787,806,000,000	57.23%
Gas	2,968,453	million ft3/yr	283,625,000,000	9.07%
Petroleum	5,256,132	thousand gal/yr	77,753,000,000	2.53%
Nuclear	48,700,000	lbs U_3O_8/yr	628,644,000,000	20.14%
Hydro [b]	--	--	337,233,000,000	10.79%
Renewables [b]	--	--	7,462,000,000	0.24%
Total			3,122,522,000,000	100%

Source: EIA 1999a.

[a] This breakdown exludes nonutility electricity genration (non and Independent Power Producers (NPPs or IPPs), which typically contribute about 11% of the U.S. total (EIA 1999).

[b] Hydro and renewables were exluded from the calculation of inputs and outputs.

Data on the inputs and outputs for electricity generation were obtained from available sources; when multiple sources of the same type of data were found, those data believed to have the highest quality were utilized (Section 5 addresses data quality). Most data obtained were fuel-specific, however some of the data found were already aggregated to the U.S.-wide level, and thus did not need converting from the fuel-specific values. Thus, for some input/output categories, few calculations were necessary; for others, more complex equations were required to calculate the final input or output data.

As stated earlier in this TM, the final electric grid inventory data (in units of grams/net kWh, for example) will be multiplied by energy use values throughout the life cycle (in units of point-of-use kWhs/functional unit). The two kWhs referred to are different, with the difference being net generated kWhs versus point-of-use kWhs. Due to losses that are associated with moving electrical energy from a point of generation to a point of use, known as 'transmission and distribution (TD) losses,' these must be accounted for in the calculations. It was found in the research for this TM that for 1997 the nationwide TD losses were on the order of 8% of net generation (EIA 1999b). Therefore, to make the kWhs equivalent, the net generation was divided by a TD factor of 1.08 to effectively convert the net kWhs to point-of-use kWhs. The net kWhs are divided by the 1.08 TD factor in all the equations shown in this TM.

The following subsections provide the methodology used and basic equations utilized to create the U.S.-wide inventory from the fuel-specific input and output values.

3.1 Inputs

3.1.1 Primary Materials

Primary materials are typically considered in LCA to be those materials that become part of the final product of the process being modeled. For the process of electricity generation, the fuels used to produce the electrical energy are usually considered to be the only 'primary' materials. Thus, for the U.S. and Japanese electric grid inventory data, the primary materials include coal, gas, petroleum and uranium. The U.S. nationwide total quantities of these fuels consumed by utilities in 1997 was obtained from the Energy Information Administration (EIA 1999a for coal, gas and petroleum; EIA 1998b for uranium). The Japanese data were obtained from the EIA's Country Energy Data Report (EIA 1997). Note that the primary material for nuclear-based electricity generation is referred to as "yellowcake," which is the most common physical state on which uranium consumption is based. Yellowcake is a yellowish-brown powder that is the product of the initial milling process that follows mining. The input data were provided on a nationwide basis, thus the equation needed to calculate each fuel's use rate in grams per kWh is shown below:

$$UR_{fuel\ i} = \frac{Con_{fuel\ i}}{\frac{Gen_{net}}{TD}} \qquad \textit{Eq. 1}$$

where,

$UR_{fuel\ i}$ = nationwide input use rate per unit of electricity for fuel *i*, where the four fuels are coal, gas, petroleum and uranium (grams/kWh),

$Con_{fuel\ i}$ = annual consumption rate for fuel *i* (mass or volume/yr; converted to grams using density as necessary, see Attachment E, Table E5),

Gen_{net} = net annual nationwide electricity generation (kWh/yr), and

TD = nationwide average transmission and distribution losses factor (percent).

In calculating the primary material consumption rates for each fuel, material densities and conversion factors for mass, volume and energy were utilized where needed, depending on whether the units of consumption were in mass or volume (see Attachment E, Table E5).

3.1.2 Ancillary Materials

Ancillary materials are considered to be those materials that help the process function or work, yet do not become part of the final product. In generating electricity, all materials used, except the fuel itself, are typically considered to be ancillary materials. The ancillary materials accounted for in the U.S. electric grid inventory data are limestone and lime which are sulfur

dioxide removal system catalysts typically used in coal firing, and cooling water which is consumed in generating electricity from all fuel types.

The limestone and lime values were derived by utilizing data from approximately five different sources, primarily the EIA, the Acid Rain database and direct contact with utility employees. In short, individual lime and limestone annual consumption rates were developed in units of pounds per year for each plant in the U.S. that utilizes a lime- or limestone-based flue gas desulfurization (FGD) system, and then those values were added to obtain the total poundage or tonnage consumed annually in the U.S. (tons per year). At that point, Equation 1 could be used (calculating only for coal) to obtain the quantity of lime or limestone consumed in grams per kWh generated. Cooling water consumption in units of gallons per kWh was obtained from the California Energy Commission (CEC 1979; cited in Paul Gipe's *Wind Energy Comes of Age*, John Wiley & Sons, 1995). Since cooling water is consumed during electricity generation for each of the fuel types followed in this inventory data set, one equation was used to calculate the nationwide average cooling water requirements:

$$UR_{water} = \frac{\sum_{i=1}^{4} \left(Con_{water} \times Gen \right)_{fuel\ i}}{\frac{Gen_{net}}{TD}} \qquad \textbf{Eq. 2}$$

where,

Ur_{water}	=	nationwide input use rate per unit of electricity for water (grams/kWh),
Con_{water}	=	average consumption rate per unit of electricity for water for fuel *i*, where the four fuels are coal, gas, petroleum and uranium (gallons/kWh; converted to grams using density, see Attachment E, Table E5),
Gen	=	net annual electricity generation rate for fuel *i* (kWh/yr),
Gen_{net}	=	net annual nationwide electricity generation (kWh/yr), and
TD	=	nationwide average transmission and distribution losses factor (percent).

3.2 Outputs

3.2.1 Air Emissions

Several sources of air emissions data where evaluated in compiling the electric grid inventory data. The evaluation revealed that AP-42 (EPA 1996) data are the most complete source of speciated air emissions data *that are easily accessible and do not require a substantial investment to obtain*. Thus, AP-42 data were used as the foundation for the air emissions estimates. ('AP-42' is the EPA's emission factors data set that addresses the type and quantity of air pollutants that result from over 200 major industries, point sources and mobile sources.)

The evaluation also revealed a few sources of higher quality data for some pollutants, and in those cases, that information was used to either augment or replace the AP-42 factors. Specifically, the air pollutant release rates for criteria pollutants were obtained from the EPA (1998b) on a nationwide annual basis and used instead of the AP-42 factors for those pollutants (the values covered all fossil fuel-based generation categories and were in units of pounds per year). The criteria pollutants include carbon dioxide (CO_2), sulfur dioxide (SO_2), nitrogen oxides

(NO_X), carbon monoxide (CO), lead (Pb) and particulate matter ten micrometers or less in diameter (PM-10), and the following equation was used to obtain the emission rates for these pollutants in units of grams/kWh:

$$RR_{air-criteria\ i} = \frac{Rel_{air-criteria\ i}}{\frac{Gen_{net}}{TD}} \qquad \textit{Eq. 3}$$

where,

$RR_{air\text{-}criteria\ i}$	=	nationwide release rate per unit of electricity for criteria pollutant *i* (grams/kWh),
$Rel_{air\text{-}criteria\ i}$	=	annual release rate for criteria pollutant *i* (lbs/yr),
Gen_{net}	=	net annual nationwide electricity generation (kWh/yr), and
TD	=	nationwide average transmission and distribution losses factor (percent).

Nuclear power plants produce electricity without combusting fuel, thus no criteria pollutants are emitted to the local air environment during nuclear power production. However, nuclear-based electricity generation does produce some airborne radionuclides, which are addressed in Section 3.2.4. No airborne releases from nuclear-based generation are addressed here.

The air pollutants accounted for in this inventory calculated from AP-42 air emission factors are shown in Table 5. Of these air emission factors, Table 5 shows the number of pollutants in each category, what fuels AP-42 has release data for, and whether the AP-42 data reflects controlled or uncontrolled release of those pollutants.

The equation used to calculate the nationwide emissions of these non-criteria pollutants is Equation 4. The equation shows a summation of three release and consumption rates, which was adjusted for the number of fuels from which the pollutants were listed in AP-42 (shown in Table 5).

For all of the pollutants in Table 5, AP-42 lists only one emission factor per pollutant per fuel (for example, pounds of benzene released per ton of coal burned). Thus, each factor represents a combined emissions estimate for the various technologies used to fire each fuel.

In augmenting the AP-42 data, it was also determined that the nationwide methane (CH_4) air releases generated during coal mining (EPA 1998c) are significant, and were added to the emissions estimates of CH_4 from coal and petroleum combustion. These emissions were presented in units of nationwide cubic feet of methane released per year.

Table 5. Air Pollutant Information from AP-42

Pollutant Category/Pollutant	# of factors provided	Fuels from Which Pollutants Were Listed in AP-42			Controlled/ Uncontrolled
		Coal	Gas	Petroleum	
Speciated organic compounds	37	✔	✔	✔	Controlled
Trace metals	13	✔	✔	✔	Controlled
Polycyclic aromatic hydrocarbons	16	✔			Controlled
Dioxins & furans	16	✔			Controlled
Methane	1	✔		✔	Uncontrolled
Nitrous oxide	1	✔	✔	✔	Uncontrolled
Hydrogen chloride	1	✔			Uncontrolled
Hydrogen fluoride	1	✔			Uncontrolled
Total organic compounds	1	✔	✔	✔	Uncontrolled
Total nonmethane organic compounds	1	✔		✔	Uncontrolled

Source: EPA 1996.

$$RR_{air-other\ j} = \frac{\sum_{i=1}^{3} \left(Rel_{air-other\ j} \times Con \right)_{fuel\ i}}{\frac{Gen_{net}}{TD}} \qquad \text{Eq. 4}$$

where,

$Rr_{air\text{-}other\ j}$ = nationwide release rate for each pollutant *j* (grams/kWh),

$Rel_{air\text{-}other\ j}$ = release rate per unit of fuel for each air pollutant *j* from fossil fuel *i* (coal - lbs/ton, gas - lbs/million cubic feet, petroleum - lbs/thousand gallons),

Con = annual consumption rate of fuel *i* (coal - tons/yr, gas - million cubic feet/yr, petroleum - thousand gallons/yr),

Gen_{net} = net annual nationwide electricity generation (kWh/yr), and

TD = nationwide average transmission and distribution losses factor (percent).

3.2.2 Solid Wastes

For the U.S. electric grid inventory data, two types of solid waste exist: coal-fired generation nonhazardous solid wastes and nuclear-based generation radioactive solid wastes. [The term 'solid waste' as it is used in this report applies to the Resource Conservation and Recovery Act (RCRA) definition which is defined in the U.S. Federal Code of Regulations (40 CFR 261).] For coal-fired generation, the solid wastes values were obtained from a 1994 Oak Ridge National Laboratory (ORNL) report entitled "Estimating Externalities of Coal Fuel Cycles," and were provided in units of tons of waste produced per gigawatthour (GWh) generated. The calculation needed to obtain the nationwide releases is as follows:

$$RR_{solid\ i} = \frac{Rel_{solid\ i} \times Gen_{coal}}{\frac{Gen_{net}}{TD}} \qquad \textit{Eq. 5}$$

where,

$RR_{solid\ i}$ = nationwide release rate per unit of electricity for solid waste *i* from coal-fired generation (grams/kWh),

$Rel_{solid\ i}$ = release rate per unit of electricity for solid waste *i* from coal-fired generation (tons/GWh),

Gen_{coal} = net annual electricity generation rate for coal (MWh/yr),

Gen_{net} = net annual nationwide electricity generation (kWh/yr), and

TD = nationwide average transmission and distribution losses factor (percent).

For the two nuclear-based generation wastes quantified, spent fuel and low-level radioactive waste (LLRW), two data sources were utilized. The spent fuel data information was obtained from the EIA in units of pounds per year and the LLRW data from an expert in the nuclear electricity generation industry (Loiselle 1998) in units of cubic feet per year (see Attachment E, Table E5 for LLRW conversion factor). The calculation used to derive the quantity of both nuclear wastes generated in units of grams per kWh was similar to Equations 1 and 3, and is shown below:

$$GR_{nuclear\ i} = \frac{Gen_{nuclear\ i}}{\frac{Gen_{net}}{TD}} \qquad \textit{Eq. 6}$$

where,

$GR_{nuclear\ i}$ = nationwide generation rate per unit of electricity for nuclear waste *i* (grams/kWh),

$Gen_{nuclear\ i}$ = nationwide annual generation rate for nuclear waste *i* (spent fuel - lbs/yr, LLRW - ft^3/yr; converted to grams using density as necessary, see Attachment E, Table E5),

Gen_{net} = net annual nationwide electricity generation (kWh/yr), and

TD = nationwide average transmission and distribution losses factor (percent).

3.2.3 Water Releases

Water release information was obtained on coal-fired generation. Radioactive water release information is presented in Section 3.2.4. Information on only three water pollutants was obtained (ORNL 1994). Data were in units of tons/GWh, and thus used an equation like Equation 5 to calculate the nationwide release per unit of electricity generated:

$$RR_{water\ i} = \frac{Rel_{water\ i} \times Gen_{coal}}{\frac{Gen_{net}}{TD}} \qquad \textit{Eq. 7}$$

where,

$RR_{water\ i}$ = nationwide release rate per unit of electricity for water pollutant *i* from coal-fired generation (grams/kWh),

$Rel_{water\ i}$ = release rate per unit of electricity for water pollutant *i* from coal-fired generation (tons/GWh),

Gen_{coal} = net annual electricity generation rate for coal (MWh/yr),

Gen_{net} = net annual nationwide electricity generation (kWh/yr), and

TD = nationwide average transmission and distribution losses factor (percent).

3.2.4 Radionuclides

During the operation of nuclear electricity generation facilities, both airborne and waterborne radioactive releases are generated that are not directly related to a facility's capacity to generate power (kWs) or to the quantity of power it generates over time (kWhs). Data were obtained on the radioactive releases of many nuclear facilities in the U.S. from an ORNL report which addressed the externalities of nuclear fuel cycles (ORNL 1995). This report presented averaged release rate information for 31 airborne and 35 waterborne radioactive releases, which were from direct measurements at many U.S.-based nuclear facilities, all of which were presented in units of Curies per year. Although the releases where found *not* to relate directly to power generation or power generating capacity, some scale was needed to convert the quantity of release from multiple facilities to a quantity of release for all the facilities in use in the U.S. Therefore, due to a lack of any other identifiable scaling mechanism, the quantity of power generated was utilized. The Curies per year value for each radioactive release was first converted into Curies per MWh by dividing by the number of MWhs generated by the average facility identified in the report. Then the values were converted into units of Becquerels per kWh. The following equation was utilized for converting airborne and waterborne radionuclides to the nationwide grid:

$$RR_{radionuclide\ i} = \frac{Rel_{radionuclide\ i} \times Gen_{nuclear}}{\frac{Gen_{net}}{TD}} \qquad \textit{Eq. 8}$$

where,

$RR_{radionuclide\ i}$ = nationwide release rate per unit of electricity for radionuclide *i* (Becquerels/kWh),

$Rel_{radionuclide\ i}$ = averaged release rate per unit of electricity for radionuclide *i* (Curies/MWh),

$Gen_{nuclear}$ = annual electricity generation rate for nuclear (MWh/yr),

Gen_{net} = net annual nationwide electricity generation (kWh/yr), and

TD = nationwide average transmission and distribution losses factor (percent).

4. FUEL-SPECIFIC RESULTS

Tables 6 through 9 present the inputs and outputs from each of the individual fuel inventories. The data in those tables were aggregated into the U.S.-wide average data for electricity generation (Table 3a) and Japanese average data (Table 3b). Additionally, the spreadsheets from which Tables 6 through 9 were derived are shown in Attachments A through E and provide some additional information about each inventory.

Table 6. Inputs and Outputs for Coal-Fired Electricity Generation in the United States[a]

Material/pollutant	Quantity	Unit
INPUTS		
Primary Materials		
Coal	9.00E+08	tons/yr
Ancillary Materials		
Limestone	1.21E+07	tons/yr
Lime	5.31E+06	tons/yr
Cooling water	4.90E-01	gal/kWh
OUTPUTS		
Air Emissions		
Methane	4.00E-02	lbs/ton
Nitrous oxide	3.00E-02	lbs/ton
Hydrogen chloride	1.20E+00	lbs/ton
Hydrogen fluoride	1.50E-01	lbs/ton
TOC	3.00E-01	lbs/ton
TNMOC	6.00E-02	lbs/ton
SPECIATED ORGANIC COMPOUNDS		
Acetaldehyde	5.70E-04	lbs/ton
Acetophenone	1.50E-05	lbs/ton
Acrolein	2.90E-04	lbs/ton
Benzene	1.30E-03	lbs/ton
Benzyl chloride	7.00E-04	lbs/ton
Bis(2-ethylhexyl)phthalate (DEHP)	7.30E-05	lbs/ton
Bromoform	3.90E-05	lbs/ton
Carbon disulfide	1.30E-04	lbs/ton
2-Chloroacetophenone	7.00E-06	lbs/ton
Chlorobenzene	2.20E-05	lbs/ton
Chloroform	5.90E-05	lbs/ton
Cumene	5.30E-06	lbs/ton
Cyanide	2.50E-03	lbs/ton
2,4-Dinitrotoluene	2.80E-07	lbs/ton
Dimethyl sulfate	4.80E-05	lbs/ton
Ethyl benzene	9.40E-05	lbs/ton

Material/pollutant	Quantity	Unit
OUTPUTS (continued)		
Air Emissions (continued)		
TRACE METALS (continued)		
Beryllium	2.10E-05	lbs/ton
Cadmium	5.10E-05	lbs/ton
Chromium	2.60E-04	lbs/ton
Chromium (VI)	7.90E-05	lbs/ton
Cobalt	1.00E-04	lbs/ton
Magnesium	1.10E-02	lbs/ton
Manganese	4.90E-04	lbs/ton
Mercury	8.30E-05	lbs/ton
Nickel	2.80E-04	lbs/ton
Selenium	1.30E-03	lbs/ton
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)		
Biphenyl	1.70E-06	lbs/ton
Acenaphthene	5.10E-07	lbs/ton
Acenaphthylene	2.50E-07	lbs/ton
Anthracene	2.10E-07	lbs/ton
Benzo(a)anthracene	8.00E-08	lbs/ton
Benzo(a)pyrene	3.80E-08	lbs/ton
Benzo(b,j,k)fluoranthene	1.10E-07	lbs/ton
Benzo(g,h,i)perylene	2.70E-08	lbs/ton
Chrysene	1.00E-07	lbs/ton
Fluoranthene	7.10E-07	lbs/ton
Fluorene	9.10E-07	lbs/ton
Indeno(1,2,3-cd)pyrene	6.10E-08	lbs/ton
Naphthalene	1.30E-05	lbs/ton
Phenanthrene	2.70E-06	lbs/ton
Pyrene	3.30E-07	lbs/ton
5-Methyl chrysene	2.20E-08	lbs/ton
DIOXINS & FURANS		
2,3,7,8-TCDD	1.43E-11	lbs/ton
Total TCDD	9.28E-11	lbs/ton
Total PeCDD	4.47E-11	lbs/ton

Table 6. Inputs and Outputs for Coal-Fired Electricity Generation in the United States[a]

Material/pollutant	Quantity	Unit		Material/pollutant	Quantity	Unit
Ethyl chloride	4.20E-05	lbs/ton		Total HxCDD	2.87E-11	lbs/ton
Ethylene dichloride	4.00E-05	lbs/ton		Total HpCDD	8.34E-11	lbs/ton
Ethylene dibromide	1.20E-06	lbs/ton		Total OCDD	4.16E-10	lbs/ton
Formaldehyde	2.40E-04	lbs/ton		Total PCDDd	6.66E-10	lbs/ton
Hexane	6.70E-05	lbs/ton		2,3,7,8-TCDF	5.10E-11	lbs/ton
Isophorone	5.80E-04	lbs/ton		Total TCDF	4.04E-10	lbs/ton
Methyl bromide	1.60E-04	lbs/ton		Total PeCDF	3.53E-10	lbs/ton
Methyl chloride	5.30E-04	lbs/ton		Total HxCDF	1.92E-10	lbs/ton
Methyl ethyl ketone	3.90E-04	lbs/ton		Total HpCDF	7.68E-11	lbs/ton
Methyl hydrazine	1.70E-04	lbs/ton		Total OCDF	6.63E-11	lbs/ton
Methyl methacrylate	2.00E-05	lbs/ton		Total PCDFd	1.09E-09	lbs/ton
Methyl tert butyl ether	3.50E-05	lbs/ton		*COAL MINE METHANE EMISSIONS*		
Methylene chloride	2.90E-04	lbs/ton		Methane	1.52E+11	ft^3/yr
Phenol	1.60E-05	lbs/ton				
Propionaldehyde	3.80E-04	lbs/ton		**Solid Wastes**		
Tetrachloroethylene	4.30E-05	lbs/ton		Dust/sludge	5.51E+01	tons/GWh
Toluene	2.40E-04	lbs/ton		Coal waste	1.43E+02	tons/GWh
1,1,1-Trichloroethane	2.00E-05	lbs/ton		Fly/bottom ash	3.57E+01	tons/GWh
Styrene	2.50E-05	lbs/ton				
Xylenes	3.70E-05	lbs/ton		**Water Releases**		
Vinyl acetate	7.60E-06	lbs/ton		Dissolver	2.78E-01	tons/GWh
TRACE METALS				Suspended solids	5.00E-03	tons/GWh
Antimony	1.80E-05	lbs/ton		Sulfate	1.92E-01	tons/GWh

[a] All inputs and outputs have been left in their original units of measure.

Table 7. Inputs and Outputs for Gas-Fired Electricity Generation in the United States

Material/pollutant	Quantity	Unit
INPUTS		
Primary Material		
Gas	3.00E+12	yr 3/yr
Ancillary Material		
Water	2.50E-01	gal/kWh
OUTPUTS		
Air Emissions		
Nitrous oxide	2.20E+00	lbs/Mft3
Filterable PM	1.50E+00	lbs/Mft3
Condensible PM	1.50E+00	lbs/Mft3
TOC	1.70E+00	lbs/Mft3
SPECIATED ORGANIC COMPOUNDS		
Fluoranthene	3.01E-06	lbs/Mft3
Formaldehyde	1.55E-01	lbs/Mft3
2-Methylnaphthalene	9.02E-06	lbs/Mft3

Pollutant	Quantity	Unit
OUTPUTS (continued)		
Air Emissions (continued)		
SPECIATED ORGANIC COMPOUNDS (continued)		
Naphthalene	2.40E-04	lbs/Mft3
Phenanthrene	1.00E-05	lbs/Mft3
Pyrene	5.01E-06	lbs/Mft3
Toluene	2.20E-03	lbs/Mft3
TRACE METALS		
Arsenic	2.30E-04	lbs/Mft3
Barium	2.40E-03	lbs/Mft3
Chromium	1.10E-03	lbs/Mft3
Cobalt	1.20E-04	lbs/Mft3
Copper	2.51E-04	lbs/Mft3
Manganese	3.81E-04	lbs/Mft3
Molybdenum	5.81E-04	lbs/Mft3
Nickel	3.61E-03	lbs/Mft3
Vanadium	3.21E-03	lbs/Mft3

[a] All inputs and outputs have been left in their original units of measure.

Table 8. Inputs and Outputs for Petroleum-Fired Electricity Generation in the U.S.

Material/Pollutant	Quantity	Unit
INPUTS		
Primary Material		
Petroleum		
Ancillary Material		
Water	4.30E-01	gal/kWh
OUTPUTS		
Air Emissions		
Methane	2.66E-01	lbs/kgal
Nitrous oxide	1.10E-01	lbs/kgal
TOC	9.93E-01	lbs/kgal
TNMOC	7.26E-01	lbs/kgal
SPECIATED ORGANIC COMPOUNDS		
Acenaphthene	2.11E-05	lbs/kgal
Acenaphthylene	2.53E-07	lbs/kgal
Anthracene	1.22E-06	lbs/kgal
Benzene	2.14E-04	lbs/kgal
Benz(a)anthracene	4.01E-06	lbs/kgal
Benzo(b,k)fluoranthene	1.48E-06	lbs/kgal
Benzo(g,h,i)perylene	2.26E-06	lbs/kgal

Pollutant	Quantity	Unit
OUTPUTS (continued)		
Air Emissions (continued		
SPECIATED ORGANIC COMPOUNDS (continued)		
OCDD	3.10E-09	lbs/kgal
Phenanthrene	1.05E-05	lbs/kgal
Pyrene	4.25E-06	lbs/kgal
Toluene	6.20E-03	lbs/kgal
1,1,1-Trichloroethane	2.36E-04	lbs/kgal
o-xylene	1.09E-04	lbs/kgal
TRACE METALS		
Antimony	5.25E-03	lbs/kgal
Arsenic	1.28E-03	lbs/kgal
Barium	2.57E-03	lbs/kgal
Beryllium	4.71E-05	lbs/kgal
Cadmium	4.67E-04	lbs/kgal
Chloride	3.47E-01	lbs/kgal
Chromium	1.28E-03	lbs/kgal
Chromium (VI)	2.48E-04	lbs/kgal
Cobalt	6.02E-03	lbs/kgal
Copper	1.76E-03	lbs/kgal
Fluoride	3.73E-02	lbs/kgal

Table 8. Inputs and Outputs for Petroleum-Fired Electricity Generation in the U.S.

Material/Pollutant	Quantity	Unit		Pollutant	Quantity	Unit
Chrysene	2.38E-06	lbs/kgal		Manganese	2.94E-03	lbs/kgal
Dibenzo(a,h)anthracene	1.67E-06	lbs/kgal		Mercury	1.31E-04	lbs/kgal
Ethylbenzene	6.36E-05	lbs/kgal		Molybdenum	7.87E-04	lbs/kgal
Fluoranthene	4.84E-06	lbs/kgal		Nickel	8.09E-02	lbs/kgal
Fluorene	4.47E-06	lbs/kgal		Phosphorous	9.46E-03	lbs/kgal
Formaldehyde	3.30E-02	lbs/kgal		Selenium	6.83E-04	lbs/kgal
Indo(1,2,3-cd)pyrene	2.14E-06	lbs/kgal		Vanadium	3.18E-02	lbs/kgal
Naphthalene	1.13E-03	lbs/kgal		Zinc	2.91E-02	lbs/kgal

[a] All inputs and outputs have been left in their original units of measure.

Table 9. Inputs and Outputs for Nuclear-Based Electricity Generation in the U.S.

Material/pollutant	Quantity	Unit	Pollutant	Quantity	Unit
INPUTS			**OUTPUTS** (continued)		
Primary Material			**Waterborne Radionuclide Emissions** (continued)		
Uranium oxide ("yellowcake")	4.87E+07	lbs/yr	Xe-135M	4.40E-08	Curies/MWh
			Cs-137	7.49E-11	Curies/MWh
Ancillary Material			Xe-138	1.46E-07	Curies/MWh
Water	6.20E-01	gal/kWh	**Waterborne Radionuclide Emissions**		
			T-3	5.48E-05	Curies/MWh
OUTPUTS			Na-24	2.75E-10	Curies/MWh
Solid Wastes			Cr-51	7.44E-09	Curies/MWh
Spent fuel	5.29E+06	lbs/yr	Mn-54	4.90E-09	Curies/MWh
LLRW	2.21E+05	ft^3/yr	Fe-55	1.75E-08	Curies/MWh
			Co-57	1.80E-10	Curies/MWh
Airborne Radionuclide Emissions			Co-58	7.33E-08	Curies/MWh
T-3	7.33E-06	Curies/MWh	Fe-59	9.00E-10	Curies/MWh
Ar-41	3.13E-06	Curies/MWh	Co-80	1.92E-08	Curies/MWh
Cr-51	1.96E-10	Curies/MWh	Zn-85	8.27E-11	Curies/MWh
Mn-54	2.78E-12	Curies/MWh	Kr-85M	4.63E-09	Curies/MWh
Co-57	5.27E-13	Curies/MWh	Sr-89	2.97E-10	Curies/MWh
Co-58	6.73E-12	Curies/MWh	Sr-90	6.97E-11	Curies/MWh
Co-60	5.06E-11	Curies/MWh	Nb-95	1.26E-09	Curies/MWh
Kr-85	5.18E-06	Curies/MWh	Sr-95	7.68E-10	Curies/MWh
Kr-85M	2.51E-07	Curies/MWh	Mo-99	9.25E-03	Curies/MWh
Kr-87	9.35E-08	Curies/MWh	Tc-99M	1.08E-10	Curies/MWh
Rb-88	1.03E-09	Curies/MWh	Ru-103	1.54E-10	Curies/MWh
Kr-88	4.39E-07	Curies/MWh	Ag-110M	1.80E-09	Curies/MWh
Br-89	3.62E-13	Curies/MWh	Sn-113	1.70E-10	Curies/MWh
Br-90	1.47E-13	Curies/MWh	Sb-124	1.54E-09	Curies/MWh
Nb-95	1.11E-13	Curies/MWh	Sb-125	6.15E-09	Curies/MWh
Zr-95	2.86E-13	Curies/MWh	I-131	3.43E-09	Curies/MWh
Tc-99M	1.48E-14	Curies/MWh	Xe-131M	5.64E-08	Curies/MWh

Table 9. Inputs and Outputs for Nuclear-Based Electricity Generation in the U.S.

Material/pollutant	Quantity	Unit	Pollutant	Quantity	Unit
Ag-110M	3.30E-15	Curies/MWh	I-132	1.30E-09	Curies/MWh
I-131	2.37E-10	Curies/MWh	Xe-133	8.66E-06	Curies/MWh
Xe-131M	4.23E-07	Curies/MWh	I-133	1.47E-09	Curies/MWh
I-132	4.80E-11	Curies/MWh	Xe-133M	7.10E-08	Curies/MWh
Xe-133	6.10E-05	Curies/MWh	Cs-134	4.13E-09	Curies/MWh
I-133	2.19E-07	Curies/MWh	I-135	1.06E-09	Curies/MWh
Xe-133M	4.06E-06	Curies/MWh	Xe-135	6.46E-08	Curies/MWh
Cs-134	9.93E-12	Curies/MWh	s-136	1.65E-10	Curies/MWh
I-134	2.49E-10	Curies/MWh	Cs-137	6.20E-09	Curies/MWh
Xe-135	2.30E-06	Curies/MWh	Ba-140	1.14E-10	Curies/MWh
I-135	1.25E-11	Curies/MWh	La-140	1.23E-10	Curies/MWh

[a] All inputs and outputs have been left in their original units of measure.

Table 10 presents the number of inventory data points for each fuel type by input or output category. As can easily be seen, most of the fuel-specific inventories are dominated by air pollution data. Of the main categories of air pollutants considered, the following breakdown lists those emissions that are the biggest contributors (have the largest emission rates in overall quantity) to each part of each fuel inventory:

- Coal – Cyanide (speciated organic compounds), magnesium (metal), naphthalene [polycyclic aromatic hydrocarbons (PAH)] and the total octochlorodibenzo-p-dioxins (dioxins and furans)
- Gas – Formaldehyde (speciated organic compound), nickel (metal)
- Petroleum – Formaldehyde (speciated organic compound), chloride (metal)
- Nuclear – Xenon-133 (airborne radionuclide), molybdenum-99 (waterborne radionuclide)

Note that in Tables 6 through 9, the units for the inputs and outputs were left as originally found in their source. All fuel-specific inputs and outputs (excluding radioactive releases) were converted to the units desired for the U.S.-wide electric grid of grams/kWh during aggregation into that inventory data set.

Table 10. Number of Inputs & Outputs Within Each Inventory

Inputs & Outputs	Coal	Gas	Petroleum	Nuclear
Primary materials	1	1	1	1
Ancillary materials	3	1	1	1
Air releases	89	29	51	31
Water releases	3	--	--	35
Solid & hazardous wastes	3	--	--	2
Total	99	31	53	70

5. DATA SOURCES & QUALITY

Source and quality information for the data presented in this TM are detailed in Table 11. In general, data assigned higher quality ratings were directly measured and represent 1997 data. As data required more calculation or estimation, or were from a previous year, data quality was reduced. Additional comments about data source and quality are in the following subsections.

5.1 Nonfuel specific data

The criteria pollutant air emission values used in this inventory all came from the *National Air Quality & Emissions Trends Report, 1997*. While this report does state that the values supplied are "estimates of the amount and kinds of pollutants being emitted … based upon best available engineering calculations," (EPA 1998b) the EPA used measured air emission rates where feasible, and thus these data were given 'Average' data quality ratings.

5.2 Coal

As the leading electricity-producing fuel in the U.S., coal has accounted for between 40% and 60% of the kWh produced by utilities in the national grid since the 1930s (NEI 1997). In 1997, coal-fired generation accounted for just over 57% of all utility-generated electricity.

Of the coal inventory data, the coal quantity used annually and the methane generated from coal mining were both directly measured data for 1997 and thus were given 'Excellent' data quality ratings. The data for speciated air emissions that came from AP-42 were deemed 'Poor,' due primarily to the following two facets of the data. First, in averaging the data quality ratings that the EPA applies to their AP-42 factors, an average rating of approximately 3 is calculated, indicating by their own standards an 'average' rating. (EPA's data quality ratings are A, B, C, D and E, where, for example, A, C and E represent 'Excellent,' 'Average' and 'Poor' respectively. This alphabetically based system was temporarily converted into a numerical system of 1 through 5 where 1 corresponds to A and 5 corresponds to E to calculate the required averages.) Second, the bulk of the AP-42 data was dated January 1995; updates were included several times since then (two in 1996 and one in 1998), however, each update included only small changes to the whole AP-42 emission factor data set.

The cooling water use (for all fuels) and the solid waste and water release data for coal were assigned a data quality rating of 'Unknown' due to a lack of information on the original data source.

Table 11. Data Sources and Quality Information for the U.S. Electric Grid Inventories

I/O Type [a]	Data	Data Source/ Reference	Data Source Comments	Data Quality [b]	Data Quality Explanation
NONFUEL SPECIFIC					
AR	Criteria pollutants	EPA 1998b	Although the EPA uses measured data wherever feasible in calculating the emissions included in this report, much data required estimating to effectively model the national totals for certain pollutant categories.	Average	Although the bulk of the data used in this analysis were measured, some estimates were required to obtain emissions information from particular industries before aggregating to obtain the U.S.-wide totals.
COAL					
PM	Coal	EIA 1998c	Measured; required for regulatory recording purposes.	Excellent	Measurements provide the highest quality data.
AM	Limestone and lime	EIA 1997	The primary data used in calculating the limestone and lime usage were measured, however approximately six sources of information were accessed to obtain the necessary information to derive final factors.	Average	Of the sources referenced for this calculation, three utilized measured data, while the remaining utilized average or poor quality data. Thus, the overall rating is 'Average.'
AM	Cooling water	CEC 1979	Only source located in which cooling water requirements were detailed for the main electricity generation categories.	Unknown	CEC did not list its data sources.
SW & WR	All	ORNL 1994	Original source of data in the ORNL 1994 report was Meridian Corporation 1989, however, could not be located.	Unknown	Original data document could not be found.
AR	All noncriteria pollutants	EPA 1996	AP-42 factors have a self-assigned 'Average' to 'Poor' quality rating.	Poor	Given 'Poor' rating for several reasons, including primarily that 1) overall AP-42 self-assigned ratings are 'Average' and 2) data applies to 1995.
AR	Methane from coal mining	EPA 1998c	Measured; reported for regulatory recording purposes.	Excellent	Measurements provide the highest quality data.
GAS & PETROLEUM					
PM	Gas and petroleum	EIA 1998c	Measured; required for regulatory recording purposes.	Excellent	Measurements provide the highest quality data.
AM	Cooling water	CEC 1979	Only source located in which cooling water requirements were detailed for the main electricity generation categories.	Unknown	CEC did not list its data sources.
AR	All noncriteria pollutants	EPA 1996	AP-42 factors have a self-assigned 'Poor' quality rating for gas and 'Average' to 'Poor' quality rating for petroleum.	Poor	Given 'Poor' rating for several reasons, including primarily that 1) overall AP-42 self-assigned ratings are 'Average' and 2) data applies to 1995.
URANIUM					
PM	Uranium	EIA 1998b	Measured data, yet had to scale using an unproven scaling mechanism.	Average	Measurements provide the highest quality data, yet the scaling mechanism utilized introduces potential error.
AM	Cooling water	CEC 1979	Only source located in which cooling water requirements were detailed for the main electricity generation categories.	Unknown	CEC did not list its data sources.
SW	Spent fuel	EIA 1996	Estimates the quantity of spent fuel that will be generated in the US in 1997, using measured historical records and knowledge of what facilities will be changing operating patterns in future years (from 1996 perspective).	Excellent	Although not directly measured, use of recently measured data along with in-depth knowledge of future industry changes to project value earns an 'Excellent' rating.
SW	LLRW	Loiselle 1998	Estimated by an industry expert.	Average	Lack of any measured data gives way to an 'Average' rating.
RR	Airborne radionuclides	ORNL 1995	Averaged measured data from nuclear generation facilities.	Excellent	Measurements provide the highest quality data.
RR	Waterborne radionuclides	ORNL 1995	Averaged measured data from nuclear generation facilities.	Excellent	Measurements provide the highest quality data.

[a] Input/Output (I/O) types: PM = primary material, AM = ancillary material, SW = solid waste, AR = airborne release, WR = water release, RR = radioactive release.

[b] The data quality ratings given were assigned to one of the following four data quality categories: Excellent, Average, Poor and Unknown.

5.3 Gas & Petroleum

Each of these data sets utilize the EIA's *Electric Power Annual* for the primary fuel consumption estimates and AP-42 data for the air emissions. The EIA data were given 'Excellent' data quality marks as these data are reported as direct measurements and applicable to 1997. The air emissions were given a quality rating of 'Poor' for the same two reasons the coal inventory data AP-42 estimates were given that rating.

5.4 Uranium

For the nuclear-related inputs and outputs, the largest category of input or output type information was radionuclide emissions. The radionuclide emission information contained in the report was obtained by averaging radionuclide emissions data from 36 different pressurized water reactors (PWRs) across the U.S. (out of just over 110 nuclear reactors total in the U.S.). As discussed previously, the emissions were not found to directly correlate to electricity generation (kWh) or generating capacity (kW), but "were more likely affected by random events within the reactor, such as fuel pin cladding failures, leaks in the primary coolant loop and steam-generator tube leaks" (ORNL 1995). Thus, all factors considered, the overall data quality rating for these emissions was deemed 'Average.' The mass of uranium consumed annually was given the 'Excellent' rating as this information is measured through reporting supplied to the EIA and applicable to 1997.

Of the remaining inputs and outputs, most received higher quality ratings except for the cooling water values which received the 'Unknown' rating due to a lack of information on the original data source.

6. DATA LIMITATIONS

Several limitations of the U.S. electrical energy grid inventory data relate to the exclusion of either entire generation categories (e.g., hydro) or life-cycle substages (see Table 2). For example, no data are readily available for the life-cycle substages of ore and fuel transportation and preliminary ore or fuel processing. Examples of ore and fuel transportation and processing burdens for which insufficient data are available include the emissions generated during the processing of crude oil to produce fuel oils Nos. 6 and 2, and the energy use and wastes generated during the processing of uranium ore into fuel pellets.

With regard to the exclusion of entire generation categories, the renewable and hydroelectric generating categories have not been included in this U.S.-wide inventory. Renewables accounted for only about 0.24% of the total electricity generated in the U.S. in 1997, and are expected to have greatly reduced impacts when compared to the other fuel types. Hydropower was omitted, as stated previously, due to the scarcity of data on hydroelectric inputs and outputs, and also that the CDP LCIA methodology does not account directly for the effects of habitat destruction (expected to be one of the largest impacts from hydroelectric generation once quantified).

Other limitations of the data are related to the use of AP-42 emissions factors, primarily due to the fact that EPA's own ratings of their factors are, at best, 'Average' (see discussion in Section 5.2). Other data limitations include the small number of sources from which much of the

data have been obtained. Not necessarily as much a limitation of the data as a limitation in the sources of the data, this is still an area for quality improvement. Also, as noted previously, nonutility electricity generation in the U.S. is excluded from this inventory, and accounts for about 11% of the total electricity generated annually.

There are some implications that can be derived from the limitations mentioned here on the U.S.-wide electric grid inventory data. These implications include the following:

- Since there are currently no other sources of detailed air emission information like AP-42, there is no way of knowing just how accurate their estimates are (possibly predicting a bias in one direction or the other). It appears that the reason that the EPA's quality ratings of their AP-42 data tend toward 'Average' is that in quite a few cases, emissions test were run on only a small number of boilers. Without a larger body of data on which to base the emission factors, it is not known how the use of these factors biases the results.
- The exclusion of the inputs and outputs from materials extraction, the initial and secondary materials processing stages, and the associated transportation for several fuel types (see Table 2) will underestimate the total inventory from electricity generation. Especially when considering the massive amount of processing that is required to develop the uranium fuel pellets that are used in nuclear generation, this may be the largest influence of all the biases for this inventory. (It should also be noted that these processing steps for developing uranium pellets are extremely energy intensive, thus decreasing the efficiency of not only the nuclear electricity generation process, but also the whole grid's overall efficiency as well.)
- The exclusion of the hydropower and renewable generation types should have little effect on the U.S.-wide electric grid inventory data because the renewables are a minimal percentage of the total generation, and hydropower involves no combustion and thus would have minimal impacts.
- The exclusion of the nonutility-type generation brings two major issues forward. First, nonutilities use cogeneration the majority of the time to produce electricity (EIA 1997). Cogeneration utilizes two cycles to produce electrical energy and another form of usable energy (typically steam) thereby increasing the overall efficiency of the energy conversion process. Second, renewables (including hydropower) and gas make up 76% of the energy generation type for nonutilities, two of the lesser polluting types of electricity generation. These two factors should combine to, for the average kWh, decrease not only the quantity of raw materials needed as inputs but also the amount of air emissions generated as outputs for the inventory.

Finally, the Japanese inventory is limited by having been derived from the U.S. fuel-specific inventories and may not accurately represent electricity production operations in Japan.

Overall, with some implications inferring an underestimate in the inventory and some inferring an overestimate, it is uncertain which way the inventory may be biased. To a certain extent, the lessened impacts from the exclusion of nonutility electricity production data seem to offset the exclusion of the processing and transportation life-cycles substages data. However, the

exclusion of this relevant data hampers the effort to build a completely accurate and representative electric grid inventory.

7. CONCLUSIONS

The U.S. electric grid inventory data presented in this TM will be used to determine the environmental burdens that result from energy consumption in the U.S. using the CDP LCIA methodology. To summarize the work done in this analysis and its use within the CDP, the following is presented:

- The fuel-specific inventories for each of the four primary generation categories used in the average electric grid were compiled from a variety of sources, and then the fuel-specific inventories were combined using a generation-based weighted average to develop the U.S.-wide and Japanese electrical energy grid inventories of material inputs and pollutant outputs in units of grams of input or output per kWh consumed (except for radioactive materials which were placed in units of Becquerels/kWh).
- The U.S.-wide electrical energy grid inventory data are used in the CDP to calculate material inputs and pollutant outputs from electricity consumed during some manufacturing, use, and final disposal of computer displays.
- The Japanese electrical energy grid inventory data are used in the CDP to calculate material inputs and pollutant outputs from electricity consumed during the manufacturing of monitors in Asia.
- The electrical energy grid data are not used for upstream life-cycle stages (i.e., extraction of materials, materials processing) as these are being obtained from secondary sources which already have included the inputs and outputs from energy consumption.

Once the data have been gathered for all of the CDP processes of interest and the inputs and outputs for each of these processes have been analyzed from a life-cycle perspective, the results will help identify how important the impacts of energy consumption are throughout a monitor's life-cycle.

ACRONYMS/ABBREVIATIONS

CCPCT	Center for Clean Products and Clean Technologies
CEC	California Energy Commission
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
DOE	Department of Energy
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FGD	Flue Gas Desulfurization
GWh	Gigawatthour
HCl	Hydrogen chloride
HF	Hydrogen fluoride
kWh	kilowatthour
LCA	Life-cycle assessment
LCI	Life-cycle inventory
LLRW	Low-level radioactive waste
MW	Megawatt
Mwh	Megawatthour
N_2O	Nitrous oxide
NO_X	Oxides of nitrogen
ORNL	Oak Ridge National Laboratory
PAH	Polycyclic aromatic hydrocarbons
Pb	Lead
PM-10	Particulate matter 10 microns or less in diameter
PWR	Pressurized Water Reactor
SO_2	Sulfur dioxide
TNMOC	Total nonmethane organic carbon
TOC	Total organic carbon
TRI	Toxic Release Inventory
U_3O_8	Uranium oxide
UT	University of Tennessee

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ATTACHMENT A. COAL INFORMATION WORKSPACE

Table A1. Mining Related Outputs - Methane Air Emissions

Pollutant	Quantity [a]	Units	Converted Quantity [b]	Units
Outputs				
Methane	169,906	million ft 3/yr	1.52E+05	million ft 3/yr

[a] Value pertains to methane emissions related to all coal mined nation-wide in U.S. (EPA 1998a).
[b] This value represents methane emissions from coal mined exclusively for electricity generation. It is calculated based on the knowledge that 89.6% of the coal mined in the U.S. in 1997 was for electricity generation, thus the toal methane emissions are multiplied by 89.6% to obtain the emissions from electricity generation alone.
(EIA web page: http://www.eia.doe.gov/cneaf/coal/cia/summary/cia_sum.html, 1997).

Table A2. Generation Related Inputs and Outputs - Excluding Air Emissions

Material/Pollutant	Quantity	Units	Converted Quantity	Units
Inputs				
Ancillary Materials				
Water [a]	0.49	gallons/kWh	---	---
Limestone [b]	12,091,817	tons/yr	---	---
Lime [b]	5,310,548	tons/yr	---	---
Outputs				
SOLID WASTES [c]				
Dust/sludge	55.143	tons/GWh	1.10E+02	lbs/MWh
Coal waste	142.857	tons/GWh	2.86E+02	lbs/MWh
Fly/bottom ash	35.714	tons/GWh	7.14E+01	lbs/MWh
WASTEWATER EMISSIONS [c]				
Dissolver	0.278	tons/GWh	5.56E-01	lbs/MWh
Suspended solids	0.005	tons/GWh	1.00E-02	lbs/MWh
Sulfate	0.192	tons/GWh	3.84E-01	lbs/MWh

[a] CEC (1979).
[b] Primary data used to calculate these values from EIA (1997); however, data were modified to derive nationwide average.
[c] ORNL (1994).

Table A3. Generation Related Outputs - Air Emissions [a]

Pollutant	Quantity (lbs/ton of coal)	EPA's Factor Raging [b]
Outputs		
Miscellaneous Compounds [c]		
Methane	0.04	B
Nitrous oxide	0.03	B
Hydrogen chloride	1.2	B
Hydrogen fluoride	0.15	B
Total organic compounds	0.3	E
Total nonmethane organic compounds	0.06	B
Speciated Organic Compounds [d], [e]		
Acetaldehyde	5.70E-04	C
Acetophenone	1.50E-05	D
Acrolein	2.90E-04	D
Benzene	1.30E-03	A
Benzyl chloride	7.00E-04	D
Bis(2-ethyhexyl)ptththalate (DEHP)	7.30E-05	D
Bromoform	3.90E-05	E
Carbon disulfide	1.30E-04	D
2-Chloroacetophenone	7.00E-06	E
Chlorobenzene	2.20E-05	D
Chloroform	5.90E-05	E
Cumene	5.30E-06	E
Cyanide	2.50E-03	D
2,4-Dinitrotoluene	2.80E-07	D
Dimethyl sulfate	4.80E-05	E
Ethyl benzene	9.40E-05	D
Ethyl chloride	4.20E-05	D
Ethylene dichloride	4.00E-05	E
Ethylene dibromide	1.20E-06	E
Formaldehyde	2.40E-04	A
Hexane	6.70E-05	D
Isophorone	5.80E-04	D
Methyl bromide	1.60E-04	D
Methyl chloride	5.30E-04	D
Methyl ethyl ketone	3.90E-04	D
Methyl hydrazine	1.70E-04	E
Methyl methacrylate	2.00E-05	E
Methyl tert butyl ether	3.50E-05	E
Methylene chloride	2.90E-04	D

Table A3. Generation Related Outputs - Air Emissions [a]

Pollutant	Quantity (lbs/ton of coal)	EPA's Factor Raging [b]
Phenol	1.60E-05	D
Propionaldehyde	3.80E-04	D
Tetrachloroethylene	4.30E-05	D
Toluene	2.40E-04	A
1,1,1-Trichloroethane	2.00E-05	E
Styrene	2.50E-05	D
Xylenes	3.70E-05	C
Vinyl acetate	7.60E-06	E
Trace Metals [d], [e]		
Antimony	1.80E-05	A
Arsenic	4.10E-04	A
Beryllium	2.10E-05	A
Cadmium	5.10E-05	A
Chromium	2.60E-04	A
Chromium (VI)	7.90E-05	D
Cobalt	1.00E-04	A
Magnesium	1.10E-02	A
Manganese	4.90E-04	A
Mercury	8.30E-05	A
Nickel	2.80E-04	A
Selenium	1.30E-03	A
Polycyclic Aromatic Hydrocarbons [d], [e]		
Biphenyl	1.70E-06	D
Acenaphthene	5.10E-07	B
Acenaphthylene	2.50E-07	B
Anthracene	2.10E-07	B
Benmzo(a)anthracne	8.00E-08	B
Benzo(a)pyrene	3.80E-08	D
Benzo(b,j,k)fluoranthene	1.10E-07	D
Benzo(g,h,i)perylene	2.70E-08	D
Chrysene	1.00E-07	C
Fluoranthene	7.10E-07	B
Fluorene	9.10E-07	B
Indeno(1,2,3-cd)pyrene	6.10E-08	C
Naphthalene	1.30E-05	C
Phenanthrene	2.70E-06	B
Pyrene	3.30E-07	B
5-Methyl chrysens	2.20E-08	D
Dioxins & Furans [d], [f]		

Table A3. Generation Related Outputs - Air Emissions [a]

Pollutant	Quantity (lbs/ton of coal)	EPA's Factor Raging [b]
2,3,7,8-TCDD	1.43E-11	E
Total TCDD	9.28E-11	D
Total PeCDD	4.47E-11	D
Total HxCDD	2.87E-11	D
Total HpCDD	8.34E-11	D
Total OCDD	4.16E-10	D
Total PCDDd	6.66E-10	D
2,3,7,8-TCDF	5.10E-11	D
Total TCDF	4.04E-10	D
Total PeCDF	3.53E-10	D
Total HxCDF	1.92E-10	D
Total HpCDF	7.68E-11	D
Total OCDF	6.63E-11	D
Total PCDFd	1.09E-09	D
TOTAL PCDD/PCDF	1.76E-09	D

[a] All the air emissions presented here are from EPA's AP-42 factors (EPA 1996).
[b] "EPA's AP-42 emissions factor rating is an overall assessment of how good a factor is, based on both the quality of the test(s) or information that is the source of the factor and on how well the factor represents the emission source." (EPA 1996) EPA's factor ratings are as follows:
A = Excellent; B = Above Average; C = Average; D = Below Average; and E = Poor.
[c] Due to a lack of data on firing configurations for all U.S. boilers, the pulverized coal (PC), dry, wall-fired boiler firing configuration (the most common configuration in the U.S.) was chosen as the representative configuration. Additionally, the factors for methane, nitrous oxide,, total organic compounds and total nonmethane organic compounds are for uncontrolled emissions, while the values for hydrogen chloride and hydrogen fluoride are for controlled and uncontrolled emissions (measurements were taken from different facilities were some had control equipment and others did not).
[d] These are all controlled factors.
[e] Apply to bituminous, subbituminous and ignite coal types. Even though these factors apply only to these three coal types, the emission factors are applied to all coal types. This was done for two reasons: 1) because no factors were given for the remaining coal types; and 2) those remaining coal types do generate some of these emissions, and it would have been erroneous to consider then 'pollutant-free."
[f] Apply to bituminous and subbituminous coal types. Even though these factors apply only to these two coal types, the emission factors are applied to all coal types. This was done for two reasons: 1) because no factors were given for the remaining coal types; and 2) those remaining coal types do generate some of these emissions, and it would have been erroneous to consider them 'pollutant-free.'

ATTACHMENT B. GAS INFORMATION WORKSPACE

Table B1. Generation Related Inputs

Material	Quantity	Units
Inputs		
Ancillary Materials		
Water [a]	0.25	gallons/kWh

[a] CEC (1979). The value listed under 'Combined Cycle' in the reference was used for gas-fired generation since the majority of combined cycle units's top cycle is fired by gas.

Table B2. Generation Related Outputs

Pollutant	Quantity (lbs/million ft3 of gas)	EPA's factor rating [b]
Outputs		
AIR EMISSIONS [a]		
Miscellaneous Compounds [c]		
Nitrous oxide	2.2	C
Total organic compounds	1.7	C
Speciated Organic Compounds [d]		
Fluoranthene	3.10E-06	E
Formaldehyde	1.55E-01	C
2-Methylnaphthalene	9.02E-06	E
Naphthalene	2.40E-04	E
Phenanthrene	1.00E-05	E
Pyrene	5.10E-06	E
Toluene	2.20E-03	E
Trace Metals [e]		
Arsenic	2.30E-04	E
Barium	2.40E-03	E
Chromium	1.10E-03	E
Cobalt	1.20E-04	E
Copper	2.51E-04	E
Manganese	3.81E-04	E
Molybdenum	5.81E-04	E
Nickel	3.61E-03	E
Vanadium	3.21E-03	E

[a] All outputs for gas-fired generation are air emissions and are from the EPA's AP-42 emission factors (EPA 1996).
[b] "EPA's AP-42 emissions factor rating is an overall assessment of how good a factor is, based on both the quality of the test(s) or information that is the source of the factor and how well the factor represents the emission source (EPA 1996). EPA's factor ratings are as follows: A = Excellent; B = Above Average; C = Average; D = Below Average; and E = Poor.
[c] Factors are for uncontrolled combustion.
[d] Each of the seven factors provided are for controlled and uncontrolled combustion.
[e] Factors are for controlled combustion.

ATTACHMENT C. PETROLEUM INFORMATION WORKSPACE

Table C1. Generation Related Inputs

Material	Quantity	Units
Inputs		
ANCILLARY MATERIALS		
Water [a]	0.43	gallons/kWh

[a] CEC (1979).

Table C2. Generation Related Outputs

Pollutant	Quantity (lbs/thousand gallons of oil)	EPA's factor rating [b]	Quantity (lbs/thousand gallons of oil)	EPA's factor rating [b]	Quantity (lbs/thousand gallons of oil)	EPA's factor rating [b]
	Fuel Oil #6		Fuel Oil #2		Average Factors	
Outputs						
AIR EMISSIONS [a]						
Miscellaneous Compounds [c]						
Methane	0.28	A	0.052	A	2.66E-01	A
Nitrous oxide	0.11	B	0.11	B	1.10E-01	B
Total organic compounds	1.04	A	0.252	A	9.93E-01	A
Total nonmethane organic compounds	0.76	A	0.2	A	7.26E-01	A
Speciated Organic Compounds [d]						
Acenaphthene	2.11E-05	C			2.11E-05	C
Acenaphthylene	2.53E-07	D			2.53E-07	D
Anthracene	1.22E-06	C			1.22E-06	C
Benzene	2.14E-04	C			2.14E-04	C
Benz(a)anthracene	4.01E-06	C			4.01E-06	C
Benzo(b,k)fluoranthene	1.48E-06	C			1.48E-06	C
Benzo(g,h,i)perylene	2.26E-06	C			2.26E-06	C
Chrysene	2.38E-06	C			2.38E-06	C
Dibenzo(a,h)anthracene	1.67E-06	D			1.67E-06	D
Ethylbenzene	6.36E-05	E			6.36E-05	E
Fluoranthene	4.84E-06	C			4.84E-06	C
Fluorene	4.47E-06	C			4.47E-06	C
Formaldehyde	3.30E-02	C			3.30E-02	C
Indo(1,2,3-cd)pyrene	2.14E-06	C			2.14E-06	C
Naphthalene	1.13E-03	C			1.13E-03	C
OCDD	3.10E-09	E			3.10E-09	E
Phenanthrene	1.05E-05	C			1.05E-05	C
Pyrene	4.25E-06	C			4.25E-06	C
Toluene	6.20E-03	D			6.20E-03	D

Table C2. Generation Related Outputs

Pollutant	Quantity (lbs/thousand gallons of oil)	EPA's factor rating [b]	Quantity (lbs/thousand gallons of oil)	EPA's factor rating [b]	Quantity (lbs/thousand gallons of oil)	EPA's factor rating [b]
	Fuel Oil #6		Fuel Oil #2		Average Factors	
1,1,1-Trichloroethane	2.36E-04	E			2.36E-04	E
o-xylene	1.09E-04	E			1.09E-04	E
Trace Metals [e]						
Antimony	5.25E-03	E			5.25E-03	E
Arsenic	1.32E-03	C	5.88E-04	E	1.28E-03	C
Barium	2.57E-03	D			2.57E-03	D
Beryllium	2.78E-05	C	3.50E-04	E	4.71E-05	C
Cadmium	3.98E-04	C	1.54E-03	E	4.67E-04	C
Chloride	3.47E-01	D			3.47E-01	D
Chromium	8.45E-04	C	8.05E-03	E	1.28E-03	C
Chromium (VI)	2.48E-04	C			2.48E-04	C
Cobalt	6.02E-03	D			6.02E-03	D
Copper	1.76E-03	C			1.76E-03	C
Fluoride	3.73E-02	D			3.73E-02	D
Manganese	3.00E-03	C	1.96E-03	E	2.94E-03	C
Mercury	1.13E-04	C	4.20E-04	E	1.31E-04	C
Molybdenum	7.87E-04	D			7.87E-04	D
Nickel	8.45E-02	C	2.38E-02	E	8.09E-02	C
Phosphorous	9.46E-03	D			9.46E-03	D
Selenium	6.83E-04	C			6.83E-04	C
Vanadium	3.18E-02	D			3.18E-02	D
Zinc	2.91E-02	D			2.91E-02	D

[a] All outputs for oil-fired generation are air emissions and are from the EPA's AP-42 emission factors (EPA 1996).
[b] "EPA's AP-42 emissions factor rating is an overall assessment of how good a factor is, based on both the quality of the test(s) or information that is the source of the factor and on how well the factor represents the emission source" (EPA 1996). EPA's factor ratings are as follows: A = Excellent; B = Above Average; C = Average; D = Below Average; and E = Poor.
[c] Factors are for uncontrolled combustion of all pollutants, except for N2O. No information was provided as to the control of N2O emissions.
[d] No information was provided as to the control of these pollutants. No emission factors were presented for fuel oil #2, thus, the factors for #6 were considered the same for #2. Even though one could assume that fuel oil #2 should have smaller quantities of pollutants to contribute per equivalent volume than fuel oil #6 (due to #6 being a residual oil and # 2 being a distillate), some of the results from the trace metals table contradict that assumption, thus substantiating this action.
[e] No information was provided as to the control of these pollutants. Where no fuel oil #2 emission factor was given, the factor for fuel oil #6 was used for both fuel oils. Even though one could assume that fuel oil #2 should have smaller quantities of pollutants to contribute per equivalent volume than fuel oil #6, some of the results from this table (where factors were reported for both fuel oils) contradict that assumption, thus substantiating this action.

Table C3. Miscellaneous Calculation Information

	Quantity	Unit	Quantity	Unit
	Fuel Oil #6		Fuel Oil #2	
Type of petroleum used at utilities [a]	94	%	6	%
AP-42 heat values for fuel oils [f]	152,000	btu/gal	140,000	but/gal

[a] Source: EIA's "Cost & Quality of Fuels for Electric Utility Plants 1997."
[b] EPA (1996).

ATTACHMENT D. NUCLEAR INFORMATION WORKSPACE

Table D1. Generation Related Inputs and Outputs - Excluding Radionuclide Emissions

Material/Pollutant	Quantity	Units	Converted Quantity	Units
Inputs				
PRIMARY MATERIALS				
Uranium oxide [a]	48,700,000	lbs/yr	---	---
ANCILLARY MATERIALS				
Water [b]	0.62	gallons/kWh	---	---
Outputs				
SOLID/HAZARDOUS WASTES				
Uranium (spent fuel generated) [c]	2,400	metric tons/yr	5.29E+06	lbs/yr
Low-level radioactive waste [d]	220,500	cubic feet/yr	---	---

[a] Known as 'yellowcake,' this post-milling uranium product is sent to conversion facilities (EIA 1998b).
[b] CEC (1979).
[c] EIA (1996); Table 18.
[d] Loisell (1998).

Table D2. Generation Related Outputs - Radionuclide Emissions

Isotope	**Quantity**	**Units**	**Converted Quantity**	**Units [d]**
Outputs [a], [b], [c]				
AIRBORNE RADIONUCLIDE EMISSIONS				
T-3	5.98E+01	Curies/yr	7.33E-06	Curies/MWh
Ar-41	2.55E+01	Curies/yr	3.13E-06	Curies/MWh
Cr-51	1.60E-03	Curies/yr	1.96E-10	Curies/MWh
Mn-54	2.27E-05	Curies/yr	2.78E-12	Curies/MWh
Co-57	4.30E-06	Curies/yr	5.27E-13	Curies/MWh
Co-58	5.49E-05	Curies/yr	6.73E-12	Curies/MWh
Co-60	4.13E-04	Curies/yr	5.06E-11	Curies/MWh
Kr-85	4.23E+01	Curies/yr	5.18E-06	Curies/MWh
Kr-85M	2.05E+00	Curies/yr	2.51E-07	Curies/MWh
Kr-87	7.63E-01	Curies/yr	9.35E-08	Curies/MWh
Rb-88	8.38E-03	Curies/yr	1.03E-09	Curies/MWh
Kr-88	3.58E+00	Curies/yr	4.39E-07	Curies/MWh
Br-89	2.95E-06	Curies/yr	3.62E-13	Curies/MWh
Br-90	1.20E-06	Curies/yr	1.47E-13	Curies/MWh
Nb-95	9.02E-07	Curies/yr	1.11E-13	Curies/MWh
Zr-95	2.33E-06	Curies/yr	2.86E-13	Curies/MWh
Tc-99M	1.21E-07	Curies/yr	1.48E-14	Curies/MWh
Ag-110M	2.69E-08	Curies/yr	3.30E-15	Curies/MWh
I-131	1.93E-03	Curies/yr	2.37E-10	Curies/MWh

Table D2. Generation Related Outputs - Radionuclide Emissions

Isotope	Quantity	Units	Converted Quantity	Units [d]
Xe-131M	3.45E+00	Curies/yr	4.23E-07	Curies/MWh
I-132	3.92E-04	Curies/yr	4.80E-11	Curies/MWh
Xe-133	4.98E+02	Curies/yr	6.10E-05	Curies/MWh
I-133	1.79E+00	Curies/yr	2.19E-07	Curies/MWh
Xe-133M	3.31E+01	Curies/yr	4.06E-06	Curies/MWh
Cs-134	8.10E-05	Curies/yr	9.93E-12	Curies/MWh
I-134	2.03E-03	Curies/yr	2.49E-10	Curies/MWh
Xe-135	1.88E+01	Curies/yr	2.30E-06	Curies/MWh
I-135	1.02E-04	Curies/yr	1.25E-11	Curies/MWh
Xe-135M	3.59E-01	Curies/yr	4.40E-08	Curies/MWh
Cs-137	6.11E-04	Curies/yr	7.49E-11	Curies/MWh
Xe-138	1.19E+00	Curies/yr	1.46E-07	Curies/MWh
T-3	4.47E+02	Curies/yr	5.48E-05	Curies/MWh
Na-24	2.24E-03	Curies/yr	2.75E-10	Curies/MWh
Cr-51	6.07E-02	Curies/yr	7.44E-09	Curies/MWh
Mn-54	4.00E-02	Curies/yr	4.90E-09	Curies/MWh
Fe-55	1.43E-01	Curies/yr	1.75E-08	Curies/MWh
Co-57	1.47E-03	Curies/yr	1.80E-10	Curies/MWh
Co-58	5.98E-01	Curies/yr	7.33E-08	Curies/MWh
Fe-59	7.34E-03	Curies/yr	9.00E-10	Curies/MWh
Co-80	1.57E-01	Curies/yr	1.92E-08	Curies/MWh
Zn-85	6.75E-04	Curies/yr	8.27E-11	Curies/MWh
Kr-85M	3.78E-02	Curies/yr	4.63E-09	Curies/MWh
Sr-89	2.42E-03	Curies/yr	2.97E-10	Curies/MWh
Sr-90	5.69E-04	Curies/yr	6.97E-11	Curies/MWh
Nb-95	1.03E-02	Curies/yr	1.26E-09	Curies/MWh
Sr-95	6.27E-03	Curies/yr	7.68E-10	Curies/MWh
Mo-99	7.55E+04	Curies/yr	9.25E-03	Curies/MWh
Tc-99M	8.78E-04	Curies/yr	1.08E-10	Curies/MWh
Ru-103	1.26E-03	Curies/yr	1.54E-10	Curies/MWh
Ag-110M	1.47E-02	Curies/yr	1.80E-09	Curies/MWh
Sn-113	1.39E-03	Curies/yr	1.70E-10	Curies/MWh
Sb-124	1.26E-02	Curies/yr	1.54E-09	Curies/MWh
Sb-125	5.02E-02	Curies/yr	6.15E-09	Curies/MWh
I-131	2.80E-02	Curies/yr	3.43E-09	Curies/MWh
Xe-131M	4.60E-01	Curies/yr	5.64E-08	Curies/MWh
I-132	1.06E-02	Curies/yr	1.30E-09	Curies/MWh
Xe-133	7.07E+01	Curies/yr	8.66E-06	Curies/MWh
I-133	1.20E-02	Curies/yr	1.47E-09	Curies/MWh

Table D2. Generation Related Outputs - Radionuclide Emissions

Isotope	Quantity	Units	Converted Quantity	Units [d]
Xe-133M	5.79E-01	Curies/yr	7.10E-08	Curies/MWh
Cs-134	3.37E-02	Curies/yr	4.13E-09	Curies/MWh
I-135	8.61E-03	Curies/yr	1.06E-09	Curies/MWh
Xe-135	5.27E-01	Curies/yr	6.46E-08	Curies/MWh
s-136	1.35E-03	Curies/yr	1.65E-10	Curies/MWh
Cs-137	5.06E-02	Curies/yr	6.20E-09	Curies/MWh
Ba-140	9.34E-04	Curies/yr	1.14E-10	Curies/MWh
La-140	1.00E-03	Curies/yr	1.23E-10	Curies/MWh

[a] ORNL (1995).

[b] There were 111 operating commercial nuclear power stations in the U.S. in 1995, of which 75 were PWRs (presssurized-water reactors) and 36 were BWRs (boiling-water reactors). Of the PWRs, 52 were designed by Westinghouse; the remaining 23 were designed by either ABB or Babcock & Wilcox. From the available data, the authors chose to use data from all Westinghouse PWRs with greater than 800 MWS capacity (36 facilities) in attempts to gather consistent data for
their calculations on transport and dose-effects for their reference PWR.

[c] "These emissions are characterisitc of normal (nonaccident) emissions, and did not appear to readily correlate to MWhs produced or reactor capacity. Amounts produced are more likely affected by random events within reactor, such as fuel pin cladding failures, leaks in the primary coolant loop, steam-generator tube leaks, etc." (ORNL 1995, pp. 6-35 & 6-36).

[d] The units of Curies/MWh were derived by dividing the Curies/yr values by the number of MWhs produced annually in the virtual facility discussed in the source for this information (8,160,000 MWh/yr).

ATTACHMENT E. SUMMARY INFORMATION WORKSPACE

Notes:
• In the tables in this Appendix, "US kWh" is utilized to identify values that are representative of an average U.S. kWh in 1997.
• Unless stated otherwise, the sources for the data presented here are detailed in Attachments A through D.

Table E1. Generation Related Inputs and Outputs - Excluding Air Emissions

Material/Pollutant	Quantity	Units	Converted Quantity	Units
Inputs				
PRIMARY MATERIALS				
Coal	900,361,000	tons/yr	2.83E+02	grams/US kWh
Gas	2,968,453,000,000	ft3/yr	2.20E+01	grams/US kWh
Petroleum	5,256,132,000	agal/yr	5.99E+00	grams/US kWh
Uranium (yellow cake)	48,700,000	lbs/yr	7.64E-03	grams/US kWh
ANCILLARY MATERIALS				
Limestone	12,091,817	tons/yr	3.79E+00	grams/US kWh
Lime	5,310,548	tons/yr	1.67E+00	grams/US kWh
Water	11,426,836,328,400	lbs/yr	1.79E+03	grams/US kWh
Outputs				
SOLID WASTES				
Dust/sludge	197,169,972,516	lbs/yr	3.09E+01	grams/US kWh
Coal waste	510,801,203,484	lbs/yr	8.01E+01	grams/US kWh
Fly/bottom ash	127,699,406,968	lbs/yr	2.00E+01	grams/US kWh
Uranium (spent fuel generated)	1.83E-06	lbs/kWh	8.30E-04	grams/US kWh
LLRW	6.10E-06	lbs/kWh	2.77E-03	grams/US kWh
WATER RELEASES				
Dissolver	994,020,136	lbs/yr	1.56E-01	grams/US kWh
Suspended solids	17,878,060	lbs/yr	2.80E-03	grams/US kWh
Sulfate	686,517,504	lbs/yr	1.08E-01	grams/US kWh

Table E2. Generation Related Outputs - Air Emissions

Pollutant	Quantity	Units	Converted Quantity	Units
Outputs				
Criteria Pollutants [a]				
Carbon dioxide	2,231,433,058	tons/yr	6.48E+02	grams/US kWh
Nitrogen oxides	6,178,000	tons/yr	1.79E+00	grams/US kWh
Sulfur dioxide	13,082,000	tons/yr	3.80E+00	grams/US kWh
Carbon monoxide	406,000	tons/yr	1.18E-01	grams/US kWh
Lead	64	tons/yr	1.86E-05	grams/US kWh
Particulate matter (10 microns or less)	290,000	tons/yr	8.43E-02	grams/US kWh
Uncategorized Pollutants				
Methane (includes coal mining releases)	6,473,160,931	lbs/yr	1.02E+00	grams/US kWh
Nitrous oxide	34,119,601	lbs/yr	5.35E-03	grams/US kWh
Hydrogen chloride	1,080,433,200	lbs/yr	1.70E-01	grams/US kWh
Hydrogen fluoride	135,054,150	lbs/yr	2.12E-02	grams/US kWh
Total organic compounds	280,372,537	lbs/yr	4.40E-02	grams/US kWh
Total nonmethane organic compounds	57,839,714	lbs/yr	9.07E-03	grams/US kWh
Speciated Organic Compounds				
Acetaldehyde	513,206	lbs/yr	8.05E-05	grams/US kWh
Acetophenone	13,505	lbs/yr	2.12E-06	grams/US kWh
Acrolein	261,105	lbs/yr	4.10E-05	grams/US kWh
Benzene	1,171,594	lbs/yr	1.84E-04	grams/US kWh
Benzo(b,k)fluoranthene	8	lbs/yr	1.22E-09	grams/US kWh
Benzyl chloride	630,253	lbs/yr	9.89E-05	grams/US kWh
Bis(2-ethylhexyl)phthalate (DEHP)	65,726	lbs/yr	1.03E-05	grams/US kWh
Bromoform	35114.079	lbs/yr	5.51E-06	grams/US kWh
2-Chloroacetophenone	6302.527	lbs/yr	9.89E-07	grams/US kWh
Carbon disulfide	117046.93	lbs/yr	1.84E-05	grams/US kWh
Chlorobenzene	19807.942	lbs/yr	3.11E-06	grams/US kWh
Chloroform	53121.299	lbs/yr	8.33E-06	grams/US kWh
Cumene	4771.9133	lbs/yr	7.49E-07	grams/US kWh
Cyanide	2250902.5	lbs/yr	3.53E-04	grams/US kWh
2,4-Dinitrotoluene	252.10108	lbs/yr	3.96E-08	grams/US kWh
Dibenzo(a,h)anthracene	8.77774044	lbs/yr	1.38E-09	grams/US kWh
Dimethyl sulfate	43217.328	lbs/yr	6.78E-06	grams/US kWh
Ethyl benzene	84968.224	lbs/yr	1.33E-05	grams/US kWh
Ethyl chloride	37815.162	lbs/yr	5.93E-06	grams/US kWh
Ethylene dichloride	36014.44	lbs/yr	5.65E-06	grams/US kWh
Ethylene dibromide	1080.4332	lbs/yr	1.70E-07	grams/US kWh

Table E2. Generation Related Outputs - Air Emissions

Pollutant	Quantity	Units	Converted Quantity	Units
Formaldehyde	849649.211	lbs/yr	1.33E-04	grams/US kWh
Hexane	60324.187	lbs/yr	9.46E-06	grams/US kWh
Indo(1,2,3-cd)pyrene	11.24812248	lbs/yr	1.76E-09	grams/US kWh
Isophorone	522209.38	lbs/yr	8.19E-05	grams/US kWh
2-Methylnaphthalene	26.77544606	lbs/yr	4.20E-09	grams/US kWh
Methyl bromide	144057.76	lbs/yr	2.26E-05	grams/US kWh
Methyl chloride	477191.33	lbs/yr	7.49E-05	grams/US kWh
Methyl ethyl ketone	351140.79	lbs/yr	5.51E-05	grams/US kWh
Methyl hydrazine	153061.37	lbs/yr	2.40E-05	grams/US kWh
Methyl methacrylate	18007.22	lbs/yr	2.83E-06	grams/US kWh
Methyl tert butyl ether	31512.635	lbs/yr	4.94E-06	grams/US kWh
Methylene chloride	261104.69	lbs/yr	4.10E-05	grams/US kWh
OCDD	0.016294009	lbs/yr	2.56E-12	grams/US kWh
Phenol	14405.776	lbs/yr	2.26E-06	grams/US kWh
Propionaldehyde	342137.18	lbs/yr	5.37E-05	grams/US kWh
Tetrachloroethylene	38715.523	lbs/yr	6.07E-06	grams/US kWh
Toluene	255205.255	lbs/yr	4.00E-05	grams/US kWh
1,1,1-Trichloroethane	19247.66715	lbs/yr	3.02E-06	grams/US kWh
Styrene	22509.025	lbs/yr	3.53E-06	grams/US kWh
Xylenes	33313.357	lbs/yr	5.23E-06	grams/US kWh
o-xylene	572.918388	lbs/yr	8.99E-08	grams/US kWh
Vinyl acetate	6842.7436	lbs/yr	1.07E-06	grams/US kWh
Trace Metals				
Antimony	43,801	lbs/yr	6.87E-06	grams/US kWh
Arsenic	376,538	lbs/yr	5.91E-05	grams/US kWh
Barium	20,633	lbs/yr	3.24E-06	grams/US kWh
Beryllium	19,155	lbs/yr	3.01E-06	grams/US kWh
Cadmium	48,371	lbs/yr	7.59E-06	grams/US kWh
Chloride	1,823,878	lbs/yr	2.86E-04	grams/US kWh
Chromium	244,073	lbs/yr	3.83E-05	grams/US kWh
Chromium (VI)	72,432	lbs/yr	1.14E-05	grams/US kWh
Cobalt	122,034	lbs/yr	1.91E-05	grams/US kWh
Copper	9,996	lbs/yr	1.57E-06	grams/US kWh
Fluoride	196,054	lbs/yr	3.08E-05	grams/US kWh
Magnesium	9,903,971	lbs/yr	1.55E-03	grams/US kWh
Manganese	457,748	lbs/yr	7.18E-05	grams/US kWh
Mercury	75,421	lbs/yr	1.18E-05	grams/US kWh
Molybdenum	5,861	lbs/yr	9.20E-07	grams/US kWh
Nickel	687,818	lbs/yr	1.08E-04	grams/US kWh
Phosphorous	49,723	lbs/yr	7.80E-06	grams/US kWh

Table E2. Generation Related Outputs - Air Emissions

Pollutant	Quantity	Units	Converted Quantity	Units
Selenium	1,174,059	lbs/yr	1.84E-04	grams/US kWh
Vanadium	176,674	lbs/yr	2.77E-05	grams/US kWh
Zinc	152,953	lbs/yr	2.40E-05	grams/US kWh
Polynuclear Aromatic Hydrocarbons (PAHs)				
Biphenyl	1,531	lbs/yr	2.40E-07	grams/US kWh
Acenaphthene	459	lbs/yr	8.94E-08	grams/US kWh
Acenaphthylene	225	lbs/yr	3.55E-08	grams/US kWh
Anthracene	189	lbs/yr	3.07E-08	grams/US kWh
Benzo(a)anthracene	72	lbs/yr	1.46E-08	grams/US kWh
Benzo(a)pyrene	34	lbs/yr	5.37E-09	grams/US kWh
Benzo(b,j,k)fluoranthene	99	lbs/yr	1.55E-08	grams/US kWh
Benzo(g,h,i)perylene	24	lbs/yr	5.68E-09	grams/US kWh
Chrysene	90	lbs/yr	1.61E-08	grams/US kWh
Fluoranthene	639	lbs/yr	1.06E-07	grams/US kWh
Fluorene	819	lbs/yr	1.32E-07	grams/US kWh
Indeno(1,2,3-cd)pyrene	55	lbs/yr	8.62E-09	grams/US kWh
Naphthalene	11,705	lbs/yr	2.88E-06	grams/US kWh
Phenanthrene	2,431	lbs/yr	3.95E-07	grams/US kWh
Pyrene	297	lbs/yr	5.25E-08	grams/US kWh
5-Methyl chrysene	20	lbs/yr	3.11E-09	grams/US kWh
Dioxins & Furans				
2,3,7,8-TCDD	0.012875162	lbs/yr	2.02E-12	grams/US kWh
Total TCDD	0.083553501	lbs/yr	1.31E-11	grams/US kWh
Total PeCDD	0.040246137	lbs/yr	6.31E-12	grams/US kWh
Total HxCDD	0.025840361	lbs/yr	4.05E-12	grams/US kWh
Total HpCDD	0.075090107	lbs/yr	1.18E-11	grams/US kWh
Total OCDD	0.374550176	lbs/yr	6.13E-11	grams/US kWh
Total PCDDd	0.599640426	lbs/yr	9.41E-11	grams/US kWh
2,3,7,8-TCDF	0.045918411	lbs/yr	7.20E-12	grams/US kWh
Total TCDF	0.363745844	lbs/yr	5.71E-11	grams/US kWh
Total PeCDF	0.317827433	lbs/yr	4.99E-11	grams/US kWh
Total HxCDF	0.172869312	lbs/yr	2.71E-11	grams/US kWh
Total HpCDF	0.069147725	lbs/yr	1.08E-11	grams/US kWh
Total OCDF	0.059693934	lbs/yr	9.37E-12	grams/US kWh
Total PCDFd	0.98139349	lbs/yr	1.54E-10	grams/US kWh
TOTAL PCDD/PCDF	1.58463536	lbs/yr	2.49E-10	grams/US kWh

[a] The criteria pollutants were not multiplied by the transmission and distribution factor due to their being reported totals for the electric industry.

Table E3. Generation Related Outputs - Radionuclides

Isotope	Quantity	Units	Converted Quality	Units
Outputs				
Airborne Radionuclides				
T-3	4606.974412	Curies/yr	5.90E+01	Becquerels/US kWh
Ar-41	1964.5125	Curies/yr	2.51E+01	Becquerels/US kWh
Cr-51	0.123263529	Curies/yr	1.58E-03	Becquerels/US kWh
Mn-54	0.001748801	Curies/yr	2.24E-05	Becquerels/US kWh
Co-57	0.000331271	Curies/yr	4.24E-06	Becquerels/US kWh
Co-58	0.00422948	Curies/yr	5.41E-05	Becquerels/US kWh
Co-60	0.031817399	Curies/yr	4.07E-04	Becquerels/US kWh
Kr-85	3258.779559	Curies/yr	4.17E+01	Becquerels/US kWh
Kr-85M	157.9313971	Curies/yr	2.02E+00	Becquerels/US kWh
Kr-87	58.78129559	Curies/yr	7.52E-01	Becquerels/US kWh
Rb-88	0.645592735	Curies/yr	8.26E-03	Becquerels/US kWh
Kr-88	275.8021471	Curies/yr	3.53E+00	Becquerels/US kWh
Br-89	0.000227267	Curies/yr	2.91E-06	Becquerels/US kWh
Br-90	9.24476E-05	Curies/yr	1.18E-06	Becquerels/US kWh
Nb-95	6.94898E-05	Curies/yr	8.89E-07	Becquerels/US kWh
Zr-95	0.000179503	Curies/yr	2.30E-06	Becquerels/US kWh
Tc-99M	9.3218E-06	Curies/yr	1.19E-07	Becquerels/US kWh
Ag-110M	2.07237E-06	Curies/yr	2.65E-08	Becquerels/US kWh
I-131	0.148686632	Curies/yr	1.90E-03	Becquerels/US kWh
Xe-131M	265.7869853	Curies/yr	3.40E+00	Becquerels/US kWh
I-132	0.030199565	Curies/yr	3.86E-04	Becquerels/US kWh
Xe-133	38365.77353	Curies/yr	4.91E+02	Becquerels/US kWh
I-133	137.9010735	Curies/yr	1.76E+00	Becquerels/US kWh
Xe-133M	2550.014265	Curies/yr	3.26E+01	Becquerels/US kWh
Cs-134	0.006240216	Curies/yr	7.99E-05	Becquerels/US kWh
I-134	0.156390603	Curies/yr	2.00E-03	Becquerels/US kWh
Xe-135	1448.346471	Curies/yr	1.85E+01	Becquerels/US kWh
I-135	0.00785805	Curies/yr	1.01E-04	Becquerels/US kWh
Xe-135M	27.65725441	Curies/yr	3.54E-01	Becquerels/US kWh
Cs-137	0.04707126	Curies/yr	6.02E-04	Becquerels/US kWh
Xe-138	91.67725	Curies/yr	1.17E+00	Becquerels/US kWh
Waterborne Radionuclides				
T-3	34436.74853	Curies/yr	4.41E+02	Becquerels/US kWh
Na-24	0.172568941	Curies/yr	2.21E-03	Becquerels/US kWh
Cr-51	4.676310147	Curies/yr	5.98E-02	Becquerels/US kWh
Mn-54	3.081588235	Curies/yr	3.94E-02	Becquerels/US kWh
Fe-55	11.01667794	Curies/yr	1.41E-01	Becquerels/US kWh
Co-57	0.113248368	Curies/yr	1.45E-03	Becquerels/US kWh
Co-58	46.06974412	Curies/yr	5.90E-01	Becquerels/US kWh
Fe-59	0.565471441	Curies/yr	7.24E-03	Becquerels/US kWh

Table E3. Generation Related Outputs - Radionuclides

Isotope	Quantity	Units	Converted Quality	Units
Co-80	12.09523382	Curies/yr	1.55E-01	Becquerels/US kWh
Zn-85	0.052001801	Curies/yr	6.65E-04	Becquerels/US kWh
Kr-85M	2.912100882	Curies/yr	3.73E-02	Becquerels/US kWh
Sr-89	0.186436088	Curies/yr	2.39E-03	Becquerels/US kWh
Sr-90	0.043835593	Curies/yr	5.61E-04	Becquerels/US kWh
Nb-95	0.793508971	Curies/yr	1.02E-02	Becquerels/US kWh
Sr-95	0.483038956	Curies/yr	6.18E-03	Becquerels/US kWh
Mo-99	5816497.794	Curies/yr	7.44E+04	Becquerels/US kWh
Tc-99M	0.067640862	Curies/yr	8.66E-04	Becquerels/US kWh
Ru-103	0.097070029	Curies/yr	1.24E-03	Becquerels/US kWh
Ag-110M	1.132483676	Curies/yr	1.45E-02	Becquerels/US kWh
Sn-113	0.107085191	Curies/yr	1.37E-03	Becquerels/US kWh
Sb-124	0.970700294	Curies/yr	1.24E-02	Becquerels/US kWh
Sb-125	3.867393235	Curies/yr	4.95E-02	Becquerels/US kWh
I-131	2.157111765	Curies/yr	2.76E-02	Becquerels/US kWh
Xe-131M	35.43826471	Curies/yr	4.54E-01	Becquerels/US kWh
I-132	0.816620882	Curies/yr	1.05E-02	Becquerels/US kWh
Xe-133	5446.707206	Curies/yr	6.97E+01	Becquerels/US kWh
I-133	0.924476471	Curies/yr	1.18E-02	Becquerels/US kWh
Xe-133M	44.60598971	Curies/yr	5.71E-01	Becquerels/US kWh
Cs-134	2.596238088	Curies/yr	3.32E-02	Becquerels/US kWh
I-135	0.663311868	Curies/yr	8.49E-03	Becquerels/US kWh
Xe-135	40.599925	Curies/yr	5.20E-01	Becquerels/US kWh
s-136	0.104003603	Curies/yr	1.33E-03	Becquerels/US kWh
Cs-137	3.898209118	Curies/yr	4.99E-02	Becquerels/US kWh
Ba-140	0.071955085	Curies/yr	9.21E-04	Becquerels/US kWh
La-140	0.077039706	Curies/yr	9.86E-04	Becquerels/US kWh

Table E4. Net Generation Information

Generation type [a]	Net Generation	
	(MWh/yr)	%
Coal	1,787,806,000	57.255%
Gas	283,625,000	9.083%
Petroleum	77,753,000	2.490%
Nuclear	628,644,000	20.133%
Hydro [b]	337,233,000	10.800%
Renewables [b]	7,462,000	0.239%
Total	3,122,522,000	100.000%

[a] This breakdown excludes nonutility electricity generation (Non and Independent Power Producers (NPPs or IPPs)), which typically contribute about 11% of the U.S. total (EIA 1999).
[b] Hydro and renewables were excluded from the calculation of inputs and outputs.

Table E5. Conversion Factors

Universal factor	1 pound =	453.59	grams
Water	1 gallon =	8.34	pounds
Coal [a]	1 pound =	10,275	btu
Gas [b]	a cubic foot =	0.0473	pounds
Petroleum	1 gallon =	7.26	pounds
Nuclear	1 Curie =	3.70E+10	Becquerals
Nuclear (LLRW)	1 cubic foot =	80	pounds
Transmission & distribution [c]	1 kWh out requires =	1.08	kWhs in

[a] Source: EIA's "Cost & Quality of Fuels for Electric Utility Plants 1997," Table ES-4.
[b] Calculated by the CCPCT with reference information from "Perry's Chemical Engineer's Handbook, 6th Edition."
[c] Source: EIA's Short-Term Energy Outlook," Table A8.

APPENDIX F

MANUFACTURING DATA COLLECTION QUESTIONNAIRE

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DESIGN FOR THE ENVIRONMENT COMPUTER DISPLAY PROJECT
Life-Cycle Inventory (LCI) Data Collection Questionnaire

Introduction
The Design for the Environment (DfE) Program in the U.S. Environmental Protection Agency's (EPA) Office of Pollution Prevention and Toxics has begun a voluntary, cooperative project with the electronics industry to assess the life-cycle environmental impacts of cathode ray tube (CRT) and liquid crystal display (LCD) desktop monitors. The DfE Program conducts comparative analyses of alternative products or processes to provide businesses with data to make environmentally informed choices about product or process improvements. The DfE Program has no regulatory or enforcement agenda and was established to act as a partner with industry to promote pollution prevention. This environmental life-cycle assessment will address human and ecological risk, energy and natural resource use, performance, and cost of various display technologies. The University of Tennessee (UT) Center for Clean Products and Clean Technologies is conducting the life-cycle inventory (LCI), which is the data collection phase of a life-cycle assessment, with technical assistance from the Asian Technology Information Program, Microelectronics and Computer Technology Corporation, the Electronics Industry Alliance, and other partners.

Boundaries
A *life-cycle* assessment considers impacts from materials acquisition, material manufacturing, product manufacturing, use, and final disposition of a product. The LCI data are intended to be used to evaluate relative environmental impacts over the entire life-cycle of a product, including transport between life-cycle stages. In this project, the product is either a color CRT or LCD monitor. Therefore, data associated with the materials and processes used directly in the manufacturing, use, and disposition of the product are relevant to the LCI and requested in this questionnaire. You will not need to include materials or energy *not directly* used in the production of the monitor or its components (e.g., general building heating and air conditioning).

Product focus
This project will evaluate CRT and LCD (twisted nematic and in-plane switching) technologies, based on 1998 production for a 17" CRT and a 15" LCD desktop monitor, with the following approximate specifications:

1024×768 resolution	200 cd/m^2 brightness
100:1 contrast ratio	262,000 colors

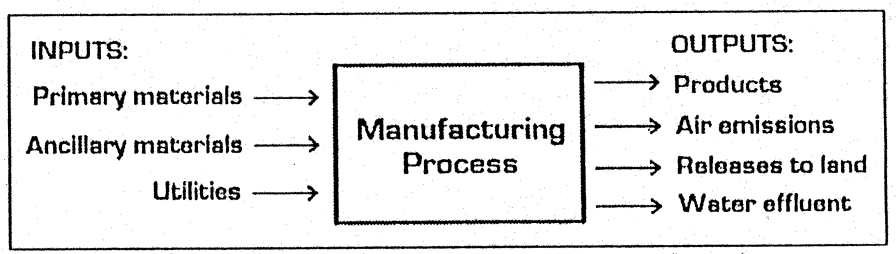

Fig. 1. Manufacturing process inventory conceptual template

Inventory data
We are asking you for data on a particular "product of interest" that you manufacture, which is defined as a material, component, or subassembly that is part of the product focus defined above. The inputs and outputs data (Fig. 1) that you provide will be aggregated in the LCI to quantify the overall inputs and outputs of a CRT and LCD. Additionally, transportation information is requested in the inventory.

Data sources
Much of the requested information can be drawn from existing sources, including, but not limited to the following:

1. Purchase and production records
2. Bills and invoices
3. Material Safety Data Sheets (MSDS)
4. Toxic Release Inventory (TRI) forms
5. Audit and analysis results (e.g., wastewater discharge analyses)
6. Local, state, and federal reporting forms (e.g., hazardous waste manifests)
7. Local, state, and federal permits
8. Monthly utility billing records

How the data will be used
UT will aggregate the inventory data and tally the average inputs and outputs for the different monitors. Information gathered by this questionnaire will be used to develop environmental profiles based on inputs and outputs for each stage in the manufacture of displays. The profiles will be used to evaluate environmental impacts from each product. Cost data will also be collected and presented along with environmental results. The environmental profiles can be used to encourage product design changes for product improvement. UT will aggregate data and ensure that data associated with particular companies remain anonymous to the EPA. UT can enter into confidentiality agreements where proprietary data are concerned. Please understand that accurate and representative information from you is critical for the success of this project.

Results of project
The results are intended to provide industry with an analysis of the life-cycle environmental impacts, cost, and performance of CRT and LCD computer monitors. Results will help identify areas for product and process improvement as related to risk and environmental impact (e.g., identifying material use inefficiencies) and will identify impacts from various life-cycle stages of the product systems. Use of the results will also help meet growing global demands of extended product responsibility.

Benefits of involvement
Your input will allow for your interests to be considered in the project development and data collection. By supplying data, the results will partially reflect your operations and, therefore, the results will be directly relevant to your interests. The project will allow you to directly apply results to your manufacturing process and identify areas for improvement. You will also be recognized as working voluntarily and cooperatively with the U.S. EPA.

Deadline
We are attempting to obtain all completed questionnaires before ***October 29, 1999***.

Your cooperation and assistance are greatly appreciated.

*For any questions, please contact **Maria Leet Socolof at 423-974-9526, <socolofml@utk.edu> or Jonathan G. Overly at 423-974-3625, <jgoverly@utk.edu> at the University of Tennessee, 311 Conference Center Bldg., Knoxville, TN 37996-4134. Fax: 423-974-1838.***
For more project details, see the Project Fact Sheet, DfE Website <www.epa.gov/dfe>, or the Draft Final Goal Definition and Scoping Document.

INSTRUCTIONS

1. Please be sure to read the introductory text on each page before filling out the questionnaire.
2. The data you supply in the tables should represent inputs and outputs associated only with the **"product of interest" (i.e., materials, components or subassemblies you manufacture that are either part of, or that are itself, the desktop monitor as defined on p. i under Product focus)**. If quantities provided are not specific to the "product of interest," please explain how they differ in the comments section at the bottom of the appropriate table.
3. Where supporting information is available as independent documents, reports or calculations, please provide them as attachments with reference to the associated page(s) or table(s) in this questionnaire.
4. If you have more than one product of interest to this project, please duplicate this questionnaire and fill out one questionnaire for each product.
5. If there is not adequate room on a page to supply your data (including comments), please copy the appropriate page and attach it to this packet.
6. The ensuing pages refer to the four indices shown below to detail specific information about the data. Additional information is provided below as required.
   Data Quality Indicators Index: These indicators will be used to assess the level of data quality in this questionnaire. Please report a DQI for the numerical value requested in each table on the following pages. The first category, Measured, pertains to a value that is a directly measured quantity. The second category, Calculated, refers to a value that required one or more calculations to obtain. The third category, Estimated, refers to a value that required a knowledgable employee's professional judgement to estimate. Lastly, the fourth category, Assumed, should be used only when a number had to be guessed.
   Hazardous and Nonhazardous Waste Management Methods Index: These methods are applicable to both hazardous and nonhazardous wastes (Tables 7a and 7b). Please give the appropriate abbreviation in the Management Method column on p. 7 where requested. Depending on whether the management method is on or offsite, please indicate by specifying "on" or "off" in the appropriate column on p. 7.

For Tables 2, 3a, 3b, 4, 7a, and 7b:

Transportation Modes Index	
A	- Large truck (18-wheeler), diesel
B	- Small truck, diesel
C	- Small truck, gasoline
D	- Rail, diesel
E	- Barge, diesel
F	- Ocean freighter, diesel
G	- Other (please specify in comments section)

For Table 6b:

Wastewater Treatment/Disposal Methods Index	
A	- Direct discharge to surface water
B	- Discharge to offsite wastewater treatment facility
C	- Underground injection
D	- Surface impoundment (e.g., settling pond)
E	- Direct discharge to land
F	- Other (please specify in comments section)

For Tables 3a, 3b, 4, 5, 6a, 7a, and 7b:

Data Quality Indicators Index	
M	- Measured
C	- Calculated
E	- Estimated
A	- Assumed

For Tables 7a and 7b:

Hazardous and Nonhazardous Waste Management Methods Index	
RU	- Reused
R	- Recycled
L	- Landfilled
Iv	- Incinerated - volume reduction
Ie	- Incinerated - energy conversion
S	- Solidified/stabilized
D	- Deep well injected
O	- Other (please specify in comments section)

IF YOU HAVE QUESTIONS, PLEASE CONTACT EITHER:

Maria L. Socolof (Project Manager): Phone: 423-974-9526, Fax: 423-974-1838, Email: socolofml@utk.edu

OR

Jonathan G. Overly (Project Engineer): Phone: 423-974-3625, Fax: 423-974-1838, Email: jgoverly@utk.edu

OFFICE OF MANAGEMENT AND BUDGET STATEMENT

The public reporting and recordkeeping burden for this collection of information is estimated to average 8 hours per response. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. The burden for this collection includes the time needed to review instructions; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. The OMB control number for this collection is 2070-0152.

Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, OPPE Regulatory Information Division, U.S. Environmental Protection Agency (2136), 401 M Street, S.W., Washington, DC 20460. Include the OMB control number in any correspondence.

1. FACILITY & CONTACT INFORMATION

Table 1.	Facility Information	Contact Information	
1. Company name:		5a. Prepared by:	Date:
2. Facility name:		5b. Title:	
3. Facility address (location):		5c. Phone number:	Ext.:
		5d. Fax number:	
		5e. Email address:	
4. Products manufactured onsite:			

2. PRODUCT OF INTEREST INFORMATION

Table 2.

NOTE: If the product of interest is an assembled monitor, please send an Owner's Manual to us at the address shown at the bottom of page ii.

1. Product of interest: _____

2. 1998 annual production (e.g., units, kg, lbs): _____

3. Facility's percent global market share for product of interest: _____

4. Product of interest unit weight: _____

5. 1998 product of interest retail unit price: _____

6. Energy consumption information (fill out only if the product of interest is an assembled monitor):
   - Active use: _____ watts
   - Standby: _____ watts
   - Suspend: _____ watts
   - Active off: _____ watts

7. Performance specifications (fill out only if the product of interest is an assembled monitor):
   - Maximum resolution: _____
   - Colors (at max. reso.): _____
   - Contrast ratio: _____
   - Brightness: _____ cd/m²

8. Brief description of the main operations/subprocesses required to manufacture the product of interest: _____

9. Product transport information. In this table, please list the top five locations (by quantity) to which you send the product of interest. You may supply one-way distances in lieu of locations. See Transportation Modes Index on p. iii for modes abbreviations. Percent capacity represents what percent of the transport vehicle's total load was carrying the products of interest.

	Location (City, State, Country)	Distance	Percent of production	Mode	Number of trips annually	Percent capacity
1)						
2)						
3)						
4)						
5)						

10. Does your facility receive any returned products from your customers? If so, is the product recycled in some way or disposed? Please explain: _____

3. PRIMARY & ANCILLARY INPUTS

1. Primary & Ancillary Materials: Primary materials, are defined as those materials that become part of the final product. Ancillary materials are those material inputs that assist production, yet do not become part of the final product. Please include the trade name and the generic name of each material where applicable.
2. CAS # or MSDS: Please either supply the chemical CAS (Chemical Abstract Service) number or attach a material "MSDS" to this document.
3. Annual quantity/units & Density/units: Please specify the amount of material consumed in 1998. Please use the units of mass-per-year (e.g., kg/yr, lb/yr). If you specify units of volume in lieu of mass, please provide the density.
4. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please supply the DQI for the *annual quantity* value given.
5. Recycled content: Please specify the recycled content of each material identified. For example, 60/40/0 would represent a material that has 60% virgin material, 40% pre-consumer recycled and 0% post-consumer recycled content. Enter N/A (not applicable) for all components that are assemblies.
6. Transportation information: See the Transportation Modes Index on p. iii for mode abbreviations. Please specify the one-way transportation distance, or the location from where the material is shipped, and the number of trips made to your facility on an annual basis. % capacity represents what percent of the transport vehicle's total *load* was carrying the materials of interest.

Table 3a. Primary Materials[1]	CAS # or MSDS[2]	Annual Quantity[3]	Units	Density[3]	Units	DQI[4]	Recycled Content[5]	Transportation Information (Receiving)[6]			
								Dist. or Location	Mode	# trips	% cap.
EXAMPLE: 'GRTX resin (polypropylene resin)	*MSDS*	*450,000*	*kg/yr*	*-----*	*---*	*M*	*60/40/0*	*450 km*	*A*	*24*	*40*
1.											
2.											
3.											
4.											
5.											
6.											
7.											

Primary material comments:

Table 3b. Ancillary Materials[1]	CAS # or MSDS[2]	Annual Quantity[3]	Units	Density[3]	Units	DQI[4]	Recycled Content[5]	Transportation Information (Receiving)[6]			
								Dist. or Location	Mode	# trips	% cap.
EXAMPLE: Petroleum naphtha (cleaning solvent)	*8032-32-4*	*920*	*liters/yr*	*0.96*	*kg/liter*	*C*	*100/0/0*	*St. Louis, MO*	*C*	*2*	*100*
1.											
2.											
3.											
4.											
5.											
6.											
7.											

Ancillary material comments:

4. UTILITY INPUTS

1. Annual quantity/units: Please specify the amount of each utility consumed in 1998. If possible, please exclude nonprocess-related consumption. If not possible, please include a comment that nonprocess-related consumption is included.
2. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please supply the DQI for the *annual quantity* value given.
3. Transportation information: See the Transportation Modes Index on p. iii for mode abbreviations. Please specify the one-way transportation distance, or the location from where the fuel is shipped, and the number of trips made to your facility on an annual basis. % capacity represents what percent of the transport vehicle's total *load* was carrying the materials of interest.
4. Individual Utility Notes:

Electricity:
The quantity of electricity should reflect only that used toward manufacturing the product of interest (identified on p. 2). One approach would be to start with your facility's total annual electrical energy consumption, estimate and remove nonprocess-related consumption, then estimate what portion of the remaining consumption is related to the specific operations of interest (if you manufacture more than one product). Please include consumption in all systems that use electricity for process-related purposes. Some examples include compressed air, chilled water, water deionization and HVAC consumption where clean or controlled environments are utilized.

Natural gas and LNG:
Please exclude all use for space heating or other nonprocess-related uses. If you choose to use units other than MCF (thousand cubic feet), please utilize only units of energy content or volume (e.g., mmBTU, therm, CCF).

Fuel oils:
Please use units of either volume or energy content (e.g., liters, cubic meters, mmBTU, MJ). Additionally, if the fuel oil is delivered by pipeline, enter "pipeline" in the Transportation Information space; if not delivered by pipeline, please include the associated transportation information.

All waters (e.g., deionized, city):
Please include all waters received onsite. Please indicate consumption in units of mass or volume.

Table 4. Utilities[4]	Annual Quantity[1]	Units	DQI[2]	Transportation Information (Receiving)[3]			
				Dist. or Location	Mode	# trips	% cap.
1. Electricity		MJ					
2. Natural gas		MCF					
3. Liquified natural gas (LNG)		MCF					
4. Fuel oil - type #2 (includes distillate and diesel)		liters					
5. Fuel oil - type #4		liters					
6. Fuel oil - type #6 (includes residual)		liters					
7. Propane		liters					
8. Water		liters					
9.							
10.							
11.							
12.							
13.							

Utility comments:

5. AIR EMISSIONS

1. Air emissions: The emissions listed in the table below are some of the more common ones found in air release inventories; if you have information on other specific emissions, please include that information in the space provided. If you have any reporting forms or other air emission records for 1998, please attach copies to this questionnaire. Also, if you have information on stack as well as fugitive emissions, please copy this page and place each set of emissions on a different page. The energy consumed in any equipment used onsite to treat air emissions should be included in the utilities values on p. 4.
2. Annual quantity/units: Please specify the amount of air emissions generated in 1998. If you do not have 1998 emissions data, use the next closest year's data you have and specify what year's data you are supplying in the comment section below. Please use units of mass-per-year (e.g., kg/yr, lb/yr).
3. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please supply the DQI for the *annual quantity* value given.

Table 5. Air Emissions[1]	CAS number	Annual Quantity[2]	Units	DQI [3]
Total particulates	-----			
Particulates < 10 microns (PM-10)	-----			
Sulfur oxides (SOx)	-----			
Nitrogen oxides (NOx)	-----			
Carbon monoxide	630-08-0			
Carbon dioxide	124-38-9			
Methane	74-82-8			
Benzene	71-43-2			
Toluene	108-88-3			
Xylenes	1330-20-7			
Naphthalene	91-20-3			
Total nonmethane VOCs	-----			
Other speciated hydrocarbon emissions:				
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				

Table 5 (continued). Air Emissions[1]	CAS number	Annual Quantity[2]	Units	DQI [3]
Ammonia	7664-41-7			
Arsenic	7440-38-2			
Chromium	7440-47-3			
Copper	7440-50-8			
Lead	7439-92-1			
Manganese	7439-96-5			
Mercury	7439-98-7			
Nickel	7440-02-0			
Other emissions:				
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Air emission comments:

6. WASTEWATER RELEASES & CONSTITUENTS

1. Annual quantity/units: Please specify the amount of wastewater(s) generated in 1998. Please use units of mass-per-year (e.g., kg/yr, lb/yr). If multiple streams exist, please copy this page and fill it out for each stream.
2. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please include one DQI for the annual wastewater stream quantity value supplied, and one DQI for the wastewater constituents information supplied. If more than one DQI is applicable to the wastewater constituents data, please clarify this in the comment section.
3. Wastewater constituents: Please let us know what type of values you are supplying (e.g., daily maximums, monthly averages, annual averages). Additionally, if you have any reporting forms of other wastewater constituent records for the 1998, please attach them to this questionnaire. The energy consumed in any equipment used onsite to treat wastewater releases should be included in the utilities values on p. 4.
4. Concentration/units: Please specify the concentration of wastewater constituents generated in 1998. Please utilize the units of mass-per-volume (e.g., mg/liter, lb/gal).
5. Wastewater treatment/disposal (WW T/D) method: See the Wastewater Treatment/Disposal Methods Index on p. iii for method abbreviations.

Table 6a. Wastewater Stream	Annual Quantity[1]	Units	DQI for Wastewater Annual Quantity[2]	DQI for Wastewater Constituents[2]

Table 6b. Wastewater Constituents[3]	CAS number	Concentration[4]	Units	WW T/D Method[5]
Dissolved solids	-----			
Suspended solids	-----			
Chemical Oxygen Demand (COD)	-----			
Biological Oxygen Demand (BOD)	-----			
Oil & grease	-----			
Hydrochloric acid	7647-01-0			
Sulfuric acid	7664-93-9			
Other acids (please specify):				
1.				
2.				
Phosphorus	7723-14-0			
Phosphates	-----			
Sulfates	-----			
Fluorides	-----			
Cyanide	-----			
Chloride	-----			
Chromium	7440-47-3			
Iron	7439-89-6			
Aluminum	7429-90-5			
Nickel	7440-02-0			

Table 6b (continued). Wastewater Constituents[3]	CAS number	Concentration[4]	Units	WW T/D Method[5]
Mercury	7439-98-7			
Lead	7439-92-1			
Nitrogen	7727-37-9			
Zinc	7440-66-6			
Tin	7440-31-5			
Ferrous sulfate	7720-78-7			
Ammonia	7664-41-7			
Nitrates	-----			
Pesticides	-----			
Other constituents:				
1.				
2.				
3.				
4.				
5.				
6.				

Wastewater comments:

7. HAZARDOUS & NONHAZARDOUS WASTES

1. Hazardous wastes and EPA hazardous waste numbers: Please list your waste streams that are considered hazardous by the U.S. EPA. Include the hazardous waste codes for any hazardous waste you include.
2. Annual quantity/units & Density/units: Please specify the amount of waste generated in 1998. Use units of mass-per-year (e.g., kg/yr, lb/yr). Please also provide the density for each waste.
3. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please supply the DQI for the *annual quantity* value given.
4. Management method: See the Management Methods Index on p. iii for abbreviations. If none are applicable, please indicate other and use the comments section to expound.
5. Transportation information: See the Transportation Modes Index on p. iii for mode abbreviations. Please specify the one-way transportation distance, or the location to where the waste is shipped, and the number of trips made from your facility on an annual basis. % capacity represents what percent of the transport vehicle's total ***load*** was carrying the wastes of interest.

Table 7a. Hazardous Wastes[1]	EPA Haz. Waste #[1]	Annual Quantity[2]	Units	Density[2]	Units	DQI [3]	Mgmt. method[4]	On or offsite?	Transportation Information (Shipping)[5] Dist. or Location	Mode	# trips	% cap.
EXAMPLE: Spent solvent (toluene)	*F005*	*20,000*	*kg/yr*	*0.9*	*kg/liter*	*M*	*Ie*	*off*	*Indianapolis, IN*	*A*	*24*	*40*
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												

Hazardous waste comments:

Table 7b. Nonhazardous Wastes	Annual Quantity[2]	Units	Density[2]	Units	DQI [3]	Mgmt. method[4]	On or offsite?	Transportation Information (Shipping)[5] Dist. or Location	Mode	# trips	% cap.
EXAMPLE: Waste metal chips	*22,000*	*kg/yr*	*1,000*	*kg/m3*	*C*	*R*	*off*	*225 km*	*A*	*2*	*100*
1.											
2.											
3.											
4.											
5.											
6.											
7.											

Nonhazardous waste comments:

APPENDIX G

SUPPLEMENTAL MANUFACTURING DATA INFORMATION

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APPENDIX G

SUPPLEMENTAL MANUFACTURING DATA INFORMATION

G-1. Frit Manufacturing Data Collection

No manufacturers were willing to supply complete frit manufacturing data as primary data for this study. Inventory data for the frit manufacturing process were obtained from secondary sources and from communications with industry representatives. Input data were derived from personal communication with an industry representative (Peer 2000) and output data were compiled from the U.S. Environmental Protection Agency's (EPA) *AP-42* publication (*Compilation of Air Pollutant Emission Factors*) (EPA 1997). The AP-42 data are provided for one ton of feed material, and it was assumed that the material efficiency is 100%, such that for each mass quantity of raw material input, the same mass quantity of frit is produced.

Limitations to these data are that a complete inventory, with all the information asked in the questionnaire for other manufacturing processes in this study, was not obtained. Personal communications were made to provide information on the major inputs to the process, based on a conversation taken place in June, 2000. The output data are based on a 1997 EPA publication. The publication date of the output data remains within the range of dates of primary data obtained in this study. Further, the frit manufacturing process is expected to be a relatively mature technology (compared to some LCD-related technologies), and 1997 data are expected to be representative of the monitors being studied in this project.

G-2. Printed Wiring Boards (PWBs) and Electronic Component Manufacturing Data Collection

Each display technology requires electronic printed wiring boards (PWBs) and their associated components such as integrated circuit (IC) chips, resistors, capacitors to operate the displays, independent of the computer's central processing unit. Therefore, the display PWBs and components are within the bounds of the analysis.

PWB and semiconductor (IC) manufacturing are highly energy and resource intensive processes. In purely a comparative analysis, we could consider eliminating the PWBs from the analysis since both the CRT and LCD display technologies use PWBs. However, the number of PWBs (4 major ones for LCDs and 2 for CRTs) and their makeup differ between the two technologies. For example, the AMLCD controller has more active parts because its addressing system is more complicated than the CRT. Therefore, exclusion of the PWB manufacturing process was chosen to be included in the scope of this project. In addition, beyond the goal of a comparative analysis between CRT and LCD, this study is intended to provide baseline data for each individual technology such that improvement assessments can be considered when evaluating the entire life cycle of a particular monitor. This provides another reason to include PWB manufacturing in the scope. However, due to the importance of collecting primary data for the other major display components (e.g., CRT tube and LCD panel/module manufacturing), a lower priority was given to obtaining PWB data.

Given the lower priority for PWB and component data collection, questionnaires were not sent to multiple PWB and component manufacturers. Alternatively, data were obtained from an industry contact knowledgeable in PWB manufacturing (Sharp 2000). PWB component manufacturing data were not obtained; however, materials use as well as energy consumption from manufacturing PWB components are expected to be small in comparison to the overall manufacturing requirements for the CRT and LCD monitors; therefore, lack of PWB component manufacturing data is not expected to have a significant impact on the results.

REFERENCES

EPA (Environmental Protection Agency). 1997. *Compilation of Air Pollutant Emission Factors (AP-42).* Fifth Edition, Volume I. June.

Peer, J. 2000. Personal communication with J. Peer, Techneglas, and J. G. Overly, University of Tennessee, Center for Clean Products and Clean Technologies. June.

Sharp, J. 2000. Personal communication with J. Sharp, Teredyne Corp.; J. G. Overly and M. Socolof, University of Tennessee, Center for Clean Products and Clean Technologies. August.

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APPENDIX H

TECHNICAL MEMORANDUM:
Use Life-Cycle Stage Approach

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APPENDIX H

TECHNICAL MEMORANDUM:
Use Life-Cycle Stage Approach

1. INTRODUCTION

1.1 Background

As part of the Environmental Protection Agency's Design for the Environment Program (DfE) Computer Display Project (CDP), the University of Tennessee Center for Clean Products and Clean Technologies is conducting an environmental life-cycle assessment (LCA) of 17" cathode ray tube (CRT) and 15" active matrix liquid crystal display (LCD) computer monitors. Chapter 1 of this report provides further details about the scope and boundaries of this project. As typically defined in LCA, the five main life-cycle stages of any product are as follows:

- Materials Extraction;
- Materials Processing;
- Product Manufacture;
- Product Use, Maintenance and Repair; and
- End-of-Life.

This technical memorandum (TM) presents the CDP's approach to developing the inventory that will be used to assess the environmental and health impacts from the use life-cycle stage of computer monitors. Maintenance and repair are not included within the boundaries of this analysis because they are expected to be minor contributors to environmental impacts compared to use and other life-cycle stages.

The purpose of this TM is to present the approach for developing the inventory of inputs and outputs associated with the actual use of the monitors. The final use-stage inventory will consist of electricity consumption from use as well as the indirect inputs and outputs from the generation of that electricity. The focus of this TM is on identifying the amount of electricity consumed during use. The inventory from electricity generation is presented in Appendix E. The final use-stage inventory combines these two sets of data and will be presented as part of the final LCI in Section 2.7 and Appendix J of this report.

In addition to energy consumption, other environmental or health issues have been associated with the use of computer monitors, including eye strain, ergonomics, and exposure to electric and magnetic fields. However, quantitative methods for assessing these impacts within the project LCA framework are not available. Thus, these impacts will be addressed qualitatively in the final LCA report for the project.

1.2 Calculating Energy Consumption During the Use Stage

CRTs and LCDs use different mechanisms to produce images on screen, which result in different energy use rates. These energy use rates can be combined with the number of hours a desktop monitor is on during its lifespan to calculate the total quantity of electrical energy consumed during the use life-cycle stage. In this project, two lifespan scenarios are considered:

- Manufactured life - the amount of time either an entire monitor or a single component will last before reaching a point where the equipment no longer functions, independent of user choices.
- Effective life - the actual amount of time a monitor is used, by one or multiple users, before it is disposed of, recycled, or re-manufactured. Reuse of a monitor by a subsequent user is considered part of its effective life. Recycling, on the other hand, is the reuse of parts or materials that require additional processing after disassembly and it is not considered part of the use stage.

These two scenarios are considered in this project in order to account for potential differences between how consumers *currently* use the equipment and how consumers could use the equipment. Currently, consumers often replace monitors before they physically break down. This behavior results in a lifespan that is not dependent on the monitor technology itself. The manufactured life, on the other hand, is based on the technology and represents how consumers could potentially use the equipment. If the lifespans are significantly different, the difference could have a large impact on how the use stage compares to the other life-cycle stages in this study. The remainder of this TM is broken down into the following sections: Methodology, Preliminary Results, Data Sources and Quality, Limitations and Uncertainties, and Discussion and Conclusions.

2. METHODOLOGY

As discussed in the previous section, calculating electrical energy consumption during the life of an electrical component requires two main pieces of information: the component's energy use rate (typically in watts or kilowatts) and the amount of time the component can or does spend in use (in hours per life).

Once energy use rates and hours per life in each mode are known, they can be multiplied to derive the total number of kilowatthours (kWh) consumed during the lifetime of a monitor according to the following general equation where " mode *I*" indicates the power consumption mode of a monitor (i.e., full-on or low, discussed further in Sect. 2.1). This basic equation will be used to calculate the total kWhs consumed over the manufactured and effective lives for LCDs and CRTs.

$$\sum_{i=1}^{2} \left[(kW \ \ consumed \ in \ mode \ i) \ x \ \left(\frac{hours}{life} \ \ spent \ in \ mode \ \ i \right) \right] = \frac{kWh}{life}$$

Section 2.1 presents information on the various energy use rates that exist for the project functional units in different power modes. Section 2.2 presents the methodology for calculating hours per life under the manufactured and effective life scenarios.

2.1 Energy Use Rate

Most desktop monitors manufactured today are built to use several different power consumption modes during normal operation. There are often up to four different power consumption modes that can be used by a monitor in going from a state of active use to a state of almost complete shut-down. These four modes, from greatest power consumption to least, are typically entitled 'full-on' or active use, 'standby,' 'suspend' and 'active-off.' For this TM, manufacturers' data on these power modes were collected from company contacts and Internet sites for 35 different 17" CRT monitors and 12 different 15" LCD monitors. The complete list of these data is presented in Attachment A, Table A1.

For the purposes of this TM, the power consumption modes have been categorized into two modes: 'full-on' and 'low.' The 'low' power mode is an average of the three low power modes typically provided by the manufacturers (i.e., standby, suspend, and active-off). These three categories were averaged to create one 'low' power consumption mode because hours per use data (needed for calculations in this TM) are only available for a 'full-on' and a reduced power mode. The low mode value for the CRT is the average of the three modal averages of standby, suspend and active-off. For the LCD, data on only two low-power modes (standby and active-off) were provided by manufacturers (see Attachment A, Table A2), and therefore, the low mode value is an average of those two modal averages. Table 1 presents the average values for full-on and low power modes that were used for subsequent calculations in this TM.

Table 1. Average Energy Use Rates [a]

Monitor Type	Full-on Power Mode		Low Power Mode [b]	
	(W)	(kW)	(W)	(kW)
17" CRT	112	0.113	13.1	0.013
15" LCD	39.7	0.040	6.44	0.006

[a] See Attachment A, Table A1 for source data.
[b] An average of company-reported values for standby, suspend and active-off (see Attachment A, Table A1).

2.2 Calculating Lifespan

As stated previously, lifespan calculations in this TM are based on two different scenarios: manufactured life and effective life. Sects. 2.2.1 and 2.2.2 present the methodology and data needed to calculate energy use under each of these two scenarios, respectively. Sect. 2.2.2 is further divided into discussions of office versus home use patterns, the amount of time a monitor is operating in each power mode, and the number of years the monitor is operating in its lifetime. These results will be combined with data from the energy use rate calculations in Sect. 2.1 to obtain the energy consumption per life for each scenario and for each monitor.

2.2.1 Scenario #1: Manufactured Life

The manufactured life is defined here as the length of time a monitor is designed to operate effectively for the user. It is the number of hours a monitor would function as manufactured, and is independent of user choices or actions. One way to estimate this manufactured life is to use the mean-time-before-failure (MTBF) specification of a monitor or its components. The CRT MTBF specification dictates the amount of time the display must operate before it reaches its brightness 'half-life,' or the ability to produce 50% of its initial, maximum brightness. The MTBF value, generally provided in total hours per life of a monitor, is what most final manufacturers or assemblers of personal computer (PC) equipment, including monitor assemblers, typically specify for a component. To meet the specification, suppliers typically calculate the MTBF (a military-based specification) based on component data. Suppliers' test results are usually called the 'calculated' MTBF. The MTBF value also depends on which combination of power modes are used during testing, which is referred to as the 'duty cycle' and each supplier may use a different duty cycle to test their component.

Additionally, monitor assemblers will often perform their own testing, typically entitled 'demonstrated' MTBF. The testing includes sequences where the monitor is 'stressed' by quickly switching back and forth from an all black picture to an all white one, or quickly switching individual pixels either on and off or through multiple colors or black and white. Manufacturers typically find that their demonstrated MTBF is on the order of twice as long as the calculated MTBF (McConnaughey 1999, Douglas 1999). However, it should be noted that the demonstrated MTBF is not a real-time testing method, as the testing data is used in a complex equation to calculate that 'demonstrated' value.

From review of the information obtained on CRT-based monitors (see Attachment A, Table A2), it appears that the CRT itself is the limiting component, or the component that 99% of the time determines whether the entire monitor has reached its end-of-life. Thus, from the limited information that was obtained on CRTs, and the limited confidence that can be instilled in that data, an average of the two ranges obtained on the estimated lifetime of CRTs (10,000 - 15,000 hours) was used as the CRT manufactured lifetime (12,500 hours) (Goldwassar 1999, Douglas 1999).

For active matrix LCDs, the components that have the greatest potential to fail first are the display panel itself (including the liquid crystals and thin-film transistors), backlights, driver integrated circuit (IC) tabs, and other smaller components. The backlights and driver IC tabs can be field-replaced, thus their failure does not necessarily represent the end of the monitor's life. However, failure of the liquid crystals or transistors, which would require replacement of the display panel itself, would most likely mean that the monitor cannot be cost-effectively repaired. The MTBFs of all these components appear to have a broad range. For example, different backlight manufacturers reported from as few as 15,000 hours to as many as 50,000 hours (Douglas 1999, Tsuda 1999, VP150 1999). However, it appears that those components that are not field-replaceable (e.g., the LCD panel) have MTBFs in the range of 40,000 - 50,000 hours (Tsuda 1999, Young 1999). Thus in this TM, the amount of time an LCD monitor would operate during its manufactured life is assumed to be the average of the two non field-replaceable values, or 45,000 hours. In order for a monitor to operate for 45,000 hours, any major field-replaceable parts that have MTBFs less than 45,000 hours will need to accounted for in this LCA project. For example, assuming the backlights last on average 32,500 hours (the average of the values

obtained for backlights), two would be needed for every panel during its lifetime. Therefore, in the final CDP LCA, the manufacturing of these type of components would need to be included in the inventory.

Little information is available on the duty cycles that component manufacturers use to test components. Thus, it is assumed that the average duty cycle utilized in testing components is 50% of the time tested in full-on mode and 50% in a lower power mode. Table 2 shows the values that are used in this TM for the hours per manufactured life for the CRT and LCD. The LCD manufactured life (45,000 hours) is 3.6 times greater than the CRT manufactured life (12,500 hours). Therefore, based on equivalent use periods, 3.6 CRTs would need to be manufactured for every single LCD.

Table 2. Manufactured Life Values

Monitor Type	Total Hours (hours/life)	Mode	Duty Cycle (% time spent in each mode during testing)	Hours per Mode (hours/life)
17" CRT	12,500	Full-on	50%	6,250
		Low	50%	6,250
15" LCD	45,000	Full-on	50%	22,500
		Low	50%	22,500

2.2.2 Scenario #2: Effective Life

The effective life scenario attempts to model the actual quantity of hours that an average monitor spends in each of the two primary power consumption modes (full-on and a lower power state) during its lifetime. The effective life of an average monitor is based on the following information:

- The proportion of computers that are used in an office environment versus a home environment, to account for different use rates in these two basic user environments;
- The amount of time in a year a typical monitor spends in full-on power mode and in a lower power-consuming mode for both office and home environments; and
- The number of years a typical monitor is used during its lifespan for both office and home environments, not including years in storage before a monitor is replaced or discarded (as it is not consuming power during storage).

Under this lifespan scenario, we assume there is no difference in the amount of time a CRT or LCD monitor is operating. That is, the hours per life for the effective life calculation is not technology-dependent. Therefore, the same set of hours-per-life values are used to calculate the kWhs used per effective lifetime for a CRT and an LCD. The remainder of this section discusses the data and methods used to calculate the final hours-per-life values used in the effective life scenario. In order to obtain these final values, we need to determine the percentage of office versus home environment users, the annual use operating patterns in the office and home environments (hours/year) within each power mode, and the number of years a monitor is in operation during life. The following three subsections address these data needs.

2.2.2.1 Percentages of Office- and Home-Environment Users

Home and office users of computer equipment do not follow the same use patterns. Thus, data are needed on the percent of users in each environment to determine the use pattern of an "average" computer monitor. The most recent data available for both home and office users are for 1997. The Computer Industry Almanac for 1997 reports an estimated 117 million total computers were in use in the United States in 1997 (CIA 1997). In addition, the 1997 Residential Energy Consumption Survey (RECS) reports that 43 million PCS were used in homes in 1997 (EIA 1999). Therefore, assuming the remaining non-household computer monitors are all in office environments, there would be approximately 74 million computers being used in office environments.

Note that an 'office' environment may be a school, hospital, or other commercial environment, and the computers they use may follow widely varying degrees of use. For example, computers (and thus monitors) in a school may only be used a few hours in a day, while hospitals might operate theirs nearly constantly. For this TM, it is assumed that on average, typical office use patterns (to be presented in Sect. 2.2.2.2) are representative of all non-home environment users.

The 1997 RECS also reported that 6% of the 43 million household computers were used to telecommute (EIA 1999), which equals approximately 2.6 million computers. The use pattern of a telecommuter is assumed to resemble more closely an office environment than a home environment; therefore, the number of office environment monitors is assumed to total 76.6 million. Therefore, for purposes of calculations in this TM, the percentage breakdown of office and home environment monitors in the United States is as follows:

- Office: (74 million + 2.6 million) / 117 million = 65%
- Home: (43 million - 2.6 million) / 117 million = 35%.

2.2.2.2 Operating Pattern (Average Hours in Use Per Year)

In order to determine the amount of electricity consumed during a monitor's effective life, we need to know the use operating patterns for both the office and home environments. The 'operating pattern' is defined here as the number of hours per year spent in each power mode. The average number of hours per mode per year will be the weighted average of the two user environments (i.e., 65% office, 35% home).

A literature search for computer monitor operating patterns was conducted for both office and home environments and a summary of literature reviewed is presented in Attachment A, Table A3. For data on office environment operating patterns, the most relevant and complete information found was from work performed by Lawrence Berkeley National Laboratory (LBNL) presented in a report entitled "Measured Energy Savings and Performance of Power-Managed Personal Computers and Monitors" (Nordman et al. 1996). Their definition of the standard operating pattern was based on earlier work performed by LBNL that studied electricity use by office equipment in commercial buildings, and referenced multiple studies on the use of office equipment, some having sample sizes as large as several hundred systems. Table 3 presents the standard office operating pattern for three different types of days (workday, weekend day and absence day), based on Nordman et al. (1996). Note that Nordman et al. "...first distinguish between weekdays and weekend days, with the latter including only Saturdays and Sundays. Then, any weekday which has less than half an hour of on-time (full-on or low power) is considered an absence day; the rest of the weekdays are workdays." Therefore, absence days may include some hours in operation. Also, some individuals may leave their computers on while out of the office, also resulting in hours in operation while the user is out of the office.

Table 3. Standard Office Operating Pattern[a]

Type of Day	Standard Office Operating Pattern			
	On			Off
	Full-on	Low	Total	
Workday (hr/day)	4.1	8.4	12.5	11.5
Weekend Day (hr/day)	0.0	4.8	4.8	19.2
Absence Day (hr/day)	0.0	4.8	4.8	19.2
Average Day[b] (hr/day)	2.3	6.9	9.2	14.8

Source: Adapted from Nordman et al. 1996, based on percentage of time in each mode.

[a] Based on the assumption that all monitors take advantage of low power modes.

[b] To calculate the average day, an average week is assumed to consist of 4 workdays, 2 weekend days, and 1 absence day per week. Average monitor usage per day weighs each average day by the number of each day type in a week.

Using the hours per day for the three basic day types, we created an average annual day for the purposes of eventually obtaining an annual average. To calculate the average day, we assumed that a typical week of computer use in the year contains 4 workdays, 2 weekend days, and 1 absence day. By including 1 absence day in the typical week, the calculation results in 52 days annually that are days of no active computer system use, and are intended to include the following: holidays, sick days, vacations, work travel and days when computers are not needed for work or are not in use in the office.

LBNL's operating patterns do not appear to take into account whether or not a monitor is actually taking advantage of the various power savings modes. In their 1996 study, Nordman et al. found that only one-third of the monitors were set up to recognize time-based indicators that power down a part of the monitor or part of the PC that sends information to the monitor. More recently, a representative of the EPA Energy Star Program estimated that approximately 90 - 95% of those monitors manufactured and sold in tandem with a PC in 1998 were pre-set up to take advantage of the multiple power consumption modes of the monitor, without any setup by the user (Fanara 1999). However, monitors are also sold individually, and no statistics were found on how many are sold that way and what percent of those are able to work with a PC's energy savings systems without assistance from the user. For the purposes of this TM, we assume that 90% of the monitors manufactured in 1998 and in use today are set up to recognize the power management signaling either from the monitor itself or from the PC to which they are connected. The lower end of the 90 - 95% range was chosen to recognize that monitors sold separately were not accounted for, and also, from an environmental impact perspective, it is conservative to assume a lower percent, which means less use of power saving features and greater energy consumption.

It should also be noted that this 90/10 split takes several assumptions into account, including but not limited to the percentage of users who alter or change their PC's and/or monitor's energy-saving settings, the percentage of users who know how to alter or change their PC's and/or monitor's energy-savings settings and the number of small-sized companies that build PC systems and whether or not they configure their systems to be able to take advantage of energy-savings settings 'out-of-the-box.' Because our confidence in this percentage split is not high, we will perform a sensitivity analysis of different percentage breakdowns of using low power modes versus not using them (50/50, 75/25, and 100/0; presented in Sect. 3.3).

This 90/10 split of using versus not using the power saving modes is implemented in the calculations by adjusting the average amount of hours per day a monitor spends in each mode for the effective life calculations (see Table 3). Thus, 10% of the value of each number in the 'Low' column of Table 3 was removed and added to the 'Full-on' value in that same row, to account for those that cannot go into a lower power-saving mode. Table 4 presents the adjusted figures for hours per day and presents the annual average values by multiplying the average day values by 365 days. The average day is calculated in Table 4 the same way it was calculated in Table 3.

Table 4. Adjusted Office Operating Pattern[a]

Type of Day	Adjusted Office Operating Pattern			
	On			Off
	Full-on	Low	Total	
Workday (hr/day)	4.9	7.6	12.5	11.5
Weekend Day (hr/day)	0.48	4.3	4.8	19.2
Absence Day (hr/day)	0.48	4.3	4.8	19.2
Average Day[b] (hr/day)	3.0	6.2	9.2	14.8
Annual Average (hr/yr)	**1,095**	**2,263**	**3,358**	**5,402**
Percent on time spent in each mode	33%	67%	100%	-----

[a] Values in Table 3 have been adjusted based on the assumption that 90% of monitors can take advantage of low power modes. Therefore, 10% of the hours in low mode in Table 4 were added to the full-on column and subtracted from the low column in this table.

[b] To calculate the average day, an average week is assumed to consist of 4 workdays, 2 weekend days, and 1 absence day per week. Average monitor usage per day weighs each average day by the number of each day type in a week.

For the home environment operating patterns, the most relevant and complete information was found in the RECS report (EIA 1999). The survey contained data on the use of computers in the home and how many hours per week the users have their computer on, without distinguishing power mode. Table 5 reveals the information obtained from the RECS report and breaks that data down to calculate a daily average and then an annual average operating pattern (i.e., the total number of hours of on time in one year).

Table 5. RECS Home Operating Pattern Breakdown

Use Frequency Category	U.S. Households with Computers (EIA 1999)		Average Hours in Use for Each Category	Average Household Use[a]
	(millions of households)	(% of households)	(hours/week)	(hours/week)
Less than 2 hours per week	8.2	23.0%	1	0.2
2 to 15 hours per week	17.4	48.9%	8.5	4.2
16 to 40 hours per week	6.7	18.8%	28	5.3
On all the time	3.3	9.3%	168	15.6
Totals	35.6	100.0%	-----	25.2
Daily Average (hours per day)				3.6
Annual Average (hours per year)				**1,315**

Note: Totals may not be additive due to independent rounding.

[a] These values are the product of the fraction of households in each category and the average hours per week in each category.

Data on the amount of time a home-environment monitor is in full-on versus a lower power mode was not provided in the RECS, nor was such data found elsewhere. Thus, lacking any other information, we have chosen to use the percentage breakdown found in the office-environment data for the home-environment data in this TM (see the bottom row of Table 4). These percentages are applied to the total 1,315 hours/year for home-environment use to estimate the amount of time in each mode. In addition, the 90/10 split of equipment that can/cannot go into lower power saving modes was applied to these values to determine the actual expected number of hours per year per mode for the home environment. In Table 6, the hours per year values for each power mode are shown. In order to determine these hours spent in each mode, the total number of hours spent on annually (1,315 hours/year) was first split by the 90/10 factor into equipment that can and cannot save energy categories. Then, the resulting 1,183 hours/year was split by the office-environment data on the percent of time spent in each mode, resulting in 390 hours annually in full-on mode and 793 hours annually in a lower power mode. The remaining 132 hours/year that cannot go into an energy saving mode, was included in the 'Full-on' row. The two values for each row are then added to obtain the total hours annually in a home environment that a monitor would spend in each power mode.

Lastly, Table 7 shows the final values obtained for the effective life calculations, as presented in this section, for hours per year per mode for office- and home-environment users.

Table 6. Splitting the Home Operating Pattern Data into the Two Power Modes

Power Mode	Percent of Time in Each Mode (from office- environment data)	Time Operating in Each Mode (hours/year)		
		90% That Can Save Energy	10% That Cannot Save Energy	Total
Full-on	33%	390	132	**522**
Low	67%	793	0	**793**
Total	100%	1,183	132	1,315

Table 7. Summary of Operating Patterns for Effective Life Calculations

User Environment	Time Operating in Each Environment (hours/year)		
	Full-On Power Mode	Low Power Mode	Total
Office	1,095	2,263	3,358
Home	522	793	1,315

2.2.2.3 Average Years Per Life

The third set of values required for the calculation of hours per effective life is the number of years of use in the life of a monitor. The number of years per effective life, multiplied by the operating patterns in hours per year (presented in Table 7), will result in the hours per effective life.

A monitor may be reused in multiple 'lives' before reaching its end-of-life. The end-of-life is defined as the point at which the monitor is no longer used for its intended purpose in the physical form in which it was originally manufactured. End-of-life options include

indefinite storage (in which case it is not reused after storage), de-manufacturing, recycling, or disposal. A monitor may be stored before being reused; however, this storage time will not affect our use calculations since no electricity is required to operate the monitor during this storage. After its first life as used by the original owner, a monitor might be used by different people and with different PC systems in subsequent lives.

For data on the number of years of use that are in a monitor's lifetime, several sources of information were reviewed. Two particular studies provided relevant data on the number of years per life (Matthews et al. 1997, NSC 1999). A study by Matthews et al. (1997), which was an update to a study originally performed in 1991, concluded that after a first life of 5 years, approximately 45% of all PC systems are reused, while the remaining 55% either go directly to recycling or landfilling (10%) or are stored and then recycled or landfilled (45%). Their study only addressed PC systems as a whole and did not break down the lifetimes of individual components. Additionally, they concluded that the period over which the systems are reused is 3 years.

In a recently completed study for the National Safety Council (NSC 1999), researchers interviewed more than 30 major manufacturers and resellers of CRT computer monitors and other computer components. NSC found that a CRT monitor's first life lasts approximately 4 years, while the total lifespan is on the order of 6 - 7 years. Since the NSC study contains results that pertain specifically to monitors, and provides the most recent data, its results are used in this TM. The values that are used for calculations in this section are 4 years for the first life of use, and 2.5 years for the second and subsequent lives of use. The operating pattern for monitors in all the years over its effective life (6.5 years) are assumed to be the same as presented in Sect. 2.2.2.2 (Table 7). However, in the lives subsequent to the first life, the hours per year values are reduced by the fraction of monitors assumed to be reused. Matthews et al. (1997) estimated that 45% of PCS are reused after a first life; thus, the effective life operating pattern values in years of life after the first life are 45% of the values in the first life (which were presented in Table 7).

While the NSC data singled out CRT monitors in their lifespan estimates, they did not single out desktop LCD monitors. Their data did contain estimates of a 'Notebook PC,' which were 2 - 3 years for the first life and 1 - 2 years for the remaining lives, however, we expect that desktop LCD monitors will more closely mirror the lifetime estimates of a desktop CRT monitor than that of a notebook PC. Consequently, it was assumed that LCD desktop monitors also spend 4 years in their first life and 2.5 years in their subsequent lives. Additionally, the NSC document did not attempt to separate those computer systems or monitors that are used in an office versus a home environment. Thus, it was assumed that the same years per life are realized for office and home environments.

2.2.2.4 Summary of Effective Life Values (Hours per Life)

Data presented throughout Sect. 2.2.2 that are needed to estimate the hours per effective life, are shown in Table 8. The values for hours per year per power mode, calculated in Sect. 2.2.2.2 and presented in Table 7 are assumed to be the operating pattern throughout the first life (first four years). In the remaining lives, the annual operating hours decreases to 45% of the hours in operation during each year in the first life, with the remaining lives lasting a total of 2.5 years (see Sect. 2.2.2.3). Table 8 also presents the total hours per effective life per mode, based on percentage in office and home environments. These values are in bold in Table 8 (4,586 and 8,961 hrs per effective life) and will be used with the energy use rates per mode (presented in Sect. 2.1, Table 1), to calculate the total energy consumption per effective life for each monitor type.

Table 8. Effective Life Values

User Environment	Power Mode	First Life (4 years)		Remaining Lives (2.5 years)		Model Totals[b] (hr/effective life)
		Operating Pattern (hr/yr)	Total (hr/4 yrs)	Operating Pattern (hr/yr)[a]	Total (hrs/2.5 yrs)	
OFFICE (65%)	Full-on	1,095	4,380	493	1,233	5,613
	Low	2,263	9,052	1,018	2,545	11,597
HOME (35%)	Full-on	522	2,088	235	588	2,676
	Low	793	3,172	357	893	4,065
WEIGHTED AVERAGE[c]	Full-on	---	---	---	---	**4,585**
	Low	---	---	---	---	**8,961**

[a] The remaining lives operating pattern is 45% of first life operating pattern, based on 45% of monitors that are reused (Matthews et al. 1997).

[b] Modal totals calculated as [(Total for first 4 years) + (Total for remaining 2.5 years)].

[c] The weighted averages shown for full-on and low power modes are based on the assumption that 65% of users operate in an office environment and 35% operate in a home environment.

3. PRELIMINARY RESULTS

In order to calculate the total kWhs consumed per manufactured life and effective life, values from Sects. 2.1 and 2.2 were combined as shown in Tables 9A and 9B. First, the energy use rates (kW) were multiplied by the lifespans (hours per life) for each mode and each monitor type. They were then summed for the two power modes to obtain a total kWh/life for each monitor type. In an LCA, comparisons are made based on functional equivalency. Therefore, if one monitor will operate for a longer period of time than another, as in the manufactured life scenario, overall life-cycle impacts should be based on an equivalent use. Thus, because the manufactured life of an LCD is 3.6 times greater than a CRT (see Sect. 2.2.1), in the final analysis, the CRT manufacturing process inventories must be multiplied by 3.6 to retain a functionally equivalent basis for the CRT and LCD monitor comparison. Since the effective life calculation is not technology-dependent, both monitor types operate for the same number of

hours in the effective life (see Table 8) and thus they are considered functionally equivalent and no modification to the overall life-cycle analysis is necessary.

Table 9A. Manufactured Life (ML) Electricity Consumption

Monitor Type	Power Mode	Energy Use Rate (kW)	ML Calculated Lifespan (hours/life)	ML Energy Consumption (kWh/life)
17" CRT	Full-on	0.113	6,250	706
	Low	0.013	6,250	81
	Total	----	12,500	787
15"LCD	Full-on	0.040	22,500	900
	Low	0.006	22,500	135
	Total	----	45,000	1,035

Table 9B. Effective Life (EL) Electricity Consumption

Monitor Type	Power Mode	Energy Use Rate (kW)	EL Calculated Lifespan (hours/life)	EL Energy Consumption (kWh/life)
17" CRT	Full-on	0.113	4,585	518
	Low	0.013	8,961	116
	Total	----	13,547	634
15"LCD	Full-on	0.040	4,585	183
	Low	0.006	8,961	54
	Total	----	13,547	237

3.1 Comparing Lifespans: Manufactured Life to Effective Life

Since the energy use rates are the same across both lifespan scenarios for CRTs and LCDs, we can compare the calculated lifespans of the manufactured and effective lives (hours per life). For the CRT monitor, the manufactured life total hours are 12,500 versus the effective life total of 13,547. While this does seem to suggest that a CRT can be used longer than is physically possible, what this brings out is the lower confidence we have in these numbers and some of their supporting values, with less confidence in the manufactured life data. Assumptions were required several times that could bias these numbers in either direction, however it is thought that most likely the manufactured life estimate is low based on the other estimates for the overall CRT monitor (see Attachment A, Table A2). However, there was no sound basis for assuming a lower value and thus the above hours per life values were used. It should also be stated that while these numbers are different, they are within an 8% error range of one another, and can be taken to be a near 1:1 ratio, indicating a similar potential lifespan.

For LCDs, the comparison across lifespan scenarios looks more like what one would expect, with the manufactured life value of 45,000 hours per life being much greater than the effective life value of 13,547 hours per life. The effective life value reflects the assumption that a user's use habits are not technology-dependent, and would seem to reveal that LCDs are not being used as long as they can physically be (less than a third as long).

The difference between the manufactured and effective lives are important when evaluating all the life-cycle stages for a particular monitor type. If the manufactured life is significantly greater than the effective life, the use stage will have greater impacts, as compared to other life-cycle stages. Therefore, it is important to focus on the lifetime scenario that is most realistic, while still recognizing the potential impacts from another feasible lifespan scenario.

In the final LCA for this project, we will use the effective life as the primary basis for the use stage inventory due to the fact that the effective life data are attempting to obtain a more realistic value for kWhs consumed per lifetime, and that we currently have greater confidence in those data versus the manufactured life data. The manufactured life data will be used to discuss potential differences in the use stage impacts based on this alternative lifetime scenario.

3.2 Sensitivity Analysis

Finally, in an effort to provide some sensitivity analysis to the final values, the assumption used in the effective life calculation that 10% of the computers manufactured in 1998 and currently in use are not able to take advantage of lower power-saving modes (a 90/10 split) was adjusted to three different splits, with all the other assumptions and calculations kept unchanged (50/50, 75/25 and 100/0, respectively in each case those that are able to go into power saving modes and those that are not). Table 10 presents the results of the sensitivity analysis for each of the four power-saving functionality scenarios.

Table 10. Sensitivity Analysis of Effective Life Results

Monitor Type	Power Mode		% that Can / % that Cannot Take Advantage of Power-Saving Features			
			50/50	75/25	**90/10**	100/0
17" CRT	Full-on	(kWh/life)	969	689	**518**	408
	Low		64	97	**116**	129
	Total		1,033	786	**634**	537
15" LCD	Full-on	(kWh/life)	343	244	**183**	145
	Low		30	45	**54**	60
	Total		373	289	**237**	205

The data in Table 10 reveal that the final electrical energy consumption values for the CRT would increase by 63% with a 50/50 split and decrease by 15% with a 100/0 split (from the 90/10 split assumption). Similarly for the LCD, the results would increase by 57% or decrease by 14%. Varying the use of power-saving features results in variations in the total amount of energy consumed for LCDs and CRTs, but does not vary the ratio of LCD to CRT energy use. Therefore, these variations will affect the magnitude of the use stage impacts for effective life scenarios when compared to other life-cycle stages, but will not affect the comparison of LCD to CRT. Additional sensitivity analyses are available in Socolof et al. (2000).

4. DATA SOURCES AND QUALITY

Source and quality information for the data utilized in this TM are detailed in Table 11. Four categories of data quality ratings were assigned: excellent, average, poor, and unknown. In general, data assigned higher quality ratings were directly measured and represent 1998 data. As data required more calculation or estimation, or were found from a previous year, the data quality rating was reduced.

In general, the overall level of data quality is between average and excellent. However, a distinct difference can be seen in the average data quality ratings given to manufactured life data (average) and the effective life data (excellent). This infers that greater confidence can be placed in the effective life data than in the manufactured life data. Additionally, the energy use rate data appears to be of average.

Table 11. Data Sources and Quality Information for the Use Life-Span Stage TM

Data	Data Source/References	Data Source Comments	Data Quality [a]	Data Quality Explanation
ENERGY USE RATE				
Various monitor manufacturer's energy use rate data	Web sites in most cases; E-mail from manufacturer in remaining cases.	It was assumed that the data provided by manufacturers on the Web sites were high-quality data in that the data should be measured and directly applicable to the equipment for which the information is provided. However, the search for information did not separate information obtained by performance level of the monitors.	Average	It was not possible to determine in what year each individual monitor was manufactured; however, it is assumed that each monitor is on the order of several months to 2 years old when promoted for sale. Thus it is estimated that the average date of the information obtained is probably relative to approximately 1997. Adding that the data was not sorted by performance level, this data was given a data quality rating of Average.
MANUFACTURED LIFE (Only those sources utilized to derive values are discussed here.)				
Discussion of CRT lifespan	McConnaughey 1999	Professional opinion provides good insights into potential ranges for certain components, however is still an opinion and not scientific data.	Average	As a computer manufacturing company employee, it is expected that they are a quality source of information on this topic; however, information is still an opinion and not scientific data, thus an Average data quality rating was assigned.
Discussion of CRT and LCD lifespans	Douglas 1999	See above comment.	Average	See above comment.
Discussion of LCD lifespan	Ritsko 1999	See above comment.	Average	See above comment.
Discussion of LCD lifespan	Tsuda 1999	See above comment.	Average	See above comment.
Discussion of CRT and LCD lifespans	Young 1999	See above comment.	Average	As the leader of a group that closely follows the trends in the LCD market and produces monthly reports on technology and market trends, it is expected that they are a quality source of information on this topic, however, information is still an opinion and not scientific data, thus an Average data quality rating was used.
17" CRT monitor specifications sheet	VP150 1998	As technical data on one specific CRT monitor the information is expected to be at least testing quality data or better.	Excellent	As direct manufacturer information applicable to 1998, this data is given an Excellent data quality rating.

Table 11. Data Sources and Quality Information for the Use Life-Span Stage TM

Data	Data Source/References	Data Source Comments	Data Quality [a]	Data Quality Explanation
EFFECTIVE LIFE				
Number of PCS in use in the U.S.	CIA 1997	Authors have much experience in obtaining and collecting computer statistics in U.S. and other countries; have been publishing this book since 1986.	Excellent	From review of the available information on the authors and data sources for the data that go into the Computer Industry Almanac, the data quality rating of Excellent is given. Even though data is from 1996, the authors used that data and recent trends information to predict 1997 values, and it is expected that the 1997 values are not significantly different than the 1998 values.
Percent of PCS in the home that are used in an office-like environment	RECS 1999	"The Residential Energy Consumption Survey provides national...information about U.S. households and their energy usage. The 1997 survey collected data from a statistically selected sample of 5,902 households that were interviewed in their homes."	Excellent	While these data are 1997 data, it is assumed that the energy usage patterns of home dwellers has not changed significantly between 1997 and 1998.
Number of PCs in use in the home	RECS 1999	See previous comment on RECS.	Excellent	See previous comment on RECS.
Office PC use pattern	Nordman 1996	Used multiple sources of previous data covering many samples of PCs, as well as their own research, to derive their equipment usage pattern.	Average	Their data was manipulated slightly to account for a greater number of affectors on typical usage patterns. By manipulating their data the data quality is slightly reduced, thus data quality rating of Average was assigned.
Home PC use pattern	RECS 1999	See previous comment on RECS.	Excellent	See previous comment on RECS.
Number of years PCS are used in 1st life and 2nd and subsequent lives	NSC 1999	"This study presents the results of the first large-scale survey (which covered the years 1997 and 1998) and analysis of end-of-life electronic product recycling and reuse in the U.S. Data were collected from 123 firms."	Excellent	Due to the applicable time frame and the body of companies who participated, these data were given data quality rating of Excellent.
Number of PCS that are used in their 2nd and subsequent lives	Matthews 1997	Performed a study in 1991, watched as the computer market changed over l6 years, then reviewed the original study finding the weak spots there. Reperformed study in 1997 making learned changes to the analysis format and using newer data (1997).	Average	While changes were made to the second study as weaker parts of previous study were uncovered, still extrapolated individual recycling firm data to obtain some base data for their estimates. While data is primarily relative to the 1997 time frame, which is very close to our year of interest of 1998, still chose data quality rating of Average due to amount of data manipulation that was required to obtain values.

[a] The data were assigned to one of the following four data quality categories: Excellent, Average, Poor, and Unknown.

5. LIMITATIONS & UNCERTAINTIES

This section is subdivided into three subsections, with each addressing the limitations and uncertainties of the energy use rate, manufactured life and effective life calculations.

5.1 Energy Use Rate

The energy use rates utilized in this TM were not from a systematic study of the energy use rates of all applicable monitors, only those for which information was located on the World Wide Web. Also, it was difficult to pinpoint the exact date from which much of the data came (see the data quality explanation of those data in Table 11). To successfully and effectively take advantage of the data on each of the three lower power modes, it would have been necessary to have hours per life data for each of the three power modes as well as for manufactured and effective lives. No sources of data, for either lifespan, separated hours per life estimates into three distinct low power modes. While this does induce error, it is expected that averaging those categories to estimate the total amount of time that a monitor spends in all the lower power modes would only have a minor effect on the final energy use rate values. The effect of averaging these categories probably overestimates the total amount of electrical energy that is consumed during lower-power mode use. This is so because those that are left on for significant periods of time (overnight, over a two-day weekend, or over an extended stay) most likely are reaching their lowest power mode within the first 1 - 2 hours and staying there for the duration of the away time.

When this information was obtained from the World Wide Web, the data were simply separated into one of the two large categories of 17" CRT and 15" LCD desktop monitors. Thus, since it is fairly common that one type of monitor manufacturer will make several different models with varying performance characteristics with one size range, a limitation of this data is that it is not sorted by performance characteristics. Additionally, the data obtained from these Web sites are most likely maximums, and were stated as such in several cases. However, if some manufacturers did not state that the reported values were maximums, then our averages are slightly high.

5.2 Manufactured Life

Only a very limited amount of information was obtained with which to make the assumptions made in this TM about manufactured life. The primary uncertainties relate not only to the assumption of the MTBF lifespan of the monitors, but also to the testing duty cycle which was completely estimated. With the lack of any high quality data, the confidence in the manufactured life calculations is low.

5.3 Effective Life

Several assumptions were made to calculate the effective life data set. They include the following:

- 90% of monitors are able to go into lower power consumption modes;
- Atypical workplace computers (e.g., those used in hospitals and schools) balance to fit the office-like use environment established in this TM;
- Atypical (average) office use environment week consists of 4 'weekdays,' 1 'absence day' and 2 'weekend days,' where the absence day accounts for holidays, sick days, work-related travel days, vacations and days of no use of the work computer;
- The percent of time a monitor spends in full-on versus lower power modes in a home environment is the same as in an office environment;
- Used the office environment split of the total on time that equipment spends in full-on versus a lower power mode for the home environment split of total on time;
- LCD desktop monitor lifetimes are more similar to desktop CRT monitors than notebook PC displays; and
- The same number of years of use per life exist for office and home environments.

While the above assumptions do introduce error, the magnitude of the error is unknown. Some assumptions may have a greater effect on the final values than others. For example, it may be concluded that the assumption that the average office PC system usage pattern is fairly accurate, while the assumption about atypical workplace computers could potentially contain significant error in either direction of the assumed value. Table 10 showed the effects on the results from varying the use of energy saving features. If several of these assumptions are biased in the same direction (either all underestimating or overestimating the results), then the effective life results have the potential to be significantly under or overestimated.

6. DISCUSSION AND CONCLUSIONS

The information presented in this TM are used to calculate the environmental burdens generated during the use life-cycle stage of the monitors. That information is then compared to those burdens that occur in the other four life-cycle stages of materials extraction, materials processing, manufacturing and end-of-life. To calculate the environmental burdens from the use life-cycle stage, the results of this TM -- the values for each monitor's electrical energy consumption over its lifetime in kWhs -- are multiplied by each of the inputs and outputs from the electricity generation process.

ACRONYMS & ABBREVIATIONS

CDP	Computer Display Project
CRT	Cathode ray tube
DfE	Design for the Environment
DOE	Department of Energy
DPMS	Display Power Management Signaling
EIA	Energy Information Administration
IC	Integrated circuit
kW	Kilowatt
kWh	Kilowatthour
LBNL	Lawrence Berkeley National Laboratory
LCA	Life-cycle assessment
LCD	Liquid crystal display
LCI	Life-cycle inventory
MTBF	Mean-time-before-failure
PC	Personal computer
RECS	Residential Energy Consumption Survey
TM	Technical memorandum
W	Watt

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Attachment A to Appendix H
Supporting Tables

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Table A-1. CRT & LCD Monitor Energy Consumption Values

CRTs	Company	Model	Size (inches)	VIS [a] (inches)	Energy Consumption (watts)								Comments/Assumptions
						Full-on		Standby [b]		Suspend		Act. Off	
	Apple	Color Sync	17.0	16.1	<	125	<	60			<	5	
		Multiple Scan 720	17.0	16.0	<	120					<	5	
	Compaq (& Digital)	V75	17.0	16.0	<	115							
		P75	17.0	16.0	<	115							
		71C	17.0	15.7	<	110	<	15	<	15	<	8	
		71P	17.0	16.0	<	120	<	15	<	15	<	8	
	EIZO	FlexScan TX-C7	17.0	15.8		140	<	12			<	5	
		FlexScan FX-C5	17.0	15.6		95	<	10			<	5	
	Hitachi	SuperScan Elite 641	17.0	15.9	<	135	<	15			<	8	
		SuperScan Pro 620	17.0	15.9	<	115	<	15			<	8	
	LG	Studioworks 74i	17.0	16.0		100		15				8	
		77M	17.0	15.9	<	130						5	
	MAG	XJ707	17.0		<	120	<	15	<	15	<	8	
		XJ717	17.0		<	120	<	10	<	10	<	5	
		XJ700T	17.0		<	120	<	15	<	15	<	5	
		DJ707 AV	17.0		<	120	<	15	<	15	<	8	
	Mitsubishi	Diamond 87TXM	17.0	16.0		120	<	100	<	15	<	8	Due to the significant difference in the Mitsubishi "Standby" power mode category values and those supplied by other manufacturers, these values were omitted from the average "Standby" power mode calculation.
		Diamond Pro 700	17.0	16.0		110	<	95	<	15			
		Diamond Plus 72	17.0	16.0		105	<	90	<	15			
		Diamond Plus 70	17.0	16.0		95	<	80	<	15			
	NEC	Multisyne A700	17.0	15.6		85					<	8	NEC representative contacted through support phone number stated that the energy saver mode power consumption is usually rated at 8 watts or less for all monitors. Due to range similarities, assumed that this rating falls into the 'Active Off' power mode consumption category.
		Multisync E700	17.0	15.6		95					<	8	
		Multisync M700	17.0	15.6		120					<	8	
		Multisync P750	17.0	15.6		125					<	8	
	Panasonic	PanaSync S17	17.0	16.0		110	<	15	<	15	<	8	The company Web site stated "typical" or "nominal" for the associated power consumption values.
		PanaMedia PM17	17.0	16.0		130	<	20	<	20	<	8	
	Philips	107S	17.0	15.9		80					<	5	
		107MB	17.0	15.9		85					<	5	
		107B	17.0	16.0		85					<	5	
	Sony	CPD-200ES	17.0	16.0	<	120	<	15			<	8	
		CPD-200GS	17.0	16.0	<	120	<	15			<	8	
	Toshiba	TekBright 700P	17.0	15.8		100							Web site indicated 110 watts maximum, 100 watts nominal.
	Viewsonic	PT775	17.0	16.0		130							The company Web site stated "typical" or "nominal" for the associated power consumption values.
		EA771B	17.0	16.0		130							
		G773	17.0	16.0	<	110							
				CRT Averages:		113.00		17.31		15.00		6.85	
				Standard deviations:		15.35		11.61		2.13		1.49	
				CRT Standby, Suspend and Active Off average:				13.05					
				Standard deviation:				5.08					

Table A1. CRT & LCD Monitor Energy Consumption Values (continued)

LCDs	Company	Model	Size/VIS [a] (inches)	Energy Consumption (watts)								Comments/Assumptions
					Full-on		Standby [b]		Suspend		Act. Off	
	Apple	Studio Display	15.1	<	35		10				8	
	Batron	FM-17TX11	15.0		35							
	Compaq	TFT500	15.0	<	50							
	Digital	51P	15.0		40		8				8	Received data through phone support (800.354.9000).
	EIZO	FlexScan L34	15.0		30	<	15			<	5	
	LG	500LC	15.1		40		5				5	
	Mitsubishi	LCD50	15.0		45		8				8	
	NEC	LCD1510	15.0		50		8					
	Samsung	500TFT	15.0	<	45					<	5	Received data via E-mail. The Samsung E-mail received stated that in full power on mode, the power consumption was a maximum of 45 watts and a nominal of 36 watts.
	Sharp	Super-V	15.0		36						2	
	Sony	CDP-L150	15.0	<	35	<	4			<	4	
	Viewsonic	VP150	15.0		35		2.6				2.6	Received data via E-mail. Full-on category value noted as "typical."
			LCD Averages:		39.67		7.58				5.29	
			Standard deviations:		6.50		3.89				2.29	
			LCD Standby, Suspend and Active Off average:				6.44					
			Standard deviation:				3.09					

[a] VIS = Viewable Image Size.
[b] The 'Standby' energy consumption category includes listings noted as "Power Save Mode 1."

Notes: The energy consumption data shown in this table were taken from the Web sites of the retailers during 1998 unless otherwise noted. The energy consumption ratings for these monitors showed various information. Sometimes the less than (<) symbol preceeded some or all values, sometimes the addendum note 'maximum' was included and sometimes only the values themselves were reported.

Table A2. CRT and LCD Monitor MTBF Values & Manufactured Life Comments

MTBF Values for the:			Source	Comments from Sources
CRT Monitor	CRT Only	LCD Monitor		
(thousand hours)				
30-60	10-15		Goldwasser 1999	- "Most manufacturers will quote an MTBF of somewhere in the 30,000 to 60,000 hour range, EXCLUSIVE of the CRT. The typical CRT, without an extended-life cathode, is usually good for 10,000 to 15,000 hours before it reaches half its initial brightness." - "CRT Life: The life of a monitor is determined by the life of the CRT. The CRT is by far the most expensive single part and it is usually not worth repairing a monitor in which the CRT requires replacement. The brightness half-life of a CRT is usually about 10-15k hours of on time independent of what is being displayed on the screen." - "In a CRT monitor, the shortest-lived component BY FAR is the CRT itself, and it ages (more properly, the cathode is aging) as long as the heater is on and the tube is under bias (i.e., receiving voltage). Most monitors don't get around to turning the heater down or off until they enter the Display Power Management Signaling (DPMS) "suspend" or "off" modes. (And no, screen-savers do NOT help here - the tube is still on and the cathode is aging.) - "In a CRT display, the CRT itself is usually the limiting factor in this (life), and in THAT specific case we usually speak of "mean time to half-bright" instead, since it's rare for a CRT to simply die once it's past its early operating life. Mean-time-to-half-bright is just what it says: how long, on average, can you operate the tube before the brightness drops to half its initial level for a given set of operating conditions. (Brightness is ALWAYS slow(ly) decreasing throughout the tube's life, due to the aging of the cathode and the phosphor.) For most tubes with standard cathodes, this will be in the neighborhood of 10,000-15,000 hours."
50-100			McConnaughey 1999	Mr. McConnaughey stated that each of the subsystems of a monitor has different components that must meet different MTBF (Mean Time Before Failure) testing. Before testing, manufacturers typically calculate what the expected MTBF should be, and then test it to obtain the demonstrated MTBF. A rule of thumb is 50,000 hours calculated and over 100,000 hours demonstrated.
75			Philips 1998	"MTBF: >75,000 h (according to MIL-HDBK 217E) at 25 degrees Celsius (excl. CRT)"
50			Maginnovision 1998	"The average MTBF (Mean Time Before Failure) for MAG InnoVision monitors is 50,000 hours, excluding the CRT."
86			PlanetMac 1999	Mean Time Before Failure = 86,000 hours.
80	10-15	(50-backlights)	Douglas 1999	Phone conversation with David Douglas at Dell in Texas. David took plenty of time to discuss MTBF, and relayed that while Dell requires suppliers of CRT components (EXCLUDING THE CRT) to meet a MTBF specification of 80,000 hours, Dell performs testing (a type of 'demonstrated' MTBF - is a torture test) that typically yields at least twice the specification value in total time the equipment can operate. With that said, David then agreed that the CRT is the component that determines a CRT-based monitor's lifetime and that it is rare that a CRT lasts anywhere near that long, with most failing in the 10,000-15,000 hours/life range. David noted that CRT semiconductors are the next component that can fail. In LCDs, components containing silicon are most likely to fail first, with most manufacturers quoting backlights that will last 50,000 hours.
			Koch 1996	Didn't supply any other data other than that they assumed 10,000 hours as the lifespan of the LCD monitor.

APPENDIX H

Table A2. CRT and LCD Monitor MTBF Values & Manufactured Life Comments

MTBF Values for the:			Source	Comments from Sources
CRT Monitor	CRT Only	LCD Monitor		
(thousand hours)				
		50: 15 for backlights	Tsuda 1999	Mr. Tsuda (Apple Computers) stated that the specs don't typically change for different size LCD monitors for specific components. MTBFs for flat panel displays are about 50,000 hours, except for the backlights which have MTBFs of about 15,000 hours. Most components can be fixed or replaced easily by trained technicians. Testing they perform is with maximum brightness, full white pattern; worst pattern for LCD is 1 pixel On/1 pixel Off.
		40	Young 1999	Through a conversation with Ross Young, Ross spoke of a note a gentlemen had sent him wherein they assumed a useful life for an LCD of 84 months and a CRT of 36 months. Additionally, it was noted that an LCD panel was assumed to have a life of around 40,000 hours, and this could increase if DPMS screen savers were implemented.
		(50-backlights)	VP150 1998	Light Source: long life, 50,000 hrs. (typ)
		(10-40 - silicon driver chips)	Ritsko 1999	Liquid crystals and thin-film transistors (TFTs) don't typically wear out, yet the amorphous silicon transistors are less reliable than the single transistors. Also, the driver (silicon) chips could be an item that might show wear, however, the chips that go in FPDs are fairly typical, use low voltages and should run between 10,000 and 40,000 hours.

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Young, R. 1999. Personal communication with Ross Young, founder and President of Display Search. August.

VP150. 1998. Viewsonic VP150 17" CRT monitor specifications sheet.

Table A3. Use Stage Data Information, Estimates and Assumptions from Reviewed Sources

Author	Operating Circumstances/Lifetime Data			Power Consumption rate/Power Management
Jung 1999	"The estimated useful life for a PC in a business environment is only two to three years, while home computers users typically use their equipment for three to five years."			
Matthews 1997	First research group to attempt to model the time effort factor of storage of computer equipment during the Use life-cycle stage. In doing so, came up with a breakdown of options (shown below). Additionally, after calculating the destinations and percent averages from their numbers, 26% of end-of-life equipment is landfilled after 8.06 years in use and storage (and possible reuse), and 74% is recycled after 8.49 years in use, storage and possible reuse.			
	Initial lifetime of PCs: 5 years	% at end of 1st life reused:	45%	
		% at end of 1st life recycled:	5%	
		% at end of 1st life stockpiled:	45%	
		% at end of 1st life landfilled:	5%	
	Lifetime of reused PC: 3 years	% reused recycled:	40%	
		% reused stockpiled:	50%	
		% reused landfilled:	10%	
	Lifetime of stockpiled PC: 3 years	% stored recycled:	75%	
		% stored landfilled:	25%	
	Calculating through the above numbers for 100 computers reveals the following breakdown:	(# out of 100)	(time)	
	Landfilled after 5 years	5	25	
	Landfilled after 8 years	15.5	124	
	Landfilled after 11 years	5.5	60.5	
	Landfilled totals	26	209.5	
	Average numbers of years to landfilling of PC:		8.06	
	Recycled after 5 years	5	25	
	Recycled after 8 years	52	416	
	Recycled after 11 years	17	187	
	Recycled totals	74	628	
	Average number of years to recycling of PC:		8.49	
NSC 1999	"The lifespan estimates used in this study were developed through interviews with more than 30 major manufacturers and resellers. Major computer manufacturers were consulted to determine the lifespan of electronic equipment. Because manufacturers know when their products were fabricated and many also have recycling facilities, these firms are qualified to make an educated lifespan estimate. Resellers and nonprofit organizations were asked to estimate the reusable life or 'second life' by product and processor type. These inputs were used to develop estimates of the first life (the amount of time a product is useful to its original owner) and the total lifespan (period from manufacturers to disposal) for each electronic product."			
		First life	Total life	
	CRT computer	4	6-7	
	Notebook PC	2-3	4	

Table A3. Use Stage Data Information, Estimates and Assumptions from Reviewed Sources

Author	Operating Circumstances/Lifetime Data			Power Consumption rate/Power Management
Chan 1997	This class report from a University of Toronto group of 4 people contains several worthwhile pieces of information. The data presented comprise responses from 180 people (130 administrative, teaching and research staff and 50 residents). Class covered 1996/1997; data were gathered during the class.			
	Hours of computer use by staff	< 4 hrs/dy	7%	
		5-8 hrs/dy	52%	
		9 or > hrs/dy	41%	
	Percentage of computers with energy-saving features installed or activated	have features	52%	
		no knowledge of features	35%	
		don't have features installed or	13%	
	Respondents who update their knowledge of computer energy-saving features	do not	75%	
		do	19%	
		no response	6%	
	Idling time of office and residential computers that are turned on	less than 2 hrs	66%	
		3-5 hrs.	22%	
		6 hrs or more	12%	
	Respondents who turn off their computer when they are away for a period (period is 45 min. or longer)	never do	70%	
		sometimes do	21%	
		always do	7%	
		no control	25%	
	Staff who shut down their computers at the end of the day	always	70%	
		sometimes	9%	
		never	19%	
		no control	2%	
	Percent of office computers left on during weekends	always	22%	
		sometimes	8%	
		never	67%	
		no control/no response	3%	
EIA 1997	The EIA's results from the Residential Energy Consumption Survey (RECS) provides some good data on			
	Hours PC turned on each week	less than 2 hrs	8.2	
		2 to 15 hrs	17.4	
		16 to 40 hrs	6.7	
		On all the time	3.3	
	How PC is used	15 hrs a week or less	26.5	
		16 hrs a week or more	10.0	
		Personal use only	4.8	

Table A3. Use Stage Data Information, Estimates and Assumptions from Reviewed Sources

Author	Operating Circumstances/Lifetime Data			Power Consumption rate/Power Management
		Business use only	2.1	
		Used for both	3.1	
	Additionally, RECS calculated that lion computers were in use in U.S. households in 1997. Other data from the RECS included "6% of the households that used PCs used that computer to tele-commute."			
CIA 1998	Estimate that 117 million computers were in use in the U.S. in 1997.			
EPA 1999	Have the EnergyStar compliance monitor specifications.			
		First low-power mode	Second	
	Low-power state:	< = 15 watts	< =8W	
	Default times:	15-30 minutes	< 70 min.	
Koch 1997	Assumed 10,000 hours/lifetime for the LCDs in the study.			
Goldberg 1998	Article reported that Walt Rosenberg, Compaq's director of environmental affairs, stated that today's machines have a useful life of two-to-three years.			
Miseli 1999	Did not separate office from home user. Assumed units operate 50% of the time (annually) around the clock. Stated that "True life of a CRT or LCD is defined for the case when it runs continually at full intensity," adding that true life for CRT is about 1.25 years and for LCD is about 2.9 years. Doubled each of those true life values for his calculations.			Assumed 90W for a CRT and 30W for an LCD.
Tekawa 1997	Assumed personal users time frame of 2 hr/dy, 365 dy/yr for 5 years, and office users time frame of 8 hr/dy, 247 dy/yr for 7 years. Assumed a ratio of personal to office user of 4.6.			Don't state the actual numbers they used, but do say they took the mean of the minimum and maximum power consumption ratings.
Atlantic 1998	They estimated that a PC's lifetime is 3 years. Then they stated that they were modeling only the first lifetime of a PC; they acknowledged other lifetimes but decided not to attempt to model them. They also estimated that the PC is turned on 8 hrs per day, 230 days per yr, altogether running for 5,520 hrs during its lifetime.			They assumed that the monitor consumes power at a rate of 100W, and that the "base case PC has no energy savings facilities."
Philips 1998	MTBF of 75,000 hrs for a 19" C1995 Typhoon high resolution CRT monitor excluding the CRT.			Power consumption: 120W typ. (140 W max)
Nordman 1996	In this document, Lawrence Berkley National Laboratory (LBNL) details results from several audits they performed determining the state of power consumption and power management in certain computers and monitors			The LBNL document provided results from a audit of 70 monitors and their setup and use of energy saving power modes. Their primary conclusions were that only approximately one-third of all monitors were "accomplishing power management." The following is a breakdown of some of what they found:
	Standard % of time in each mode by day type, by operating pattern	Full-on	Low	- 34 apparently meet Energy Star requirements
	Workday	17%	35%	- 30 were 'universal,' (able to initiate power mgmt two ways)
	Weekend day	0%	20%	- 30 were left on at time of audit (12 in suspend mode)
	Absence day	0%	20%	
	Weekdays average	13%	45%	
	All days average	10%	35%	
				This document also contained data on the actual power consumed by 3-17" monitors over a 4-6 week period, broken down by power consumption mode, and the results are shown below:
				Monitor #1: Full-on = 91 watts; Low = 7 watts
				Monitor #2: Full-on = 84 watts; Low = 3 watts
				Monitor #3: Full-on= 85 watts; Low = 4 watts

Table A3. Use Stage Data Information, Estimates and Assumptions from Reviewed Sources

Author	Operating Circumstances/Lifetime Data	Power Consumption rate/Power Management		
CCPCT 1998		The University of Tennessee CCPCT reviewed the available CRT and LCD energy consumption information (mostly via the WWW) and produced the energy consumption breakdown shown at left by energy consuming state. The units are all watts.		
		CRT	Full-on:	113.29
			Standby:	17.18
			Active off:	6.85
		LCD	Full-on:	40.00
			Standby:	7.58
			Active-off:	5.70

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APPENDIX I

TECHNICAL MEMORANDUM:
End-of-Life Approach for the DfE Computer Display Project

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APPENDIX I

TECHNICAL MEMORANDUM:
End-of-Life Approach for the DfE Computer Display Project

I. INTRODUCTION

The Computer Display Project, sponsored by the U.S. Environmental Protection Agency (EPA) as part of its Design for the Environment (DfE) program, is investigating the life-cycle impacts of cathode ray tube (CRT) displays and liquid crystal displays (LCDs) for use in desktop computers.

A meaningful comparison of the two technologies from the environmental perspective can be made only if the life-cycle impacts associated with various stages, namely, raw material extraction, materials processing, manufacture, use, and end-of-life (EOL), are evaluated. The functional units being compared are the 17-inch CRT display monitor and the 15-inch active matrix liquid crystal display (AMLCD) monitor. The two are considered to be functionally equivalent with respect to the viewing area available to the user. EOL issues are of growing interest to manufacturers nowadays due to Extended Producer Responsibility (EPR) concerns (Fishbein 1998) and the consequent higher expectations from manufacturers for influencing the ultimate fate of their products.

The purpose of this memorandum is to describe the approach for evaluating the EOL life-cycle stages of CRTs and AMLCDs for the Computer Display Project. This approach includes:

(1) developing scenarios to represent reasonable EOL alternatives; and
(2) collecting life-cycle inventory (LCI) data for the EOL alternatives.

1.1 Background

Estimates from 1998 revealed that more than 20 million personal computer central processing units (CPU) became obsolete in that year (NSC 1999). Earlier estimates indicated that approximately 10 million television sets and 12 million computer monitors reach the end of their useful lives each year (MCC 1996). Assuming that one monitor became obsolete for every CPU in 1998, and since LCDs have not been in existence long enough to have attained "end-of-life" (EOL) status in sufficiently large numbers, it is expected that approximately 20 million CRTs are retired annually. There is not much information available on the disposition options for LCDs.

The major existing EOL environmental concern associated with CRTs is disposal of leaded glass. LCDs, on the other hand, do not contain any leaded glass and are much lighter in weight, but contain other materials of concern, such as mercury used in the backlights.

1.1.1 CRT EOL Issues

According to practices followed by leading CRT recyclers such as Envirocycle (Envirocycle 1999), the material of greatest value recovered from CRTs is leaded glass (which is also the major component by weight), followed by small quantities of metals. Also, whenever the incoming EOL product is a complete computer monitor, some plastics and metals can be recovered from its outer casing and other parts.

The closed loop recycling of leaded glass involves recovering and processing the material for use as cullet in the manufacture of new CRTs. CRT manufacturers will use the cullet if it meets quality standards and is of the same chemistry and type as required by them in their manufacturing operations. Thus, effective recycling of post-consumer CRT glass requires very careful sorting and separation into various types, followed by decontamination (removal of coatings). Resmelting (for lead recovery) and downcycling (into other glass applications) are some of the other "open loop recycling" alternatives. In 1997 and 1998, CRT computer monitor recycling was done for 1.3 million units (46 million pounds) and 1.5 million units (51 million pounds), respectively (NSC, 1999).

1.1.2 Regulations Regarding CRT Disposal

Color CRTs may fail the EPA Toxicity Characteristic Leachate Procedure (TCLP) test, and therefore may be classified as hazardous waste under current EPA regulations. Some experts believe that this classification poses barriers to the effective recycling of CRTs, on account of special permits and transportation requirements for handling hazardous waste (EPA-CSI 1999). However, EPA has implemented a glass-to-glass recycling exception.

In order to landfill CRTs in accordance with EPA regulations, they must be dismantled, and the glass crushed and stabilized by micro-encapsulation in cement. However, this method has some drawbacks. Crushing increases surface area and, consequently, the potential to leach lead. Though cement encapsulation is the required method, it has been found that cement disintegrates faster than glass (MCC 1994).

To encourage recycling, some states have developed new initiatives that will ease some of the regulatory barriers. Massachusetts, for example, has proposed to specifically exempt "intact" CRTs from being classified as hazardous waste and simultaneously banned them from disposal in municipal landfills and combustion facilities (MDEP 1999). These measures could promote the recycling of CRTs by making the process of handling and transportation much easier, and the paperwork less cumbersome.

1.1.3 LCD EOL Issues

Currently, no infrastructure or established process exists for recycling LCDs specifically. Of the small numbers of LCDs that have reached the EOL stage (predominantly as notebook computers), a much smaller number is likely to have reached recycling facilities. No specific details are available on the materials recovered from them as they are expected to have been processed along with other electronic products, with some valuable and/or potentially recyclable materials removed. The following components and materials of potential reuse or recycling value found in LCDs have been identified by MCC (MCC 1994):

- Thin film transistors (TFTs).
- Color filters.
- Glass.

The toxicity potential of heavy metals is of concern in the EOL stage. The heavy metals found in the LCD monitors are identified in the main body of this LCA report. This study will consider the presence of heavy metals or other materials of potential concern in the wastes and emissions generated.

1.2 EOL Disposition Options

In the past, landfilling has been the prevalent method for the disposition of post-use computer monitors (i.e., those re-used after being resold or donated). However, with increasing awareness of potentially harmful life-cycle environmental impacts, dwindling natural resources, government regulations against disposal of toxic substances in landfills, and the consequent development of markets for recycled components and materials, more options are now available for the disposition of post-use computer monitors. They are briefly described below.

1.2.1 Reuse

Reuse, often as a result of reselling, involves continued use of the monitor for the purpose for which it was built, and is considered to occur within its originally intended useful life. Reuse does not usually entail major repairs or modifications, and is a preferred EOL option because the original materials contained in it are put to use for an extended period of time, thus conserving valuable natural resources (energy and raw materials) needed to manufacture new monitors or to dispose of discarded ones. However, reuse could result in reduced energy efficiency during the use stage as monitor manufacturers continually strive to improve the energy efficiency of their products.

1.2.2 Remanufacturing

Remanufacturing is a viable option for monitors that are no longer functional but could be refurbished (upgraded or restored to working conditions) at a cost lower than that of manufacturing a new monitor, to be sold again in domestic or foreign markets.[1] Here again, energy and raw materials are conserved, though some new parts/components may be required. Another important benefit of remanufacturing is solid waste reduction, achieved by diverting the monitor materials away from the landfill. Remanufacturing processes span a wide range of activities, from as little as replacing button tops to as extensive as testing and replacing PCBs or transformers.

[1] In addition to cost, the arrival of new technology is another factor that inhibits remanufacturing. In such cases, remanufacturers seek to find markets where products based on old technology are still in demand.

1.2.3 Recycling

Recycling involves recovering the individual materials from EOL monitors, to be used in the production of new monitors (closed-loop recycling) or in other products (open-loop recycling). Identification, sorting, cleaning, and further processing (e.g., smelting) are often required before the recovered materials can be used again. Though materials recycling involves several processing steps, it results in the conservation of energy and raw materials, and diversion of materials that would otherwise have been landfilled, through the creation of new, desirable products that are in-line with current market demand.

1.2.4 Waste-to-Energy (WTE) Incineration

A portion of municipal solid waste (MSW) is routinely sent to incinerators or municipal waste-to-energy (WTE) facilities for energy recovery. The quantity of ash (bottom ash and fly ash) left over is a small fraction, around 25% (EPA 1998) of the original waste input, and can be disposed of either as non-hazardous or hazardous waste, depending on whether it passes the TCLP test or not. The obvious benefits are reduced solid waste and the energy produced, which is often counted as a credit in life-cycle energy calculations.[2]

1.2.5 Landfilling

Landfilling solid waste in Subtitle C (for hazardous) or D (for non-hazardous) landfills is the least preferred option, since all the other options have some expected environmental benefits. The disposal of waste in Subtitle C landfills is usually the most undesirable, as it often involves treatment to immobilize the hazardous materials before they can be landfilled, thus increasing the quantity and cost of disposal. Also, hazardous waste sites have the potential to turn into high liability ("Superfund") sites. Some states have regulatory activities that might not accept monitors in Subtitle D landfills.

2. METHODOLOGY

This section outlines key assumptions, defines conceptual models proposed for determining the flow of materials through the EOL processes, and highlights some important issues pertaining to CRTs and LCDs.

The major steps are listed below:

- Assumptions about the distribution of EOL options were made.
- Data were collected for various disposition options using existing inventory reports and inventory questionnaires sent to recyclers.
- Data were normalized to the functional unit and included as the EOL inventories.

[2] The energy used in different life-cycle stages is summed up to arrive at the total energy used in the life cycle of the product. In case of WTE incineration, where energy is recovered instead of being used up, it is treated as a negative value and subtracted from the total.

2.1 EOL Conceptual Models

A monitor is assumed to have reached EOL status when:

- It has served its useful life and/or is no longer functional.
- Technological obsolescence renders it unusable.

The EOL options for CRT and LCD monitors are graphically depicted in Figure 1. Estimates of the percent distribution of monitors going to each EOL option are presented below. As the functional unit in this study is one monitor over its lifetime, the percentages are used as probabilities for the EOL disposition of a particular monitor.

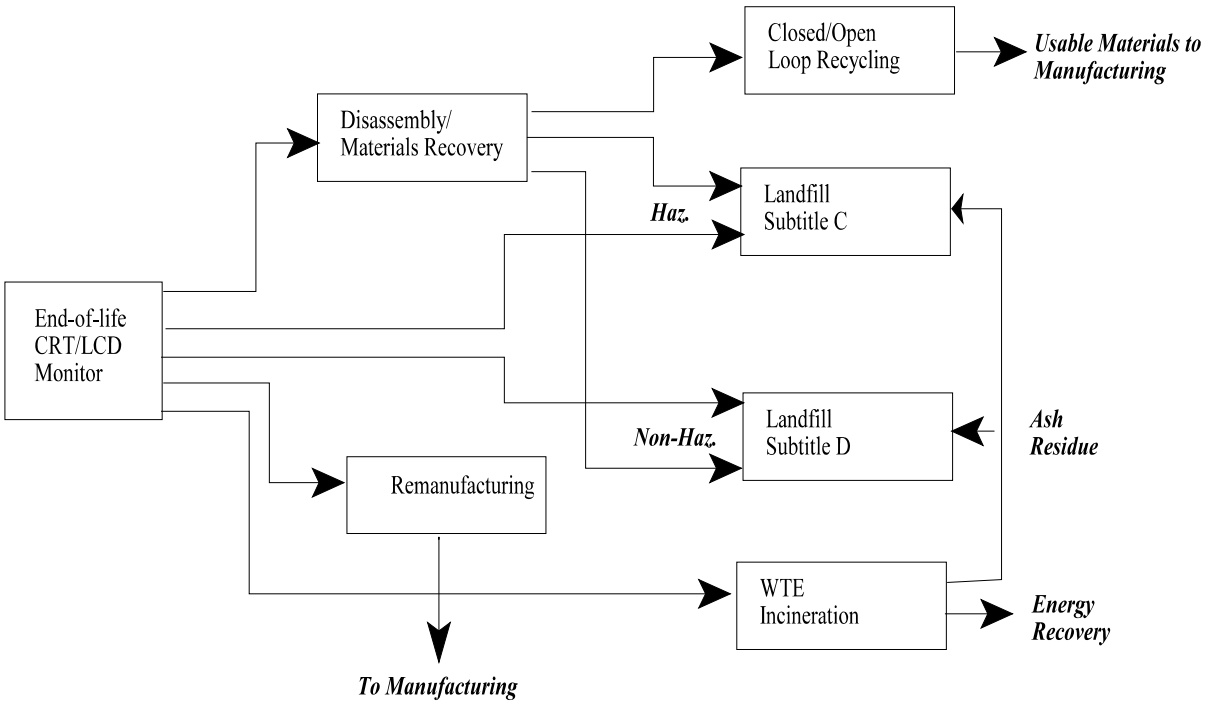

Figure 1. Conceptual Model Showing End-of-Life Disposition Options for CRT and LCD Monitors

2.2.1 CRT

The National Safety Council (NSC 1999) reported that 11% of all personal computer CPUs are recycled. Assuming one monitor is recycled with every CPU, and assuming these represent CRTs, we assume 11% of CRTs go to recycling. The NSC report also stated that 3% of personal computers are "refurbished and resold or donated." We thus used 3% as an estimate of the CRT monitors that are remanufactured, although we recognize this might be an overestimate, as we do not know if those resold and donated are also remanufactured. Given that this is a small percentage, this error is not expected to have a large effect. Further data are lacking on the percent of monitors being incinerated or going to landfills. To estimate the percent incinerated, we used the percent of all municipal solid waste in the United States being incinerated, which is estimated at 15% (EPA 1998). Summing the percents for recycling, re-manufacturing, and incineration equals 29%. This leaves 71% that is assumed to be landfilled. In the life-cycle analysis in this study, only one landfilling process is modeled, which is assumed to represent both hazardous waste and solid waste landfilling. The landfilling process is derived from Ecobalance data and is a combination of four major materials in a CRT (glass, steel, plastic, and aluminum), based on the proportion of each of those materials in the CRT. The inventories for each material are of generic materials (not necessarily the precise materials in the CRT). For example, the glass is generic glass, and not leaded glass, and the plastics are generic "plastic" and may not represent the exact plastics in the CRT.

Although the percentage of monitors that are landfilled are not separated into hazardous and non-hazardous waste landfilling processes, we have still attempted to estimate the proportion of CRTs that go to each landfill. Due to a lack of data, we assumed as a best estimate that the percent of monitors that are in households are equivalent to the percent of landfilled monitors that would be disposed of in a solid waste (Subtitle D) landfill and the percent of monitors that are in businesses would be disposed of in a hazardous waste (subtitle C) landfill. As presented in the Use Stage discussion in the main body of this report (Section 2.4.1.2), 35% of monitors are in households and 65% are in office and other environments. Therefore, of the 71% of monitors assumed to going to landfills, 25% are assumed to be sent to solid waste landfills and 46% to hazardous waste landfills. To summarize, the EOL dispositions assumed for the CRT are as follows:

- Incineration: 15%
- Recycling: 11%
- Remanufacturing: 3%
- Hazardous waste landfill: 46%
- Solid waste landfill: 25%

2.2.1 LCD

Data were even more lacking for the EOL dispositions of LCDs. The same 15% of municipal solid waste incinerated in the United States was assumed for LCD incineration as it was for the CRT. An individual in the monitor recycling business estimated that no more than 5% of LCDs are sent to hazardous waste landfills and that essentially none are currently being recycled (Vorhees 2000). Given this limited data, the remaining 80% needed to be split between

solid waste landfilling and remanufacturing. Given no other data, we assumed half of the remaining 80% goes to solid waste landfills and half to remanufacturing. Assuming that 40% are remanufactured is likely an overestimate; however, no supporting data were available to modify this estimate. Therefore, in the baseline analysis of this study, the following percentages have been used:

- Incineration: 15%
- Recycling: 15%
- Remanufacturing: 15%
- Hazardous waste landfill: 5%
- Solid waste landfill: 50%

Sensitivity analyses have been conducted to determine the effects of these assumptions on the results and are discussed in Chapters 2 (LCI) and 3 (LCIA) of the main report.

2.2 Assumptions

In developing the EOL model for CRT and LCD monitors, it was necessary to make several assumptions. In addition to the percent distributions presented above, the following assumptions apply to the EOL data:

- Reuse and resale are not included in the EOL scenarios modeled as these events are considered to occur within the originally intended useful life of the monitor.
- The monitors currently in storage are not considered to have reached EOL yet and have, therefore, been excluded from the EOL model. Moreover, they are assumed not to have environmental impacts while in storage, and maintenance of storage space is assumed to the beyond the scope of this study.
- Only waste-to-energy incineration is modeled because there is very limited straight incineration (without energy recovery) being done in the U.S. at present. In fact, the 1996 total U.S. WTE design capacity was 100,355 tons per day, with 110 WTE facilities in operation. In contrast, the capacity for incineration without energy recovery was only 2,451 tons per day, with a total of 19 facilities in operation. In general, WTE has become the prevalent method for MSW combustion since the 1980s (EPA 1998).

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ATTACHMENT A TO APPENDIX EOL:
EOL QUESTIONNAIRE

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DESIGN FOR THE ENVIRONMENT COMPUTER DISPLAY PROJECT
Life-Cycle Inventory (LCI) Data Collection Questionnaire for the End-of-Life Stage

Introduction

The Design for the Environment (DfE) Program in the U.S. Environmental Protection Agency's (EPA) Office of Pollution Prevention and Toxics has begun a voluntary, cooperative project with the electronics industry to assess the life-cycle environmental impacts of cathode ray tube (CRT) and liquid crystal display (LCD) desktop monitors. The DfE Program conducts comparative analyses of alternative products or processes to provide businesses with data to make environmentally informed choices about product or process improvements. The DfE Program has no regulatory or enforcement agenda and was established to act as a partner with industry to promote pollution prevention. This environmental life-cycle assessment will address human and ecological risk, energy and natural resource use, performance, and cost of various display technologies. The University of Tennessee (UT) Center for Clean Products and Clean Technologies is conducting the life-cycle inventory (LCI), which is the data collection phase of a life-cycle assessment, with technical assistance from Microelectronics and Computer Technology Corporation, the Electronics Industry Alliance, and other partners.

Boundaries

A *life-cycle* assessment considers impacts from materials acquisition, material manufacturing, product manufacturing, use, and final disposition of a product. The LCI data are intended to be used to evaluate relative environmental impacts over the entire life-cycle of a product, including transport between life-cycle stages. In this project, the product is either a color CRT or LCD monitor. Therefore, data associated with the materials and processes used directly in the manufacturing, use, and disposition of the product are relevant to the LCI and requested in this questionnaire. Please include only materials or energy *directly* used in the disassembly, remanufacturing, recycling, or disposal of the monitor or its components (e.g., *do not include* general building heating and air conditioning).

Product focus

This project focuses on 17" CRT and 15" LCD desktop monitors. We will appreciate your providing data specifically on these sizes, to the extent possible.

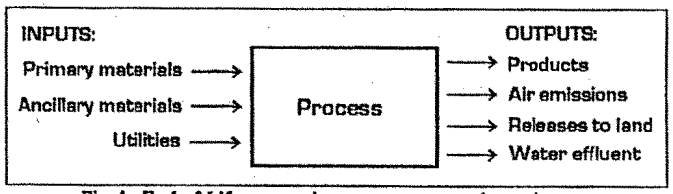

Fig. 1. End-of-Life process inventory conceptual template

Inventory data

We are asking you for data on CRT and LCD desktop monitors that you either remanufacture, or disassemble and recover, reuse, or recycle components and materials from. The inputs and outputs data (Fig. 1) that you provide will be aggregated in the LCI to quantify the overall inputs and outputs of a CRT and LCD. Additionally, transportation information is requested in the inventory.

Data sources
Much of the requested information can be drawn from existing sources, including, but not limited to the following:

1. Purchase and production records
2. Bills and invoices
3. Material Safety Data Sheets (MSDS)
4. Toxic Release Inventory (TRI) forms
5. Audit and analysis results (e.g., wastewater discharge analyses)
6. Local, state, and federal reporting forms (e.g., hazardous waste manifests)
7. Local, state, and federal permits
8. Monthly utility billing records

How the data will be used
UT will collect inventory data and tally the inputs and outputs for the different monitors. Information gathered by these questionnaires will be used to develop environmental profiles based on inputs and outputs for each stage in the life cycle of displays. The profiles will be used to evaluate environmental impacts from each product. Cost data will also be collected and presented along with environmental results. The environmental profiles can be used to encourage product design changes for product improvement. UT will aggregate data and ensure that data associated with particular companies remain anonymous to the EPA. UT can enter into confidentiality agreements where proprietary data are concerned. Please understand that accurate and representative information from you is critical for the success of this project.

Results of project
The results are intended to provide industry with an analysis of the life-cycle environmental impacts, cost, and performance of CRT and LCD computer monitors. Results will help identify areas for product and process improvement as related to risk and environmental impact (e.g., identifying material use inefficiencies) and will identify impacts from various life-cycle stages of the product systems. Use of the results will also help meet growing global demands of extended product responsibility.

Benefits of involvement
Your input will allow for your interests to be considered in the project development and data collection. By supplying data, the results will partially reflect your operations and, therefore, the results will be directly relevant to your interests. The project will allow you to directly apply results to your own processes and identify areas for improvement. You will also be recognized as working voluntarily and cooperatively with the U.S. EPA.

Deadline
Please complete this form and return it to us at the address below by ***September 30, 1999***. If this is not possible, please contact Maria Leet Socolof at 423-974-9526 or at the addresses below to discuss alternative dates.

Your cooperation and assistance are greatly appreciated.

*For any questions, please contact **Maria Leet Socolof at 423-974-9526**, <socolofml@utk.edu> or **Rajive Dhingra at 423-974-8752**, <rdhingra@utk.edu> at the University of Tennessee, 311 Conference Center Bldg., Knoxville, TN 37996-4134.*
For more project details, see the Project Fact Sheet, DfE Website <http://www.epa.gov/opptintr/dfe/compdisp/compdisp.html>, or the Draft Final Goal Definition and Scoping Document.

INSTRUCTIONS

1. Please be sure to read the introductory text on each page before filling out the questionnaire.
2. The data you supply in the tables should represent inputs and outputs associated only with the **"product of interest" (i.e., materials, components or subassemblies that are either part of, or that are itself, the desktop monitor as defined on p. 1 under Product focus).** If quantities provided are not specific to the "product of interest," please explain how they differ in the comments section at the bottom of the appropriate table.
3. Where supporting information is available as independent documents, reports or calculations, please provide them as attachments with reference to the associated page(s) or table(s) in this questionnaire.
4. If you have more than one product of interest to this project, please duplicate this questionnaire and fill out one questionnaire for each product.
5. If there is not adequate room on a page to supply your data (including comments), please copy the appropriate page and attach it to this packet.
6. The ensuing pages refer to the four indices shown below to detail specific information about the data. Additional information is provided below as required.
   Data Quality Indicators Index: These indicators will be used to assess the level of data quality in this questionnaire. Please report a DQI for the numerical value requested in each table on the following pages. The first category, Measured, pertains to a value that is a directly measured quantity. The second category, Calculated, refers to a value that required one or more calculations to obtain. The third category, Estimated, refers to a value that required a knowledgable employee's professional judgement to estimate. Lastly, the fourth category, Assumed, should be used only when a number had to be guessed.
   Hazardous and Nonhazardous Waste Management Methods Index: These methods are applicable to both hazardous and nonhazardous wastes (Tables 8a and 8b). Please give the appropriate abbreviation in the Management Method column on p. 8 where requested. Depending on whether the management method is on or offsite, please indicate by specifying "on" or "off" in the appropriate column on p. 8.

For Tables 2, 3a, 3b, 4, 5, 8a, and 8b:

Transportation Modes Index	
A	- Large truck (18-wheeler), diesel
B	- Small truck, diesel
C	- Small truck, gasoline
D	- Rail, diesel
E	- Barge, diesel
F	- Ocean freighter, diesel
G	- Other (please specify in comments section)

For Table 7b:

Wastewater Treatment/Disposal Methods Index	
A	- Direct discharge to surface water
B	- Discharge to offsite wastewater treatment facility
C	- Underground injection
D	- Surface impoundment (e.g., settling pond)
E	- Direct discharge to land
F	- Other (please specify in comments section)

For Tables 3a, 3b, 4, 5, 6, 7a, 8a and 8b:

Data Quality Indicators Index	
M	- Measured
C	- Calculated
E	- Estimated
A	- Assumed

For Tables 8a and 8b:

Hazardous and Nonhazardous Waste Management Methods Index	
RU	- Reused
R	- Recycled
L	- Landfilled
Iv	- Incinerated - volume reduction
Ie	- Incinerated - energy conversion
S	- Solidified/stabilized
D	- Deep well injected
O	- Other (please specify in comments section)

IF YOU HAVE QUESTIONS, PLEASE CONTACT EITHER:

Maria L. Socolof (Project Manager): Phone: 423-974-9526 Email: socolofml@utk edu

OR

Rajive Dhingra (Project Engineer): Phone: 423-974-8752 Email: rdhingra@utk.edu

1. FACILITY & CONTACT INFORMATION

Table 1.	Facility Information	Contact Information	
1. Company name:		5a. Prepared by:	Date:
2. Facility name:		5b. Title:	
3 Facility address (location):		5c. Phone number:	Ext.:
		5d. Fax number:	
		5e. Email address:	
4. Products handled onsite:			

2. PRODUCT OF INTEREST INFORMATION

Table 2.

1. Product of interest: _____
   E.g., End-of-Life CRT/LCD desktop monitor

2. No. of monitors processed annually (e.g., units, kg, lbs): _____

3. Facility's percent global market share for handling product of interest: _____

4. Product of interest unit weight: _____

5. Brief description of the main operations/subprocesses required to process the product of interest: _____

6. Product transport information. In this table, please list the top five locations (by quantity) from where you receive the product of interest. See Transportation Modes Index on p. iii for modes' abbreviations. Percent capacity represents what percent of the transport vehicle's total load was carrying the products of interest.

Location (City, State)	Mode	Number of trips annually	Percent capacity
1)			
2)			
3)			
4)			
5)			

3. PRIMARY & ANCILLARY INPUTS

1. Primary & Ancillary Materials: Primary materials are defined as those materials that become part of a product output. Ancillary materials are those material inputs that assist in a process, yet do not become part of the final product. Please include the trade name and the generic name of each material where applicable.
2. CAS # or MSDS: Please include either the CAS (Chemical Abstract Service) number of each material (fill in the blank with the number), or state "MSDS" and append a copy to this document.
3. Annual quantity/units & Density/units: Please specify the amount of material consumed annually. Please use the units of mass-per-year (e.g., kg/yr, lb/yr). If you specify units of volume in lieu of mass, please provide the density.
4. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please supply the DQI for the *annual quantity* value given.
5. Recycled content: Please specify the recycled content of each material identified. For example, 60/40/0 would represent a material that has 60% virgin material, 40% pre-consumer recycled and 0% post-consumer recycled content. Enter N/A (not applicable) for all components that are assemblies.
6. Transportation information: See the Transportation Modes Index on p. iii for mode abbreviations. Please specify where the material is coming from (location) and the number of trips made to your facility on an annual basis. % capacity represents what percent of the transport vehicle's total *load* was carrying the materials of interest.

Table 3a. Primary Materials[1]	CAS # or MSDS[2]	Annual Quantity[3]	Units	Density[3]	Units	DQI[4]	Recycled Content[5]	Transportation Information (Receiving)[6]			
								Location	Mode	# trips	% cap.
1.											
2.											
3.											
4.											
5.											
6.											
7.											

Primary material comments:

Table 3b. Ancillary Materials[1]	CAS # or MSDS[2]	Annual Quantity[3]	Units	Density[3]	Units	DQI[4]	Recycled Content[5]	Transportation Information (Receiving)[6]			
								Location	Mode	# trips	% cap.
1.											
2.											
3.											
4.											
5.											
6.											
7.											

Ancillary material comments:

4. UTILITY INPUTS

1. Annual quantity/units: Please specify the amount of each utility consumed annually. If possible, please exclude nonprocess-related consumption. If not possible, please include a comment that nonprocess-related consumption is included.
2. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please supply the DQI for the *annual quantity* value given.
3. Transportation information: See the Transportation Modes Index on p. iii for mode abbreviations. Please specify where the fuel is coming from (Location) and the number of trips made to your facility on an annual basis. Percent capacity represents what percent of the transport vehicle's total *load* was carrying the fuel of interest.
4. Individual Utility Notes:

Electricity:
The quantity of electricity should reflect only that used toward manufacturing the product of interest (identified on p. 2). One approach would be to start with your facility's total annual electrical energy consumption, estimate and remove nonprocess-related consumption, then estimate what portion of the remaining consumption is related to the specific operations of interest (if you manufacture more than one product). Please include consumption in all systems that use electricity for process-related purposes. Some examples include compressed air, chilled water, water deionization and HVAC consumption where clean or controlled environments are utilized.

Natural gas and LNG:
Please exclude all use for space heating or other nonprocess-related uses. If you choose to use units other than MCF (thousand cubic feet), please utilize only units of energy content or volume (e.g., mmBTU, therm, CCF).

Fuel oils:
Please use units of either volume or energy content (e.g., liters, cubic meters, mmBTU, MJ). Additionally, if the fuel oil is delivered by pipeline, enter "pipeline" in the Transportation Information space; if not delivered by pipeline, please include the associated transportation information.

All waters (e.g., deionized, city):
Please include all waters received onsite for process-related uses. Please indicate consumption in units of mass or volume.

Table 4. Utilities[4]		Annual Quantity[1]	Units	DQI[2]	Transportation Information (Receiving)[3]			
					Location (City, State)	Mode	# trips	% cap.
1.	Electricity		MJ					
2.	Natural gas		MCF					
3.	Liquified natural gas (LNG)		MCF					
4.	Fuel oil - type #2 (includes distillate and diesel)		liters					
5.	Fuel oil - type #4		liters					
6.	Fuel oil - type #6 (includes residual)		liters					
7.	Other petroleum-based fuel		liters					
8.	Water		liters					
9.								
10.								
11.								
12.								
13.								

Utility comments:

5. PRODUCT OUTPUTS

1. Product Outputs: Product outputs are defined as useable products, materials, components or sub-assemblies.
2. CAS # or MSDS (if applicable): Please include either the CAS (Chemical Abstract Service) number of each material (fill in the blank with the number), or state "MSDS" and append a copy to this document.
3. Annual quantity/units & Density/units: Please specify the amount of material produced annually. Please use the units of mass-per-year (e.g., kg/yr, lb/yr). If you specify units of volume in lieu of mass, please provide the density.
4. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please supply the DQI for the *annual quantity* value given.
5. Recycled content (if known): Please specify the recycled content of each material identified. For example, 60/40/0 would represent a material that has 60% virgin material, 40% pre-consumer recycled and 0% post-consumer recycled content. Enter N/A (not applicable) for all components that are assemblies.
6. Transportation information: See the Transportation Modes Index on p. iii for mode abbreviations. Please specify where the material is being sent (location) and the number of trips made on an annual basis. % capacity represents what percent of the transport vehicle's total *load* was carrying the materials of interest.

Table 5. Product Outputs[1]		CAS # or MSDS[2]	Annual Quantity[3]	Units	Density[3]	Units	DQI[4]	Recycled Content[5]	Transportation Information (Shipping)[6]			
									Location	Mode	# trips	% cap.
1.												
2.												
3.												
4.												
5.												
6.												
7.												
Product output comments:												

6. AIR EMISSIONS

1. Air emissions: The emissions listed in the table below are some of the more common ones found in air release inventories; if you have information on other specific emissions, please include that information in the space provided. If you have any recent reporting forms or other air emission records, please attach copies to this questionnaire. Also, if you have information on stack* as well as fugitive* emissions, please copy this page and place each set of emissions on a different page. The energy consumed in any equipment used onsite to treat air emissions should be included in the utilities values on p. 4.
   *Stack emissions** are releases to air that occur through confined air streams, such as stacks, vents, ducts, or pipes.
   *Fugitive emissions** are all releases to air that are not released through a confined air stream. Fugitive emissions include equipment leaks, evaporative losses from surface impoundments and spills, and releases from building ventilation systems.
2. Annual quantity/units: Please specify the amount of air emissions generated annually. Please use units of mass-per-year (e.g., kg/yr, lb/yr).
3. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please supply the DQI for the *annual quantity* value given.

Table 6. Air Emissions[1]	CAS number	Annual Quantity[2]	Units	DQI [3]
Total particulates	-----			
Particulates < 10 microns (PM-10)	-----			
Sulfur oxides (SOx)	-----			
Nitrogen oxides (NOx)	-----			
Carbon monoxide	630-08-0			
Carbon dioxide	124-38-9			
Methane	74-82-8			
Benzene	71-43-2			
Toluene	108-88-3			
Xylenes	1330-20-7			
Naphthalene	91-20-3			
Total nonmethane VOCs	-----			
Other speciated hydrocarbon emissions:				
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Table 6 (continued). Air Emissions[1]	CAS number	Annual Quantity[2]	Units	DQI [3]
Ammonia	7664-41-7			
Arsenic	7440-38-2			
Chromium	7440-47-3			
Copper	7440-50-8			
Lead	7439-92-1			
Manganese	7439-96-5			
Mercury	7439-98-7			
Nickel	7440-02-0			
Other emissions:				
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

Air emission comments:

7. WASTEWATER RELEASES & CONSTITUENTS

1. Annual quantity/units: Please specify the amount of wastewater(s) generated annually. Please use units of mass-per-year (e.g., kg/yr, lb/yr). If multiple streams exist, please copy this page and fill it out for each stream.
2. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please include one DQI for the annual wastewater stream quantity value supplied, and one DQI for the wastewater constituents information supplied. If more than one DQI is applicable to the wastewater constituents data, please clarify this in the comment section.
3. Wastewater constituents: Please let us know what type of values you are supplying (e.g., daily maximums, monthly averages, annual averages). Additionally, if you have any recent reporting forms or other wastewater constituent records, please attach them to this questionnaire. The energy consumed in any equipment used onsite to treat wastewater releases should be included in the utilities values on p. 4.
4. Concentration/units: Please specify the concentration of wastewater constituents generated annually. Please utilize the units of mass-per-volume (e.g., mg/liter, lb/gal).
5. Wastewater treatment/disposal (WW T/D) method: See the Wastewater Treatment/Disposal Methods Index on p. iii for method abbreviations.

Table 7a. Wastewater Stream	Annual Quantity[1]	Units	DQI for Wastewater Annual Quantity[2]	DQI for Wastewater Constituents[2]

Table 7b. Wastewater Constituents[3]	CAS number	Concentration[4]	Units	WW T/D Method[5]
Dissolved solids	-----			
Suspended solids	-----			
Chemical Oxygen Demand (COD)	-----			
Biological Oxygen Demand (BOD)	-----			
Oil & grease	-----			
Hydrochloric acid	7647-01-0			
Sulfuric acid	7664-93-9			
Other acids (please specify):				
1.				
2.				
Phosphorus	7723-14-0			
Phosphates	-----			
Sulfates	-----			
Fluorides	-----			
Cyanide	-----			
Chloride	-----			
Chromium	7440-47-3			
Iron	7439-89-6			
Aluminum	7429-90-5			
Nickel	7440-02-0			

Table 6b (continued). Wastewater Constituents[3]	CAS number	Concentration[4]	Units	WW T/D Method[5]
Mercury	7439-98-7			
Lead	7439-92-1			
Nitrogen	7727-37-9			
Zinc	7440-66-6			
Tin	7440-31-5			
Ferrous sulfate	7720-78-7			
Ammonia	7664-41-7			
Nitrates	-----			
Pesticides	-----			
Other constituents:				
1.				
2.				
3.				
4.				
5.				
6.				

Wastewater comments:

8. HAZARDOUS & NONHAZARDOUS WASTES

1. Hazardous wastes and EPA hazardous waste numbers: Please list your waste streams that are considered hazardous by the U.S. EPA. Include the hazardous waste codes for any hazardous waste you include.
2. Annual quantity/units & Density/units: Please specify the amount of waste generated annually. Use units of mass-per-year (e.g., kg/yr, lb/yr). Please also provide the density for each waste.
3. Data quality indicators: See the Data Quality Indicators Index on p. iii for abbreviations. Please supply the DQI for the *annual quantity* value given.
4. Management method: See the Management Methods Index on p. iii for abbreviations. If none are applicable, please indicate other and use the comments section to expound.
5. Transportation information: See the Transportation Modes Index on p. iii for abbreviations. Please specify where the waste is sent (location) and the number of trips made from your facility on an annual basis. % capacity represents what percent of the transport vehicle's total *load* was carrying the waste of interest.

Table 8a. Hazardous Wastes[1]	EPA Haz. Waste #[1]	Annual Quantity[2]	Units	Density[2]	Units	DQI [3]	Mgmt. method[4]	On or offsite?	Transportation Information (Shipping)[5] Location	Mode	# trips	% cap.
EXAMPLE: Spent solvent (toluene)	*F005*	*20,000*	*kg/yr*	*0.9*	*kg/liter*	*M*	*le*	*off*	*Indianapolis, IN*	*A*	*24*	*40*
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												

Hazardous waste comments:

Table 8b. Nonhazardous Wastes	Annual Quantity[2]	Units	Density[2]	Units	DQI [3]	Mgmt. method[4]	On or offsite?	Transportation Information (Shipping)[5] Location	Mode	# trips	% cap.
EXAMPLE: Waste metal chips	*22,000*	*kg/yr*	*1,000*	*kg/m3*	*C*	*R*	*off*	*Scottsdale, AZ*	*A*	*2*	*100*
1.											
2.											
3.											
4.											
5.											
6.											
7.											

Nonhazardous waste comments:

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APPENDIX J

LIFE-CYCLE INVENTORY TABLES

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APPENDIX J

LIFE-CYCLE INVENTORY TABLES

Table J-1. CRT primary materials (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
ABS resin	0	4.24E-01	0	0	4.24E-01	0.0649%
Aluminum (elemental)	0	3.60E-01	0	0	3.60E-01	0.0552%
Amyl acetate (mixed isomers)	0	1.20E-03	0	0	1.20E-03	0.0002%
Aquadag	0	2.06E-02	0	0	2.06E-02	0.0032%
Assembled CRT monitor	0	0	2.20E+01	0	2.20E+01	3.3765%
Audio cable assembly	0	9.45E-02	0	0	9.45E-02	0.0145%
Barium Carbonate	0	2.97E-01	0	0	2.97E-01	0.0455%
Bauxite (Al2O3, ore)	1.37E+00	0	0	0	1.37E+00	0.2096%
Blue Phosphor (ZnS)	0	3.84E-03	0	0	3.84E-03	0.0006%
Blue Phosphor (ZnS.Ag.Al)	0	1.67E-03	0	0	1.67E-03	0.0003%
Borax	0	8.00E-03	0	0	8.00E-03	0.0012%
Cables/wires	0	3.94E-01	0	0	3.94E-01	0.0604%
Cathode ray tube (CRT)	0	1.07E+01	0	0	1.07E+01	1.6381%
Coal, average (in ground)	3.57E+00	5.15E+00	1.79E+02	1.79E-02	1.88E+02	28.8170%
Connector	0	5.67E-02	0	0	5.67E-02	0.0087%
CRT glass, unspecified	0	9.76E+00	0	0	9.76E+00	1.4950%
CRT magnet assembly	0	7.56E-02	0	0	7.56E-02	0.0116%
CRT shield assembly - ASTM A366/CC#2	0	2.42E-01	0	0	2.42E-01	0.0370%
Deflection Yoke assembly	0	1.51E-01	0	0	1.51E-01	0.0232%
Demagnetic coil - PU coated paper	0	1.26E-01	0	0	1.26E-01	0.0193%
Electron gun	0	1.01E-01	0	0	1.01E-01	0.0154%
Ferrite	0	1.70E-01	0	0	1.70E-01	0.0261%
Frit	0	6.67E-02	0	0	6.67E-02	0.0102%
Fuel oil #4	0	0	0	-9.53E-02	-9.53E-02	-0.0146%
Glass, unspecified	0	4.91E-02	0	0	4.91E-02	0.0075%
Green Phosphor (ZnS)	0	3.34E-03	0	0	3.34E-03	0.0005%
Green Phosphor (ZnS.Cu.Al)	0	1.34E-03	0	0	1.34E-03	0.0002%
Iron (Fe, ore)	6.90E+00	0	0	0	6.90E+00	1.0567%
Iron ore	2.37E-01	0	0	0	2.37E-01	0.0363%
Iron scrap	9.46E-01	0	0	0	9.46E-01	0.1449%
Lead	0	4.94E-01	0	0	4.94E-01	0.0757%
Lead (Pb, ore)	4.96E-01	0	0	0	4.96E-01	0.0759%
Natural gas	0	1.47E+00	1.40E+01	-8.88E-02	1.54E+01	2.3551%
Natural gas (in ground)	8.41E-01	3.27E+00	0	-1.64E+00	2.47E+00	0.3786%
Nickel (Ni, ore)	9.80E-02	0	0	0	9.80E-02	0.0150%
Nickel Alloy (invar)	0	2.72E-01	0	0	2.72E-01	0.0417%
Petroleum (in ground)	1.32E+00	3.72E+02	3.80E+00	-1.52E+00	3.75E+02	57.5016%
Phosphate ester	0	8.31E-03	0	0	8.31E-03	0.0013%
Polycarbonate resin	0	9.23E-01	0	0	9.23E-01	0.1415%
Polystyrene (PS, high impact)	0	1.51E-01	0	0	1.51E-01	0.0232%
Potassium Carbonate	0	3.78E-01	0	0	3.78E-01	0.0579%
Power cord assembly	0	1.13E-01	0	0	1.13E-01	0.0174%
PPE	0	7.35E-01	0	0	7.35E-01	0.1126%
Printed wiring board (PWB)	0	8.47E-01	0	0	8.47E-01	0.1298%
PWB-laminate	0	8.47E-01	0	0	8.47E-01	0.1298%

Table J-1. CRT primary materials (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Recycled CRT Glass	0	2.06E+00	0	0	2.06E+00	0.3155%
Red Phosphor (Y2O2S)	0	4.65E-03	0	0	4.65E-03	0.0007%
Red Phosphor (Y2O2S.Eu)	0	1.33E-03	0	0	1.33E-03	0.0002%
Sand	0	2.40E+00	0	0	2.40E+00	0.3678%
Sand (in ground)	2.42E-05	0	0	0	2.42E-05	3.71E-08
Silica	0	5.33E-03	0	0	5.33E-03	0.0008%
Sodium Carbonate	0	4.88E-01	0	0	4.88E-01	0.0747%
Sodium chloride (NaCl, in ground or in sea)	3.17E-04	0	0	0	3.17E-04	4.85E-07
Solder (63% tin; 37% lead)	0	5.08E-02	0	0	5.08E-02	0.0078%
Solder, unspecified	0	2.67E-02	0	0	2.67E-02	0.0041%
Steel	2.48E-06	5.16E+00	0	0	5.16E+00	0.7907%
Strontium Carbonate	0	3.31E-01	0	0	3.31E-01	0.0508%
Styrene-butadiene copolymers	0	8.27E-01	0	0	8.27E-01	0.1268%
Sulfur	1.03E-05	0	0	0	1.03E-05	1.58E-08
Tricresyl phosphate	0	2.30E-02	0	0	2.30E-02	0.0035%
Triphenyl phosphate	0	5.29E-02	0	0	5.29E-02	0.0081%
Uranium, yellowcake	0	3.81E-04	4.85E-03	4.85E-07	5.23E-03	0.0008%
Video cable assembly	0	1.13E-01	0	0	1.13E-01	0.0174%
Zircon Sand	0	5.43E-02	0	0	5.43E-02	0.0083%
Total Primary Inputs	1.58E+01	4.21E+02	2.19E+02	-3.32E+00	6.53e+02	100.00%

Table J-2. CRT ancillary materials (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
2,2,4-trimethylpentane	0	1.50e-04	0	0	1.50e-04	7.59e-06
Acetone	0	3.17e-04	0	0	3.17e-04	1.60e-05
Acrylic Polymer, unspecified	0	9.13e-03	0	0	9.13e-03	4.61e-04
Alkali cleaning agent	0	7.72e-02	0	0	7.72e-02	3.90e-03
Alkali soda (to neutralize acid waste water)	0	5.45e-02	0	0	5.45e-02	2.75e-03
Aluminum Oxide	0	3.37e-02	0	0	3.37e-02	1.70e-03
Aluminum sulfate	7.41e-04	0	0	0	7.41e-04	3.74e-05
Ammonia	0	1.19e-04	0	0	1.19e-04	6.03e-06
Ammonium bifluoride	0	2.04e-03	0	0	2.04e-03	1.03e-04
Ammonium chloride	0	7.76e-02	0	0	7.76e-02	3.92e-03
Ammonium Dichromate	0	3.50e-05	0	0	3.50e-05	1.76e-06
Ammonium fluoride	0	8.91e-04	0	0	8.91e-04	4.50e-05
Ammonium hydroxide	0	7.90e-02	0	0	7.90e-02	3.99e-03
Ammonium Oxalate	0	8.92e-05	0	0	8.92e-05	4.50e-06
Ammonium Oxalate Monohydrate	0	3.16e-04	0	0	3.16e-04	1.60e-05
Barium sulfate	2.68e-03	0	0	0	2.68e-03	1.35e-04
Barium sulfate (BaSO4, in ground)	1.10e-03	0	0	0	1.10e-03	5.55e-05
Bauxite	6.31e-04	0	0	0	6.31e-04	3.18e-05
Bauxite (Al2O3, ore)	1.10e-03	4.47e-02	0	-1.14e-04	4.57e-02	2.31e-03
Bentonite (in ground)	2.48e-03	0	0	0	2.48e-03	1.25e-04
Borax	5.20e-07	0	0	0	5.20e-07	2.62e-08
Boric acid	0	4.73e-03	0	0	4.73e-03	2.39e-04
Calcium Chloride	0	1.27e-01	0	0	1.27e-01	6.42e-03
Calcium hydroxide	0	9.54e-02	0	0	9.54e-02	4.81e-03
Calcium sulfate	6.08e-05	0	0	0	6.08e-05	3.07e-06
Calcium sulfate (CaSO4, ore)	2.30e-05	0	0	0	2.30e-05	1.16e-06
Cerium Oxide	0	3.28e-03	0	0	3.28e-03	1.65e-04
Chlorine	0	4.03e-02	0	0	4.03e-02	2.04e-03
Chromium (VI)	0	7.63e-05	0	0	7.63e-05	3.85e-06
Chromium ore	1.09e-07	0	0	0	1.09e-07	5.51e-09
Chromium Oxide	0	5.62e-05	0	0	5.62e-05	2.83e-06
Clay (in ground)	4.49e-03	0	0	8.19e+00	8.19e+00	41.35%
Coal, average (in ground)	0	0	0	3.06e-03	3.06e-03	1.55e-04
Copper (Cu, ore)	8.67e-04	0	0	0	8.67e-04	4.37e-05
Cyclohexane	0	1.88e-04	0	0	1.88e-04	9.48e-06
Deoiling agent (unspecified)	1.33e-03	0	0	0	1.33e-03	6.72e-05
Dimethyl Formamide	0	4.36e-05	0	0	4.36e-05	2.20e-06
Dioctyl Sebacate	2.32e-04	0	0	0	2.32e-04	1.17e-05
Dolomite	1.43e-10	0	0	0	1.43e-10	7.24e-12
Dolomite (in ground)	1.60e-05	0	0	0	1.60e-05	8.05e-07
Etoxy Naphtol Sulphonic Acid (ENSA)	9.96e-05	0	0	0	9.96e-05	5.03e-06
Explosive (unspecified)	3.12e-04	0	0	0	3.12e-04	1.57e-05
Ferric chloride	0	1.37e-01	0	0	1.37e-01	6.93e-03
Fluorocarbon resin	0	3.75e-05	0	0	3.75e-05	1.89e-06
Fluorspar (CaF2, ore)	1.69e-06	0	0	0	1.69e-06	8.55e-08
Formaldehyde	0	6.60e-03	0	0	6.60e-03	3.33e-04
Glycol ethers	0	2.35e-02	0	0	2.35e-02	1.19e-03
Gravel/Sand	6.82e-03	0	0	0	6.82e-03	3.44e-04

Table J-2. CRT ancillary materials (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
HV Carbon (paste)	0	1.14e-05	0	0	1.14e-05	5.75e-07
Hydrochloric acid	0	2.36e-01	0	0	2.36e-01	1.19%
Hydrofluoric acid	0	8.65e-02	0	0	8.65e-02	4.36e-03
Hydrogen peroxide	0	8.45e-02	0	0	8.45e-02	4.26e-03
Iron (Fe, ore)	7.23e-02	0	0	3.41e-03	7.57e-02	3.82e-03
Iron ore	1.27e-04	0	0	0	1.27e-04	6.41e-06
Iron sulfate (FeSO4, ore)	2.56e-05	0	0	0	2.56e-05	1.29e-06
Isopentylacetate	0	1.74e-03	0	0	1.74e-03	8.80e-05
Isopropyl alcohol	0	1.94e-02	0	0	1.94e-02	9.80e-04
Lead (Pb, ore)	6.50e-05	0	0	0	6.50e-05	3.28e-06
Lime	0	3.04e-02	1.06e+00	1.06e-04	1.09e+00	5.49%
Limestone	0	6.91e-02	2.41e+00	2.41e-04	2.48e+00	12.51%
Limestone (CaCO3, in ground)	8.60e-01	1.08e+00	0	-2.39e-01	1.70e+00	8.58%
Lubricant (unspecified)	4.11e-02	0	0	0	4.11e-02	2.07e-03
Magnesium	5.08e-04	0	0	0	5.08e-04	2.56e-05
Maize	1.14e-04	0	0	0	1.14e-04	5.74e-06
Manganese (Mn, ore)	6.35e-08	0	0	0	6.35e-08	3.21e-09
Muratic Acid (drum)	0	1.87e-03	0	0	1.87e-03	9.41e-05
Natural gas (in ground)	0	0	0	4.52e-03	4.52e-03	2.28e-04
Nickel (Ni, ore)	2.45e-08	0	0	0	2.45e-08	1.24e-09
Nitric acid	0	1.44e-01	0	0	1.44e-01	7.26e-03
Nitrogen	0	4.57e-02	0	0	4.57e-02	2.31e-03
Oil (in ground)	0	0	0	3.35e-02	3.35e-02	1.69e-03
Olivine	1.08e-10	0	0	0	1.08e-10	5.43e-12
Olivine ore	1.24e-05	0	0	0	1.24e-05	6.27e-07
Oxalic acid	0	5.35e-05	0	0	5.35e-05	2.70e-06
Oxygen (Liquid)	0	7.57e-03	0	0	7.57e-03	3.82e-04
Periodic Acid	0	2.26e-04	0	0	2.26e-04	1.14e-05
Phenolsulphonic Acid	3.12e-03	0	0	0	3.12e-03	1.57e-04
Polyethylene glycol	0	5.04e-02	0	0	5.04e-02	2.55e-03
Polyvinyl alcohol	0	8.11e-03	0	0	8.11e-03	4.09e-04
Polyvinyl Pyrrolidone (PVP)	0	2.41e-02	0	0	2.41e-02	1.22e-03
Potassium chloride (KCl, as K2O, in ground)	1.92e-03	0	0	0	1.92e-03	9.69e-05
Potassium hydroxide	0	4.27e-02	0	0	4.27e-02	2.15e-03
Potassium permanganate	0	1.16e-03	0	0	1.16e-03	5.87e-05
Potassium peroxymonosulfate	0	7.06e-02	0	0	7.06e-02	3.56e-03
Potatoes	3.06e-05	0	0	0	3.06e-05	1.54e-06
Pumice	0	7.86e-02	0	0	7.86e-02	3.97e-03
PWB-solder mask solids	0	4.37e-02	0	0	4.37e-02	2.20e-03
Pyrite (FeS2, ore)	1.94e-01	0	0	0	1.94e-01	9.77e-03
Raw materials (unspecified)	8.16e-03	0	0	0	8.16e-03	4.12e-04
Sand (in ground)	5.85e-02	2.74e-02	0	2.71e+00	2.80e+00	14.13%
Silver (Ag, ore)	2.75e-09	0	0	0	2.75e-09	1.39e-10
Sodium Carbonate	0	3.22e-02	0	0	3.22e-02	1.63e-03
Sodium chloride	0	0	0	1.55e-04	1.55e-04	7.80e-06
Sodium chloride (NaCl, in ground or in sea)	7.61e-01	1.26e-02	0	-3.07e-05	7.73e-01	3.90%
Sodium Dichromate	2.63e-04	1.05e-04	0	0	3.68e-04	1.86e-05
Sodium Dichromate Dihydrate (VI)	0	3.10e-05	0	0	3.10e-05	1.56e-06

Table J-2. CRT ancillary materials (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Sodium hydroxide	0	1.98e-01	0	0	1.98e-01	9.97e-03
Sodium Hypochlorite	0	9.25e-05	0	0	9.25e-05	4.67e-06
Sodium Metabisulfite	0	4.67e-03	0	0	4.67e-03	2.36e-04
Sodium Persulfate	0	3.54e-04	0	0	3.54e-04	1.79e-05
Sulfur	3.28e-03	0	0	0	3.28e-03	1.66e-04
Sulfur (S, in ground)	5.39e-03	0	0	0	5.39e-03	2.72e-04
Sulfuric acid	0	2.38e-01	0	0	2.38e-01	1.20%
Sulfuric acid, aluminum salt	0	6.75e-02	0	0	6.75e-02	3.41e-03
Surfactant, unspecified	0	1.42e-04	0	0	1.42e-04	7.17e-06
Synthetic resin, unspecified	0	8.53e-04	0	0	8.53e-04	4.30e-05
Talcum (ore)	8.89e-03	0	0	0	8.89e-03	4.49e-04
Tin (Sn, ore)	2.43e-02	0	0	0	2.43e-02	1.23e-03
Toluene	0	4.80e-03	0	0	4.80e-03	2.42e-04
unspecified CRT process material	0	5.77e-03	0	0	5.77e-03	2.91e-04
Uranium (U, ore)	0	0	0	4.16e-08	4.16e-08	2.10e-09
Wastepaper	1.70e-03	0	0	0	1.70e-03	8.59e-05
Xylene (mixed isomers)	0	4.80e-04	0	0	4.80e-04	2.42e-05
Zinc (Zn, ore)	3.79e-02	0	0	0	3.79e-02	1.91e-03
Total ancillary materials	2.11e+00	3.54e+00	3.47e+00	1.07e+01	1.98e+01	100.00%

Table J-3. CRT utility inputs

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Fuels (kg/functional unit):						
Fuel Oil #2 (distillate)	0	1.16e+00	0	0	1.16e+00	0.27%
Fuel oil #4 (avg. of #2 + #6)	0	1.37e-01	0	-1.38e+00	-1.24e+00	-0.29%
Fuel oil #6 (residual)	0	3.68e+00	0	0	3.68e+00	0.85%
LNG	0	3.35e-01	0	0	3.35e-01	0.08%
LPG	0	3.51e+02	0	3.03e-03	3.51e+02	81.10%
Natural gas	0	2.44e+00	0	-1.30e+00	1.14e+00	0.26%
Coal, average (in ground)	2.25e+00	1.36e+01	0	-1.16e-02	1.58e+01	3.66%
Coal, lignite (in ground)	9.73e-01	0	0	0	9.73e-01	0.22%
Natural gas (in ground)	2.76e+00	4.56e+01	0	-2.09e-01	4.82e+01	11.14%
Petroleum (in ground)	2.02e+00	9.71e+00	0	-5.77e-02	1.17e+01	2.70%
Uranium (U, ore)	1.21e-04	2.29e-04	0	-1.99e-07	3.49e-04	8.06E-07
Total fuels	8.00e+00	4.28e+02	0	-2.95e+00	4.33e+02	100.00%
Electricity (MJ/functional unit):						
Electricity	7.32e+01	1.29e+02	2.29e+03	2.29e-01	2.49e+03	
Water (kg or L/functional unit):						
Water	5.54e+02	1.14e+04	1.14e+03	-2.73e+01	1.31e+04	
Total energy (fuels and electricity, MJ/functional unit):						
Energy	3.66e+02	1.83e+04	2.29e+03	-1.28e+02	2.08e+04	

Table J-4. CRT air pollutant emissions (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
1,1,1-Trichloroethane	0	2.31e-07	1.92e-06	-3.01e-08	2.12e-06	3.19e-09
1,2-Dichloroethane		3.74e-07	3.59e-06	-5.75e-08	3.90e-06	5.88e-09
1,2-Dichlorotetrafluoroethane	3.38e-07	0	0	0	3.38e-07	5.09e-10
1,4-Dichlorobenzene	0	3.06e-07	0	-2.26e-09	3.03e-07	4.57e-10
2,3,7,8-TCDD	0	3.73e-14	1.28e-12	1.28e-16	1.32e-12	1.99e-15
2,3,7,8-TCDF	0	1.31e-13	4.57e-12	4.58e-16	4.71e-12	7.09e-15
2,4-Dinitrotoluene	0	2.62e-09	2.51e-08	-4.22e-10	2.73e-08	4.11e-11
2-Chloroacetophenone	0	6.55e-08	6.28e-07	-1.46e-10	6.93e-07	1.04e-09
2-Methylnaphthalene	0	6.39e-09	2.67e-09	-5.37e-11	9.01e-09	1.36e-11
3-Methylcholanthrene	0	4.59e-10	0	-4.04e-12	4.54e-10	6.84e-13
5-Methyl chrysene	0	2.06e-10	1.97e-09	-3.32e-11	2.15e-09	3.23e-12
Acenaphthene	0	1.05e-08	5.68e-08	-7.77e-10	6.65e-08	1.00e-10
Acenaphthylene	0	2.86e-09	2.26e-08	-3.81e-10	2.50e-08	3.77e-11
Acetaldehyde	2.16e-06	5.33e-06	5.11e-05	-8.59e-07	5.78e-05	8.70e-08
Acetic acid	1.86e-05	0	0	0	1.86e-05	2.80e-08
Acetone	2.14e-06	0	0	0	2.14e-06	3.22e-09
Acetophenone	0	1.40e-07	1.35e-06	-2.26e-08	1.46e-06	2.20e-09
Acetylene	3.64e-05	0	0	0	3.64e-05	5.48e-08
Acrolein	2.38e-11	2.71e-06	2.60e-05	-4.37e-07	2.83e-05	4.26e-08
Adsorbable organic halides	1.14e-16	0	0	0	1.14e-16	1.71e-19
Alcohols	7.89e-06	0	0	0	7.89e-06	1.19e-08
Aldehydes	1.13e-04	1.52e-03	0	-1.63e-04	1.47e-03	2.21e-06
Alkane (unspecified)	3.37e-04	0	0	0	3.37e-04	5.07e-07
Alkenes	6.21e-05	0	0	0	6.21e-05	9.35e-08
Alkyne (unspecified)	4.10e-06	0	0	0	4.10e-06	6.18e-09
Aluminum (elemental)	3.35e-04	1.98e-05	0	-8.66e-08	3.55e-04	5.34e-07
Ammonia	4.36e-04	2.35e-03	0	-1.06e-04	2.68e-03	4.04e-06
Anthracene	0	2.88e-09	1.21e-10	-3.22e-10	2.68e-09	4.04e-12
Antimony	4.36e-07	1.66e-06	3.59e-06	-6.55e-08	5.61e-06	8.45e-09
Aromatic hydrocarbons	3.73e-04	5.29e-08	0	-1.37e-10	3.73e-04	5.61e-07
Arsenic	1.53e-04	1.54e-05	3.75e-05	-2.64e-06	2.03e-04	3.06e-07
Barium	5.18e-06	8.85e-07	2.06e-06	-2.45e-08	8.10e-06	1.22e-08
Benzaldehyde	1.26e-11	0	0	0	1.26e-11	1.90e-14
Benzene	6.17e-05	1.58e-02	1.17e-04	-7.31e-04	1.52e-02	2.29e-05
Benzo[a]anthracene	0	2.21e-09	9.27e-09	-1.25e-10	1.14e-08	1.71e-11
Benzo[a]pyrene	1.35e-06	7.92e-10	3.41e-09	-6.06e-11	1.35e-06	2.03e-09
Benzo[b,j,k]fluoranthene	0	1.30e-09	1.06e-08	-1.66e-10	1.18e-08	1.77e-11
Benzo[b]fluoranthene	0	5.07e-10	0	-4.23e-12	5.03e-10	7.58e-13
Benzo[g,h,i]perylene	0	1.05e-09	3.60e-09	-4.36e-11	4.61e-09	6.94e-12
Benzo[k]fluoranthene	0	5.07e-10	0	-4.23e-12	5.03e-10	7.58e-13
Benzyl chloride	0	6.55e-06	6.28e-05	-1.06e-06	6.83e-05	1.03e-07
Beryllium	7.37e-08	1.49e-06	1.91e-06	-3.06e-07	3.16e-06	4.76e-09
Biphenyl	0	1.59e-08	1.52e-07	-2.56e-09	1.66e-07	2.50e-10
Boron	7.51e-05	0	0	0	7.51e-05	1.13e-07
Bromine	3.80e-06	0	0	0	3.80e-06	5.72e-09
Bromium (Br)	7.09e-07	0	0	0	7.09e-07	1.07e-09
Bromoform	0	3.65e-07	3.50e-06	-5.88e-08	3.80e-06	5.73e-09
Bromomethane	0	1.50e-06	1.43e-05	-2.41e-07	1.56e-05	2.35e-08

Table J-4. CRT air pollutant emissions (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Butane	4.16e-05	5.35e-04	0	-4.72e-06	5.72e-04	8.61e-07
Butene	3.56e-07	0	0	0	3.56e-07	5.37e-10
Cadmium	6.60e-06	1.04e-06	4.82e-06	-6.37e-08	1.24e-05	1.87e-08
Calcium	3.01e-04	1.72e-05	0	-7.51e-08	3.18e-04	4.80e-07
Carbon	3.64e-07	0	0	0	3.64e-07	5.49e-10
Carbon dioxide	2.92e+01	1.79e+02	4.45e+02	2.59e+00	6.55e+02	98.68%
Carbon disulfide	0	1.22e-06	1.17e-05	-1.96e-07	1.27e-05	1.91e-08
Carbon monoxide	4.18e-02	4.58e-01	8.09e-02	-4.17e-03	5.76e-01	8.68e-04
Carbon tetrachloride	0	0	0	2.84e-09	2.84e-09	4.27e-12
CFC-13	5.04e-10	0	0	0	5.04e-10	7.58e-13
Chloride ions	3.06e-04	9.83e-05	1.82e-04	-2.54e-06	5.83e-04	8.78e-07
Chlorine	1.09e-06	5.84e-09	0	-2.72e-10	1.10e-06	1.65e-09
Chloroacetophenone	0	0	0	-1.04e-08	-1.04e-08	-1.57e-11
Chlorobenzene	0	2.06e-07	1.97e-06	-3.32e-08	2.15e-06	3.23e-09
Chloroform	0	5.52e-07	5.29e-06	-8.61e-08	5.76e-06	8.67e-09
Chromium	0	1.39e-07	0	0	1.39e-07	2.09e-10
Chromium (III)	7.72e-07	2.22e-05	2.45e-09	-2.14e-06	2.09e-05	3.14e-08
Chromium (VI)	7.72e-07	2.15e-05	7.21e-06	-2.14e-06	2.74e-05	4.12e-08
Chrysene	0	1.91e-09	1.02e-08	-1.55e-10	1.20e-08	1.80e-11
Cobalt	1.01e-06	3.92e-06	1.22e-05	-2.01e-07	1.69e-05	2.54e-08
Copper	4.71e-05	1.91e-06	9.96e-07	-2.54e-08	5.00e-05	7.52e-08
Cumene	0	4.35e-08	4.75e-07	-7.99e-09	5.11e-07	7.69e-10
Cumene hydroperoxide	0	6.06e-09	0	0	6.06e-09	9.12e-12
Cyanide (-1)	1.34e-07	2.34e-05	2.24e-04	-3.77e-06	2.44e-04	3.67e-07
Di(2-ethylhexyl)phthalate	0	6.83e-07	6.55e-06	-1.10e-07	7.12e-06	1.07e-08
Dibenzo[a,h]anthracene	0	6.71e-10	8.74e-10	-2.82e-12	1.54e-09	2.32e-12
Dichlorobenzene (mixed isomers)	0	0	0	-4.36e-10	-4.36e-10	-6.56e-13
Dichlorodifluoromethane	8.02e-10	0	0	0	8.02e-10	1.21e-12
Dichloromethane	0	2.71e-06	2.60e-05	-4.33e-07	2.83e-05	4.26e-08
Dimethyl Formamide	0	3.49e-05	0	0	3.49e-05	5.25e-08
Dimethyl sulfate	0	4.49e-07	4.30e-06	-7.24e-08	4.68e-06	7.05e-09
Dimethylbenzanthracene	0	3.82e-09	0	-3.39e-11	3.79e-09	5.70e-12
Dioxins, remaining unspeciated	2.79e-13	1.11e-10	5.84e-11	2.11e-10	3.81e-10	5.73e-13
Ethane	5.59e-04	7.90e-04		-6.97e-06	1.34e-03	2.02e-06
Ethanethiol	6.74e-07	0	0	0	6.74e-07	1.01e-09
Ethanol	9.49e-06	0	0	0	9.49e-06	1.43e-08
Ethyl Chloride	0	3.93e-07	3.77e-06	-6.33e-08	4.10e-06	6.17e-09
Ethylbenzene	2.25e-06	8.97e-07	8.46e-06	-1.32e-07	1.15e-05	1.73e-08
Ethylene	4.48e-04	0	0	0	4.48e-04	6.75e-07
Ethylene dibromide	0	1.12e-08	1.08e-07	-1.81e-09	1.17e-07	1.76e-10
Fluoranthene	0	8.56e-09	6.71e-08	-1.08e-09	7.46e-08	1.12e-10
Fluorene	0	1.02e-08	8.39e-08	-1.38e-09	9.28e-08	1.40e-10
Fluoride	2.12e-07	3.12e-07	1.95e-05	1.95e-09	2.01e-05	3.02e-08
Fluorides (F-)	6.70e-07	3.98e-05	0	-3.15e-07	4.01e-05	6.04e-08
Fluorine	8.94e-10	0	0	0	8.94e-10	1.35e-12
Formaldehyde	2.04e-05	1.24e-03	8.46e-05	-8.83e-06	1.33e-03	2.01e-06
Furans, remaining unspeciated	0	5.13e-10	9.32e-11	-1.14e-10	4.92e-10	7.41e-13
Halogenated hydrocarbons (unspecified)	2.27e-06	2.94e-13	0	-7.58e-16	2.27e-06	3.41e-09

Table J-4. CRT air pollutant emissions (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Halogenated matter (unspecified)	1.86e-11	0	0	0	1.86e-11	2.79e-14
HALON-1301	5.81e-07	5.11e-10	0	-1.33e-12	5.82e-07	8.76e-10
HCFC-22	2.66e-09	0	0	0	2.66e-09	4.01e-12
Heptane	1.54e-05	0	0	0	1.54e-05	2.33e-08
Hexane	6.97e-06	4.59e-04	6.01e-06	-4.15e-06	4.68e-04	7.05e-07
HFC-125	4.54e-09	0	0	0	4.54e-09	6.84e-12
Hydrocarbons, remaining unspeciated	1.28e-02	1.58e-01	0	-6.12e-04	1.70e-01	2.57e-04
Hydrochloric acid	2.39e-03	1.12e-02	1.08e-01	-1.04e-03	1.20e-01	1.81e-04
Hydrofluoric acid	5.54e-04	1.40e-03	1.35e-02	-2.26e-04	1.52e-02	2.29e-05
Hydrogen	2.96e-04	0	0	0	2.96e-04	4.46e-07
Hydrogen cyanide	1.54e-10	0	0	0	1.54e-10	2.32e-13
Hydrogen sulfide	4.49e-05	3.11e-03	0	-1.31e-05	3.14e-03	4.73e-06
Indeno(1,2,3-cd)pyrene	0	1.50e-09	6.59e-09	-9.62e-11	7.99e-09	1.20e-11
Iodine	9.41e-07	0	0	0	9.41e-07	1.42e-09
Iron	2.36e-04	3.83e-05	0	-1.67e-07	2.74e-04	4.13e-07
Isophorone	0	5.43e-06	5.20e-05	-8.74e-07	5.66e-05	8.52e-08
Isopropylpropionate	4.01e-10	0	0	0	4.01e-10	6.04e-13
Lanthanum	8.40e-08	0	0	0	8.40e-08	1.27e-10
Lead	1.66e-03	1.30e-05	1.27e-05	1.42e-05	1.70e-03	2.55e-06
Lead (Pb, ore)	0	4.41e-07	0	0	4.41e-07	6.64e-10
Magnesium	1.57e-04	1.03e-04	9.86e-04	-1.66e-05	1.23e-03	1.85e-06
Manganese	1.96e-06	2.33e-05	4.56e-05	-4.99e-06	6.59e-05	9.93e-08
Manganese (Mn, ore)	0	1.09e-06	0	0	1.09e-06	1.64e-09
Mercaptans	2.07e-07	0	0	0	2.07e-07	3.12e-10
Mercury	3.00e-06	1.12e-06	7.51e-06	-1.15e-07	1.15e-05	1.73e-08
Metals, remaining unspeciated	1.21e-04	3.16e-07	0	-1.08e-09	1.22e-04	1.83e-07
Methane	6.40e-02	9.08e-01	6.45e-01	-4.30e-02	1.57e+00	2.37e-03
Methanol	6.73e-06	0	0	0	6.73e-06	1.01e-08
Methyl chloride	0	4.96e-06	4.75e-05	-7.99e-07	5.17e-05	7.78e-08
Methyl ethyl ketone	0	3.65e-06	3.50e-05	-5.88e-07	3.80e-05	5.73e-08
Methyl hydrazine	0	1.59e-06	1.52e-05	-2.56e-07	1.66e-05	2.50e-08
Methyl methacrylate	0	1.87e-07	1.79e-06	-3.02e-08	1.95e-06	2.94e-09
Methyl tert-butyl ether	0	3.27e-07	3.14e-06	-5.28e-08	3.41e-06	5.14e-09
Molybdenum	4.61e-07	2.13e-06	5.84e-07	-2.06e-08	3.15e-06	4.75e-09
Naphthalene	1.49e-08	6.04e-07	1.83e-06	-2.92e-08	2.42e-06	3.64e-09
Nickel	4.13e-05	1.39e-04	6.85e-05	-4.59e-06	2.45e-04	3.68e-07
Nitrogen dioxide	5.76e-02	0	0	1.85e-03	5.95e-02	8.96e-05
Nitrogen oxides	6.99e-03	6.95e-01	1.18e+00	-1.90e-02	1.86e+00	2.80e-03
Nitrous oxide	9.47e-04	1.66e-02	3.40e-03	-1.11e-03	1.98e-02	2.99e-05
Nonmethane hydrocarbons, remaining unspeciated	9.97e-02	1.10e-01	0	-1.91e-03	2.08e-01	3.13e-04
n-Propane	1.50e-04	1.69e-06	0	-3.70e-07	1.51e-04	2.27e-07
Other organics	5.60e-04	7.83e-02	0	-3.65e-03	7.52e-02	1.13e-04
o-xylene	0	1.13e-06	5.71e-08	-3.79e-08	1.15e-06	1.73e-09
Pentachlorobenzene	1.93e-15	0	0	0	1.93e-15	2.91e-18
Pentachlorophenol	3.12e-16	0	0	0	3.12e-16	4.71e-19
Pentane	3.47e-05	6.62e-04	0	-5.84e-06	6.91e-04	1.04e-06
Perfluoroethane	1.44e-05	0	0	0	1.44e-05	2.17e-08
Perfluoromethane	1.30e-04	0	0	0	1.30e-04	1.95e-07

Table J-4. CRT air pollutant emissions (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Phenanthrene	0	3.22e-08	2.51e-07	-4.11e-09	2.79e-07	4.20e-10
Phenol	2.93e-06	1.50e-07	1.43e-06	-2.41e-08	4.49e-06	6.77e-09
Phosphorus (yellow or white)	1.91e-06	1.26e-05	4.95e-06	-1.20e-07	1.94e-05	2.92e-08
Phosphorus pentoxide	8.18e-10	0	0	0	8.18e-10	1.23e-12
PM	1.28e-01	1.31e-01	0	-1.88e-02	2.40e-01	3.62e-04
PM-10	0	3.15e-03	5.78e-02	4.78e-06	6.09e-02	9.17e-05
Polycyclic aromatic hydrocarbons	1.87e-05	5.87e-11	0	-1.52e-13	1.87e-05	2.82e-08
Potassium	4.90e-05	0	0	0	4.90e-05	7.37e-08
Propionaldehyde	4.61e-13	3.55e-06	3.41e-05	-5.73e-07	3.71e-05	5.58e-08
Propionic acid	2.03e-10	0	0	0	2.03e-10	3.06e-13
Propylene	3.77e-05	0	0	0	3.77e-05	5.68e-08
Pyrene	0	5.44e-09	3.33e-08	-5.09e-10	3.82e-08	5.76e-11
Scandium	2.04e-08	0	0	0	2.04e-08	3.08e-11
Selenium	4.69e-07	1.29e-05	1.17e-04	-1.96e-06	1.28e-04	1.93e-07
Silicon	1.06e-03	1.72e-05	0	-7.51e-08	1.08e-03	1.62e-06
Sodium	2.88e-05	1.02e-04	0	-4.45e-07	1.30e-04	1.96e-07
Strontium	5.83e-06	0	0	0	5.83e-06	8.78e-09
Styrene	0	2.34e-07	2.24e-06	-3.77e-08	2.44e-06	3.67e-09
Sulfur dioxide	3.37e-01	1.26e-01	2.49e+00	8.30e-04	2.96e+00	4.45e-03
Sulfur oxides	5.71e-03	8.20e-01	0	-2.97e-02	7.96e-01	1.20e-03
Sulfuric acid	8.81e-07	0	0	0	8.81e-07	1.33e-09
Tars (unspecified)	9.87e-13	0	0	0	9.87e-13	1.49e-15
Tetrachloroethylene	0	4.02e-07	3.86e-06	-6.20e-08	4.20e-06	6.32e-09
Thallium	1.39e-08	0	0	0	1.39e-08	2.10e-11
Thorium	4.51e-08	0	0	0	4.51e-08	6.79e-11
Tin	2.62e-08	0	0	0	2.62e-08	3.94e-11
Titanium	1.00e-05	0	0	0	1.00e-05	1.51e-08
TOCs, remaining unspeciated	0	2.89e-04	5.76e-03	5.76e-07	6.05e-03	9.11e-06
Toluene	2.17e-05	3.84e-03	2.54e-05	-3.87e-07	3.89e-03	5.86e-06
Trichloroethylene	0	0	0	2.84e-09	2.84e-09	4.27e-12
Trichlorofluoromethane	8.27e-09	0	0	0	8.27e-09	1.25e-11
Uranium	4.43e-08	0	0	0	4.43e-08	6.67e-11
Vanadium	6.77e-05	2.74e-04	1.76e-05	-1.39e-06	3.57e-04	5.38e-07
Vinyl acetate	0	7.11e-08	6.82e-07	-1.15e-08	7.41e-07	1.12e-09
Vinyl chloride	0	0	0	5.67e-09	5.67e-09	8.54e-12
VOCs, remaining unspeciated	1.10e-03	0	0	0	1.10e-03	1.65e-06
Waste metals, unspecified	1.45e-05	0	0	0	1.45e-05	2.18e-08
Xylene (mixed isomers)	3.65e-05	3.84e-04	3.32e-06	-6.94e-09	4.24e-04	6.38e-07
Zinc (elemental)	5.84e-04	1.56e-05	1.52e-05	-2.78e-07	6.15e-04	9.26e-07
Zirconium	2.14e-08	0	0	0	2.14e-08	3.23e-11
Total air pollutants	3.00e+01	1.83e+02	4.49e+02	2.47e+00	6.64e+02	100.00%

Table J-5. CRT water outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
WASTEWATER STREAMS							
Wastewater stream	surface water	1.70e+01	1.41e+03	0	-3.65e+00	1.42e+03	93.76%
Wastewater stream	treatment	0	9.48e+01	0	0	9.48e+01	6.24%
Total wastewater streams		1.70e+01	1.51e+03	0.00e+00	-3.65e+00	1.52e+03	100.00%
WATER POLLUTANTS							
1,1,1-Trichloroethane	surface water	1.70e-13	0	0	0	1.70e-13	8.15e-15
1,2-Dichloroethane	surface water	0	0	0	8.41e-11	8.41e-11	4.03e-12
Acetic acid	surface water	1.49e-09	0	0	0	1.49e-09	7.16e-11
Acids (H+)	surface water	1.52e-04	1.03e-07	0	-4.78e-09	1.53e-04	7.30e-06
Adsorbable organic halides	surface water	1.04e-05	3.76e-10	0	-9.75e-13	1.04e-05	4.97e-07
Alcohols	surface water	1.19e-07	0	0	0	1.19e-07	5.71e-09
Aldehydes	surface water	3.10e-09	0	0	0	3.10e-09	1.48e-10
Alkane (unspecified)	surface water	6.77e-06	0	0	0	6.77e-06	3.24e-07
Alkenes	surface water	5.27e-07	0	0	0	5.27e-07	2.52e-08
Aluminum (+3)	surface water	2.74e-03	1.43e-04	0	-3.70e-07	2.89e-03	1.38e-04
Aluminum hydroxide	surface water	1.39e-09	0	0	0	1.39e-09	6.65e-11
Ammonia	surface water	1.86e-04	0	0	-4.05e-06	1.81e-04	8.69e-06
Ammonia ions	surface water	3.54e-06	2.76e-02	0	-6.63e-05	2.75e-02	1.32e-03
Aromatic hydrocarbons	surface water	3.00e-05	8.81e-08	0	-2.28e-10	3.01e-05	1.44e-06
Arsenic cmpds	surface water	5.47e-06	0	0	1.35e-08	5.48e-06	2.63e-07
Barium cmpds	surface water	3.53e-04	2.82e-07	0	4.03e-07	3.53e-04	1.69e-05
Barium sulfate	surface water	6.71e-04	0	0	0	6.71e-04	3.21e-05
Benzene	surface water	7.40e-06	0	0	8.41e-11	7.40e-06	3.54e-07
BOD	surface water	3.93e-04	1.95e-01	0	-4.65e-04	1.95e-01	9.34e-03
Boric acid	surface water	1.77e-06	0	0	0	1.77e-06	8.49e-08
Boron (B III)	surface water	1.75e-06	0	0	0	1.75e-06	8.39e-08
Cadmium cmpds	surface water	5.59e-07	2.94e-10	0	8.03e-10	5.60e-07	2.68e-08
Calcium (+2)	surface water	4.96e-03	0	0	0	4.96e-03	2.38e-04
Carbon tetrachloride	surface water	0	0	0	8.41e-11	8.41e-11	4.03e-12
Carbonate ion	surface water	4.83e-03	0	0	0	4.83e-03	2.31e-04
Cesium (+2)	surface water	1.93e-08	0	0	0	1.93e-08	9.24e-10
Chloride ions	surface water	4.29e-01	6.48e+00	0	-2.39e-02	6.88e+00	32.95%
Chlorine	surface water	8.94e-07	0	0	0	8.94e-07	4.28e-08
Chloroform	surface water	1.75e-11	0	0	8.41e-11	1.02e-10	4.87e-12
Chromium	surface water	8.20e-08	0	0	0	8.20e-08	3.93e-09
Chromium (III)	surface water	2.73e-05	3.77e-08	0	1.32e-08	2.74e-05	1.31e-06
Chromium (VI)	surface water	4.68e-07	3.77e-08	0	1.32e-08	5.19e-07	2.49e-08
Chromium ore	surface water	0	1.02e-05	0	0	1.02e-05	4.90e-07
Chromium ore	treatment	0	1.03e-06	0	0	1.03e-06	4.95e-08
Cobalt (Co I, Co II, Co III)	surface water	2.45e-06	0	0	0	2.45e-06	1.17e-07
COD	surface water	1.00e-02	1.60e+00	0	-3.94e-03	1.61e+00	7.71%
COD	treatment	0	8.33e-03	0	0	8.33e-03	3.99e-04
Copper	surface water	0	1.80e-06	0	0	1.80e-06	8.63e-08
Copper (+1 & +2)	surface water	1.61e-05	5.87e-09	0	-1.52e-11	1.61e-05	7.70e-07
Copper (+1 & +2)	treatment	0	9.71e-05	0	0	9.71e-05	4.65e-06
Cyanide (-1)	surface water	1.85e-06	6.06e-07	0	-1.07e-12	2.46e-06	1.18e-07
Dichloromethane	surface water	5.02e-08	0	0	1.35e-10	5.03e-08	2.41e-09
Dissolved organic matter (chlorinated)	surface water	2.27e-06	0	0	0	2.27e-06	1.08e-07
Dissolved organics	surface water	5.54e-04	2.71e-07	0	-1.26e-08	5.55e-04	2.66e-05

Table J-5. CRT water outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Dissolved solids	surface water	5.30e-03	3.62e+00	0	-8.77e-05	3.62e+00	17.36%
Dissolved solids	treatment	0	8.01e-02	0	0	8.01e-02	3.84e-03
Edetic acid (EDTA)	surface water	3.01e-09	0	0	0	3.01e-09	1.44e-10
Ethylbenzene	surface water	6.70e-07	0	0	3.04e-10	6.71e-07	3.21e-08
Fluoride	surface water	1.89e-05	3.45e-03	0	0	3.47e-03	1.66e-04
Fluoride	treatment	0	3.51e-04	0	0	3.51e-04	1.68e-05
Fluorides (F-)	surface water	9.63e-05	2.97e-03	0	-7.72e-06	3.06e-03	1.46e-04
Formaldehyde	surface water	2.20e-13	0	0	0	2.20e-13	1.05e-14
Halogenated matter (organic)	surface water	2.71e-10	1.17e-10	0	-3.05e-13	3.88e-10	1.86e-11
Hexachloroethane	surface water	3.09e-17	0	0	0	3.09e-17	1.48e-18
Hydrazine	surface water	1.38e-09	0	0	0	1.38e-09	6.62e-11
Hydrocarbons, remaining unspeciated	surface water	1.58e-04	3.52e-04	0	-4.25e-07	5.09e-04	2.44e-05
Hypochlorite	surface water	5.26e-09	0	0	0	5.26e-09	2.52e-10
Hypochlorous acid	surface water	5.26e-09	0	0	0	5.26e-09	2.52e-10
Iodide (-1)	surface water	3.23e-06	0	0	0	3.23e-06	1.54e-07
Iron	surface water	0	2.93e-03	0	0	2.93e-03	1.40e-04
Iron (+2 & +3)	surface water	1.76e-03	3.55e-07	0	-1.57e-08	1.76e-03	8.42e-05
Lead	surface water	0	4.64e-05	0	0	4.64e-05	2.22e-06
Lead	treatment	0	1.03e-06	0	0	1.03e-06	4.95e-08
Lead cmpds	surface water	1.59e-05	1.17e-09	0	1.60e-09	1.59e-05	7.59e-07
Lead cmpds	treatment	0	1.62e-05	0	0	1.62e-05	7.75e-07
Lithium salts	surface water	1.55e-10	0	0	0	1.55e-10	7.40e-12
Magnesium (+2)	surface water	2.68e-03	0	0	0	2.68e-03	1.28e-04
Manganese	surface water	0	3.60e-06	0	0	3.60e-06	1.73e-07
Manganese cmpds	surface water	1.02e-04	0	0	0	1.02e-04	4.88e-06
Mercury compounds	surface water	9.68e-07	1.35e-12	0	4.33e-11	9.68e-07	4.63e-08
Metals, remaining unspeciated	surface water	6.74e-04	9.75e-03	0	-3.42e-05	1.04e-02	4.98e-04
Molybdenum	surface water	0	1.20e-07	0	0	1.20e-07	5.77e-09
Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	surface water	8.27e-06	0	0	0	8.27e-06	3.96e-07
Morpholine	surface water	1.46e-08	0	0	0	1.46e-08	7.01e-10
Nickel	surface water	0	7.94e-05	0	0	7.94e-05	3.80e-06
Nickel (+2)	surface water	6.69e-07	0	0	0	6.69e-07	3.20e-08
Nickel cmpds	surface water	1.75e-05	5.87e-10	0	-1.52e-12	1.75e-05	8.38e-07
Nitrate	surface water	9.24e-05	6.10e-05	0	-1.96e-06	1.51e-04	7.25e-06
Nitrates/nitrites	surface water	2.29e-05	3.95e-06	0	0	2.69e-05	1.29e-06
Nitrites	surface water	1.91e-06	0	0	0	1.91e-06	9.15e-08
Nitrogen	surface water	4.46e-05	7.18e-03	0	0	7.23e-03	3.46e-04
Nitrogen dioxide	surface water	6.20e-04	0	0	0	6.20e-04	2.97e-05
Oil & grease	surface water	0	7.46e-03	0	0	7.46e-03	3.57e-04
Other nitrogen	surface water	5.28e-04	1.59e-08	0	-4.11e-11	5.28e-04	2.53e-05
Other organics	surface water	3.98e-05	0	0	0	3.98e-05	1.90e-06
Oxalic acid	surface water	6.02e-09	0	0	0	6.02e-09	2.88e-10
o-xylene	surface water	0	0	0	7.84e-10	7.84e-10	3.76e-11
Phenol	surface water	6.25e-05	3.63e-03	0	-9.41e-06	3.68e-03	1.76e-04
Phosphate (PO43-)	surface water	1.75e-04	0	0	0	1.75e-04	8.39e-06
Phosphate as P2O5	surface water	0	1.21e-06	0	0	1.21e-06	5.80e-08
Phosphates	surface water	3.36e-05	5.85e-07	0	6.93e-09	3.42e-05	1.64e-06
Phosphorus (yellow or white)	surface water	3.94e-06	5.05e-05	0	0	5.44e-05	2.61e-06

Table J-5. CRT water outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Phosphorus pentoxide	surface water	2.45e-08	0	0	0	2.45e-08	1.18e-09
Polycyclic aromatic hydrocarbons	surface water	7.88e-06	1.41e-09	0	-3.66e-12	7.88e-06	3.77e-07
Potassium (+1)	surface water	1.12e-03	0	0	0	1.12e-03	5.38e-05
Rubidium ion (Rb+)	surface water	1.93e-07	0	0	0	1.93e-07	9.26e-09
Salts (unspecified)	surface water	1.71e-03	1.62e-03	0	-4.21e-06	3.33e-03	1.59e-04
Sand	surface water	1.80e-08	0	0	0	1.80e-08	8.62e-10
Saponifiable oils and fats	surface water	2.38e-04	0	0	0	2.38e-04	1.14e-05
Selenium	surface water	1.34e-05	0	0	8.15e-11	1.34e-05	6.44e-07
Silver compounds	surface water	1.16e-08	0	0	2.55e-09	1.41e-08	6.78e-10
Sodium	surface water	9.07e-05	0	0	0	9.07e-05	4.34e-06
Sodium (+1)	surface water	2.90e-01	7.04e+00	0	-3.08e-02	7.30e+00	34.94%
Strontium (Sr II)	surface water	3.73e-04	0	0	0	3.73e-04	1.79e-05
Sulfate ion (-4)	surface water	3.75e-02	9.61e-04	0	-1.85e-06	3.84e-02	1.84e-03
Sulfate ion (-4)	treatment	0	1.09e-03	6.84e-02	6.84e-06	6.95e-02	3.33e-03
Sulfide	surface water	3.99e-06	5.97e-08	0	-2.64e-09	4.05e-06	1.94e-07
Sulfites	surface water	1.73e-06	0	0	0	1.73e-06	8.27e-08
Sulfur	surface water	3.32e-11	0	0	0	3.32e-11	1.59e-12
Suspended solids	surface water	7.72e-03	8.69e-01	0	-2.11e-03	8.74e-01	4.19%
Suspended solids	treatment	0	1.29e-03	1.78e-03	1.78e-07	3.07e-03	1.47e-04
Tars (unspecified)	surface water	1.53e-14	0	0	0	1.53e-14	7.34e-16
Tetrachloroethylene	surface water	7.61e-14	0	0	8.41e-11	8.42e-11	4.03e-12
Tin (Sn++, Sn4+)	surface water	1.35e-04	0	0	0	1.35e-04	6.45e-06
Titanium tetrachloride	surface water	1.59e-04	0	0	0	1.59e-04	7.60e-06
TOCs	surface water	2.85e-03	8.81e-07	0	-2.28e-09	2.86e-03	1.37e-04
Toluene	surface water	8.52e-06	1.29e-08	0	2.90e-09	8.54e-06	4.09e-07
Trichloroethylene	surface water	4.68e-12	0	0	8.41e-11	8.88e-11	4.25e-12
Triethylene glycol	surface water	1.00e-05	0	0	0	1.00e-05	4.81e-07
Vanadium (V3+, V5+)	surface water	1.42e-05	0	0	0	1.42e-05	6.78e-07
Vinyl chloride	surface water	0	0	0	1.69e-10	1.69e-10	8.07e-12
VOCs, remaining unspeciated	surface water	6.75e-06	0	0	0	6.75e-06	3.23e-07
Waste metals, unspecified	surface water	2.14e-04	0	0	0	2.14e-04	1.03e-05
Waste oil	surface water	3.65e-03	1.01e-01	0	-3.13e-04	1.04e-01	4.98e-03
Xylene (mixed isomers)	surface water	2.17e-05	0	0	7.31e-10	2.17e-05	1.04e-06
Zinc (+2)	surface water	6.66e-05	1.23e-08	0	-3.17e-10	6.66e-05	3.19e-06
Zinc (elemental)	surface water	0	1.39e-05	0	0	1.39e-05	6.64e-07
Zinc (elemental)	treatment	0	1.03e-06	0	0	1.03e-06	4.95e-08
Total water pollutants		8.12e-01	2.01e+01	7.02e-02	-6.18e-02	2.09e+01	100.00%

Table J-6. CRT hazardous waste outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Barium debris (D008 waste)	landfill	0	2.14E-04	0	0	2.14E-04	2.26E-05
Broken CRT glass	landfill	0	1.88E-03	0	0	1.88E-03	1.99E-04
Carbon and filmer waste	landfill	0	1.03E-03	0	0	1.03E-03	1.09E-04
Chrome debris (D007 waste)	treatment	0	1.47E-04	0	0	1.47E-04	1.56E-05
Chrome liquid waste (D007 waste)	recycling/reuse	0	9.80E-03	0	0	9.80E-03	1.04E-03
cinders from CRT glass mfg (70% PbO)	landfill	0	8.26E-03	0	0	8.26E-03	8.73E-04
CRT glass faceplate EP dust (Pb) (D008 waste)	landfill	0	1.03E-03	0	0	1.03E-03	1.09E-04
CRT glass funnel EP dust (Pb) (D008 waste)	recycling/reuse	0	5.01E-03	0	0	5.01E-03	5.30E-04
CRT glass, cullet	recycling/reuse	0	0	0	4.84E-01	4.84E-01	5.12%
CRT glass, funnel	recycling/reuse	0	0	0	2.29E-01	2.29E-01	2.42%
EOL CRT Monitor, landfilled	landfill	0	0	0	7.20E+00	7.20E+00	76.11%
Frit	landfill	0	2.99E-03	0	0	2.99E-03	3.16E-04
General Hazardous Waste	landfill	4.85E-02	0	0	-9.61E-05	4.84E-02	5.12E-03
General Hazardous Waste	treatment	0	1.24E-01	0	0	1.24E-01	1.31E-02
Hazardous sludge (Pb) (D008)	landfill	0	1.52E-03	0	0	1.52E-03	1.60E-04
Hazardous waste	landfill	3.85E-04	6.15E-01	0	-1.50E-03	6.14E-01	6.49%
Hydrofluoric acid	landfill	0	1.78E-03	0	0	1.78E-03	1.88E-04
Lead contaminated grit (D008 waste)	landfill	0	3.46E-05	0	0	3.46E-05	3.65E-06
Lead debris (D008 waste)	landfill	0	2.14E-04	0	0	2.14E-04	2.26E-05
Lead sulfate cake	landfill	0	2.67E-05	0	0	2.67E-05	2.82E-06
Printed wiring board (PWB)	recycling/reuse	0	0	0	1.46E-01	1.46E-01	1.54E-02
PWB-Decontaminating debris	treatment	0	1.55E-02	0	0	1.55E-02	1.64E-03
PWB-Lead contaminated waste oil	treatment	0	1.16E-02	0	0	1.16E-02	1.23E-03
PWB-Route dust	recycling/reuse	0	1.20E-02	0	0	1.20E-02	1.27E-03
PWB-Solder dross	recycling/reuse	0	6.70E-02	0	0	6.70E-02	7.09E-03
PWB-Waste cupric etchant	recycling/reuse	0	2.25E-01	0	0	2.25E-01	2.38%
Silica coat waste	treatment	0	2.86E-04	0	0	2.86E-04	3.02E-05
Slag and ash	landfill	0	2.47E-03	0	0	2.47E-03	2.61E-04
sludge from CRT glass mfg (1% PbO)	landfill	0	8.77E-04	0	0	8.77E-04	9.28E-05
Slurry scrap (chromium-based)	landfill	0	8.62E-04	0	0	8.62E-04	9.12E-05
Spent solvent, unspecified	treatment	0	2.75E-04	0	0	2.75E-04	2.90E-05
Transformer	recycling/reuse	0	0	0	2.28E-01	2.28E-01	2.41%
Unspecified sludge	landfill	0	5.22E-03	0	0	5.22E-03	5.52E-04
Unspecified sludge	recycling/reuse	0	5.56E-03	0	0	5.56E-03	5.88E-04
Waste acid (mostly 3% HCl solution)	recycling/reuse	0	3.93E-03	0	0	3.93E-03	4.16E-04
Waste Batch (Ba, Pb) (D008 waste)	landfill	0	1.41E-03	0	0	1.41E-03	1.50E-04
Waste finishing sludge (Pb) (D008 waste)	landfill	0	2.56E-04	0	0	2.56E-04	2.70E-05
Waste oxygenated solvents	treatment	0	9.48E-05	0	0	9.48E-05	1.00E-05
Waste water treatment (WWT) filters	landfill	0	3.40E-04	0	0	3.40E-04	3.60E-05
Total hazardous waste		4.89E-02	1.13E+00	0.00E+00	8.28E+00	9.46E+00	100.00%

Table J-7. CRT solid waste outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
abrasive sludge	recycling/reuse	0	4.21E-02	0	0	4.21E-02	2.44E-04
acid absorbent	landfill	0	8.13E-05	0	0	8.13E-05	4.72E-07
Aluminum (elemental)	landfill	5.68E-05	0	0	0	5.68E-05	3.29E-07
Aluminum scrap	recycling/reuse	0	1.82E-04	0	1.10E-01	1.10E-01	6.37E-04
Aluminum scrap, Wabash 319	recycling/reuse	0	5.08E-07	0	0	5.08E-07	2.95E-09
Arsenic	landfill	2.27E-08	0	0	0	2.27E-08	1.32E-10
Bauxite residues	landfill	0	1.21E-02	0	-2.96E-05	1.21E-02	7.03E-05
blasting media	landfill	0	3.66E-04	0	0	3.66E-04	2.12E-06
Broken CRT glass	recycling/reuse	0	1.08E+00	0	0	1.08E+00	0.62%
Cables/wires	recycling/reuse	0	8.86E-03	0	0	8.86E-03	5.14E-05
Cadmium	landfill	1.65E-09	0	0	0	1.65E-09	9.59E-12
Calcium	landfill	2.27E-04	0	0	0	2.27E-04	1.32E-06
Carbon	landfill	1.75E-04	0	0	0	1.75E-04	1.01E-06
Carbon Steel Scrap	recycling/reuse	0	0	0	4.10E-01	4.10E-01	0.24%
Cardboard	recycling/reuse	9.81E-05	0	0	0	9.81E-05	5.69E-07
Chromium (III)	landfill	1.42E-07	0	0	0	1.42E-07	8.23E-10
Chromium (VI)	landfill	1.42E-07	0	0	0	1.42E-07	8.23E-10
Coal waste	landfill	0	1.46E+00	5.09E+01	5.09E-03	5.23E+01	30.37%
Cobalt	landfill	1.00E-09	0	0	0	1.00E-09	5.81E-12
Cobalt nitrate	treatment	0	6.10E-05	0	0	6.10E-05	3.54E-07
Copper	landfill	5.01E-09	0	0	0	5.01E-09	2.91E-11
Copper scrap	recycling/reuse	0	0	0	6.67E-02	6.67E-02	3.87E-04
CRT glass, faceplate	landfill	0	2.43E-02	0	0	2.43E-02	1.41E-04
CRT glass, faceplate	recycling/reuse	0	0	0	3.54E-01	3.54E-01	0.21%
Diesel fuel	treatment	0	4.07E-05	0	0	4.07E-05	2.36E-07
Dust	treatment	0	3.43E-03	0	0	3.43E-03	1.99E-05
Dust/sludge	landfill	0	5.64E-01	1.97E+01	1.97E-03	2.02E+01	11.75%
EOL CRT Monitor, incinerated	treatment	0	0	0	3.31E+00	3.31E+00	1.92%
EOL CRT Monitor, landfilled	landfill	0	0	0	3.91E+00	3.91E+00	2.27%
EOL CRT Monitor, recycled	recycling/reuse	0	0	0	2.42E+00	2.42E+00	1.40%
EOL CRT Monitor, remanufactured	recycling/reuse	0	0	0	6.60E-01	6.60E-01	0.38%
Ferric chloride	recycling/reuse	0	3.69E-01	0	0	3.69E-01	0.21%
FGD sludge	landfill	0	2.14E-01	0	-9.24E-04	2.14E-01	0.12%
flame retardant high-impact polystyrene (HIPS)	recycling/reuse	0	0	0	4.03E-01	4.03E-01	0.23%
Fly/bottom ash	landfill	0	3.65E-01	1.27E+01	1.27E-03	1.31E+01	7.59%
Iron	landfill	1.14E-04	0	0	0	1.14E-04	6.59E-07
Iron scrap	recycling/reuse	3.43E-01	0	0	2.50E+00	2.85E+00	1.65%
Lead	landfill	2.29E-08	0	0	0	2.29E-08	1.33E-10
Manganese	landfill	2.27E-06	0	0	0	2.27E-06	1.32E-08
Mercury	landfill	1.42E-10	0	0	0	1.42E-10	8.21E-13
Mineral waste	landfill	4.42E-01	2.61E-03	0	-6.76E-06	4.44E-01	0.26%
Mining waste	landfill	4.48E-01	0	0	-1.90E-06	4.48E-01	0.26%
Mixed industrial (waste)	landfill	4.87E-02	1.00E+00	0	-5.12E-04	1.05E+00	0.61%
Nickel	landfill	7.50E-09	0	0	0	7.50E-09	4.35E-11
Nickel nitrate	treatment	0	6.10E-05	0	0	6.10E-05	3.54E-07
Nitrogen	landfill	4.23E-08	0	0	0	4.23E-08	2.45E-10
Non mineral waste (inert)	landfill	2.95E-05	0	0	0	2.95E-05	1.71E-07
Non toxic chemical waste (unspecified)	landfill	4.07E-03	6.11E-04	0	-1.58E-06	4.68E-03	2.71E-05

Table J-7. CRT solid waste outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Oily rags & filter media	landfill	0	3.25E-04	0	0	3.25E-04	1.89E-06
Oily rags & filter media	recycling/reuse	0	4.07E-05	0	0	4.07E-05	2.36E-07
parts cleaner solvent	recycling/reuse	0	8.13E-05	0	0	8.13E-05	4.72E-07
Phosphorus (yellow or white)	landfill	2.90E-06	0	0	0	2.90E-06	1.68E-08
Plating process sludge	landfill	0	3.28E-04	0	0	3.28E-04	1.90E-06
PM	landfill	0	5.33E-04	0	0	5.33E-04	3.09E-06
Potassium Carbonate	landfill	0	3.30E-03	0	0	3.30E-03	1.91E-05
Printed wiring board (PWB)	recycling/reuse	0	3.70E-02	0	0	3.70E-02	2.15E-04
PWB-Drill dust	landfill	0	1.49E-02	0	0	1.49E-02	8.67E-05
Sewage sludge (unspecified)	landfill	6.64E-05	0	0	0	6.64E-05	3.85E-07
Slag and ash	landfill	9.65E-02	6.66E+01	0	-1.49E+01	5.18E+01	30.06%
Slag and ash	recycling/reuse	0	6.85E-01	0	-3.01E-03	6.82E-01	0.40%
Sludge (aquadag)	landfill	0	2.22E-03	0	0	2.22E-03	1.29E-05
sludge (calcium fluoride, CaF2)	recycling/reuse	0	1.75E-02	0	0	1.75E-02	1.02E-04
Sludge (phosphor)	landfill	0	4.31E-03	0	0	4.31E-03	2.50E-05
Sodium Carbonate	landfill	0	3.29E-03	0	0	3.29E-03	1.91E-05
Spent solvents (toluene,xylene,dimethyl formamide,isopropyl alcohol)	recycling/reuse	0	4.17E-02	0	0	4.17E-02	2.42E-04
Stannous sludge	recycling/reuse	6.64E-04	0	0	0	6.64E-04	3.85E-06
Steel scrap (tinplated)	recycling/reuse	1.58E-01	0	0	0	1.58E-01	9.15E-04
Sulfur	landfill	2.55E-05	0	0	0	2.55E-05	1.48E-07
Unspecified sludge	landfill	0	7.69E-03	0	0	7.69E-03	4.46E-05
Unspecified sludge	recycling/reuse	0	1.26E-01	0	0	1.26E-01	7.29E-04
Unspecified solid waste	landfill	4.94E+00	0	0	-7.86E-01	4.15E+00	2.41%
Unspecified solid waste	recycling/reuse	3.07E+00	4.33E-01	0	0	3.50E+00	2.03%
Unspecified solid waste	treatment	0	3.66E+00	0	0	3.66E+00	2.12%
Unspecified solid waste (incinerated)	treatment	4.24E-03	1.33E-02	0	-5.82E-05	1.75E-02	1.01E-04
Unspecified waste	landfill	0	3.38E+00	0	-1.49E-02	3.36E+00	1.95%
Unspecified waste	recycling/reuse	0	0	0	-8.90E-02	-8.90E-02	-5.17E-04
Waste alkali (cleaning caustic and alkali soda effluent)	recycling/reuse	0	2.12E-02	0	0	2.12E-02	1.23E-04
Waste alkali, unspecified	treatment	0	4.21E-05	0	0	4.21E-05	2.44E-07
Waste metals, unspecified	recycling/reuse	0	8.79E-02	0	0	8.79E-02	5.10E-04
Waste oil	landfill	8.15E-05	0	0	0	8.15E-05	4.73E-07
Waste oil	recycling/reuse	0	1.43E-03	0	0	1.43E-03	8.29E-06
Waste oil	treatment	0	9.09E-03	0	0	9.09E-03	5.28E-05
Waste Plastic (packing material)	treatment	0	3.01E-02	0	0	3.01E-02	1.75E-04
Waste Plastic (styrene foam)	recycling/reuse	0	3.77E-03	0	0	3.77E-03	2.19E-05
Waste plastics from CRT monitor	recycling/reuse	0	8.09E-02	0	0	8.09E-02	4.70E-04
Waste refractory	landfill	0	2.44E-03	0	0	2.44E-03	1.42E-05
Waste water treatment (WWT) sludge	landfill	0	3.43E-01	0	0	3.43E-01	0.20%
Waste water treatment (WWT) sludge	recycling/reuse	0	3.72E-01	0	0	3.72E-01	0.22%
Wastepaper	recycling/reuse	0	8.34E-03	0	0	8.34E-03	4.84E-05
Wood, average	landfill	0	4.94E-03	0	0	4.94E-03	2.87E-05
Zinc (elemental)	landfill	9.01E-07	0	0	0	9.01E-07	5.23E-09
Total solid waste		9.55E+00	8.12E+01	8.33E+01	-1.66E+00	1.72E+02	100.00%

Table J-8. CRT radioactive waste outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Highly radioactive waste (Class C)	landfill	8.65e-06	0	0	0	8.65e-06	2.98e-03
Low-level radioactive waste	landfill	4.11e-04	1.38e-04	1.76e-03	1.76e-07	2.31e-03	79.47%
Radioactive waste (unspecified)	landfill	1.88e-05	0	0	0	1.88e-05	6.46e-03
Uranium, depleted	landfill	0	4.15e-05	5.27e-04	5.27e-08	5.69e-04	19.59%
Total radioactive waste		4.39e-04	1.80e-04	2.28e-03	2.29e-07	2.90e-03	100.00%

Table J-9. CRT radioactivity outputs (Bq/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Americium-241 (isotope)	landfill	3.00e+02	0	0	0	3.00e+02	3.34e-06
Americium-243 (isotope)	landfill	6.53e+00	0	0	0	6.53e+00	7.26e-08
Antimony-124 (isotope)	surface water	6.75e-02	0	0	0	6.75e-02	7.52e-10
Antimony-124 (isotope)	treatment	0	6.21e-01	7.89e+00	7.89e-04	8.51e+00	9.47e-08
Antimony-125 (isotope)	treatment	0	2.47e+00	3.14e+01	3.14e-03	3.39e+01	3.77e-07
Argon-41 (isotope)	air	0	1.26e+03	1.60e+04	1.60e+00	1.72e+04	1.92e-04
Barium-140 (isotope)	treatment	0	4.60e-02	5.85e-01	5.85e-05	6.31e-01	7.02e-09
Bromine-89 (isotope)	air	0	1.45e-04	1.85e-03	1.85e-07	1.99e-03	2.22e-11
Bromine-90 (isotope)	air	0	5.91e-05	7.51e-04	7.52e-08	8.10e-04	9.02e-12
Carbon-14 (isotope)	air	2.97e+01	0	0	0	2.97e+01	3.31e-07
Cesium-134 (isotope)	air	1.14e-03	3.99e-03	5.07e-02	5.07e-06	5.58e-02	6.22e-10
Cesium-134 (isotope)	surface water	5.94e-02	0	0	0	5.94e-02	6.61e-10
Cesium-134 (isotope)	treatment	0	1.66e+00	2.11e+01	2.11e-03	2.28e+01	2.53e-07
Cesium-135 (isotope)	landfill	1.46e+05	0	0	0	1.46e+05	1.63e-03
Cesium-136 (isotope)	treatment	0	1.44e-02	9.03e-01	9.04e-05	9.18e-01	1.02e-08
Cesium-137 (isotope)	air	1.14e-03	3.01e-02	3.83e-01	3.83e-05	4.14e-01	4.61e-09
Cesium-137 (isotope)	landfill	4.09e-01	0	0	0	4.09e-01	4.55e-09
Cesium-137 (isotope)	surface water	8.71e-02	0	0	0	8.71e-02	9.69e-10
Cesium-137 (isotope)	treatment	0	2.49e+00	3.17e+01	3.17e-03	3.42e+01	3.80e-07
Chromium-51 (isotope)	air	0	7.89e-02	1.00e+00	1.00e-04	1.08e+00	1.20e-08
Chromium-51 (isotope)	treatment	0	2.99e+00	3.80e+01	3.80e-03	4.10e+01	4.56e-07
Cobalt-57 (isotope)	air	0	2.12e-04	2.69e-03	2.69e-07	2.90e-03	3.23e-11
Cobalt-57 (isotope)	treatment	0	7.25e-02	9.20e-01	9.21e-05	9.93e-01	1.11e-08
Cobalt-58 (isotope)	air	1.14e-03	5.49e+01	3.44e+03	3.44e-01	3.49e+03	3.89e-05
Cobalt-58 (isotope)	surface water	1.95e-01	0	0	0	1.95e-01	2.17e-09
Cobalt-58 (isotope)	treatment	0	2.95e+01	3.74e+02	3.75e-02	4.04e+02	4.50e-06
Cobalt-60 (isotope)	air	1.14e-03	2.04e-02	2.59e-01	2.59e-05	2.80e-01	3.12e-09
Cobalt-60 (isotope)	surface water	1.22e-01	0	0	0	1.22e-01	1.36e-09
Cobalt-80 (isotope)	treatment	0	7.74e+00	9.83e+01	9.83e-03	1.06e+02	1.18e-06
Curium-244 (isotope)	landfill	6.08e+02	0	0	0	6.08e+02	6.77e-06
Curium-245 (isotope)	landfill	6.78e-02	0	0	0	6.78e-02	7.55e-10
Iodine-129 (isotope)	landfill	9.58e-03	0	0	0	9.58e-03	1.07e-10
Iodine-131 (isotope)	air	6.67e-03	9.51e-02	1.21e+00	1.21e-04	1.31e+00	1.46e-08
Iodine-131 (isotope)	surface water	7.40e-03	0	0	0	7.40e-03	8.24e-11
Iodine-131 (isotope)	treatment	0	1.38e+00	1.75e+01	1.75e-03	1.89e+01	2.10e-07
Iodine-132 (isotope)	air	0	1.93e-02	2.45e-01	2.46e-05	2.65e-01	2.95e-09
Iodine-132 (isotope)	treatment	0	5.22e-01	6.64e+00	6.64e-04	7.16e+00	7.97e-08
Iodine-133 (isotope)	air	1.30e-02	8.82e+01	1.12e+03	1.12e-01	1.21e+03	1.35e-05
Iodine-133 (isotope)	treatment	0	5.91e-01	7.51e+00	7.52e-04	8.10e+00	9.02e-08
Iodine-134 (isotope)	air	0	1.00e-01	1.27e+00	1.27e-04	1.37e+00	1.53e-08
Iodine-135 (isotope)	air	0	5.03e-03	6.39e-02	6.39e-06	6.89e-02	7.67e-10
Iodine-135 (isotope)	treatment	0	4.24e-01	5.39e+00	5.39e-04	5.82e+00	6.47e-08
Iron-55 (isotope)	treatment	0	7.05e+00	8.95e+01	8.96e-03	9.66e+01	1.07e-06
Iron-59 (isotope)	treatment	0	3.62e-01	4.60e+00	4.60e-04	4.96e+00	5.52e-08
Krypton-85 (isotope)	air	1.73e+02	2.08e+03	2.65e+04	2.65e+00	2.87e+04	3.20e-04
Krypton-85M (isotope)	air	0	1.01e+02	1.28e+03	1.28e-01	1.38e+03	1.54e-05
Krypton-85M (isotope)	treatment	0	1.86e+00	2.37e+01	2.37e-03	2.55e+01	2.84e-07

Table J-9. CRT radioactivity outputs (Bq/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Krypton-87 (isotope)	air	0	3.76e+01	4.78e+02	4.78e-02	5.15e+02	5.74e-06
Krypton-88 (isotope)	air	0	1.76e+02	2.24e+03	2.24e-01	2.42e+03	2.69e-05
Lanthanum-140 (isotope)	treatment	0	4.93e-02	6.26e-01	6.26e-05	6.75e-01	7.52e-09
Lead-210 (isotope)	air	1.02e+00	0	0	0	1.02e+00	1.14e-08
Manganese-54 (isotope)	air	0	1.12e-03	1.42e-02	1.42e-06	1.53e-02	1.71e-10
Manganese-54 (isotope)	surface water	9.76e-03	0	0	0	9.76e-03	1.09e-10
Manganese-54 (isotope)	treatment	0	1.97e+00	2.50e+01	2.51e-03	2.70e+01	3.01e-07
Molybdenum-99 (isotope)	treatment	0	3.72e+06	4.73e+07	4.73e+03	5.10e+07	56.75%
Neptunium-237 (isotope)	landfill	9.39e+01	0	0	0	9.39e+01	1.05e-06
Niobium-95 (isotope)	air	0	4.45e-05	5.65e-04	5.65e-08	6.09e-04	6.78e-12
Niobium-95 (isotope)	treatment	0	5.08e-01	6.45e+00	6.45e-04	6.96e+00	7.74e-08
Palladium-107 (isotope)	landfill	3.30e-02	0	0	0	3.30e-02	3.67e-10
Plutonium-239 (isotope)	landfill	1.14e+05	0	0	0	1.14e+05	1.26e-03
Plutonium-240 (isotope)	landfill	1.62e+05	0	0	0	1.62e+05	1.80e-03
Plutonium-241 (isotope)	landfill	3.74e+07	0	0	0	3.74e+07	41.67%
Plutonium-242 (isotope)	landfill	6.10e+02	0	0	0	6.10e+02	6.79e-06
Polonium-210 (isotope)	air	1.76e+00	0	0	0	1.76e+00	1.96e-08
Potassium-40 (isotope)	air	2.73e-01	0	0	0	2.73e-01	3.04e-09
Protactinium-234 (isotope)	air	1.61e-02	0	0	0	1.61e-02	1.79e-10
Protactinium-234 (isotope)	surface water	2.98e-01	0	0	0	2.98e-01	3.32e-09
Radioactive aerosols and halogenes (unspecified)	air	8.95e-02	0	0	0	8.95e-02	9.96e-10
radioactive gas (unspecified)	air	2.86e+03	0	0	0	2.86e+03	3.18e-05
Radioactive substance (unspecified)	air	8.69e+02	9.19e+02	0	-2.38e+00	1.79e+03	1.99e-05
Radioactive substance (unspecified)	surface water	1.61e+01	8.52e+00	0	-2.21e-02	2.46e+01	2.73e-07
Radium-222 (isotope)	air	1.04e+01	0	0	0	1.04e+01	1.16e-07
Radium-224 (isotope)	surface water	9.67e-01	0	0	0	9.67e-01	1.08e-08
Radium-226 (isotope)	air	1.37e+00	0	0	0	1.37e+00	1.53e-08
Radium-226 (isotope)	landfill	6.35e+02	0	0	0	6.35e+02	7.07e-06
Radium-226 (isotope)	surface water	5.73e+02	0	0	0	5.73e+02	6.38e-06
Radium-228 (isotope)	air	1.35e-01	0	0	0	1.35e-01	1.50e-09
Radium-228 (isotope)	surface water	1.93e+00	0	0	0	1.93e+00	2.15e-08
Radon-220 (isotope)	air	3.17e+00	0	0	0	3.17e+00	3.53e-08
Radon-222 (isotope)	air	1.37e+05	0	0	0	1.37e+05	1.52e-03
Rubidium-88 (isotope)	air	0	4.13e-01	5.25e+00	5.25e-04	5.66e+00	6.30e-08
Ruthenium-103 (isotope)	treatment	0	6.21e-02	7.89e-01	7.89e-05	8.51e-01	9.47e-09
Samarium-151 (isotope)	landfill	1.35e+02	0	0	0	1.35e+02	1.50e-06
Selenium-79 (isotope)	landfill	1.05e-01	0	0	0	1.05e-01	1.17e-09
Silver-110M (isotope)	air	0	1.33e-06	1.68e-05	1.68e-09	1.82e-05	2.02e-13
Silver-110M (isotope)	surface water	2.93e-01	0	0	0	2.93e-01	3.26e-09
Silver-110M (isotope)	treatment	0	7.25e-01	9.20e+00	9.21e-04	9.93e+00	1.11e-07
Sodium-24 (isotope)	treatment	0	1.10e-01	1.40e+00	1.40e-04	1.51e+00	1.68e-08
Strontium-89 (isotope)	treatment	0	1.19e-01	1.52e+00	1.52e-04	1.63e+00	1.82e-08
Strontium-90 (isotope)	landfill	2.18e+04	0	0	0	2.18e+04	2.43e-04
Strontium-90 (isotope)	treatment	0	2.80e-02	3.56e-01	3.56e-05	3.84e-01	4.28e-09
Strontium-95 (isotope)	treatment	0	3.09e-01	3.93e+00	3.93e-04	4.23e+00	4.71e-08
Sulfur-136 (isotope)	treatment	0	6.65e-02	8.45e-01	8.46e-05	9.12e-01	1.01e-08

Table J-9. CRT radioactivity outputs (Bq/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Technetium-99M (isotope)	air	0	5.96e-06	7.57e-05	7.58e-09	8.17e-05	9.10e-13
Technetium-99M (isotope)	landfill	4.46e+00	0	0	0	4.46e+00	4.97e-08
Technetium-99M (isotope)	treatment	0	4.33e-02	5.50e-01	5.50e-05	5.93e-01	6.60e-09
Thorium-228 (isotope)	air	1.14e-01	0	0	0	1.14e-01	1.27e-09
Thorium-228 (isotope)	surface water	3.87e+00	0	0	0	3.87e+00	4.30e-08
Thorium-230 (isotope)	air	2.33e-01	0	0	0	2.33e-01	2.59e-09
Thorium-230 (isotope)	landfill	6.35e+02	0	0	0	6.35e+02	7.07e-06
Thorium-230 (isotope)	surface water	2.79e+01	0	0	0	2.79e+01	3.10e-07
Thorium-232 (isotope)	air	7.28e-02	0	0	0	7.28e-02	8.10e-10
Thorium-234 (isotope)	air	1.61e-02	0	0	0	1.61e-02	1.79e-10
Thorium-234 (isotope)	surface water	2.98e-01	0	0	0	2.98e-01	3.32e-09
Tin-113 (isotope)	treatment	0	6.85e-02	8.70e-01	8.71e-05	9.39e-01	1.04e-08
Tin-126 (isotope)	landfill	1.84e-01	0	0	0	1.84e-01	2.05e-09
Tritium-3 (isotope)	air	3.47e+02	2.95e+03	3.74e+04	3.75e+00	4.07e+04	4.53e-04
Tritium-3 (isotope)	surface water	3.56e+03	0	0	0	3.56e+03	3.96e-05
Tritium-3 (isotope)	treatment	0	2.20e+04	2.80e+05	2.80e+01	3.02e+05	3.36e-03
Uranium-234 (isotope)	air	4.07e-01	0	0	0	4.07e-01	4.53e-09
Uranium-234 (isotope)	landfill	4.82e+02	0	0	0	4.82e+02	5.36e-06
Uranium-234 (isotope)	surface water	9.84e+00	0	0	0	9.84e+00	1.10e-07
Uranium-235 (isotope)	air	3.04e-03	0			3.04e-03	3.38e-11
Uranium-235 (isotope)	landfill	8.69e+00	0	0	0	8.69e+00	9.67e-08
Uranium-235 (isotope)	surface water	4.27e-01	0	0	0	4.27e-01	4.75e-09
Uranium-238 (isotope)	air	6.69e-01	0	0	0	6.69e-01	7.44e-09
Uranium-238 (isotope)	landfill	1.35e+02	0	0	0	1.35e+02	1.50e-06
Uranium-238 (isotope)	surface water	9.23e+00	0	0	0	9.23e+00	1.03e-07
Xenon-131M (isotope)	air	0	1.70e+02	2.16e+03	2.16e-01	2.33e+03	2.59e-05
Xenon-131M (isotope)	treatment	0	2.27e+01	2.88e+02	2.88e-02	3.11e+02	3.46e-06
Xenon-133 (isotope)	air	2.43e+03	6.28e+03	3.12e+05	3.12e+01	3.21e+05	3.57e-03
Xenon-133 (isotope)	treatment	0	3.48e+03	4.43e+04	4.43e+00	4.78e+04	5.31e-04
Xenon-133M (isotope)	air	0	1.99e+04	2.07e+04	2.07e+00	4.06e+04	4.52e-04
Xenon-133M (isotope)	treatment	0	2.85e+01	3.62e+02	3.63e-02	3.91e+02	4.35e-06
Xenon-135 (isotope)	air	0	9.27e+02	1.18e+04	1.18e+00	1.27e+04	1.41e-04
Xenon-135 (isotope)	treatment	0	2.60e+01	3.30e+02	3.30e-02	3.56e+02	3.96e-06
Xenon-135M (isotope)	air	0	1.77e+01	2.25e+02	2.25e-02	2.42e+02	2.70e-06
Xenon-138 (isotope)	air	0	5.87e+01	7.45e+02	7.45e-02	8.04e+02	8.95e-06
Zinc-85 (isotope)	treatment	0	3.33e-02	4.23e-01	4.23e-05	4.56e-01	5.07e-09
Zirconium-93 (isotope)	landfill	5.87e-01	0	0	0	5.87e-01	6.53e-09
Zirconium-95 (isotope)	air	0	1.15e-04	1.46e-03	1.46e-07	1.57e-03	1.75e-11
Total radioactivity outputs		3.80e+07	3.78e+06	4.80e+07	4.80e+03	8.98e+07	100.00%

Table J-10. LCD primary material inputs (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
1,4-butanolide	0	4.06e-04	0	0	4.06E-04	1.12E-06
15" LCD light guide	0	3.74e-01	0	0	3.74E-01	1.03E-03
1-methyl-2-pyrrolidinone	0	4.06e-04	0	0	4.06E-04	1.12E-06
2-(2-butoxyethoxy)-ethanol acetate	0	8.08e-06	0	0	8.08E-06	2.23E-08
3,4,5-trifluorobromobenzene	0	2.64e-04	0	0	2.64E-04	7.29E-07
3,4-difluorobromobenzene	0	3.65e-04	0	0	3.65E-04	1.01E-06
4-4(-propylcyclohexyl)cyclohexanone	0	2.18e-04	0	0	2.18E-04	6.00E-07
4-bromophenol	0	3.27e-04	0	0	3.27E-04	9.00E-07
4-ethylphenol	0	7.00e-05	0	0	7.00E-05	1.93E-07
4-pentylphenol	0	3.42e-04	0	0	3.42E-04	9.43E-07
4-propionylphenol	0	1.94e-04	0	0	1.94E-04	5.36E-07
AlNd	0	2.97e-05	0	0	2.97E-05	8.18E-08
Aluminum (elemental)	0	1.34e-01	0	0	1.34E-01	3.70E-04
Argon	0	3.53e-05	0	0	3.53E-05	9.74E-08
Assembled 15" LCD backlight unit	0	1.48e+00	0	0	1.48E+00	4.07E-03
Assembled LCD monitor	0	0	6.50E+00	0	6.50E+00	1.79%
Backlight lamp (CCFL)	0	1.94e-03	0	0	1.94E-03	5.34E-06
Barium Carbonate	0	1.37e-02	0	0	1.37E-02	3.79E-05
Bauxite (Al2O3, ore)	0	5.09e-01	0	0	5.09E-01	1.40E-03
Cables/wires	0	2.34e-01	0	0	2.34E-01	6.45E-04
Coal, average (in ground)	1.72E+00	8.03E+00	6.69E+01	1.27E-02	7.67E+01	21.15%
Fuel oil #4	0	0	0	-6.18E-02	-6.18E-02	-1.70E-04
Glass, unspecified	0	4.37E-02	0	0	4.37E-02	1.20E-04
Glycol ethers	0	4.06E-04	0	0	4.06E-04	1.12E-06
Indium tin oxide	0	5.26E-04	0	0	5.26E-04	1.45E-06
Iron (Fe, ore)	3.26E+00	0	0	0	3.26E+00	8.98E-03
Iron scrap	4.63E-01	0	0	0	4.63E-01	1.28E-03
LCD front glass (with color filters)	0	1.78E-01	0	0	1.78E-01	4.92E-04
LCD glass	0	4.52E-01	0	0	4.52E-01	1.25E-03
LCD material (confidential)	0	3.11E-04	0	0	3.11E-04	8.56E-07
LCD module	0	1.18E+00	0	0	1.18E+00	3.26E-03
LCD spacers, unspecified	0	1.69E-05	0	0	1.69E-05	4.66E-08
Liquid crystals, for 15" LCD	0	1.24E-03	0	0	1.24E-03	3.43E-06
Mercury	0	3.99E-06	0	0	3.99E-06	1.10E-08
Metals, remaining unspeciated	0	6.81E-04	0	0	6.81E-04	1.88E-06
Mild fiber	0	7.34E-07	0	0	7.34E-07	2.02E-09
Molybdenum	0	1.78E-04	0	0	1.78E-04	4.92E-07
MoW	0	9.09E-04	0	0	9.09E-04	2.51E-06
Natural gas	0	4.22E+00	5.22E+00	-5.75E-02	9.39E+00	2.59%
Natural gas (in ground)	2.29E+02	5.16E+00	0	-1.08E+00	2.33E+02	64.25%
Neon	0	6.31E-05	0	0	6.31E-05	1.74E-07
Petroleum (in ground)	7.09E-01	2.23E+01	1.42E+00	-1.00E+00	2.34E+01	6.45%
Pigment color resist, unspecified	0	3.72E-02	0	0	3.72E-02	1.03E-04
Polarizer	0	4.07E-02	0	0	4.07E-02	1.12E-04
Poly(methyl methacrylate)	0	3.83E-01	0	0	3.83E-01	1.06E-03
Polycarbonate resin	0	5.16E-01	0	0	5.16E-01	1.42E-03
Polyester adhesive	0	6.25E-04	0	0	6.25E-04	1.72E-06
Polyethylene terephthalate	0	5.88E-02	0	0	5.88E-02	1.62E-04

Table J-10. LCD primary material inputs (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Polyimide alignment layer, unspecified	0	4.86E-04	0	0	4.86E-04	1.34E-06
Polyvinyl alcohol	0	8.61E-03	0	0	8.61E-03	2.37E-05
Potassium Carbonate	0	1.75E-02	0	0	1.75E-02	4.83E-05
PPE	0	3.00E-01	0	0	3.00E-01	8.27E-04
Printed wiring board (PWB)	0	3.74E-01	0	0	3.74E-01	1.03E-03
PWB-laminate	0	3.74E-01	0	0	3.74E-01	1.03E-03
Recycled LCD glass	0	9.54E-02	0	0	9.54E-02	2.63E-04
Rubber, unspecified	0	6.01E-04	0	0	6.01E-04	1.66E-06
Sand	0	1.11E-01	0	0	1.11E-01	3.07E-04
Sodium Carbonate	0	2.26E-02	0	0	2.26E-02	6.23E-05
Solder (60% tin, 40% lead)	0	3.81E-02	0	0	3.81E-02	1.05E-04
Solder (63% tin; 37% lead)	0	2.24E-02	0	0	2.24E-02	6.18E-05
Steel	0	2.53E+00	0	0	2.53E+00	6.97E-03
Strontium Carbonate	0	1.53E-02	0	0	1.53E-02	4.23E-05
Styrene-butadiene copolymers	0	3.62E-01	0	0	3.62E-01	9.97E-04
Titanium	0	1.33E-04	0	0	1.33E-04	3.67E-07
Triallyl isocyanurate	0	1.54E-05	0	0	1.54E-05	4.26E-08
Triphenyl phosphate	0	9.25E-02	0	0	9.25E-02	2.55E-04
Unspecified LCD material	0	1.19E-04	0	0	1.19E-04	3.29E-07
Uranium, yellowcake	0	1.03E-03	1.81E-03	3.4352E-07	2.84E-03	7.84E-06
Zircon Sand	0	1.31E-03	0	0	1.31E-03	3.62E-06
Total primary inputs	2.35E+02	4.97E+01	8.01E+01	-2.19E+00	3.63E+02	100.00%

Table J-11. LCD ancillary material inputs (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
1,4-butanolide	0	4.04e-05	0	0	4.04e-05	1.94e-07
1-Methoxy-2-propanol	0	1.10e-02	0	0	1.10e-02	5.27e-05
2-(2-butoxyethoxy)-ethanol	0	3.04e-02	0	0	3.04e-02	1.46e-04
2,2,4-trimethylpentane	0	1.52e-05	0	0	1.52e-05	7.32e-08
2-ethoxyl ethylacetate	0	1.78e-03	0	0	1.78e-03	8.53e-06
Acetic acid	0	6.40e-03	0	0	6.40e-03	3.07e-05
Acetone	0	1.56e-01	0	0	1.56e-01	7.50e-04
Al-etchant, unspecified	0	5.88e-03	0	0	5.88e-03	2.83e-05
Aluminum Oxide	0	1.56e-03	0	0	1.56e-03	7.50e-06
Aluminum sulfate	3.63e-04	1.05e-01	0	0	1.05e-01	5.04e-04
Ammonia	0	1.55e-02	0	0	1.55e-02	7.46e-05
Ammonium bifluoride	0	2.36e-03	0	0	2.36e-03	1.13e-05
Ammonium chloride	0	3.42e-02	0	0	3.42e-02	1.64e-04
Ammonium fluoride	0	1.14e-02	0	0	1.14e-02	5.48e-05
Ammonium hydroxide	0	3.42e-02	0	0	3.42e-02	1.64e-04
Argon	0	7.87e-03	0	0	7.87e-03	3.78e-05
Barium sulfate	9.64e-04	0	0	0	9.64e-04	4.63e-06
Bauxite	2.10e-04	0	0	0	2.10e-04	1.01e-06
Bauxite (Al2O3, ore)	5.59e-04	2.16e-03	0	-7.63e-05	2.64e-03	1.27e-05
Bentonite (in ground)	1.00e-03	0	0	0	1.00e-03	4.82e-06
Borax	0	9.13e-05	0	0	9.13e-05	4.39e-07
Calcium hydroxide	0	1.39e-01	0	0	1.39e-01	6.67e-04
Calcium sulfate	7.37e-06	0	0	0	7.37e-06	3.54e-08
Calcium sulfate (CaSO4, ore)	9.75e-06	0	0	0	9.75e-06	4.68e-08
Carbon dioxide	0	4.86e-03	0	0	4.86e-03	2.33e-05
Cerium Oxide	0	1.52e-04	0	0	1.52e-04	7.29e-07
Chlorine	0	1.55e-02	0	0	1.55e-02	7.46e-05
Chromium ore	1.79e-08	0	0	0	1.79e-08	8.59e-11
Chromium Oxide	0	2.60e-06	0	0	2.60e-06	1.25e-08
Clay (in ground)	1.30e-03	0	0	1.69e+00	1.69e+00	8.12e-03
Cleaner, unspecified	0	1.47e-04	0	0	1.47e-04	7.05e-07
Coal, average (in ground)	0	0	0	7.38e-04	7.38e-04	3.54e-06
Copper (Cu, ore)	2.63e-04	0	0	0	2.63e-04	1.26e-06
Cresol-formaldehyde resin	0	8.29e-04	0	0	8.29e-04	3.98e-06
Cr-etchant, unspecified	0	1.77e-02	0	0	1.77e-02	8.49e-05
Cyclohexane	0	3.91e-03	0	0	3.91e-03	1.88e-05
Deoiling agent (unspecified)	6.53e-04	0	0	0	6.53e-04	3.14e-06
Developing solution, unspecified	0	4.00e-02	0	0	4.00e-02	1.92e-04
Diethyl ether	0	9.28e-05	0	0	9.28e-05	4.46e-07
Diluent, unspecified	0	8.27e-03	0	0	8.27e-03	3.97e-05
Dimethylsulfoxide	0	6.63e-02	0	0	6.63e-02	3.18e-04
Dioctyl Sebacate	1.14e-04	0	0	0	1.14e-04	5.47e-07
Dolomite (in ground)	2.08e-03	0	0	0	2.08e-03	9.98e-06
Ethanol	0	2.53e-02	0	0	2.53e-02	1.21e-04
Ethanol amine	0	7.85e-02	0	0	7.85e-02	3.77e-04
Ethylacetate	0	9.68e-04	0	0	9.68e-04	4.65e-06
Etoxy Naphtol Sulphonic Acid (ENSA)	4.88e-05	0	0	0	4.88e-05	2.34e-07
Exfoliation liquid, unspecified	0	1.43e-02	0	0	1.43e-02	6.86e-05
Explosive (unspecified)	9.77e-05	0	0	0	9.77e-05	4.69e-07

Table J-11. LCD ancillary material inputs (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Ferric chloride	0	8.92e-03	0	0	8.92e-03	4.28e-05
Ferromanganese (Fe, Mn, C)	3.83e-07	0	0	0	3.83e-07	1.84e-09
Fluorocarbon resin	0	3.38e-06	0	0	3.38e-06	1.63e-08
Fluorspar (CaF2, ore)	5.37e-06	0	0	0	5.37e-06	2.58e-08
Flux, unspecified	0	7.35e-05	0	0	7.35e-05	3.53e-07
Formaldehyde	0	2.91e-03	0	0	2.91e-03	1.40e-05
Glycol ethers	0	3.16e-02	0	0	3.16e-02	1.52e-04
Gravel	9.08e-08	0	0	0	9.08e-08	4.36e-10
Gravel/Sand	1.01e-03	0	0	0	1.01e-03	4.85e-06
HCFC-225ca	0	1.37e-04	0	0	1.37e-04	6.57e-07
HCFC-225cb	0	1.37e-04	0	0	1.37e-04	6.57e-07
Helium	0	6.18e-04	0	0	6.18e-04	2.97e-06
Heptane	0	1.03e-02	0	0	1.03e-02	4.93e-05
Hexamethyldisilizane	0	2.58e-04	0	0	2.58e-04	1.24e-06
Hydrochloric acid	0	1.29e-01	0	0	1.29e-01	6.21e-04
Hydrofluoric acid	0	4.58e-02	0	0	4.58e-02	2.20e-04
Hydrogen	0	4.44e-01	0	0	4.44e-01	2.13e-03
Hydrogen peroxide	0	1.38e-02	0	0	1.38e-02	6.65e-05
Iron (Fe, ore)	7.65e-03	0	0	7.04e-04	8.35e-03	4.01e-05
Iron sulfate (FeSO4, ore)	7.99e-06	0	0	0	7.99e-06	3.84e-08
Isopropyl alcohol	0	3.49e-01	0	0	3.49e-01	1.67e-03
ITO etchant, unspecified	0	2.94e-03	0	0	2.94e-03	1.41e-05
Krypton	0	2.58e-05	0	0	2.58e-05	1.24e-07
Lead (Pb, ore)	2.47e-05	0	0	0	2.47e-05	1.19e-07
Lime	0	4.74e-02	3.95e-01	7.49e-05	4.42e-01	2.12e-03
Limestone	0	1.08e-01	8.99e-01	1.71e-04	1.01e+00	4.84e-03
Limestone (CaCO3, in ground)	5.07e-01	5.49e-02	0	-1.55e-01	4.06e-01	1.95e-03
LNG	0	1.94e+02	0	0	1.94e+02	9.32e-01
Lubricant (unspecified)	2.02e-02	0	0	0	2.02e-02	9.68e-05
Manganese (Mn, ore)	1.04e-08	0	0	0	1.04e-08	5.00e-11
Methyl ethyl ketone	0	4.91e-04	0	0	4.91e-04	2.36e-06
Monosilane	0	1.12e-03	0	0	1.12e-03	5.40e-06
Natural gas (in ground)	0	0	0	1.09e-03	1.09e-03	5.22e-06
N-Butylacetate	0	3.83e-02	0	0	3.83e-02	1.84e-04
Nickel (Ni, ore)	6.05e-09	0	0	0	6.05e-09	2.91e-11
Nitric acid	0	7.23e-02	0	0	7.23e-02	3.47e-04
Nitric acid second cerium ammonium	0	1.13e-02	0	0	1.13e-02	5.43e-05
Nitrogen	0	6.02e+00	0	0	6.02e+00	2.89e-02
Nitrogen fluoride	0	1.08e-01	0	0	1.08e-01	5.19e-04
Nitrous oxide	0	1.36e-03	0	0	1.36e-03	6.51e-06
Oil (in ground)	0	0	0	8.06e-03	8.06e-03	3.87e-05
Olivine	2.72e-07	0	0	0	2.72e-07	1.31e-09
Olivine ore	7.92e-06	0	0	0	7.92e-06	3.80e-08
Orthoboric acid	0	7.30e-04	0	0	7.30e-04	3.51e-06
Oxygen	0	7.75e-03	0	0	7.75e-03	3.72e-05
Perchloric acid	0	3.82e-03	0	0	3.82e-03	1.84e-05
Perfluoromethane	0	1.29e-03	0	0	1.29e-03	6.18e-06
Phenolsulphonic Acid	1.53e-03	0	0	0	1.53e-03	7.34e-06
Phosphine	0	2.69e-02	0	0	2.69e-02	1.29e-04

Table J-11. LCD ancillary material inputs (kg/functional unit)

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Phosphoric acid	0	3.95e-02	0	0	3.95e-02	1.90e-04
Photoresist, unspecified	0	1.68e-02	0	0	1.68e-02	8.05e-05
Polyaluminum chloride	0	6.40e-03	0	0	6.40e-03	3.07e-05
Polyethylene glycol	0	2.23e-02	0	0	2.23e-02	1.07e-04
Polyethylene mono(nonylphenyl) ether glycol	0	3.40e-04	0	0	3.40e-04	1.63e-06
Polyethylene terephthalate	0	3.20e-02	0	0	3.20e-02	1.53e-04
Polyimide, unspecified	0	2.94e-05	0	0	2.94e-05	1.41e-07
Potassium chloride (KCl, as K2O, in ground)	3.03e-05	0	0	0	3.03e-05	1.45e-07
Potassium hydroxide	0	1.88e-02	0	0	1.88e-02	9.04e-05
Potassium permanganate	0	5.14e-04	0	0	5.14e-04	2.47e-06
Potassium peroxymonosulfate	0	3.12e-02	0	0	3.12e-02	1.50e-04
Process material for backlight assembly	0	7.03e-05	0	0	7.03e-05	3.37e-07
Propylene glycol	0	4.46e-03	0	0	4.46e-03	2.14e-05
Propylene glycol monomethyl ether acetate	0	1.56e-02	0	0	1.56e-02	7.50e-05
Pumice	0	3.64e-03	0	0	3.64e-03	1.75e-05
PWB-solder mask solids	0	1.93e-02	0	0	1.93e-02	9.25e-05
Pyrite (FeS2, ore)	3.77e-02	0	0	0	3.77e-02	1.81e-04
Raw materials (unspecified)	4.06e-03	0	0	0	4.06e-03	1.95e-05
Rinse, unspecified	0	5.27e-02	0	0	5.27e-02	2.53e-04
Sand (in ground)	9.55e-03	1.32e-03	0	5.60e-01	5.71e-01	2.74e-03
Silver (Ag, ore)	4.51e-10	0	0	0	4.51e-10	2.17e-12
Sodium Carbonate	0	1.42e-02	0	0	1.42e-02	6.82e-05
Sodium chloride (NaCl, in ground or in sea)	4.37e-01	6.08e-04	0	1.08e-05	4.38e-01	2.10e-03
Sodium Dichromate	1.29e-04	0	0	0	1.29e-04	6.19e-07
Sodium dihydrogen phosphate dihydrate	0	4.06e-06	0	0	4.06e-06	1.95e-08
Sodium hydroxide	0	4.45e-01	0	0	4.45e-01	2.14e-03
Solder, unspecified	0	7.35e-05	0	0	7.35e-05	3.53e-07
Sulfur (S, in ground)	1.53e-02	0	0	0	1.53e-02	7.34e-05
Sulfur hexafluoride	0	1.62e-02	0	0	1.62e-02	7.79e-05
Sulfuric acid	0	3.25e-01	0	0	3.25e-01	1.56e-03
Surfactant, unspecified	0	1.09e-04	0	0	1.09e-04	5.25e-07
Synthetic resin, unspecified	0	6.57e-04	0	0	6.57e-04	3.16e-06
Tetrahydrofuran	0	3.82e-03	0	0	3.82e-03	1.84e-05
Tetramethyl ammonium hydroxide	0	1.29e-01	0	0	1.29e-01	6.18e-04
Tin (Sn, ore)	1.19e-02	0	0	0	1.19e-02	5.72e-05
Toluene	0	2.75e-02	0	0	2.75e-02	1.32e-04
Unspecified ancillary material	0	4.19e-04	0	0	4.19e-04	2.01e-06
Unspecified LCD process material	0	2.57e-02	0	0	2.57e-02	1.23e-04
Unspecified LCD process material ("Natural Sweeper")	0	1.09e-04	0	0	1.09e-04	5.23e-07
Uranium (U, ore)	0	0	0	1.00e-08	1.00e-08	4.81e-11
Water	0	6.88e-02	0	0	6.88e-02	3.30e-04
Xylene (mixed isomers)	0	1.57e-03	0	0	1.57e-03	7.54e-06
Zinc (Zn, ore)	6.61e-10	0	0	0	6.61e-10	3.18e-12
Total ancillary inputs	1.06e+00	2.04e+02	1.29e+00	2.11e+00	2.08e+02	100.00%

Table J-12. LCD utility inputs

Material	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Fuels (kg/functional unit):						
Fuel Oil #2 (distillate)	0	5.42E-02	0	0	5.42E-02	0.14%
Fuel oil #4 (avg. of #2 + #6)	0	2.11E-01	0	-9.09E-01	-6.99E-01	-1.81%
Fuel oil #6 (residual)	0	1.25E-01	0	0	1.25E-01	0.33%
Kerosene	0	4.65E-01	0	0	4.65E-01	1.21%
LNG	0	3.22E+00	0	0	3.22E+00	8.34%
LPG	0	1.68E+01	0	1.38E-03	1.68E+01	43.63%
Natural gas	0	1.16E+00	0	-8.61E-01	3.01E-01	0.78%
Steam	0	1.45E-01	0	0	1.45E-01	0.37%
Coal, average (in ground)	2.49E+00	6.86E-01	0	-7.66E-03	3.17E+00	8.21%
Coal, lignite (in ground)	4.10E-01	0	0	0	4.10E-01	1.06%
Natural gas (in ground)	1.03E+01	2.41E+00	0	-1.38E-01	1.26E+01	32.66%
Petroleum (in ground)	1.52E+00	4.84E-01	0	-3.81E-02	1.96E+00	5.08%
Uranium (U, ore)	7.86E-05	1.15E-05	0	-1.32E-07	9.01E-05	2.33E-06
Total fuels	1.47E+01	2.58E+01	0	-1.95E+00	3.86E+01	100.00%
Electricity (MJ/functional unit):						
Electricity	3.46E+01	3.16E+02	8.53E+02	1.62E-01	1.20E+03	
Water (kg or L/functional unit):						
Water	2.63E+02	2.15E+03	4.25E+02	-1.80E+01	2.82E+03	
Total energy (fuels and electricity, MJ/functional unit):						
Energy	6.33E+02	1.44E+03	8.53E+02	-8.44E+01	2.84E+03	

Table J-13. LCD air emissions (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	Fraction of Total
1,1,1-Trichloroethane	Air	1.62e-08	2.28e-07	7.16e-07	-1.95e-08	9.40e-07	2.72e-09
1,2-Dichloroethane	Air	3.24e-08	1.75e-07	1.34e-06	-3.85e-08	1.51e-06	4.36e-09
1,2-Dichlorotetrafluoroethane	Air	8.90e-08	0	0	0	8.90e-08	2.57e-10
1,4-Dichlorobenzene	Air	1.89e-07	1.89e-08	0	-1.49e-09	2.06e-07	5.96e-10
2,3,7,8-TCDD	Air	0	5.90e-14	4.79e-13	9.08e-17	5.38e-13	1.55e-15
2,3,7,8-TCDF	Air	0	2.05e-13	1.71e-12	3.24e-16	1.91e-12	5.53e-15
2,4-Dinitrotoluene	Air	2.27e-10	1.22e-09	9.37e-09	-2.74e-10	1.05e-08	3.05e-11
2-Chloroacetophenone	Air	5.67e-09	3.06e-08	2.34e-07	-9.35e-11	2.70e-07	7.82e-10
2-Methylnaphthalene	Air	3.78e-09	1.18e-09	9.95e-10	-3.53e-11	5.92e-09	1.71e-11
3-Methylcholanthrene	Air	2.83e-10	2.84e-11	0	-2.66e-12	3.09e-10	8.94e-13
5-Methyl chrysene	Air	1.78e-11	9.60e-11	7.36e-10	-2.15e-11	8.29e-10	2.40e-12
Acenaphthene	Air	9.25e-10	1.49e-08	2.12e-08	-5.04e-10	3.65e-08	1.06e-10
Acenaphthylene	Air	4.89e-10	1.27e-09	8.42e-09	-2.47e-10	9.93e-09	2.87e-11
Acetaldehyde	Air	7.90e-07	2.49e-06	1.91e-05	-5.57e-07	2.18e-05	6.30e-08
Acetic acid	Air	4.22e-06	1.36e-03	0	0	1.36e-03	3.93e-06
Acetone	Air	3.26e-07	1.86e-04	0	0	1.86e-04	5.39e-07
Acetophenone	Air	1.22e-08	6.55e-08	5.02e-07	-1.47e-08	5.65e-07	1.63e-09
Acetylene	Air	1.14e-05	0	0	0	1.14e-05	3.30e-08
Acrolein	Air	2.35e-07	1.27e-06	9.71e-06	-2.83e-07	1.09e-05	3.16e-08
Adsorbable organic halides	Air	3.56e-17	0	0	0	3.56e-17	1.03e-19
Alcohols	Air	2.85e-06	0	0	0	2.85e-06	8.23e-09
Aldehydes	Air	8.53e-04	8.98e-05	0	-1.05e-04	8.37e-04	2.42e-06
Al-etchant, unspecified	Air	0	1.37e-02	0	0	1.37e-02	3.97e-05
Alkane (unspecified)	Air	1.07e-04	0	0	0	1.07e-04	3.10e-07
Alkenes	Air	1.79e-05	0	0	0	1.79e-05	5.18e-08
Alkyne (unspecified)	Air	5.46e-08	0	0	0	5.46e-08	1.58e-10
Aluminum (elemental)	Air	8.09e-05	9.59e-07	0	-5.72e-08	8.18e-05	2.36e-07
Ammonia	Air	1.12e-02	6.26e-02	0	-6.95e-05	7.37e-02	2.13e-04
Anthracene	Air	5.61e-10	1.68e-09	7.27e-09	-2.09e-10	9.30e-09	2.69e-11
Antimony	Air	2.28e-07	3.24e-06	1.63e-06	-4.25e-08	5.05e-06	1.46e-08
Argon	Air	0	5.80e-03	0	0	5.80e-03	1.68e-05
Aromatic hydrocarbons	Air	7.67e-05	2.55e-09	0	-9.05e-11	7.67e-05	2.22e-07
Arsenic	Air	1.63e-06	3.14e-06	1.40e-05	-1.72e-06	1.70e-05	4.93e-08
Barium	Air	1.39e-06	1.76e-06	7.67e-07	-1.65e-08	3.91e-06	1.13e-08
Benzaldehyde	Air	2.78e-14	0	0	0	2.78e-14	8.04e-17
Benzene	Air	8.85e-02	2.70e-03	4.36e-05	-4.82e-04	9.07e-02	2.62e-04
Benzo[a]anthracene	Air	3.92e-10	2.78e-09	3.46e-09	-8.13e-11	6.55e-09	1.89e-11
Benzo[a]pyrene	Air	4.40e-08	1.91e-10	1.27e-09	-3.93e-11	4.54e-08	1.31e-10
Benzo[b,j,k]fluoranthene	Air	8.92e-11	1.37e-09	3.97e-09	-1.07e-10	5.32e-09	1.54e-11
Benzo[b]fluoranthene	Air	2.91e-10	3.09e-11	0	-2.79e-12	3.19e-10	9.24e-13
Benzo[g,h,i]perylene	Air	2.23e-10	1.48e-09	1.35e-09	-2.83e-11	3.02e-09	8.74e-12
Benzo[k]fluoranthene	Air	2.91e-10	3.09e-11	0	-2.79e-12	3.19e-10	9.24e-13
Benzyl chloride	Air	5.67e-07	3.05e-06	2.34e-05	-6.84e-07	2.64e-05	7.62e-08
Beryllium	Air	2.19e-07	1.86e-07	7.12e-07	-1.99e-07	9.18e-07	2.65e-09
Biphenyl	Air	1.38e-09	7.42e-09	5.69e-08	-1.66e-09	6.40e-08	1.85e-10
Boron	Air	1.79e-05	0	0	0	1.79e-05	5.16e-08
Bromine	Air	9.94e-07	0	0	0	9.94e-07	2.87e-09
Bromoform	Air	3.16e-08	1.70e-07	1.31e-06	-3.81e-08	1.47e-06	4.25e-09
Bromomethane	Air	1.30e-07	6.98e-07	5.36e-06	-1.56e-07	6.03e-06	1.74e-08

Table J-13. LCD air emissions (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	Fraction of Total
Butane	Air	3.42e-04	3.31e-05	0	-3.11e-06	3.72e-04	1.07e-06
Butene	Air	1.09e-07	0	0	0	1.09e-07	3.15e-10
Cadmium	Air	2.93e-07	5.25e-07	1.80e-06	-6.58e-08	2.55e-06	7.37e-09
Calcium	Air	8.74e-05	8.31e-07	0	-4.96e-08	8.82e-05	2.55e-07
Carbon dioxide	Air	1.07e+02	6.22e+01	1.66e+02	1.39e+00	3.36e+02	9.72e-01
Carbon disulfide	Air	1.05e-07	5.67e-07	4.35e-06	-1.27e-07	4.90e-06	1.42e-08
Carbon monoxide	Air	3.74e-01	3.85e-02	3.02e-02	-3.45e-03	4.39e-01	1.27e-03
Carbon tetrachloride	Air	0	0	0	5.85e-10	5.85e-10	1.69e-12
Chloride ions	Air	1.77e-04	2.09e-04	6.78e-05	-1.64e-06	4.52e-04	1.31e-06
Chlorine	Air	6.64e-07	1.01e-09	0	-1.80e-10	6.65e-07	1.92e-09
Chloroacetophenone	Air	0	0	0	-6.74e-09	-6.74e-09	-1.95e-11
Chlorobenzene	Air	1.78e-08	9.60e-08	7.36e-07	-2.15e-08	8.29e-07	2.40e-09
Chloroform	Air	4.78e-08	2.57e-07	1.97e-06	-5.70e-08	2.22e-06	6.43e-09
Chromium	Air	6.40e-09	0	0	0	6.40e-09	1.85e-11
Chromium (III)	Air	1.50e-06	2.96e-06	9.07e-06	-1.43e-06	1.21e-05	3.50e-08
Chromium (VI)	Air	1.50e-06	1.52e-06	2.69e-06	-1.43e-06	4.29e-06	1.24e-08
Chrysene	Air	3.77e-10	1.89e-09	3.81e-09	-1.00e-10	5.98e-09	1.73e-11
Cobalt	Air	5.36e-07	4.13e-06	4.54e-06	-1.30e-07	9.07e-06	2.62e-08
Copper	Air	8.26e-07	1.15e-06	3.72e-07	-1.65e-08	2.33e-06	6.75e-09
Cr-etchant, unspecified	Air	0	4.12e-02	0	0	4.12e-02	1.19e-04
Cumene	Air	4.30e-09	2.75e-09	1.77e-07	-5.18e-09	1.79e-07	5.18e-10
Cumene hydroperoxide	Air	0	2.04e-08	0	0	2.04e-08	5.89e-11
Cyanide (-1)	Air	2.04e-06	1.09e-05	8.37e-05	-2.44e-06	9.42e-05	2.72e-07
Cyclohexane	Air	0	4.85e-05	0	0	4.85e-05	1.40e-07
Di(2-ethylhexyl)phthalate	Air	5.92e-08	3.19e-07	2.44e-06	-7.13e-08	2.75e-06	7.95e-09
Dibenzo[a,h]anthracene	Air	1.98e-10	1.02e-09	3.26e-10	-1.85e-12	1.54e-09	4.46e-12
Dichlorobenzene (mixed isomers)	Air	0	0	0	-2.82e-10	-2.82e-10	-8.16e-13
Dichloromethane	Air	2.35e-07	1.27e-06	9.71e-06	-2.82e-07	1.09e-05	3.16e-08
Diethyl ether	Air	0	9.26e-05	0	0	9.26e-05	2.68e-07
Diethylene glycol	Air	0	9.69e-05	0	0	9.69e-05	2.80e-07
Dimethyl sulfate	Air	3.89e-08	2.09e-07	1.61e-06	-4.69e-08	1.81e-06	5.23e-09
Dimethylbenzanthracene	Air	2.36e-09	2.36e-10	0	-2.23e-11	2.58e-09	7.45e-12
Dioxins, remaining unspeciated	Air	1.32e-11	8.22e-12	2.18e-11	1.33e-10	1.76e-10	5.08e-13
Ethane	Air	6.08e-04	4.88e-05	0	-4.59e-06	6.53e-04	1.89e-06
Ethanethiol	Air	4.50e-07	0	0	0	4.50e-07	1.30e-09
Ethanol	Air	6.51e-07	4.63e-05	0	0	4.69e-05	1.36e-07
Ethyl Chloride	Air	3.40e-08	1.83e-07	1.41e-06	-4.10e-08	1.58e-06	4.57e-09
Ethylacetate	Air	0	1.22e-07	0	0	1.22e-07	3.53e-10
Ethylacetate	Treatment	0	2.32e-06	0	0	2.32e-06	6.70e-09
Ethylbenzene	Air	2.28e-07	4.48e-07	3.16e-06	-9.00e-08	3.75e-06	1.08e-08
Ethylene	Air	1.02e-04	0	0	0	1.02e-04	2.94e-07
Ethylene dibromide	Air	9.73e-10	5.24e-09	4.02e-08	-1.17e-09	4.52e-08	1.31e-10
Fluoranthene	Air	1.07e-09	6.31e-09	2.50e-08	-6.98e-10	3.17e-08	9.17e-11
Fluorene	Air	1.20e-09	6.68e-09	3.13e-08	-8.93e-10	3.83e-08	1.11e-10
Fluoride	Air	0	3.78e-08	7.29e-06	1.38e-09	7.33e-06	2.12e-08
Fluorides (F-)	Air	9.48e-07	2.24e-05	0	-2.05e-07	2.32e-05	6.69e-08
Fluorine	Air	2.83e-07	0	0	0	2.83e-07	8.18e-10
Formaldehyde	Air	1.87e-05	1.09e-04	3.16e-05	-5.78e-06	1.54e-04	4.45e-07
Furans, remaining unspeciated	Air	6.10e-11	3.02e-11	3.48e-11	-7.40e-11	5.20e-11	1.50e-13

Table J-13. LCD air emissions (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	Fraction of Total
Halogenated hydrocarbons (unspecified)	Air	1.12e-06	1.42e-14	0	-4.93e-16	1.12e-06	3.24e-09
Halogenated matter (unspecified)	Air	4.67e-19	0	0	0	4.67e-19	1.35e-21
HALON-1301	Air	7.95e-08	2.47e-11	0	-8.75e-13	7.95e-08	2.30e-10
HCFC-225ca	Air	0	1.40e-04	0	0	1.40e-04	4.05e-07
HCFC-225cb	Air	0	1.40e-04	0	0	1.40e-04	4.05e-07
Heptane	Air	1.09e-06	7.77e-05	0	0	7.88e-05	2.28e-07
Hexamethyldisilizane	Air	0	1.37e-06	0	0	1.37e-06	3.97e-09
Hexane	Air	2.86e-04	2.86e-05	2.24e-06	-2.73e-06	3.14e-04	9.07e-07
Hydrocarbons, remaining unspeciated	Air	9.30e-03	7.75e-03	0	-6.51e-04	1.64e-02	4.74e-05
Hydrochloric acid	Air	1.50e-03	6.58e-02	4.02e-02	-6.88e-04	1.07e-01	3.09e-04
Hydrofluoric acid	Air	2.27e-04	5.27e-02	5.02e-03	-1.47e-04	5.78e-02	1.67e-04
Hydrogen	Air	2.99e-04	1.33e-04	0	0	4.32e-04	1.25e-06
Hydrogen cyanide	Air	3.83e-06	0	0	0	3.83e-06	1.11e-08
Hydrogen sulfide	Air	1.55e-05	1.51e-04	0	-8.88e-06	1.57e-04	4.55e-07
Indeno(1,2,3-cd)pyrene	Air	3.44e-10	1.57e-09	2.46e-09	-6.23e-11	4.31e-09	1.25e-11
Iodine	Air	2.95e-07	0	0	0	2.95e-07	8.52e-10
Iron	Air	4.76e-05	1.85e-06	0	-1.11e-07	4.94e-05	1.43e-07
Isophorone	Air	4.70e-07	2.53e-06	1.94e-05	-5.67e-07	2.18e-05	6.32e-08
Isopropyl alcohol	Air	0	1.78e-02	0	0	1.78e-02	5.13e-05
Isopropylpropionate	Air	9.91e-11	0	0	0	9.91e-11	2.87e-13
ITO etchant, unspecified	Air	0	6.86e-03	0	0	6.86e-03	1.98e-05
Lanthanum	Air	2.63e-08	0	0	0	2.63e-08	7.61e-11
Lead	Air	3.13e-06	6.63e-07	4.76e-06	4.76e-06	1.33e-05	3.85e-08
Lead (Pb, ore)	Air	1.48e-06	0	0	0	1.48e-06	4.29e-09
Magnesium	Air	4.06e-05	4.80e-05	3.68e-04	-1.07e-05	4.46e-04	1.29e-06
Manganese	Air	2.94e-06	1.24e-06	1.70e-05	-3.23e-06	1.80e-05	5.19e-08
Manganese (Mn, ore)	Air	0	3.67e-06	0	0	3.67e-06	1.06e-08
Mercaptans	Air	1.81e-07	0	0	0	1.81e-07	5.24e-10
Mercury	Air	8.53e-07	4.57e-07	2.80e-06	-8.64e-08	4.03e-06	1.16e-08
Metals, remaining unspeciated	Air	2.64e-05	1.60e-08	0	-7.10e-10	2.64e-05	7.63e-08
Methane	Air	3.54e+00	1.22e-01	2.41e-01	-2.82e-02	3.87e+00	1.12e-02
Methanol	Air	1.11e-06	0	0	0	1.11e-06	3.20e-09
Methyl chloride	Air	4.30e-07	2.31e-06	1.77e-05	-5.18e-07	2.00e-05	5.77e-08
Methyl ethyl ketone	Air	3.16e-07	2.43e-06	1.31e-05	-3.81e-07	1.54e-05	4.46e-08
Methyl ethyl ketone	Treatment	0	1.34e-04	0	0	1.34e-04	3.88e-07
Methyl hydrazine	Air	1.38e-07	7.42e-07	5.69e-06	-1.66e-07	6.40e-06	1.85e-08
Methyl methacrylate	Air	1.62e-08	8.73e-08	6.69e-07	-1.95e-08	7.53e-07	2.18e-09
Methyl tert-butyl ether	Air	2.84e-08	1.52e-07	1.17e-06	-3.81e-07	9.71e-07	2.81e-09
Molybdenum	Air	2.98e-07	6.21e-07	2.18e-07	-1.35e-08	1.12e-06	3.25e-09
Monosilane	Air	0	1.54e-03	0	0	1.54e-03	4.44e-06
Naphthalene	Air	1.30e-07	7.67e-07	6.82e-07	-1.90e-08	1.56e-06	4.51e-09
N-bromoacetamide	Air	0	9.18e-03	0	0	9.18e-03	2.65e-05
Nickel	Air	8.06e-06	5.57e-05	2.56e-05	-2.98e-06	8.64e-05	2.50e-07
Nitric acid	Air	0	2.69e-04	0	0	2.69e-04	7.76e-07
Nitrogen dioxide	Air	3.08e-02	0	0	4.46e-04	3.12e-02	9.03e-05
Nitrogen fluoride	Air	0	2.45e-01	0	0	2.45e-01	7.09e-04
Nitrogen oxides	Air	6.56e-01	7.62e-01	4.39e-01	-1.36e-02	1.84e+00	5.33e-03
Nitrous oxide	Air	1.24e-03	1.20e-03	1.27e-03	-7.19e-04	2.98e-03	8.63e-06

Table J-13. LCD air emissions (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	Fraction of Total
Nonmethane hydrocarbons, remaining unspeciated	Air	2.07e-01	8.87e-03	0	-1.26e-03	2.15e-01	6.22e-04
n-Propane	Air	4.49e-05	8.67e-08	0	-2.40e-07	4.48e-05	1.29e-07
Other organics	Air	4.45e-01	1.35e-02	0	-2.41e-03	4.56e-01	1.32e-03
o-xylene	Air	4.83e-06	2.24e-07	2.13e-08	-2.50e-08	5.05e-06	1.46e-08
Pentane	Air	4.18e-04	4.10e-05	0	-3.85e-06	4.55e-04	1.31e-06
Perfluoroethane	Air	5.36e-06	0	0	0	5.36e-06	1.55e-08
Perfluoromethane	Air	4.83e-05	0	0	0	4.83e-05	1.40e-07
Phenanthrene	Air	4.92e-09	1.92e-08	9.35e-08	-2.66e-09	1.15e-07	3.33e-10
Phenol	Air	9.34e-07	6.98e-08	5.36e-07	-1.56e-08	1.52e-06	4.41e-09
Phosphine	Air	0	6.26e-02	0	0	6.26e-02	1.81e-04
Phosphoric acid	Air	0	4.85e-05	0	0	4.85e-05	1.40e-07
Phosphorus (yellow or white)	Air	7.54e-07	6.20e-07	1.85e-06	-7.84e-08	3.14e-06	9.09e-09
Phosphorus pentoxide	Air	2.56e-10	0	0	0	2.56e-10	7.40e-13
PM	Air	9.16e-02	6.99e-03	0	-1.24e-02	8.62e-02	2.49e-04
PM-10	Air	3.45e-07	6.85e-03	2.16e-02	3.43e-06	2.84e-02	8.21e-05
Polycyclic aromatic hydrocarbons	Air	6.77e-06	2.84e-12	0	-1.01e-13	6.77e-06	1.96e-08
Polyimide, unspecified	Air	0	1.40e-04	0	0	1.40e-04	4.04e-07
Potassium	Air	1.10e-05	0	0	0	1.10e-05	3.19e-08
Process material for backlight assembly	Air	0	7.03e-05	0	0	7.03e-05	2.03e-07
Propionaldehyde	Air	3.08e-07	1.66e-06	1.27e-05	-3.71e-07	1.43e-05	4.14e-08
Propylene	Air	1.18e-05	0	0	0	1.18e-05	3.42e-08
Pyrene	Air	1.08e-09	4.51e-09	1.24e-08	-3.30e-10	1.77e-08	5.11e-11
Scandium	Air	6.40e-09	0	0	0	6.40e-09	1.85e-11
Selenium	Air	1.21e-06	6.11e-06	4.36e-05	-1.27e-06	4.97e-05	1.44e-07
Silicon	Air	2.89e-04	8.31e-07	0	-4.96e-08	2.90e-04	8.37e-07
Sodium	Air	7.73e-06	4.92e-06	0	-2.93e-07	1.24e-05	3.57e-08
Strontium	Air	1.65e-06	0	0	0	1.65e-06	4.78e-09
Styrene	Air	2.03e-08	1.09e-07	8.37e-07	-2.44e-08	9.42e-07	2.72e-09
Sulfur dioxide	Air	4.63e-02	2.95e-01	9.30e-01	2.96e-04	1.27e+00	3.68e-03
Sulfur hexafluoride	Air	0	7.30e-03	0	0	7.30e-03	2.11e-05
Sulfur oxides	Air	2.57e-02	4.07e-02	0	-1.93e-02	4.71e-02	1.36e-04
Sulfuric acid	Air	6.31e-07	0	0	0	6.31e-07	1.82e-09
Tars (unspecified)	Air	3.09e-13	0	0	0	3.09e-13	8.92e-16
Tetrachloroethylene	Air	3.49e-08	1.88e-07	1.44e-06	-4.14e-08	1.62e-06	4.68e-09
Tetramethyl ammonium hydroxide	Air	0	6.43e-01	0	0	6.43e-01	1.86e-03
Thallium	Air	4.36e-09	0	0	0	4.36e-09	1.26e-11
Thorium	Air	1.41e-08	0	0	0	1.41e-08	4.09e-11
Tin	Air	8.21e-09	0	0	0	8.21e-09	2.37e-11
Titanium	Air	2.85e-06	0	0	0	2.85e-06	8.24e-09
TOCs, remaining unspeciated	Air	0	6.74e-04	2.15e-03	4.08e-07	2.82e-03	8.16e-06
Toluene	Air	1.05e-05	5.95e-05	9.49e-06	-2.95e-07	7.92e-05	2.29e-07
Trichloroethylene	Air	0	0	0	5.85e-10	5.85e-10	1.69e-12
Unspecified LCD process material	Air	0	4.49e-02	0	0	4.49e-02	1.30e-04
Uranium	Air	1.39e-08	0	0	0	1.39e-08	4.01e-11
Vanadium	Air	1.77e-05	3.22e-05	6.57e-06	-9.16e-07	5.56e-05	1.61e-07
Vinyl acetate	Air	6.16e-09	3.31e-08	2.54e-07	-7.42e-09	2.86e-07	8.28e-10
Vinyl chloride	Air	0	0	0	1.17e-09	1.17e-09	3.38e-12
Waste metals, unspecified	Air	6.33e-06	0	0	0	6.33e-06	1.83e-08

Table J-13. LCD air emissions (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	Fraction of Total
Xylene (mixed isomers)	Air	9.57e-06	1.49e-07	1.24e-06	-2.71e-08	1.09e-05	3.16e-08
Zinc (elemental)	Air	6.60e-06	1.80e-05	5.69e-06	-1.81e-07	3.01e-05	8.69e-08
Zirconium	Air	6.71e-09	0	0	0	6.71e-09	1.94e-11
Total air emissions		1.12e+02	6.48e+01	1.68e+02	1.30e+00	3.46e+02	1.00e+00

Table J-14. LCD water outputs (wastewater and water pollutants) (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
WASTEWATER STREAM							
Wastewater stream	surface water	8.57e+00	2.52e+03	0	-2.41e+00	2.53e+03	80.91%
Wastewater stream	treatment	0	5.97e+02	0	0	5.97e+02	19.09%
Total wastewater streams		8.57e+00	3.12e+03	0	-2.41e+00	3.13e+03	100.00%
WATER POLLUTANTS							
1,1,1-Trichloroethane	surface water	2.78e-14	2.29e-08	0	0	2.29e-08	1.36E-08
1,2-Dichloroethane	surface water	0	0	0	1.74e-11	1.74e-11	1.03E-11
Acids (H+)	surface water	1.34e-04	1.76e-08	0	-3.15e-09	1.34e-04	0.0080%
Adsorbable organic halides	surface water	5.26e-08	1.82e-11	0	-6.44e-13	5.26e-08	3.14E-08
Alcohols	surface water	3.75e-08	0	0	0	3.75e-08	2.23E-08
Aldehydes	surface water	5.08e-10	0	0	0	5.08e-10	3.03E-10
Alkane (unspecified)	surface water	1.92e-06	0	0	0	1.92e-06	0.0001%
Alkenes	surface water	1.77e-07	0	0	0	1.77e-07	1.06E-07
Aluminum (+3)	surface water	6.00e-04	6.88e-06	0	-2.44e-07	6.07e-04	0.0361%
Aluminum hydroxide	surface water	4.36e-10	0	0	0	4.36e-10	2.60E-10
Ammonia	surface water	6.23e-04	0	0	-3.91e-06	6.19e-04	0.0369%
Ammonia ions	surface water	2.51e-05	1.33e-03	0	-4.38e-05	1.31e-03	0.0782%
Antimony	surface water	0	1.14e-07	0	0	1.14e-07	6.80E-08
Aromatic hydrocarbons	surface water	8.45e-06	4.25e-09	0	-1.51e-10	8.46e-06	0.0005%
Arsenic	surface water	0	1.14e-07	0	0	1.14e-07	6.80E-08
Arsenic cmpds	surface water	1.24e-06	0	0	5.34e-09	1.24e-06	0.0001%
Barium cmpds	surface water	8.36e-05	1.36e-08	0	7.51e-08	8.37e-05	0.0050%
Barium sulfate	surface water	1.86e-04	0	0	0	1.86e-04	0.0111%
Benzene	surface water	1.93e-06	0	0	1.74e-11	1.93e-06	0.0001%
BOD	surface water	7.72e-04	2.79e-02	0	-3.18e-04	2.83e-02	1.6873%
BOD	treatment	0	5.74e-02	0	0	5.74e-02	3.4201%
Borax	treatment	0	1.31e-06	0	0	1.31e-06	0.0001%
Boric acid	surface water	5.57e-07	0	0	0	5.57e-07	3.32E-07
Boron	surface water	0	4.58e-06	0	0	4.58e-06	0.0003%
Boron (B III)	surface water	9.79e-08	0	0	0	9.79e-08	5.83E-08
Cadmium	surface water	0	1.14e-07	0	0	1.14e-07	6.80E-08
Cadmium cmpds	surface water	1.89e-07	1.42e-11	0	2.85e-10	1.89e-07	1.13E-07
Calcium (+2)	surface water	1.37e-03	0	0	0	1.37e-03	0.0816%
Carbon tetrachloride	surface water	0	0	0	1.74e-11	1.74e-11	1.03E-11
Carbonate ion	surface water	2.69e-03	0	0	0	2.69e-03	0.1601%
Cesium (+2)	surface water	5.92e-09	0	0	0	5.92e-09	3.53E-09
Chloride ions	surface water	2.33e-01	3.12e-01	0	-1.58e-02	5.29e-01	31.5275%
Chlorine	surface water	6.36e-07	0	0	0	6.36e-07	3.79E-07
Chloroform	surface water	2.87e-12	0	0	1.74e-11	2.02e-11	1.21E-11
Chromium	surface water	0	8.84e-06	0	0	8.84e-06	0.0005%
Chromium (III)	surface water	6.23e-06	3.49e-09	0	1.80e-09	6.23e-06	0.0004%
Chromium (VI)	surface water	2.94e-07	2.33e-07	0	1.80e-09	5.29e-07	3.15E-07
Cobalt (Co I, Co II, Co III)	surface water	7.70e-10	0	0	0	7.70e-10	4.59E-10
COD	surface water	7.67e-03	8.20e-02	0	-2.69e-03	8.70e-02	5.1827%
COD	treatment	0	3.90e-02	0	0	3.90e-02	2.3251%
Colon bacillus (bacteria in large intestine)	surface water	0	3.89e-03	0	0	3.89e-03	0.2320%
Copper	surface water	0	9.18e-07	0	0	9.18e-07	0.0001%
Copper (+1 & +2)	surface water	3.80e-06	2.84e-10	0	-1.01e-11	3.80e-06	0.0002%

Table J-14. LCD water outputs (wastewater and water pollutants) (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Copper (+1 & +2)	treatment	0	4.28e-05	0	0	4.28e-05	0.0026%
Cyanide (-1)	surface water	4.49e-06	3.66e-06	0	-7.04e-13	8.15e-06	0.0005%
Cyanide (-1)	treatment	0	6.67e-07	0	0	6.67e-07	3.97E-07
Dichloromethane	surface water	8.22e-09	0	0	2.78e-11	8.25e-09	4.91E-09
Dissolved organic matter (chlorinated)	surface water	1.31e-06	0	0	0	1.31e-06	0.0001%
Dissolved organics	surface water	1.20e-03	4.67e-08	0	-8.34e-09	1.20e-03	0.0716%
Dissolved solids	surface water	3.21e-03	1.75e-01	0	-5.69e-05	1.78e-01	10.6251%
Edetic acid (EDTA)	surface water	9.46e-10	0	0	0	9.46e-10	5.63E-10
Ethylbenzene	surface water	1.43e-07	0	0	6.28e-11	1.43e-07	8.50E-08
Fluoride	surface water	3.39e-06	0	0	0	3.39e-06	0.0002%
Fluorides (F-)	surface water	5.14e-05	1.29e-02	0	-5.01e-06	1.30e-02	0.7724%
Fluorides (F-)	treatment	0	2.40e-04	0	0	2.40e-04	0.0143%
Formaldehyde	surface water	3.54e-14	0	0	0	3.54e-14	2.11E-14
Halogenated matter (organic)	surface water	1.65e-13	5.67e-12	0	-2.01e-13	5.64e-12	3.36E-12
Hexachloroethane	surface water	5.06e-18	0	0	0	5.06e-18	3.01E-18
Hexane	surface water	0	5.88e-04	0	0	5.88e-04	0.0351%
Hydrazine	surface water	4.35e-10	0	0	0	4.35e-10	2.59E-10
Hydrocarbons, remaining unspeciated	surface water	8.97e-05	1.70e-05	0	-7.87e-07	1.06e-04	0.0063%
Hydrochloric acid	treatment	0	3.29e-06	0	0	3.29e-06	0.0002%
Hypochlorite	surface water	8.62e-10	0	0	0	8.62e-10	5.14E-10
Hypochlorous acid	surface water	8.62e-10	0	0	0	8.62e-10	5.14E-10
Iodide (-1)	surface water	5.93e-07	0	0	0	5.93e-07	3.53E-07
Iron	surface water	0	1.31e-04	0	0	1.31e-04	0.0078%
Iron	treatment	0	8.33e-05	0	0	8.33e-05	0.0050%
Iron (+2 & +3)	surface water	3.71e-04	1.73e-08	0	-1.02e-08	3.71e-04	0.0221%
Lead	surface water	0	8.18e-06	0	0	8.18e-06	0.0005%
Lead	treatment	0	8.33e-07	0	0	8.33e-07	4.96E-07
Lead cmpds	surface water	3.68e-06	5.67e-11	0	4.98e-10	3.68e-06	0.0002%
Lead cmpds	treatment	0	7.14e-06	0	0	7.14e-06	0.0004%
Lithium salts	surface water	4.86e-11	0	0	0	4.86e-11	2.89E-11
Magnesium (+2)	surface water	5.13e-04	0	0	0	5.13e-04	0.0305%
Manganese	surface water	0	2.29e-07	0	0	2.29e-07	1.36E-07
Manganese cmpds	surface water	1.48e-05	0	0	0	1.48e-05	0.0009%
Mercury	treatment	0	8.33e-08	0	0	8.33e-08	4.96E-08
Mercury	surface water	9.08e-08	9.69e-08	0	0	1.88e-07	1.12E-07
Mercury compounds	surface water	5.82e-07	6.52e-14	0	1.62e-11	5.82e-07	3.47E-07
Metals, remaining unspeciated	surface water	3.55e-04	4.72e-04	0	-2.45e-05	8.03e-04	0.0478%
Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	surface water	1.88e-06	0	0	0	1.88e-06	0.0001%
Morpholine	surface water	4.60e-09	0	0	0	4.60e-09	2.74E-09
Nickel	surface water	0	2.33e-07	0	0	2.33e-07	1.39E-07
Nickel	treatment	0	3.33e-06	0	0	3.33e-06	0.0002%
Nickel (+2)	surface water	4.39e-07	0	0	0	4.39e-07	2.62E-07
Nickel cmpds	surface water	3.29e-06	2.84e-11	0	-1.01e-12	3.29e-06	0.0002%
Nitrate	surface water	1.97e-05	3.15e-06	0	-1.27e-06	2.15e-05	0.0013%
Nitrates/nitrites	surface water	8.00e-05	0	0	0	8.00e-05	0.0048%
Nitrites	surface water	4.23e-07	0	0	0	4.23e-07	2.52E-07
Nitrogen	surface water	1.44e-05	7.98e-02	0	0	7.98e-02	4.7566%

Table J-14. LCD water outputs (wastewater and water pollutants) (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Nitrogen	treatment	0	1.26e-02	0	0	1.26e-02	0.7494%
Nitrogen dioxide	surface water	3.04e-04	0	0	0	3.04e-04	0.0181%
Oil & grease	surface water	2.18e-06	5.36e-04	0	0	5.38e-04	0.0321%
Oil & grease	treatment	0	3.61e-03	0	0	3.61e-03	0.2150%
Organic phosphorus, unspecified	surface water	0	2.29e-07	0	0	2.29e-07	1.36E-07
Orthoboric acid	treatment	0	1.31e-06	0	0	1.31e-06	0.0001%
Other nitrogen	surface water	2.25e-04	7.66e-10	0	-2.72e-11	2.25e-04	0.0134%
Other organics	surface water	2.12e-05	0	0	0	2.12e-05	0.0013%
Oxalic acid	surface water	1.89e-09	0	0	0	1.89e-09	1.13E-09
o-xylene	surface water	0	0	0	1.37e-10	1.37e-10	8.14E-11
Phenol	surface water	4.50e-05	1.76e-04	0	-6.22e-06	2.14e-04	0.0128%
Phosphate (PO43-)	surface water	1.11e-04	0	0	0	1.11e-04	0.0066%
Phosphates	surface water	2.23e-07	2.83e-08	0	7.27e-10	2.52e-07	1.50E-07
Phosphorus (yellow or white)	surface water	1.92e-06	4.33e-03	0	0	4.33e-03	0.2581%
Phosphorus (yellow or white)	treatment	0	6.91e-03	0	0	6.91e-03	0.4114%
Phosphorus pentoxide	surface water	7.63e-09	0	0	0	7.63e-09	4.54E-09
Polychlorinated biphenyls	surface water	0	1.14e-08	0	0	1.14e-08	6.80E-09
Polycyclic aromatic hydrocarbons	surface water	2.87e-06	6.81e-11	0	-2.41e-12	2.87e-06	0.0002%
Potassium (+1)	surface water	2.46e-04	0	0	0	2.46e-04	0.0146%
Rubidium ion (Rb+)	surface water	5.93e-08	0	0	0	5.93e-08	3.53E-08
Salts (unspecified)	surface water	2.54e-04	7.84e-05	0	-2.78e-06	3.29e-04	0.0196%
Sand	surface water	2.95e-09	0	0	0	2.95e-09	1.76E-09
Saponifiable oils and fats	surface water	7.30e-05	0	0	0	7.30e-05	0.0044%
Selenium	surface water	2.99e-06	0	0	2.88e-11	2.99e-06	0.0002%
Silver compounds	surface water	3.56e-09	0	0	5.26e-10	4.09e-09	2.43E-09
Sodium (+1)	surface water	1.73e-01	3.41e-01	0	-2.03e-02	4.94e-01	29.4192%
Strontium (Sr II)	surface water	9.60e-05	0	0	0	9.60e-05	0.0057%
Sulfate ion (-4)	surface water	2.40e-02	2.94e-03	0	-1.20e-06	2.69e-02	1.6033%
Sulfate ion (-4)	treatment	0	1.32e-04	2.55e-02	4.84e-06	2.57e-02	1.5285%
Sulfide	surface water	2.20e-06	9.86e-09	0	-1.74e-09	2.20e-06	0.0001%
Sulfites	surface water	4.80e-07	0	0	0	4.80e-07	2.86E-07
Sulfur	surface water	1.04e-11	0	0	0	1.04e-11	6.18E-12
Suspended solids	surface water	4.98e-03	5.80e-02	0	-1.44e-03	6.15e-02	3.6643%
Suspended solids	treatment	0	5.60e-03	6.65e-04	1.26e-07	6.26e-03	0.3732%
Tars (unspecified)	surface water	5.06e-15	0	0	0	5.06e-15	3.01E-15
Tetrachloroethylene	surface water	1.26e-14	2.29e-08	0	1.74e-11	2.29e-08	1.37E-08
Tin	surface water	0	4.58e-07	0	0	4.58e-07	2.73E-07
Tin (Sn++, Sn4+)	surface water	5.11e-05	0	0	0	5.11e-05	0.0030%
Titanium tetrachloride	surface water	3.52e-05	0	0	0	3.52e-05	0.0021%
TOCs	surface water	8.96e-04	4.25e-08	0	-1.51e-09	8.96e-04	0.0534%
Toluene	surface water	1.60e-06	6.24e-10	0	5.83e-10	1.60e-06	0.0001%
Trichloroethylene	surface water	7.66e-13	2.29e-08	0	1.74e-11	2.29e-08	1.37E-08
Triethylene glycol	surface water	1.86e-06	0	0	0	1.86e-06	0.0001%
Vanadium (V3+, V5+)	surface water	3.18e-06	0	0	0	3.18e-06	0.0002%
Vinyl chloride	surface water	0	0	0	3.48e-11	3.48e-11	2.07E-11
VOCs, remaining unspeciated	surface water	2.07e-06	0	0	0	2.07e-06	0.0001%
Waste metals, unspecified	surface water	9.37e-05	0	0	0	9.37e-05	0.0056%
Waste oil	surface water	1.75e-03	4.87e-03	0	-2.06e-04	6.41e-03	0.3817%
Xylene (mixed isomers)	surface water	6.41e-06	0	0	1.76e-10	6.41e-06	0.0004%
Zinc (+2)	surface water	7.41e-06	1.40e-09	0	-2.09e-10	7.41e-06	0.0004%
Zinc (elemental)	surface water	0	2.63e-06	0	0	2.63e-06	0.0002%
Total water pollutants		4.60e-01	1.23e+00	2.62e-02	-4.09e-02	1.68e+00	100.00%

Table J-15. LCD hazardous waste outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Acetic acid	landfill	0	4.46E-03	0	0	4.46E-03	7.09E-04
Acetone	treatment	0	2.77E-02	0	0	2.77E-02	4.40E-03
Acid waste (D002 waste)	treatment	0	1.19E-03	0	0	1.19E-03	1.89E-04
Barium debris (D008 waste)	landfill	0	9.91E-06	0	0	9.91E-06	1.57E-06
Chrome debris (D007 waste)	treatment	0	6.83E-06	0	0	6.83E-06	1.08E-06
Chrome liquid waste (D007 waste)	recycling/reuse	0	4.54E-04	0	0	4.54E-04	7.22E-05
Chromium	landfill	0	1.52E-06	0	0	1.52E-06	2.41E-07
EOL LCD Monitor, landfilled	landfill	0	0	0	1.64E+00	1.64E+00	26.13%
Ferric chloride	recycling/reuse	0	1.37E-02	0	0	1.37E-02	2.18E-03
Flammable liquids (F003 waste)	treatment	0	9.13E-04	0	0	9.13E-04	1.45E-04
Hazardous waste, unspecified	landfill	6.72E-03	2.97E-02	0	-1.05E-03	3.54E-02	5.62E-03
Hazardous waste, unspecified	recycling/reuse	0	1.42E-02	0	0	1.42E-02	2.26E-03
Hazardous waste, unspecified	treatment	0	6.16E-02	0	0	6.16E-02	9.78E-03
HCFC-225ca	recycling/reuse	0	3.11E-05	0	0	3.11E-05	4.94E-06
HCFC-225cb	recycling/reuse	0	3.11E-05	0	0	3.11E-05	4.94E-06
Hydrofluoric acid	landfill	0	8.24E-05	0	0	8.24E-05	1.31E-05
Isopropyl alcohol	recycling/reuse	0	1.69E-01	0	0	1.69E-01	2.69%
Isopropyl alcohol	treatment	0	1.91E+00	0	0	1.91E+00	30.41%
Mercury	recycling/reuse	0	2.00E-06	0	0	2.00E-06	3.18E-07
Nitric acid	landfill	0	3.43E-04	0	0	3.43E-04	5.45E-05
Phosphoric acid	landfill	0	1.44E-02	0	0	1.44E-02	2.29E-03
PWB-Decontaminating debris	treatment	0	6.85E-03	0	0	6.85E-03	1.09E-03
PWB-Lead contaminated waste oil	treatment	0	5.14E-03	0	0	5.14E-03	8.16E-04
PWB-Route dust	recycling/reuse	0	5.31E-03	0	0	5.31E-03	8.43E-04
PWB-Solder dross	recycling/reuse	0	2.96E-02	0	0	2.96E-02	4.70E-03
PWB-Waste cupric etchant	recycling/reuse	0	9.93E-02	0	0	9.93E-02	1.58%
Remover, unspecified	recycling/reuse	0	8.84E-02	0	0	8.84E-02	1.40%
Remover, unspecified	treatment	0	3.03E-01	0	0	3.03E-01	4.81%
Rinse, unspecified	recycling/reuse	0	4.67E-02	0	0	4.67E-02	7.42E-03
Silver	landfill	0	2.72E-09	0	0	2.72E-09	4.33E-10
Sodium sulfate	recycling/reuse	0	2.44E-01	0	0	2.44E-01	3.89%
Spent solvent (non-halogenated)	treatment	0	4.66E-02	0	0	4.66E-02	7.41E-03
Spent solvent (with halogenated materials)	treatment	0	1.55E-02	0	0	1.55E-02	2.47E-03
Spent solvents (F003 waste)	treatment	0	2.74E-04	0	0	2.74E-04	4.35E-05
Tetramethyl ammonium hydroxide	recycling/reuse	0	1.42E-01	0	0	1.42E-01	2.26%
Thinner, unspecified	treatment	0	5.40E-01	0	0	5.40E-01	8.57%
Unspecified sludge	land (other than	0	3.09E-02	0	0	3.09E-02	4.91E-03
Waste acid (chrome mixed acid)	recycling/reuse	0	7.18E-03	0	0	7.18E-03	1.14E-03
Waste acid (mainly HF)	recycling/reuse	0	5.69E-01	0	0	5.69E-01	9.04%
Waste acid (mainly HF)	treatment	0	1.36E-01	0	0	1.36E-01	2.15%
Waste acid (mostly 3% HCl solution)	recycling/reuse	0	1.82E-04	0	0	1.82E-04	2.89E-05
Waste acids, unspecified	recycling/reuse	0	3.24E-02	0	0	3.24E-02	5.15E-03
Waste Batch (Ba, Pb) (D008 waste)	landfill	0	6.55E-05	0	0	6.55E-05	1.04E-05
Waste CCFL, with lead	treatment	0	8.17E-08	0	0	8.17E-08	1.30E-08
Waste CCFL, with mercury	treatment	0	8.17E-10	0	0	8.17E-10	1.30E-10
Waste glass, with mercury	landfill	0	1.05E-10	0	0	1.05E-10	1.67E-11
Waste metals, unspecified	recycling/reuse	0	1.17E-03	0	0	1.17E-03	1.85E-04
Waste solvent (photoresist)	recycling/reuse	0	2.05E-02	0	0	2.05E-02	3.26E-03
Waste solvent (photoresist)	treatment	0	2.17E-02	0	0	2.17E-02	3.45E-03
Total hazardous waste		6.72E-03	4.64E+00	0.00E+00	1.64E+00	6.29E+00	100.00%

Table J-16. LCD solid waste outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
abrasive sludge	recycling/reuse	0	1.95E-03	0	0	1.95E-03	3.73E-05
acid absorbent	landfill	0	3.77E-06	0	0	3.77E-06	7.20E-08
Aluminum (elemental)	landfill	1.23E-05	0	0	0	1.23E-05	2.35E-07
Aluminum scrap	recycling/reuse	2.55E-07	8.77E-06	0	9.52E-03	9.53E-03	1.82E-04
Aluminum scrap, Wabash 319	recycling/reuse	0	2.37E-08	0	0	2.37E-08	4.53E-10
Arsenic	landfill	4.91E-09	0	0	0	4.91E-09	9.38E-11
Bauxite residues	landfill	1.70E-05	5.87E-04	0	-1.96E-05	5.84E-04	1.12E-05
blasting media	landfill	0	1.70E-05	0	0	1.70E-05	3.24E-07
Broken CCFL	landfill	0	2.69E-07	0	0	2.69E-07	5.14E-09
Cadmium	landfill	4.92E-10	0	0	0	4.92E-10	9.40E-12
Calcium	landfill	4.91E-05	0	0	0	4.91E-05	9.38E-07
Carbon	landfill	3.79E-05	0	0	0	3.79E-05	7.24E-07
CARBON STEEL SCRAP	recycling/reuse	0	0	0	4.58E-01	4.58E-01	8.75E-03
Cardboard	treatment	0	1.82E-05	0	0	1.82E-05	3.47E-07
Chromium (III)	landfill	3.07E-08	0	0	0	3.07E-08	5.87E-10
Chromium (VI)	landfill	3.07E-08	0	0	0	3.07E-08	5.87E-10
Cinders from LCD glass mfg	landfill	0	3.83E-04	0	0	3.83E-04	7.31E-06
Coal waste	landfill	0	2.28E+00	1.90E+01	3.60E-03	2.13E+01	40.64%
Cobalt	landfill	2.36E-10	0	0	0	2.36E-10	4.51E-12
Cobalt nitrate	treatment	0	2.83E-06	0	0	2.83E-06	5.40E-08
Copper	landfill	1.18E-09	0	0	0	1.18E-09	2.26E-11
Diesel fuel	treatment	0	1.88E-06	0	0	1.88E-06	3.60E-08
Dust	treatment	0	1.59E-04	0	0	1.59E-04	3.03E-06
Dust/sludge	landfill	0	8.80E-01	7.34E+00	1.39E-03	8.23E+00	15.72%
EOL LCD Monitor, incinerated	treatment	0	0	0	9.75E-01	9.75E-01	1.86%
EOL LCD Monitor, landfilled	landfill	0	0	0	8.94E-01	8.94E-01	1.71%
EOL LCD Monitor, recycled	recycling/reuse	0	0	0	9.75E-01	9.75E-01	1.86%
EOL LCD Monitor, remanufactured	recycling/reuse	0	0	0	9.75E-01	9.75E-01	1.86%
FGD sludge	landfill	2.45E-02	1.09E-02	0	-6.11E-04	3.48E-02	6.64E-04
Fly/bottom ash	landfill	0	5.70E-01	4.75E+00	9.01E-04	5.32E+00	10.16%
Iron	landfill	2.46E-05	0	0	0	2.46E-05	4.70E-07
Iron scrap	recycling/reuse	1.67E-01	0	0	1.10E+00	1.27E+00	2.42%
Isopropyl alcohol	recycling/reuse	0	2.53E-02	0	0	2.53E-02	4.84E-04
Isopropyl alcohol	treatment	0	1.03E-02	0	0	1.03E-02	1.97E-04
LCD glass	recycling/reuse	0	0	0	8.77E-02	8.77E-02	1.68E-03
LCD glass EP dust	landfill	0	4.77E-05	0	0	4.77E-05	9.12E-07
LCD glass EP dust	recycling/reuse	0	2.32E-04	0	0	2.32E-04	4.43E-06
LCD glass, unspecified	landfill	0	1.13E-03	0	0	1.13E-03	2.15E-05
LCD panel waste	landfill	0	2.43E-02	0	0	2.43E-02	4.64E-04
Lead	landfill	5.42E-09	0	0	0	5.42E-09	1.04E-10
Manganese	landfill	4.91E-07	0	0	0	4.91E-07	9.38E-09
Mercury	landfill	3.33E-11	0	0	0	3.33E-11	6.36E-13
Mineral waste	landfill	2.20E-01	1.26E-04	0	-4.46E-06	2.21E-01	4.21E-03
Mining waste	landfill	1.41E-01	0	0	-1.23E-06	1.41E-01	2.69E-03
Mixed industrial (waste)	landfill	4.34E-02	4.83E-02	0	-1.35E-03	9.04E-02	1.73E-03
Nickel	landfill	1.77E-09	0	0	0	1.77E-09	3.38E-11
Nickel nitrate	treatment	0	2.83E-06	0	0	2.83E-06	5.40E-08
Nitrogen	landfill	9.83E-09	0	0	0	9.83E-09	1.88E-10
Non mineral waste (inert)	landfill	9.80E-06	0	0	0	9.80E-06	1.87E-07
Non toxic chemical waste (unspecified)	landfill	5.72E-03	2.95E-05	0	-1.05E-06	5.75E-03	1.10E-04
Oily rags & filter media	landfill	0	1.51E-05	0	0	1.51E-05	2.88E-07
Oily rags & filter media	recycling/reuse	0	1.88E-06	0	0	1.88E-06	3.60E-08

Table J-16. LCD solid waste outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
parts cleaner solvent	recycling/reuse	0	3.77E-06	0	0	3.77E-06	7.20E-08
Phosphorus (yellow or white)	landfill	6.29E-07	0	0	0	6.29E-07	1.20E-08
Plating process sludge	landfill	0	1.52E-05	0	0	1.52E-05	2.90E-07
Polycarbonate	recycling/reuse	0	0	0	3.90E-01	3.90E-01	7.46E-03
Polyester resin	recycling/reuse	0	3.20E-02	0	0	3.20E-02	6.11E-04
Polyethylene, foamed	treatment	0	9.99E-04	0	0	9.99E-04	1.91E-05
Polyethylene/polypropylene waste	treatment	0	2.72E-03	0	0	2.72E-03	5.20E-05
Potassium Carbonate	landfill	0	1.53E-04	0	0	1.53E-04	2.91E-06
Printed wiring board (PWB)	landfill	0	7.50E-03	0	0	7.50E-03	1.43E-04
PWB-Drill dust	landfill	0	6.59E-03	0	0	6.59E-03	1.26E-04
Remover, unspecified	treatment	0	3.09E-02	0	0	3.09E-02	5.90E-04
Sewage sludge (unspecified)	landfill	3.25E-05	0	0	0	3.25E-05	6.22E-07
Slag and ash	recycling/reuse	8.02E+00	3.40E+00	0	-9.67E+00	1.75E+00	3.35%
Slag and ash	landfill	8.19E-02	3.49E-02	0	-1.99E-03	1.15E-01	2.19E-03
sludge (calcium fluoride, CaF2)	recycling/reuse	0	8.13E-04	0	0	8.13E-04	1.55E-05
Sludge from LCD glass mfg	landfill	0	4.06E-05	0	0	4.06E-05	7.77E-07
Sodium Carbonate	landfill	0	1.53E-04	0	0	1.53E-04	2.91E-06
Stannous sludge	recycling/reuse	3.25E-04	0	0	0	3.25E-04	6.22E-06
Steel scrap (tinplated)	recycling/reuse	7.73E-02	0	0	0	7.73E-02	1.48E-03
Sulfur	landfill	7.37E-06	0	0	0	7.37E-06	1.41E-07
Unspecified nonhazardous waste	recycling/reuse	0	1.26E-04	0	0	1.26E-04	2.40E-06
Unspecified sludge	landfill	0	3.56E-04	0	0	3.56E-04	6.80E-06
Unspecified sludge	recycling/reuse	0	8.46E-01	0	0	8.46E-01	1.62%
Unspecified sludge	treatment	0	5.73E-02	0	0	5.73E-02	1.09E-03
Unspecified solid waste	landfill	2.40E+00	0	0	-5.10E-01	1.89E+00	3.62%
Unspecified solid waste	recycling/reuse	1.50E+00	2.11E-01	0	0	1.71E+00	3.27%
Unspecified solid waste	treatment	0	1.63E+00	0	0	1.63E+00	3.11%
Unspecified solid waste (incinerated)	treatment	4.61E-04	6.44E-04	0	-3.84E-05	1.07E-03	2.04E-05
Unspecified waste	recycling/reuse	4.05E-01	1.72E-01	0	-9.83E-03	5.67E-01	1.08E-02
Unspecified waste	landfill	0	0	0	-9.74E-02	-9.74E-02	-1.86E-03
Used silica gel	landfill	0	6.22E-04	0	0	6.22E-04	1.19E-05
Waste acid (containing F and detergents)	landfill	0	2.70E-01	0	0	2.70E-01	5.16E-03
Waste acids, unspecified	treatment	0	1.05E-01	0	0	1.05E-01	2.00E-03
Waste alkali (color filter developer,	recycling/reuse	0	8.91E-02	0	0	8.91E-02	1.70E-03
Waste alkali, unspecified	recycling/reuse	0	3.23E-01	0	0	3.23E-01	6.18E-03
Waste alkali, unspecified	treatment	0	1.95E-06	0	0	1.95E-06	3.73E-08
Waste backlight casing (PC)	landfill	0	1.46E-05	0	0	1.46E-05	2.79E-07
Waste backlight light guide (PMMA)	landfill	0	1.52E-03	0	0	1.52E-03	2.90E-05
Waste LCD glass	landfill	0	2.63E-01	0	0	2.63E-01	5.03E-03
Waste LCD glass	recycling/reuse	0	7.20E-01	0	0	7.20E-01	1.38%
Waste metals, unspecified	recycling/reuse	0	2.93E-03	0	0	2.93E-03	5.61E-05
Waste oil	treatment	0	1.64E-02	0	0	1.64E-02	3.14E-04
Waste oil	landfill	3.17E-05	0	0	0	3.17E-05	6.05E-07
Waste plastic from LCD modules	recycling/reuse	0	7.40E-02	0	0	7.40E-02	1.41E-03
Waste plastic from LCD modules	treatment	0	4.03E-01	0	0	4.03E-01	7.70E-03
Waste plastics from LCD monitor	landfill	0	4.05E-02	0	0	4.05E-02	7.75E-04
Waste refractory	landfill	0	1.13E-04	0	0	1.13E-04	2.16E-06
Zinc (elemental)	landfill	1.96E-07	0	0	0	1.96E-07	3.75E-09
Total solid waste		1.31E+01	1.26E+01	3.11E+01	-4.42E+00	5.23E+01	100.00%

Table J-17. LCD radioactive waste outputs (kg/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% of Total
Highly radioactive waste (Class C)	landfill	2.72e-06	0	0	0	2.72e-06	0.18%
Low-level radioactive waste	landfill	1.28e-04	3.74e-04	6.56e-04	1.24e-07	1.16e-03	78.49%
Radioactive waste (unspecified)	landfill	5.77e-06	0	0	0	5.77e-06	0.39%
Uranium, depleted	landfill	0	1.12e-04	1.97e-04	3.73e-08	3.09e-04	20.93%
Total radioactive waste		1.37e-04	4.87e-04	8.52e-04	1.62e-07	1.48e-03	100.00%

Table J-18. LCD radioactivity outputs (Bq/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Americium-241 (isotope)	landfill	9.42e+01	0	0	0	9.42e+01	0.0002%
Americium-243 (isotope)	landfill	2.05e+00	0	0	0	2.05e+00	5.11E-08
Antimony-124 (isotope)	surface water	2.12e-02	0	0	0	2.12e-02	5.29E-10
Antimony-124 (isotope)	treatment	0	1.68e+00	2.94e+00	5.59e-04	4.63e+00	1.15E-07
Antimony-125 (isotope)	treatment	0	6.70e+00	1.17e+01	2.23e-03	1.84e+01	4.59E-07
Argon-41 (isotope)	air	0	3.40e+03	5.96e+03	1.13e+00	9.36e+03	0.0233%
Barium-140 (isotope)	treatment	0	1.25e-01	2.18e-01	4.14e-05	3.43e-01	8.55E-09
Bromine-89 (isotope)	air	0	3.93e-04	6.89e-04	1.31e-07	1.08e-03	2.70E-11
Bromine-90 (isotope)	air	0	1.60e-04	2.80e-04	5.32e-08	4.40e-04	1.10E-11
Carbon-14 (isotope)	air	9.35e+00	0	0	0	9.35e+00	2.33E-07
Cesium-134 (isotope)	air	3.58e-04	1.08e-02	1.89e-02	3.59e-06	3.01e-02	7.50E-10
Cesium-134 (isotope)	surface water	1.87e-02	0	0	0	1.87e-02	4.65E-10
Cesium-134 (isotope)	treatment	0	4.49e+00	7.87e+00	1.49e-03	1.24e+01	3.08E-07
Cesium-135 (isotope)	landfill	4.59e+04	0	0	0	4.59e+04	0.1145%
Cesium-136 (isotope)	treatment	0	1.75e-03	3.37e-01	6.40e-05	3.39e-01	8.45E-09
Cesium-137 (isotope)	air	3.58e-04	8.15e-02	1.43e-01	2.71e-05	2.25e-01	5.60E-09
Cesium-137 (isotope)	landfill	1.28e-01	0	0	0	1.28e-01	3.20E-09
Cesium-137 (isotope)	surface water	2.74e-02	0	0	0	2.74e-02	6.82E-10
Cesium-137 (isotope)	treatment	0	6.75e+00	1.18e+01	2.24e-03	1.86e+01	4.63E-07
Chromium-51 (isotope)	air	0	2.13e-01	3.74e-01	7.09e-05	5.87e-01	1.46E-08
Chromium-51 (isotope)	treatment	0	8.10e+00	1.42e+01	2.69e-03	2.23e+01	0.0001%
Cobalt-57 (isotope)	air	0	5.74e-04	1.00e-03	1.91e-07	1.58e-03	3.94E-11
Cobalt-57 (isotope)	treatment	0	1.96e-01	3.43e-01	6.52e-05	5.40e-01	1.35E-08
Cobalt-58 (isotope)	air	3.58e-04	6.66e+00	1.28e+03	2.43e-01	1.29e+03	0.0032%
Cobalt-58 (isotope)	surface water	6.14e-02	0	0	0	6.14e-02	1.53E-09
Cobalt-58 (isotope)	treatment	0	7.98e+01	1.40e+02	2.65e-02	2.20e+02	0.0005%
Cobalt-60 (isotope)	air	3.58e-04	5.51e-02	9.65e-02	1.83e-05	1.52e-01	3.79E-09
Cobalt-60 (isotope)	surface water	3.84e-02	0	0	0	3.84e-02	9.56E-10
Cobalt-80 (isotope)	treatment	0	2.09e+01	3.67e+01	6.96e-03	5.76e+01	0.0001%
Curium-244 (isotope)	landfill	1.91e+02	0	0	0	1.91e+02	0.0005%
Curium-245 (isotope)	landfill	2.13e-02	0	0	0	2.13e-02	5.31E-10
Iodine-129 (isotope)	landfill	3.01e-03	0	0	0	3.01e-03	7.50E-11
Iodine-131 (isotope)	air	2.10e-03	2.57e-01	4.51e-01	8.56e-05	7.11e-01	1.77E-08
Iodine-131 (isotope)	surface water	2.33e-03	0	0	0	2.33e-03	5.80E-11
Iodine-131 (isotope)	treatment	0	3.73e+00	6.54e+00	1.24e-03	1.03e+01	2.56E-07
Iodine-132 (isotope)	air	0	5.23e-02	9.16e-02	1.74e-05	1.44e-01	3.59E-09
Iodine-132 (isotope)	treatment	0	1.41e+00	2.48e+00	4.70e-04	3.89e+00	9.70E-08
Iodine-133 (isotope)	air	4.09e-03	2.39e+02	4.18e+02	7.94e-02	6.57e+02	0.0016%
Iodine-133 (isotope)	treatment	0	1.60e+00	2.80e+00	5.32e-04	4.40e+00	1.10E-07
Iodine-134 (isotope)	air	0	2.71e-01	4.74e-01	9.00e-05	7.45e-01	1.86E-08
Iodine-135 (isotope)	air	0	1.36e-02	2.38e-02	4.52e-06	3.74e-02	9.33E-10
Iodine-135 (isotope)	treatment	0	1.15e+00	2.01e+00	3.82e-04	3.16e+00	7.88E-08
Iron-55 (isotope)	treatment	0	1.91e+01	3.34e+01	6.34e-03	5.25e+01	0.0001%
Iron-59 (isotope)	treatment	0	9.79e-01	1.72e+00	3.25e-04	2.69e+00	6.72E-08
Krypton-85 (isotope)	air	5.45e+01	5.64e+03	9.88e+03	1.88e+00	1.56e+04	0.0388%
Krypton-85M (isotope)	air	0	2.73e+02	4.79e+02	9.09e-02	7.53e+02	0.0019%
Krypton-85M (isotope)	treatment	0	5.04e+00	8.83e+00	1.68e-03	1.39e+01	3.46E-07
Krypton-87 (isotope)	air	0	1.02e+02	1.78e+02	3.38e-02	2.80e+02	0.0007%
Krypton-88 (isotope)	air	0	4.77e+02	8.37e+02	1.59e-01	1.31e+03	0.0033%
Lanthanum-140 (isotope)	treatment	0	1.33e-01	2.34e-01	4.43e-05	3.67e-01	9.15E-09
Lead-210 (isotope)	air	3.21e-01	0	0	0	3.21e-01	7.99E-09

Table J-18. LCD radioactivity outputs (Bq/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Manganese-54 (isotope)	air	0	3.03e-03	5.30e-03	1.01e-06	8.33e-03	2.08E-10
Manganese-54 (isotope)	surface water	3.07e-03	0	0	0	3.07e-03	7.65E-11
Manganese-54 (isotope)	treatment	0	5.34e+00	9.35e+00	1.77e-03	1.47e+01	3.66E-07
Molybdenum-99 (isotope)	treatment	0	1.01e+07	1.76e+07	3.35e+03	2.77e+07	69.0936%
Neptunium-237 (isotope)	landfill	2.95e+01	0	0	0	2.95e+01	0.0001%
Niobium-95 (isotope)	air	0	1.20e-04	2.11e-04	4.00e-08	3.31e-04	8.25E-12
Niobium-95 (isotope)	treatment	0	1.37e+00	2.41e+00	4.57e-04	3.78e+00	9.43E-08
Palladium-107 (isotope)	landfill	1.04e-02	0	0	0	1.04e-02	2.58E-10
Plutonium-239 (isotope)	landfill	3.57e+04	0	0	0	3.57e+04	0.0890%
Plutonium-240 (isotope)	landfill	5.08e+04	0	0	0	5.08e+04	0.1267%
Plutonium-241 (isotope)	landfill	1.18e+07	0	0	0	1.18e+07	29.3291%
Plutonium-242 (isotope)	landfill	1.92e+02	0	0	0	1.92e+02	0.0005%
Polonium-210 (isotope)	air	5.52e-01	0	0	0	5.52e-01	1.38E-08
Potassium-40 (isotope)	air	8.57e-02	0	0	0	8.57e-02	2.14E-09
Protactinium-234 (isotope)	air	5.06e-03	0	0	0	5.06e-03	1.26E-10
Protactinium-234 (isotope)	surface water	9.36e-02	0	0	0	9.36e-02	2.33E-09
Radioactive aerosols and halogenes (unspecified)	air	2.81e-02	0	0	0	2.81e-02	7.01E-10
radioactive gas (unspecified)	air	8.98e+02	0	0	0	8.98e+02	0.0022%
Radioactive substance (unspecified)	air	1.29e+00	4.44e+01	0	-1.57e+00	4.41e+01	0.0001%
Radioactive substance (unspecified)	surface water	1.20e-02	4.11e-01		-1.46e-02	4.09e-01	1.02E-08
Radium-222 (isotope)	air	3.26e+00	0	0	0	3.26e+00	8.13E-08
Radium-224 (isotope)	surface water	2.97e-01	0	0	0	2.97e-01	7.40E-09
Radium-226 (isotope)	air	4.31e-01	0	0	0	4.31e-01	1.07E-08
Radium-226 (isotope)	landfill	2.44e+02	0	0	0	2.44e+02	0.0006%
Radium-226 (isotope)	surface water	1.80e+02	0	0	0	1.80e+02	0.0004%
Radium-228 (isotope)	air	4.23e-02	0	0	0	4.23e-02	1.05E-09
Radium-228 (isotope)	surface water	5.93e-01	0	0	0	5.93e-01	1.48E-08
Radon-220 (isotope)	air	9.93e-01	0	0	0	9.93e-01	2.47E-08
Radon-222 (isotope)	air	4.30e+04	0	0	0	4.30e+04	0.1072%
Rubidium-88 (isotope)	air	0	1.12e+00	1.96e+00	3.72e-04	3.08e+00	7.67E-08
Ruthenium-103 (isotope)	treatment	0	1.68e-01	2.94e-01	5.59e-05	4.63e-01	1.15E-08
Samarium-151 (isotope)	landfill	4.25e+01	0	0	0	4.25e+01	0.0001%
Selenium-79 (isotope)	landfill	3.31e-02	0	0	0	3.31e-02	8.25E-10
Silver-110M (isotope)	air	0	3.59e-06	6.29e-06	1.19e-09	9.88e-06	2.46E-13
Silver-110M (isotope)	surface water	9.21e-02	0	0	0	9.21e-02	2.29E-09
Silver-110M (isotope)	treatment	0	1.96e+00	3.43e+00	6.52e-04	5.40e+00	1.35E-07
Sodium-24 (isotope)	treatment	0	2.99e-01	5.23e-01	9.93e-05	8.22e-01	2.05E-08
Strontium-89 (isotope)	treatment	0	3.23e-01	5.65e-01	1.07e-04	8.88e-01	2.21E-08
Strontium-90 (isotope)	landfill	6.86e+03	0	0	0	6.86e+03	0.0171%
Strontium-90 (isotope)	treatment	0	7.59e-02	1.33e-01	2.52e-05	2.09e-01	5.21E-09
Strontium-95 (isotope)	treatment	0	8.36e-01	1.47e+00	2.78e-04	2.30e+00	5.74E-08
Sulfur-136 (isotope)	treatment	0	1.80e-01	3.15e-01	5.99e-05	4.96e-01	1.24E-08
Technetium-99M (isotope)	air	0	1.61e-05	2.83e-05	5.36e-09	4.44e-05	1.11E-12
Technetium-99M (isotope)	landfill	1.40e+00	0	0	0	1.40e+00	3.50E-08
Technetium-99M (isotope)	treatment	0	1.17e-01	2.05e-01	3.89e-05	3.22e-01	8.03E-09
Thorium-228 (isotope)	air	3.57e-02	0	0	0	3.57e-02	8.89E-10
Thorium-228 (isotope)	surface water	1.19e+00	0	0	0	1.19e+00	2.96E-08
Thorium-230 (isotope)	air	7.31e-02	0	0	0	7.31e-02	1.82E-09
Thorium-230 (isotope)	landfill	2.44e+02	0	0	0	2.44e+02	0.0006%
Thorium-230 (isotope)	surface water	8.76e+00	0	0	0	8.76e+00	2.18E-07
Thorium-232 (isotope)	air	2.28e-02	0	0	0	2.28e-02	5.68E-10

Table J-18. LCD radioactivity outputs (Bq/functional unit)

Material	Disposition	Upstream	Mfg	Use	EOL	Total	% or Fraction of Total
Thorium-234 (isotope)	air	5.06e-03	0	0	0	5.06e-03	1.26E-10
Thorium-234 (isotope)	surface water	9.36e-02	0	0	0	9.36e-02	2.33E-09
Tin-113 (isotope)	treatment	0	1.85e-01	3.25e-01	6.16e-05	5.10e-01	1.27E-08
Tin-126 (isotope)	landfill	5.79e-02	0	0	0	5.79e-02	1.44E-09
Tritium-3 (isotope)	air	1.09e+02	7.98e+03	1.40e+04	2.65e+00	2.21e+04	0.0550%
Tritium-3 (isotope)	surface water	1.12e+03	0	0	0	1.12e+03	0.0028%
Tritium-3 (isotope)	treatment	0	5.96e+04	1.04e+05	1.98e+01	1.64e+05	0.4091%
Uranium-234 (isotope)	air	1.28e-01	0	0	0	1.28e-01	3.19E-09
Uranium-234 (isotope)	landfill	1.51e+02	0	0	0	1.51e+02	0.0004%
Uranium-234 (isotope)	surface water	3.09e+00	0	0	0	3.09e+00	7.71E-08
Uranium-235 (isotope)	air	9.55e-04	0	0	0	9.55e-04	2.38E-11
Uranium-235 (isotope)	landfill	2.73e+00	0	0	0	2.73e+00	6.81E-08
Uranium-235 (isotope)	surface water	1.34e-01	0	0	0	1.34e-01	3.35E-09
Uranium-238 (isotope)	air	2.10e-01	0	0	0	2.10e-01	5.23E-09
Uranium-238 (isotope)	landfill	4.23e+01	0	0	0	4.23e+01	0.0001%
Uranium-238 (isotope)	surface water	2.90e+00	0	0	0	2.90e+00	7.23E-08
Xenon-131M (isotope)	air	0	4.60e+02	8.06e+02	1.53e-01	1.27e+03	0.0032%
Xenon-131M (isotope)	treatment	0	6.14e+01	1.07e+02	2.04e-02	1.69e+02	0.0004%
Xenon-133 (isotope)	air	7.63e+02	4.98e+03	1.16e+05	2.21e+01	1.22e+05	0.3045%
Xenon-133 (isotope)	treatment	0	9.43e+03	1.65e+04	3.13e+00	2.60e+04	0.0647%
Xenon-133M (isotope)	air	0	6.59e+04	7.73e+03	1.47e+00	7.36e+04	0.1835%
Xenon-133M (isotope)	treatment	0	7.72e+01	1.35e+02	2.57e-02	2.13e+02	0.0005%
Xenon-135 (isotope)	air	0	2.51e+03	4.39e+03	8.33e-01	6.90e+03	0.0172%
Xenon-135 (isotope)	treatment	0	7.03e+01	1.23e+02	2.34e-02	1.93e+02	0.0005%
Xenon-135M (isotope)	air	0	4.79e+01	8.39e+01	1.59e-02	1.32e+02	0.0003%
Xenon-138 (isotope)	air	0	1.59e+02	2.78e+02	5.28e-02	4.37e+02	0.0011%
Zinc-85 (isotope)	treatment	0	9.00e-02	1.58e-01	2.99e-05	2.48e-01	6.18E-09
Zirconium-93 (isotope)	landfill	1.84e-01	0	0	0	1.84e-01	4.60E-09
Zirconium-95 (isotope)	air	0	3.11e-04	5.44e-04	1.03e-07	8.55e-04	2.13E-11
Total radioactivity outputs		1.20e+07	1.02e+07	1.79e+07	3.40e+03	4.01e+07	100%

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APPENDIX K

LCIA SUPPORTING TABLES

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APPENDIX K

LCIA SUPPORTING TABLES

Table K-1. Fuel conversion factors

Fuel	Heat Value (H) (MJ/L)	Reference	Density (D) (kg/L)	Reference
Fuel oil # 2 (distillate)	36.739	(1)	0.843	(2)
Fuel oil # 6 (residual)	38.579	(1)	0.944	(2)
Fuel oil # 4 (average # 2 & # 6)	37.659	(1)	0.894	(2)
Liquified natural gas (LNG) [a]	21.185	(3)	0.412	(4)
Liquified petroleum gas (LPG)	23.276	(1)	0.542	(2)
Natural gas	0.034	(5)	7.58×10^{-4}	(6)

[a] At -260 ^{o} F; 1 ft ^{3} of liquid methane = 630 ft ^{3} of gaseous methane.

References:

1. Davis, S.C. 1999. *Transportation Energy Data Book, Edition 19.* 1999. Center for Transportation Analysis, Oak Ridge National Laboratory, ORNL 6958, Appendix B, Table B1. Oak Ridge, Tennessee. September.
2. Energy Information Administration (EIA) 1999. International Energy Annual 1997. U.S. Department of Energy. DOE/EIA-0219 (97), Washington, DC. April.
3. Natural Gas Vehicle Quick Reference Fuel Guide. http:\naturalfuels.com\quick_ref_fuel_guide.htm. Downloaded 8/25/00.
4. Perry, R.H. and Green, D. (Eds.) 1984. Perry's Chemical Engineer's Handbook, 6th Edition, page 9-14. McGraw Hill, Inc., New York, NY.
5. Based on: Wang, M. 1999. The Greenhouse Gases, Regulated Emissions, and energy Use in Transportation (GREET) Model, Version 1.5. Argonne National Laboratory, University of Chicago.
6. Calculated from: Perry, R.H. and D. Green (Eds.) 1984. Perry's Chemical Engineer's Handbook, 6th Edition, page 9-15, Table 9-13, and p. 9-16, Table 9-14. McGraw-Hill, Inc., New York, NY.

Table K-2. Global warming potentials (GWP)

Chemical	Synonym	CAS #	GWP [a]
carbon dioxide	CO_2	124-38-9	1
trifluoromethane	HFC-23	75-46-7	11,700
difluoromethane	HFC-32	75-10-5	650
methyl fluoride	HFC-41	593-53-3	150
1,1,1,2,2,3,4,5,5,5-decafluoropentane	HFC-43-10mee20.8	138495-42-8	1300
pentafluoroethane	HFC-125	354-33-6	2800
1,1,2,2-tetrafluoro-1,2-diiodoethane	HFC-134	359-35-3	1000
1,1,1,2-tetrafluoroethane	HFC-134a	811-97-2	1300
1,1-difluoroethane	HFC-152a	75-37-6	140
1,1,2-trifluoroethane	HFC-143	430-66-0	300
1,1,1-trifluoroethane	HFC-143a	420-46-2	3800
1,1,1,2,3,3,3-heptafluoropropane	HFC-227ea	431-89-0	2900
1,1,1,3,3,3-hexafluoropropane	HFC-236fa	690-39-1	6300
1,1,2,2,3-pentafluoropropane	HFC-245ca	679-86-7	560
sulfur hexafluoride	sulfur hexafluoride	2551-62-4	23,900
carbon tetrafluoride	perfluoromethane	75-73-0	6500
hexafluoroethane/Freon 116	perfluoroethane	76-16-4	9200
octafluoropropane	perfluoropropane	76-19-7	7000
decafluorobutane	perfluorobutane	355-25-9	7000
cyclooctafluorobutane	perfluorocyclobutane	115-25-3	8700
dodecafluoro-pentane	perfluoropentane	678-26-2	7500
tetradecafluorohexane	perfluorohexane	355-42-0	7400
methane	methane	74-82-8	21
nitrous oxide	nitrous oxide	10024-97-2	310

[a] IPCC's 1995 GWP estimates, 100-year time horizon. Because of the difficulties in calculating indirect effects of CFCs and halons, no indirect values were included.
Source: Houghton *et al.* 1996.

Table K-3. Ozone depletion potentials (ODP)

Chemical	Synonym(s)	CAS #	Ozone Depletion Potential [e]	
			ODP [a]	ODP [b]
1,1,1-trichloroethane [c]	methyl chloroform	71-55-56	0.12	0.1
1,2,2-trichloroethane [c]	methyl chloroform	79-00-5	--	--
CFC-11 [c]	trichlorofluoromethane	75-69-4	1	1.0
CFC-113 [c]	trichlorotrifluoroethane	76-13-1	1.07	0.8
CFC-114 [c]	dichlorotetrafluoroethane	76-14-2	0.8	1.0
CFC-115 [c]	(mono)chloropentafluoroethane	76-15-3	0.5	0.6
CFC-12 [c]	dichlorodifluoromethane	75-71-8	1	1.0
CFC-13 [c]	chlorotrifluoromethane	75-72-9	1	1.0
CFC-111 [c]	pentachlorofluoroethane	354-56-3	--	1.0
CFC-112 [c]	tetrachlorodifluoroethane	76-12-0	--	1.0
CFC-211 [c]	heptachlorofluoropropane	N/A	--	1.0
CFC-212 [c]	hexachlorodifluoropropane	76564-99-3	--	1.0
CFC-213 [c]	pentachlorotrifluoropropane	2354-06-5	--	1.0
CFC-214 [c]	tetrachlorotetrafluoropropane	2268-46-4	--	1.0
CFC-215 [c]	trichloropentafluoropropane	4259-43-2	--	1.0
CFC-216 [c]	dichlorohexafluoropropane	661-97-2	--	1.0
CFC-217 [c]	monochloroheptafluoropropane	422-86-6	--	1.0
CHF2Br	HBFC-22B1; bromodifluoromethane	1511-62-2	0.74	--
carbon tetrachloride [c]	tetrachloromethane	56-23-5	1.08	1.1
HALON-1201	--	--	1.4	--
HALON-1202	difluorodibromomethane	75-61-6	1.25	--
HALON-1211 [c]	bromochlorodifluoromethane	353-59-3	4	3.0
HALON-1301 [c]	bromotrifluoromethane	75-63-8	16	10.0
HALON-2311	--	–	0.14	--
HALON-2401	--	--	0.25	--
HALON-2402 [c]	dibromotetrafluoroethane	124-73-2	7	6.0
HCFC-123 [d]	2,2-dichloro-1,1,1-trifluoroethane	306-83-2	0.02	0.02
HCFC-124 [d]	2-chloro-1,1,1,2-tetrafluorethane	2837-89-0	0.022	0.02
HCFC-141b [d]	1,1-dichloro-1-fluoroethane	1717-00-6	0.11	0.1
HCFC-142b [d]	1-chloro-1,1-difluoroethane	75-68-3	0.065	0.06
HCFC-22 [d]	chlorodifluoromethane	75-45-6	0.055	0.05
HCFC-225ca [d]	3,3-dichloro-1,1,1,2,2-pentafluoropropane	442-56-0	0.025	--
HCFC-225cb [d]	1,3-dichloro-1,1,2,2,3-pentafluoropropane	507-55-1	0.033	--
bromomethane [c]	methyl bromide	74-83-9	0.6	0.7

[a] Source: Heijungs *et al.* 1992.
[b] Listed in Title VI of the 1990 Clean Air Act Amendments (CAAA).
[c] Class I substance as listed in Title VI of the 1990 CAAA..
[d] Class II substance as listed in Title VI of the 1990 CAAA. (Additional Class III substances listed in the CAAA but not listed here currently have no ODP data.)
[e] Weight ratios, compared to CFC-11 = 1.
"–" represents no data.

Table K-4. Photochemical oxidant creation potentials (POCP)

Chemical/Material	Synonym(s)	CAS #	POCP [a]
1,1,1-trichloroethane	methyl chloroform	71-55-6	0.021
1,2-dichloroethane	ethylene dichloride	107-06-2	0.021
acetone	--	67-64-1	0.178
acetylene	--	74-86-2	0.168
alcohols [b]	--	N/A	0.196
aldehydes [b]	--	N/A	0.443
benzene	--	71-43-2	0.189
caprolactam	aminocaproic lactum	105-60-2	0.761
chlorophenols [b]	--	20-05-3	0.761
crude oil [b]	--	8002-05-9	0.398
CxHy [b]	hydrocarbons	N/A	0.398
CxHy aliphatic [b]	aliphatic hydrocarbons	N/A	0.398
CxHy aromatic [b]	aromatic hydrocarbons	N/A	0.761
CxHy chloro [b]	chlorinated hydrocarbons	N/A	0.021
dichloromethane	methylene chloride	75-09-2	0.021
diethyl ether	ethyl ether	66-29-7	0.398
diphenyl	biphenyl	92-52-4	0.761
ethanol	ethyl alcohol	64-17-5	0.268
ethene	ethylene	74-85-1	1
ethylene glycol	--	107-21-1	0.196
ethylene oxide	--	75-21-8	0.377
formaldehyde	--	50-00-0	0.421
hexachlorobiphenyl	2,2',4,4',5'5'-hexachloro-1,1-biphenyl	35065-27-1	0.761
hydroxy compounds [b]	--	N/A	0.377
isopropanol	isopropyl alcohol; 2-propanol	67-63-0	0.196
ketones [b]	--	N/A	0.326
methane	--	74-82-8	0.007
methyl ethyl ketone	MEK	78-93-3	0.473
methyl mercaptan	--	74-93-1	0.377
naphthalene	--	91-20-3	0.761
non methane VOC [b]	--	N/A	0.416
PAH [b]	PAC; polycyclic aromatic hydrocarbons	N/A	0.761
pentane	--	109-66-0	0.408
petrol [b]	gasoline	N/A	0.398
phenol	--	108-95-2	0.761
phthalic acid anhydride	phthalic anhydride	85-44-9	0.761
propane	--	74-98-6	0.42
propene	propylene	115-07-1	1.03
propionaldehyde	propanal	123-38-6	0.603

Table K-4. Photochemical oxidant creation potentials (POCP)

Chemical/Material	Synonym(s)	CAS #	POCP [a]
styrene	vinyl benzene	100-42-5	0.761
terpentine [b]	--	N/A	0.377
tetrachloromethane	carbon tetrachloride	56-23-5	0.021
toluene	--	108-88-3	0.563
trichloroethene	trichloroethylene	79-01-6	0.066
vinyl acetate	--	108-05-4	0.223
vinyl chloride	--	75-01-4	0.021

Source: Heijungs *et al.* 1992.
"–" represents no data.

Table K-5. Acidification potentials (AP)

Chemical	Synonym(s)	CAS #	AP [a]
ammonia	NH_3	7664-41-7	1.88 [b]
hydrochloric acid	HCl	7647-01-0	0.88 [b]
hydrofluoric acid	hydrogen fluoride, HF	7664-39-3	1.6 [b]
nitric oxide	NO	10102-43-9	1.07 [b]
nitrogen dioxide	NO_2	10102-44-0	0.7 [b]
nitrogen oxides	NO_X	N/A	0.7 [b]
sulfur dioxide	SO_2	7446-09-5	1 [b]
sulfur oxides	SO_X	N/A	1 [b]
sulfur trioxide	SO_3	7446-11-9	0.80 [c]
nitric acid	HNO_3	7697-37-2	0.51 [c]
sulfuric acid	H_2SO_4	7664-93-9	0.65 [c]
phosphoric acid	H_3O_4P	7664-38-2	0.98 [c]
hydrogen sulfide	H_2S	7783-06-4	1.88 [c]

[a] Ratios per equal weights, compared to SO_2, SO_X = 1 for emissions to air.
[b] Source: Heijungs *et al.* 1992.
[c] Source: Hauschild and Wenzel 1997.

Table K-6. Eutrophication potential nutrient enrichment chemicals

Chemical/Parameter (releases to water)	Synonym	CAS #	EP [a]
COD	chemical oxygen demand	N/A	0.022 [b]
ammonia	NH_3	7664-41-7	0.33 [b]
ammonium ion	NH_4^+	N/A	0.33 [b]
total nitrogen	N	N/A	0.42 [b]
phosphate	PO_4^{-3}	N/A	1.0 [b]
total phosphorus	P	N/A	3.06 [b]
nitrate	NO_3^-	NA	0.10 [c]

[a] Ratios per equal weights, compared to phosphate = 1.
[b] Source: Heijungs *et al.* 1992.
[c] Source: Lindfors *et al.* 1995.
NOTE: Eutrophication potentials for releases to air are available but not used in this methodology because partitioning between air and water phases is not considered in this methodology.

Table K-7. Odor threshold values (OTV)

Chemical	Synonym(s)	CAS #	OTV (mg/m^3)
acetaldehyde	ethanal	75-07-0	0.00027 [a]
acetic acid	succinate	64-19-7	0.061 [a]
acetonitrile	methyl cyanide	75-05-8	<67 [b]
acetophenone	acetylbenzene	98-86-2	1.5 [b]
acrolein	2-propenal	107-02-8	0.069 [a]
acrylic acid	propenoic acid	79-10-7	0.27 [b]
acrylontirile	vinyl cyanide	107-13-1	3.4 [b]
ammonia	NH_3	7664-41-7	1.0 [a]
aniline	--	62-53-3	38 [b]
benzene	--	71-43-2	108 [b]
benzyl chloride	alpha-chlorotoluene	100-44-7	0.21 [b]
1,3-butadiene	butadiene	106-99-0	1 [b]
butanal	butyraldehyde	123-72-8	0.00084 [a]
butanoic acid	butyric acid	107-92-6	0.00035 [a]
1-butanol	butyl alcohol, –	71-36-3	0.077 [a]
2-butanone	methyl ethyl ketone	78-93-3	0.68 [a]
n-butylacetate	--	123-86-4	0.031 [a]
butylacrylate	--	141-32-2	0.0015 [a]
n-butylpropionate	--	590-01-2	0.086 [a]
carbon disulfide	CS_2	75-15-0	0.18 [a]
carbon tetrachloride	tetrachloromethane	56-23-5	884 [b]
carbonyl sulfide	carbon oxysulfide	463-58-1	0.25 [b]
chlorine	--	7782-50-5	0.23 [b]
2-chloroacetophenone	phenyl chloromethyl ketone	532-27-4	0.1 - 0.7 [b]
chlorobenzene	--	108-90-7	1.0 [a]
chloroform	trichloromethane	67-66-3	650 [b]
m-cresol	3-methylphenol	108-93-4	0.00022 - 0.035 [b]
cumene	isopropylbenzene	98-82-8	0.04 [b]
decaline	veraline (-)form	14727-56-1	2.8 [a]
P-dichlorobenzene	1,4-dichlorobenzene	106-46-7	0.73 [b]
dichloromethane	methylene chloride	75-09-2	640 [a]
diethylamine	--	109-89-7	0.09 [a]
dimethylamine	--	124-40-3	0.0014 [a]
1,2-dimethylbenzene	o-xylene	95-47-6	0.78 [a]
1,3-dimethylbenzene	m-xylene	108-38-3	0.54 [a]
1,4-dimethylbenzene	p-xylene	106-42-3	0.52 [a]
1,1-dimethylhydrazine	N,N-dimethylhydrazine	57-14-7	15 - 65 [b]
dioxane	1,4-diethylene dioxide; 1,4-dioxane	123-91-1	2.9 [b]

Table K-7. Odor threshold values (OTV)

Chemical	Synonym(s)	CAS #	OTV (mg/m^3)
ethanal	acetaldehyde	75-07-0	0.00027 [a]
ethanethiol	ethylmercaptan	75-08-1	0.000044 [a]
ethanol	ethyl alcohol	64-17-5	0.64 [a]
ethyl acetate	--	141-78-6	2.1 [a]
ethyl acrylate	--	140-88-5	0.00082 [a]
2-ethyl-5,5-dimethyl-1,3-dioxane	--	--	0.0000056 [a]
ethyl butyrate	--	105-54-4	0.00003 [a]
ethylene dichloride	1,2-dichloroethane	107-06-2	25 [b]
ethylene oxide	oxirane	75-21-8	470 [b]
ethylthioethane	diethylsulfide	352-93-2	0.0014 [a]
hydrazine	--	302-01-2	3.9 - 5.2 [b]
hydrogen sulfide	H_2S	7783-06-4	0.00043 [a]
isopentylacetate	iso-amylacetate	123-92-2	0.075 [a]
isophorone	3,5,5-trimethyl-2-cyclohexenone	78-59-1	1.1 [b]
isopropylbenzene	cumene	98-82-8	0.073 [a]
isopropylpropionate	--	637-78-5	0.32 [a]
methanal	formaldehyde	50-00-0	0.49 [a]
methanethiol	methyl mercaptan	74-93-1	0.00024 [a]
methanol	methyl alcohol	67-56-1	5.5 [b]
methyl acetate	acetic acid	79-20-9	22 [a]
methylamine	--	74-89-5	0.0012 [a]
3-methylbutanoic acid	isovaleric acid	503-74-2	0.00022 [a]
methyldithiomethane	dimethyldisulfide	624-92-0	0.0015 [a]
methyl hydrazine	--	60-34-4	1.9 - 5.7 [b]
methyl methacrylate	2-propenoic acid	80-62-6	0.2 [b]
4-methylpentanon-2	methylisobutylketone, MIBK	108-10-1	0.4 [b]
o-cresol	2-methylphenol	95-48-7	0.0018 [a]
m-cresol	3-methylphenol	108-37-4	0.00057 [a]
p-cresol	4-methylphenol	106-44-5	0.00018 [a]
2-methylpropanoic acid	isobutyric acid	79-31-2	0.005 [a]
2-methylpropanol-1	isobutanol	78-73-1	0.035 [a]
2-methylpropene	isobutene	115-11-7	15 [a]
methyl acrylate	2-propenoic acid, methyl	96-33-3	0.01 [a]
methyl propionate	--	554-12-1	3.5 [a]
methylthiomethane	dimethylsulfide	75-18-3	0.0003 [a]
naphthalene	--	91-20-3	0.2 [b]
nitrobenzene	--	98-95-3	906 [b]
pentanal	valeraldehyde	110-62-3	0.0024 [a]

Table K-7. Odor threshold values (OTV)

Chemical	Synonym(s)	CAS #	OTV (mg/m^3)
phenol	--	108-95-2	0.039 [a]
phosphine	--	7803-51-2	0.014 - 2.8 [b]
propanal	propionaldehyde	123-38-6	0.0035 [a]
propanoic acid	propionic acid	79-09-4	0.0052 [a]
2-propanon	acetone	67-64-1	72 [a]
2-propenal	acrolein	107-02-8	0.069 [a]
propionaldehyde	2-propynal	123-38-6	0.003 [a]
propylene dichloride	1,2-dichloropropane	78-87-5	1.2 [b]
propylene oxide	methyloxidrane	75-56-9	24 [b]
pyridine	--	110-86-1	0.12 [a]
quinoline	--	91-22-5	28 [b]
styrene	vinylbenzene	100-42-5	0.068 [a]
styrene oxide	1-phenyl-1,2-epoxyethane	96-09-3	0.3 [b]
tetrachloroethene	perchloroethene; tetrachloroethylene	127-18-4	8.3 [a]
1,1,2,2-tetrachloroethane	acetylene tetrachloride	79-34-5	50 [b]
terephthaloyldichloride	terephthalic acid dichloride	100-20-9	0.0032 [a]
toluene	methylbenzene	108-88-3	0.6 [b]
trichloroethene	trichloroethylene	79-01-6	3.9 [a]
1,1,1-trichloroethane	methyl chloroform	71-55-6	5.3 [a]
2,4,6-trichlorophenol	--	88-06-2	0.00016 [b]
triethylamine	--	121-44-8	1.1 [b]
trimethylamine	--	75-50-3	0.00026 [a]
1,2,4-trimethylbenzene	pseudocumene	95-63-6	0.14 [a]
1,3,5-trimethylbenzene	mesitylene	108-67-8	0.18 [a]
vinyl acetate	--	108-05-4	0.4 [b]
glycol ethers	--	N/A	0.3 [b]
3-methylindole	skatole	83-34-1	0.1 [b]
polycyclic organic matter	--	N/A	0.074 [b]

[a] Source: Roos C. 1989 (as cited in Hiejungs *et al.* 1992).
[b] EPA 1992. *Reference Guide to Odor Thresholds for Hazardous Air Pollutants Listed in the Clean Air Act Amendments of 1990*. Washington, DC. EPA/600/R/92/047.
NOTE: When values were available from both sources, the lower value was used.
"–" represents no data.

Table K-8. Chemicals in the CDP inventory classified as potentially toxic

Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
71-55-6	1,1,1-trichloroethane	- -	- -	- -	2.50e+02	1.21e+03	X	X	48.0	7.0
76-14-2	1,2-dichlorotetrafluoroethane (CFC 114)	- -	- -	- -	2.73e+02	X	X	X	XX	XX
106-99-0	1,3-butadiene	X	1.8	B2,2B	X	2.80e+03	X	X	4.0	1.0
96-48-0	1,4-butanolide	X	X	3	X	X	100	X	XX	XX
107-98-2	1-Methoxy-2-propanol	- -	- -	- -	X	658	X	X	XX	XX
872-50-4	1-Methyl-2-pyrrolidinone (NMP)	- -	- -	- -	X	X	X	40	XX	XX
112-34-5	2-(2-butoxyethoxy)ethanol (glycol ether)	- -	- -	- -	X	X		X	XX	XX
124-17-4	2-(2-butoxyethoxy)ethyl acetate	- -	- -	- -	1000	X	X	X	XX	XX
540-84-1	2,2,4-trimethylpentane (Isooctane)	- -	- -	- -	- -	- -	- -	- -	XX	XX
51207-31-9	2,3,7,8-Tetrachlorodibenzo Furan	1.50e+04	1.50e+04	3	- -	- -	- 24	- -	XX	XX
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-Dioxin	1.50e+05	1.50e+05	1	9.00e-08	X	X	X	XX	XX
121-14-2	2,4-Dinitrotoluene	0.68	X	B2	0.2	X	X	X	24.0	6.0
532-27-4	2-Chloroacetophenone	- -	- -	- -	X	X	X	1.0	XX	XX
111-15-9	2-ethoxyl ethylacetate	- -	- -	- -	- -	- -	- -	- -	XX	XX
91-57-6	2-Methylnaphthalene	- -	- -	- -	- -	- -	- -	- -	XX	XX
138526-69-9	3,4,5-trifluorobromobenzene	- -	- -	- -	- -	- -	- -	- -	XX	XX
348-61-8	3,4-difluorobromobenzene	- -	- -	- -	- -	- -	- -	- -	XX	XX
56-49-5	3-Methylcholanthrene	- -	- -	- -	X	X	2.86	X	XX	XX
82832-73-3 (d)	4-(4-propylcyclohexyl)cyclohexanone	- -	- -	- -	- -	- -	- -	- -	XX	XX
106-41-2	4-bromophenol	- -	- -	- -	- -	- -	- -	- -	XX	XX
123-07-9	4-ethylphenol	- -	- -	- -	- -	- -	- -	- -	XX	XX
14938-35-3	4-pentylphenol	- -	- -	- -	- -	- -	- -	- -	XX	XX
70-70-2	4-propionylphenol	- -	- -	- -	- -	- -	- -	- -	XX	XX
3697-24-3	5-Methyl chrysene (category: PAH)	X	X	2B	- -	- -	- -	- -	XX	XX
83-32-9	Acenaphthene (category: PAH)	- -	- -	- -	175	X	350	X	XX	XX
208-96-8	Acenaphthylene (category: PAH)	X	X	D	- -	- -	- -	- -	XX	XX
75-07-0	Acetaldehyde	Y	7.70e-03	2B	125	300	X	X	34.0	9.0

Table K-8. Chemicals in the CDP inventory classified as potentially toxic

Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
64-19-7	Acetic acid	- -	- -	- -	195	X	X	X	XX	XX
67-64-1	Acetone	X	X	D	100	X	X	X	720	180
98-86-2	Acetophenone	- -	- -	- -	423	X	X	X	XX	XX
74-86-2	Acetylene	- -	- -	- -	- -	- -	- -	- -	XX	XX
107-02-8	Acrolein	X	X	C,3	- -	- -	- -	- -	XX	XX
No CAS #	Aluminium (Al3+)	- -	- -	- -	- -	- -	- -	- -	3.6	0.36
7429-90-5	Aluminum (Al)	X	X	SAR0	60	X	X	X	XX	XX
1344-28-1	Aluminum oxide	- -	- -	- -	- -	- -	- -	- -	XX	XX
7664-41-7	Ammonia	- -	- -	- -	34	40	X	X	2.0	9.00e-02
1341-49-7	Ammonium bifluoride	- -	- -	- -	5.10e-02	X	X	X	XX	XX
7789-09-5	Ammonium Dichromate	X	X	A1	- -	- -	- -	- -	XX	XX
12125-01-8	Ammonium Fluoride	- -	- -	- -	- -	- -	- -	- -	XX	XX
1336-21-6	Ammonium hydroxide	- -	- -	- -	- -	- -	- -	- -	XX	XX
1113-38-8	Ammonium Oxalate	- -	- -	- -	- -	- -	- -	- -	XX	XX
6009-70-7	Ammonium Oxalate Monohydrate	- -	- -	- -	- -	- -	- -	- -	XX	XX
628-63-7	Amyl Acetate (mixed isomers)	- -	- -	- -	- -	- -	- -	- -	XX	XX
120-12-7	Anthracene (category: PAH)	X	X	SAR1	1000	X	X	X	0.01	- -
7440-36-0	Antimony (Sb)	- -	- -	- -	X	X	0.35	X	14.4	1.6
7440-38-2	Arsenic (As)	1.5	50	A	8.00e-04	X	X	X	14.4	2.1
"20-01-9"	Arsenic compounds [Arsenic (As3+, As5+)]	1.5	X	A,1	8.00e-04	X	X	X	32.0	2.0
7440-39-3	Barium (Ba)	- -	- -	- -	0.21	X	X	X	580	50.0
513-77-9	Barium carbonate	X	X	D	0.21	X	X	X	XX	XX
"20-02-0"	Barium compounds [Barium (Ba++)]	X	X	D	0.21	X	X	X	200	10.0
7727-43-7	Barium Sulfate	X	X	D	0.21	X	X	X	- -	- -
100-52-7	Benzaldehyde	- -	- -	- -	143	X	X	X	27.0	XX
71-43-2	Benzene	0.055	0.029	A,1	1.0	1.15	10	98	19.0	4.0
56-55-3	Benzo(a)anthracene (category: PAH)	0.73	0.31	B2	- -	- -	- -	- -	XX	XX
50-32-8	Benzo(a)pyrene	7.3	3.1	B2,2A	- -	- -	- -	- -	XX	XX

Table K-8. Chemicals in the CDP inventory classified as potentially toxic

Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
56832-73-6	Benzo(b,j,k)fluoranthene (category: PAH)	X	X	B2	- -	- -	- -	- -	XX	XX
191-24-2	Benzo(g,h,i)perylene (category: PAH)	X	X	D	- -	- -	- -	- -	XX	XX
205-99-2	Benzo[b]fluoranthene	0.73	0.31	B2	- -	- -	- -	- -	XX	XX
100-44-7	Benzyl chloride	0.17	X	B2,3	- -	- -	- -	- -	XX	XX
7440-41-7	Beryllium (Be)	4.3	8.4	X	X	X	X	5.50e-04	XX	XX
92-52-4	Biphenyl (category: PAH)	X	X	SAR0	50	X	X	X	2.0	0.12
68611-71-2 (d)	Blue phosphor (ZnS)	- -	- -	- -	- -	- -	- -	- -	XX	XX
1314-98-3	Blue phosphor (ZnS:Ag:Al)	- -	- -	- -	- -	- -	- -	- -	XX	XX
1303-96-4	borax	- -	- -	- -	- -	- -	- -	- -	XX	XX
11113-50-1	boric acid	- -	- -	- -	67	X	62.5	X	- -	- -
No CAS #	Boron (B III)	- -	- -	- -	8.8	X	X	X	113	27.0
7440-42-8	Boron (B)	- -	- -	- -	8.8	X	X	X	113	27.0
7726-95-6	Bromine	- -	- -	- -	- -	- -	- -	- -	XX	XX
75-25-2	Bromoform	7.90e-03	3.90e-03	B2	17.9	X	X	X	XX	XX
74-83-9	Bromomethane [Methyl bromide]	X	X	C,3	0.4	4.3	X	X	11.0	3.0
7440-43-9	Cadmium (Cd)	X	6.1	B1,1	X	X	4.00e-02	2.20e-02	0.001	0.001
"20-04-2"	Cadmium cmpds (as CdCl2) [Cadmium (Cd++)]	X	X	B1,2A	5.00e-03	X	X	X	0.1	- -
75-15-0	Carbon disulfide	- -	- -	- -	X	10	X	X	694	174
630-08-0	Carbon monoxide (CO)	- -	- -	- -	X	114.5	X	55	XX	XX
56-23-5	Carbon tetrachloride	1.30e-01	5.30e-02	B2,2B	1	34.3	X	X	41.0	5.0
No CAS #	Cerium (Ce++)	- -	- -	- -	- -	- -	- -	- -	- -	- -
1306-38-3	Cerium oxide	- -	- -	- -	X	X	X	5.0	XX	XX
No CAS #	Cesium (Cs++)	- -	- -	- -	- -	- -	- -	- -	- -	- -
75-72-9	CFC 13	- -	- -	- -	- -	- -	- -	- -	XX	XX
7782-50-5	Chlorine (Cl2)	- -	- -	- -	14.0	X	X	X	0.34	0.02
1341-24-8	Chloroacetophenone	- -	- -	- -	- -	- -	- -	- -	XX	XX
108-90-7	Chlorobenzene	X	X	SAR0	12.5	377	X	X	17.0	2.0

Table K-8. Chemicals in the CDP inventory classified as potentially toxic

Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
67-66-3	Chloroform	6.10e-03	8.10e-02	B2,2B	X	X	12.9	X	71.0	18.0
16065-83-1	Chromium (Cr III)	X	X	D	1468	X	X	X	3.3	0.33
7440-47-3	Chromium (Cr)	X	X	1	- -	- -	- -	- -	52.0	5.2
1333-82-0	Chromium oxide (chromium trioxide)	X	X	D	1468	X	X	X	XX	XX
18540-29-9	Chromium, hexavalent	X	41	A,1	2.5	X	X	X	22.6	2.23
218-01-9	Chrysene (category: PAH)	7.30e-03	3.10e-03	X	- -	- -	- -	- -	XX	XX
No CAS #	Cobalt (Co I, Co II, Co III)	- -	- -	- -	- -	- -	- -	- -	- -	- -
7440-48-4	Cobalt (Co)	- -	- -	- -	- -	- -	- -	- -	XX	XX
7440-50-8	Copper (Cu)	X	X	D	5.30e-01	X	X	X	1.40e-02	4.00e-03
No CAS #	Copper (Cu+, Cu++)	- -	- -	- -	5.30e-01	X	X	X	1.40e-02	4.00e-03
9065-82-1	cresol-formaldehyde resins	- -	- -	- -	- -	- -	- -	- -	XX	XX
98-82-8	Cumene	X	X	SAR0	154	537	X	X	6.0	0.49
80-15-9	Cumene hydroperoxide	X	X	SAR1	X	31	X	X	62.0	16.0
57-12-5	Cyanide (CN)	X	X	D	10.8	X	X	X	56.0	5.7
110-82-7	Cyclohexane	X	X	SAR0	X	1500	X	X	5.0	0.39
117-81-7	Di(2-ethylhexyl)phthalate [Bis(2-ethylhexyl)phthalate]	X	X	B2,2B	50	50	X	X	1.0	0.08
53-70-3	Dibenzo(a,h)anthracene	7.3	3.1	B2	- -	- -	- -	- -	XX	XX
25321-22-6	Dichlorobenzene (mixed isomers)	X	X	SAR0	X	610.4	X	X	1.0	0.05
75-71-8	Dichlorodifluoromethane (CFC 12)	- -	- -	- -	15	X	X	X	XX	XX
75-09-2	Dichloromethane (Methylene chloride)	7.50e-03	1.65e-03	B2,2B	155	796	X	X	330	83.0
68334-30-5	Diesel fuel	X	X	C	- -	- -	- -	- -	XX	XX
60-29-7	Diethyl ether (Ethyl ether)	- -	- -	- -	500	X	X	X	XX	XX
111-46-6	Diethylene Glycol	- -	- -	- -	1250	X	X	X	XX	XX
68-12-2	Dimethyl formamide	- -	- -	- -	X	X	X	7.9	XX	XX
77-78-1	Dimethyl sulfate	X	X	B1,2A	- -	- -	- -	- -	XX	XX
57-97-6	Dimethylbenzanthracene	- -	- -	- -	X	X	X	1.40e-02	XX	XX
67-68-5	di-methyl-sulfoxide	- -	- -	- -	X	X	1.0	X	XX	XX
122-62-3	Dioctyl Sebacate	- -	- -	- -	200	X	X	X	XX	XX

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Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
60-00-4	Edetic Acid (EDTA)	- -	- -	- -	- -	- -	- -	- -	473	240
74-84-0	Ethane	- -	- -	- -	- -	- -	- -	- -	XX	XX
75-08-1	Ethanethiol [Mercaptans]	- -	- -	- -	- -	- -	- -	- -	XX	XX
141-43-5	ethanol amine	- -	- -	- -	320	X	X	12.7	XX	XX
75-00-3	Ethyl chloride	X	X	3	X	3600	X	X	16.0	4.0
100-41-4	Ethylbenzene	X	X	SAR0	136	2370	X	X	11.0	1.0
74-85-1	Ethylene	X	X	SAR0	X	11600	X	X	14.0	3.0
106-93-4	Ethylene dibromide	85	7.60e-01	B2	- -	- -	- -	- -	XX	XX
107-06-2	Ethylene dichloride	9.10e-02	9.10e-02	B2,2B	18	221	X	X	136	34.0
unknown	Etoxy Naphtol Sulphonic Acid (ENSA)	- -	- -	- -	- -	- -	- -	- -	XX	XX
No CAS #	Ferromanganese (Fe, Mn, C)	- -	- -	- -	- -	- -	- -	- -	XX	XX
206-44-0	Fluoranthene (category: PAH)	X	X	D	125	X	X	X	XX	XX
86-73-7	Fluorene (category: PAH)	X	X	D	125	X	X	X	XX	XX
16984-48-8	Fluoride	- -	- -	- -	- -	- -	- -	- -	- -	- -
No CAS #	Fluorides (F-)	- -	- -	- -	6.00e-02	X	X	X	- -	- -
7782-41-4	Fluorine (F2)	- -	- -	- -	6.00e-02	X	X	X	XX	XX
9002-84-0	Fluorocarbon resin [Tetrafluoroethylene (C2F4)]	X	X	3	- -	- -	- -	- -	XX	XX
50-00-0	Formaldehyde (CH2O)	X	4.50e-02	B1,2A	15	0.6	X	X	24.0	6.0
No CAS #	Fuel Oil #2 (distillate and diesel)	- -	- -	- -	- -	- -	- -	- -	XX	XX
No CAS #	Fuel Oil #4 (distillate and residual)	- -	- -	- -	- -	- -	- -	- -	XX	XX
No CAS #	Fuel Oil #6 (residual)	- -	- -	- -	- -	- -	- -	- -	XX	XX
111-76-2	glycol ethers [2-butoxy ethanol]	X	X	C,3	203	121	X	X	1,490	373
unknown	Green Phosphor (ZnS.Cu.Al)	- -	- -	- -	- -	- -	- -	- -	XX	XX
68611-68-7 (d)	Green phosphors (ZnS)	- -	- -	- -	- -	- -	- -	- -	XX	XX
75-63-8	Halon 1301	- -	- -	- -	- -	- -	- -		XX	XX
75-45-6	HCFC 22	- -	- -	- -	X	5,260	X	X	XX	XX

Table K-8. Chemicals in the CDP inventory classified as potentially toxic

Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
422-56-0	HCFC-225ca	- -	- -	- -	- -	- -	- -	- -	XX	XX
507-55-1	HCFC-225cb	- -	- -	- -	- -	- -	- -	- -	XX	XX
142-82-5	Heptane (n-Heptane)	X	X	D	1,000	X	X	1,630	XX	XX
67-72-1	Hexachloroethane	1.40e-02	1.40e-02	C,3	1.0	X	X	X	1.0	0.35
999-97-3	Hexamethyldisilazane (HMDS)	- -	- -	- -	- -	- -	- -	- -	XX	XX
110-54-3	Hexane	- -	- -	- -	X	X	X	73	2.5	0.25
354-33-6	HFC 125	- -	- -	- -	X	2.45e+05	X	X	XX	XX
302-01-2	Hydrazine	3	17	B2	- -	- -	- -	- -	4.83	0.48
7647-01-0	hydrochloric acid	X	X	3	X	15	X	X	19.0	0.95
7664-39-3	Hydrofluoric acid (hydrogen fluoride)	- -	- -	- -	- -	- -	- -	- -	265	13
74-90-8	Hydrogen Cyanide	X	X	SAR0	10.8	X	30	7.07	1,385	346
7722-84-1	Hydrogen Peroxide	X	X	3	- -	- -	- -	- -	XX	XX
7783-06-4	Hydrogen Sulfide	- -	- -	- -	3.1	X	X	15	XX	XX
7790-92-3	Hypochlorous Acid	- -	- -	- -	- -	- -	- -	- -	- -	- -
193-39-5	Indeno(1,2,3-cd)pyrene (category: PAH)	7.30e-01	3.10e-01	B2	- -	- -	- -	- -	XX	XX
50926-11-9	Indium tin oxide (ITO)	- -	- -	- -	- -	- -	- -	- -	XX	XX
123-92-2	Isopentyl acetate (Amyl Acetate)	- -	- -	- -	- -	- -	- -	- -	XX	XX
78-59-1	Isophorone	9.50e-04	X	C	150	X	X	X	XX	XX
67-63-0	Isopropyl alcohol	X	X	1	230	268.3	X	X	8,623	2,156
637-78-5	Isopropylpropionate	- -	- -	- -	- -	- -	- -	- -	XX	XX
7439-91-0	Lanthanum (La)	- -	- -	- -	- -	- -	- -	- -	XX	XX
7439-92-1	Lead (Pb)	X	X	B2,2B	- -	- -	- -	- -	31.5	0.004
"20-11-1"	Lead compounds (as PbCl2) [Lead (Pb++, Pb4+)]	X	X	B2,2B	- -	- -	- -	- -	5.0	0.26
1317-36-8	Lead oxide	X	X	B2	- -	- -	- -	- -	XX	XX
7446-14-2	Lead sulfate cake	X	X	B2	- -	- -	- -	- -	60.8	6.08
NA	Liquified petroleum gas (LPG)	- -	- -	- -	- -	- -	- -	- -	2600	260
NA	Lithium Salts (Lithine)	- -	- -	- -	- -	- -	- -	- -	- -	- -
NA	LNG (Liquified natural gas)	- -	- -	- -	- -	- -	- -	- -	XX	XX

Table K-8. Chemicals in the CDP inventory classified as potentially toxic

Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
7439-96-5	Manganese	X	X	D	0.14	X	X	0.15	- -	- -
"21-12-2"	Manganese cmpds (as MnCl2) [Manganese (Mn II, Mn IV, Mn VII)]	X	X	D	0.14	X	X	0.15	150.0	8.0
7439-97-6	Mercury (Hg)	X	X	D,3	X	6.00e-03	X	9.00e-03	0.155	0.005
no CAS#	Mercury cmpds (as HgCl2) [Mercury (Hg+, Hg++)]	X	X	C	X	X	0.226	X	0.155	0.005
74-82-8	Methane (natural gas)	- -	- -	- -	- -	- -	- -	- -	XX	XX
67-56-1	Methanol	X	X	SAR0	500	130	X	X	29,400	7,350
74-87-3	Methyl chloride	1.30e-02	6.30e-03	C,3	X	1138.4	X	1550	550	138
78-93-3	Methyl ethyl ketone	X	X	D	125	8047	X	X	3,220	805
60-34-4	Methyl hydrazine	3	17.2	A3	- -	- -	- -	- -	XX	XX
80-62-6	Methyl methacrylate	X	X	SAR0	7.5	111.7	X	X	259	65
1634-04-4	Methyl tert butyl ether	X	X	SAR0	100	2880	X	X	786	197
7439-98-7	Molybdenum (Mo)	- -	- -	- -	X	X	0.14	X	157	0.125
no CAS#	Molybdenum cmpds [Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)]	- -	- -	- -	- -	- -	- -	- -	157	0.125
7803-62-5	Monosilane Gas	- -	- -	- -	- -	- -	- -	- -	XX	XX
110-91-8	Morpholine	X	X	3	X	X	X	36		
91-20-3	Naphthalene	X	X	C	71	X	X	9.3	6.0	0.59
79-15-2	N-bromoacetamide (NBA)	- -	- -	- -	- -	- -	- -	- -	XX	XX
123-86-4	N-butyl acetate [Butyl acetate]	- -	- -	- -	X	X	X	210	XX	XX
7440-00-8	Neodymium (Nd)	- -	- -	- -	- -	- -	- -	- -	XX	XX
7440-02-0	Nickel (Ni)	X	X	A	5	X	X	X	2.48	0.09
"20-14-4"	Nickel cmpds (as NiCl2) [Nickel (Ni++, Ni3+)]	X	X	A,1	- -	- -	- -	- -	27	1.0
14797-55-8	Nitrates	- -	- -	- -	1.6	X	X	X	2,213	213
7697-37-2	Nitric Acid	- -	- -	- -	- -	- -	- -	- -	26	1.0
14797-65-0	Nitrites (NO2-)	- -	- -	- -	1.6	X	X	X	225	1.0
10102-44-0	Nitrogen Dioxide	- -	- -	- -	- -	- -	- -	- -	196	19.6

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Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
7783-54-2	Nitrogen fluoride (nitrogen trifluoride)	- -	- -	- -	- -	- -	- -	- -	XX	XX
no CAS#	Nitrogen Oxides (NOx)	- -	- -	- -	- -	- -	- -	- -	XX	XX
10024-97-2	Nitrous oxide	- -	- -	- -	- -	- -	- -	- -	XX	XX
10043-35-3	orthoboric acid	- -	- -	- -	67	X	62.5	X	XX	XX
95-47-6	o-xylene	X	X	D	179	X	X	X	16.0	2.0
608-93-5	Pentachlorobenzene	X	X	D	X	X	8.3	X	XX	XX
87-86-5	Pentachlorophenol	X	X	B2	3	X	X	X	XX	XX
109-66-0	Pentane	X	X	D	- -	- -	- -	- -	XX	XX
7601-90-3	Perchloric acid	- -	- -	- -	- -	- -	- -	- -	XX	XX
76-16-4	Perfluoroethane (Hexafluorocarbon)	- -	- -	- -	X	X	X	1.17e+06	XX	XX
75-73-0	Perfluoromethane (CF4)	- -	- -	- -	- -	- -	- -	- -	XX	XX
10450-60-9	Periodic Acid	- -	- -	- -	- -	- -	- -	- -	XX	XX
No CAS #	Petroleum	- -	- -	- -	- -	- -	- -	- -	XX	XX
85-01-8	Phenanthrene (category: PAH)	X	X	D	- -	- -	- -	- -	XX	XX
108-95-2	Phenol	X	X	D,3	60	X	X	X	34.0	8.0
98-67-9	Phenolsulphonic Acid	- -	- -	- -	- -	- -	- -	- -	XX	XX
57583-54-7 (d)	Phosphate ester, plastic components	- -	- -	- -	1300	X	X	X	XX	XX
7803-51-2	Phosphine gas	- -	- -	- -	0.026	0.25	X	X	XX	XX
7664-38-2	phosphoric acid	- -	- -	- -	X	50	X	180	70.0	4.0
7723-14-0	Phosphorus	X	X	D	1.50e-02	X	X	X	0.02	- -
1314-56-3	Phosphorus Pentoxide	- -	- -	- -	- -	- -	- -	- -	- -	- -
NA	PM [particulates, total]	- -	- -	- -	- -	- -	- -	- -	XX	XX
NA	PM-10 [Particulates < 10 microns]	- -	- -	- -	- -	- -	- -	- -	XX	XX
1336-36-3	Polychloriniated biphenyl (PCB)	X	X	B2,2A	7.00e-03	X	X	X	3.0	0.14
9016-45-9	Polyethylene mono(nonylphenyl)ether glycol [Tergitol NP-33 (glycol ether)]	- -	- -	- -	1000	X	67.5	X	XX	XX
9002-89-5	Polyvinyl alcohol	X	X	3	- -	- -	- -	- -	XX	XX
9003-39-8	Polyvinyl Pyrrolidone (PVP)	X	X	3	550	X	5500	X	XX	XX

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Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
8486041	PPE [Polyphenylene ether]	- -	- -	- -	- -	- -	- -	- -	XX	XX
123-38-6	Propionaldehyde	X	X	SAR3	X	200	X	X	44.0	11.0
115-07-1	Propylene	X	X	SAR0	X	9375	X	X	5.0	1.0
108-32-7	Propylene carbonate	- -	- -	- -	- -	- -	- -	- -	XX	XX
57-55-6	propylene glycol	- -	- -	- -	X	170	X	X	XX	XX
108-65-6	propylene glycol monomethyl ether acetate [1-Methoxy-2-propyl Acetate (glycol ether)]	- -	- -	- -	- -	- -	- -	- -	XX	XX
129-00-0	Pyrene (category: PAH)	X	X	D	75	X	X	X	XX	XX
68784-83-8 (d)	Red phosphors	- -	- -	- -	- -	- -	- -	- -	XX	XX
No CAS#	Red phosphors ($Y_2O_2S.Eu$)	- -	- -	- -	- -	- -	- -	- -	XX	XX
No CAS #	Rubidium (Rb+)	- -	- -	- -	- -	- -	- -	- -	- -	- -
7440-20-2	Scandium (Sc)	- -	- -	- -	- -	- -	- -	- -	XX	XX
7782-49-2	Selenium (Se)	X	X	D	1.50e-02	X	X	X	XX	XX
7440-21-3	Silicon (Si)	- -	- -	- -	- -	- -	- -	- -	XX	XX
7440-22-4	Silver	X	X	D	X	X	1.40e-02	X	4.00e-03	0.001
no CAS#	Silver compounds [Silver (Ag+)]	X	X	D	X	X	1.40e-02	X	12.0	0.001
10588-01-9	Sodium Dichromate	X	X	3	X	X	0.18	0.25	XX	XX
2151247	Sodium Dichromate Dihydrate (VI)	- -	- -	- -	- -	- -	- -	- -	XX	XX
13472-35-0	sodium dihydrogen phosphate dihydrate	- -	- -	- -	- -	- -	- -	- -	XX	XX
7681-52-9	Sodium Hypochlorite	X	X	3	2.1	X	X	X	XX	XX
7681-57-4	Sodium Metabisulfite	X	X	3	- -	- -	- -	- -	XX	XX
7775-27-1	Sodium Persulfate	- -	- -	- -	- -	- -	- -	- -	XX	XX
No CAS #	Strontium (Sr II)	- -	- -	- -	190	X	X	X	- -	- -
7440-24-6	Strontium (Sr)	- -	- -	- -	190	X	X	X	XX	XX
1633-05-2	Strontium carbonate	- -	- -	- -	190	X	X	X	XX	XX
100-42-5	Styrene	X	X	C,2B	100	565	X	X	4.0	0.44
7446-09-5	Sulfur dioxide	X	X	3	X	0.104	X	X	XX	XX
2551-62-4	sulfur hexafluoride	- -	- -	- -	- -	- -	- -	- -	XX	XX

Table K-8. Chemicals in the CDP inventory classified as potentially toxic

Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
no CAS#	sulfur oxides (SOx)	- -	- -	- -	- -	- -	- -	- -	XX	XX
7664-93-9	sulfuric acid	X	X	1	X	0.1	X	X	31.0	2.0
10124-29-5	Sulfuric acid, aluminum salt	- -	- -	- -	X	X	154	X	XX	XX
127-18-4	tetrachloroethylene	5.20e-02	2.00e-03	B2,2B	14	740.2	X	X	17.0	2.0
109-99-9	Tetrahydrofuran (THF)	- -	- -	- -	782	0.2	X	X	XX	XX
75-59-2	Tetramethyl ammonium hydroxide (TMAH)	- -	- -	- -	- -	- -	- -	- -	XX	XX
7440-28-0	Thallium (TI)	- -	- -	- -	- -	- -	- -	- -	XX	XX
7440-29-1	Thorium (Th)	X	X	A	- -	- -	- -	- -	XX	XX
7440-31-5	Tin (Sn)	- -	- -	- -	- -	- -	- -	- -	626.0	62.6
No CAS #	Tin (Sn++, Sn4+)	- -	- -	- -	- -	- -	- -	- -	626.0	62.6
7440-32-6	Titanium	X	X	C	X	0.8	1146	X	- -	- -
7550-45-0	Titanium tetrachloride	- -	- -	- -	X	9.00e-03	X	X	25.0	1.0
108-88-3	Toluene	X	X	D,3	100	411.1	X	X	34.0	4.0
1025-15-6	triallyl isocyanurate	- -	- -	- -	- -	- -	- -	- -	XX	XX
79-01-6	trichloroethylene (TCE)	1.10e-02	6.00e-03	B2,3	24	586.6	X	X	44.0	8.0
75-69-4	Trichlorofluoromethane (CFC 11)	- -	- -	- -	X	X	349	X	XX	XX
1330-78-5	Tricresyl phosphate	- -	- -	- -	- -	- -	- -	- -	XX	XX
112-27-6	Triethylene Glycol	- -	- -	- -	X	X	1200	X	8.81e+04	8,810
115-86-6	Triphenyl phosphate	- -	- -	- -	- -	- -	- -	- -	XX	XX
7440-33-7	Tungsten (W)	- -	- -	- -	- -	- -	- -	- -	XX	XX
1344-59-8	U_3O_8 (yellowcake)	- -	- -	- -	- -	- -	- -	- -	XX	XX
7440-61-1	Uranium (U)	X	X	A1	0.2	X	X	X	XX	XX
7440-62-2	Vanadium (V)	- -	- -	- -	3.00e-03	X	X	X	XX	XX
No CAS #	Vanadium (V3+, V5+)	- -	- -	- -	- -	- -	- -	- -	- -	- -
108-05-4	Vinyl acetate	X	X	SAR0	100	176	X	X	100	25.0
75-01-4	Vinyl chloride	1.4	3.08e-02	A,1	X	6.98e+04	X	X	143	36.0
1330-20-7	Xylene (C24H30) [mixed isomers]	X	X	D	179	X	X	X	13	1.0
7440-66-6	Zinc (Zn)	X	X	D	0.9	X	1	X	9.00e-02	0.036
No CAS #	Zinc (Zn++)	- -	- -	- -	- -	- -	- -	- -	17.0	- -

Table K-8. Chemicals in the CDP inventory classified as potentially toxic

Cas #	Material	Chronic							Aquatic ecotoxicity	
		oral SF (mg/kg-day)$^{-1}$	inhal SF (mg/kg-day)$^{-1}$	WOE (EPA & IARC)(a)	oral NOAEL (b) (mg/kg-day)	inhal NOAEL (b) (mg/m^3)	oral LOAEL (b,c) (mg/kg-day)	inhal LOAEL (b,c) (mg/m^3)	fish LC50 (mg/L)	fish NOAEL (mg/L)
14940-68-2	Zircon sand [Zircon (Zr)]	- -	- -	- -	- -	- -	- -	- -	XX	XX
7440-67-7	Zirconium (Zr)	- -	- -	- -	3,494	X	X	X	XX	XX

Key:
(a)=See Table 3-3 in Section 3.1.2.12 for a description of WOE classifications.
(b)=only lowest value of the NOAEL (or LOAEL/10) is used to calculate chronic, non-cancer effects
(c)=LOAEL only needed if no NOAEL found
(d)=CAS # was provided by a company, but could not be confirmed.
XX=aquatic toxicity data not needed because there are no waterborne releases of this chemical in the CDP LCIs.
X=data not needed because other data are provided to calculate impact score (e.g., LOAEL not needed if NOAEL provided, and WOE used if SF not available).
SAR0=not a probable carcinogen based on structure-activity relationship (SAR) evaluation.
SAR1=possible carcinogen based on SAR evaluation.
- - =no data available, defaulted to mean hazard value (see Section 3.1.2.12 for an explanation of hazard values).
Sources:

- Oral and inhalation slope factors (SF): Integrated Risk Information System (IRIS) or Health Effects Assessment Summary Tables (HEAST) (EPA, 1994) as cited in Risk Assessment Information System (RAIS): http://risk.lsd.ornl.gov/rap_hp.shtml.
- Weight of Evidence (WOE): IRIS Web site (http://www.epa.gov/IRIS).
- Oral no observable adverse effect level (NOAEL), inhalation NOAEL, oral lowest obserable adverse effect level (LOAEL) and inhalation LOAEL: IUCLID, 1996; HEAST, 1994; Kincaid and Geibig, 1998; EPA, 2000a; SRC, 2000; EPA, 2000b; Geibig and Swanson, 2000; Sax and Lewis, 1987; NIOSH, 1978; EPA, 1984; and EPA, 1987.
- Fish LC50 and fish NOAEL: EPA, 2001; HSDB; Davis et al. 1994, Appendix E; and Geiger et al., 1984, 1985, 1986, 1988, 1990.

Table K-9. List of Materials Excluded from Toxic Classification

CAS #	Material	Reason for Exclusion [a]
NA	ABS plastic	judgment
21645-51-2	Aluminium Hydroxide (Al(OH)3)	GRAS
10043-01-3	Aluminium Sulfate (Al2(SO4)3)	GRAS
10043-01-3	Aluminum Sulfate (Al2(SO4)3)	GRAS
7440-37-1	Argon (Ar gas)	judgment
1302-78-9	Bentonite (Al2O3.4SiO2.H2O, in ground)	judgment
NA	BOD (Biological Oxygen Demand)	judgment
106-97-8	Butane (n-C4H10)	GRAS
25167-67-3	Butene (1-CH3CH2CHCH2)	judgment
7440-70-2	Calcium (Ca)	judgment
No CAS #	Calcium (Ca++)	judgment
10043-52-4	Calcium Chloride (CaCl2)	judgment
1305-62-0	Calcium hydroxide [Ca(OH)2, hydrated lime]	judgment
7778-18-9	Calcium Sulfate	judgment
124-38-9	Carbon Dioxide (CO2)	judgment
NA	Carbonate ion [Carbonates (CO3--, HCO3-, CO2]	judgment
NA	COD (Chemical Oxygen Demand)	judgment
16887-00-6	Chloride (Cl-)	judgment
1318-74-7	Clay (in ground)	judgment
NA	Dissolved solids	judgment
No CAS #	Dolomite (CaCO3.MgCO3, in ground)	judgment
26265-08-7	Epoxy resin (PC Board-epoxy resin)	judgment
141-78-6	Ethyl acetate (C4H8O2)	GRAS
64-17-5	Ethanol (Ethyl Alcohol)	GRAS
7705-08-0	Ferric chloride (FeCl3)	GRAS
NA	Ferrite	judgment
No CAS #	Glass	judgment
7440-59-7	Helium (He)	GRAS
NA	Nonmethane hydrocarbons	judgment
NA	Hydrocarbons (unspecified)	judgment
1333-74-0	Hydrogen gas (H2)	judgment
14380-61-1	Hypochlorite (ClO-)	judgment
20461-54-5	Iodide (I-)	judgment
7553-56-2	Iodine (I)	judgment
7439-89-6	Iron (Fe)	judgment
No CAS #	Iron (Fe++, Fe3+)	judgment
7720-78-7	Iron Sulfate (FeSO4, ore)	judgment
8008-20-6	Kerosene	judgment

Table K-9. List of Materials Excluded from Toxic Classification

CAS #	Material	Reason for Exclusion [a]
7439-90-9	Krypton Gas	judgment
No CAS #	Lignite (in ground)	judgment
1305-78-8	Lime	judgment
471-34-1	Limestone (CaCO3, in ground)	judgment
7439-95-4	Magnesium (Mg)	judgment
No CAS #	Magnesium cmpds [Magnesium (Mg++)]	judgment
7440-01-9	Neon	judgment
7727-37-9	Nitrogen	GRAS
74-98-6	n-propane [Propane (C3H8)]	GRAS
NA	Oil & grease	judgment
No CAS #	Olivine ((Mg,Fe)2SiO4, ore)	judgment
144-62-7	Oxalic Acid (C2H2O4)	judgment
7782-44-7	Oxygen (O2)	judgment
NA	Phosphates (PO4-3)	judgment
9011-87-4	Poly(methyl methacrylate) [PMMA (Acrylic resin)]	judgment
25971-63-5	Polycarbonate resin	judgment
NA	Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	judgment
9002-88-4	polyethylene (PE) foam, cushion	judgment
No CAS #	Polyimide Resin	judgment
9003-53-6	Polystyrene [Styrene, polymer (C8H8)]	judgment
7440-09-7	Potassium (K)	judgment
No CAS #	Potassium (K+)	judgment
584-08-7	Potassium carbonate (K2CO3)	judgment
7447-40-7	Potassium Chloride (KCl, as K2O, in ground)	judgment
79-09-4	Propionic Acid (CH3CH2COOH)	GRAS
1332-09-8	Pumice	judgment
1309-36-0	Pyrite (FeS2, ore)	judgment
14808-60-7	Silica sand [Silicon dioxide (SiO2)]	GRAS
7440-23-5	Sodium (Na)	judgment
No CAS #	Sodium (Na+)	judgment
497-19-8	Sodium carbonate (Na2CO3, soda ash)	judgment
7647-14-5	Sodium Chloride (NaCl, in ground or in sea)	GRAS
1310-73-2	Sodium hydroxide (NaOH)	judgment
9003-55-8	Styrene-butadiene copolymers (C12H14)	judgment
14808-79-8	Sulfates (SO4--)	judgment
18496-25-8	Sulfides (S--)	judgment
14265-45-3	Sulfites (SO3--)	judgment
7704-34-9	Sulfur	judgment

Table K-9. List of Materials Excluded from Toxic Classification

CAS #	Material	Reason for Exclusion [a]
NA	Suspended Solids	judgment
14807-96-6	Talcum (4SiO2.3MgO.H2O, ore)	judgment
No CAS #	TOCs (Total organic compounds)	judgment

[a] NOTES:

(1) GRAS = Generally Regarded as Safe by the U.S. Food and Drug Administration.

(2) Some materials were excluded based on judgement if they are nutrients: calcium, chloride, iodine, iron, magnesium, phosphorous, potassium, sodium (per the Risk Assessment Guidance for Superfund [RAGS], EPA/540/1-89/002, December 1989 and the RAGS Region IV update).

(3) This list was reviewed by the U.S. EPA DFE Workgroup (Appendix C, Table C-2).

Table K-10. Chemicals used to calculate mean slope factor values for calculating carcinogenic hazard value

Chemical	CAS #	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$
Acephate	30560-19-1	8.70E-03	
Acetaldehyde	75-07-0		7.70E-03
Acrylamide	79-06-1	4.50E+00	4.50E+00
Acrylonitrile	107-13-1	5.40E-01	2.40E-01
Alachlor	15972-60-8	8.00E-02	
Aldrin	309-00-2	1.70E+01	1.70E+01
Aniline	62-53-3	5.70E-03	
Aramite	140-57-8	2.50E-02	2.50E-02
Aroclor 1016	12674-11-2	4.00E-01	4.00E-01
Aroclor 1016	12674-11-2	2.00E+00	2.00E+00
Aroclor 1221	11104-28-2	4.00E-01	4.00E-01
Aroclor 1221	11104-28-2	2.00E+00	2.00E+00
Aroclor 1232	11141-16-5	4.00E-01	4.00E-01
Aroclor 1232	11141-16-5	2.00E+00	2.00E+00
Aroclor 1242	53469-21-9	4.00E-01	4.00E-01
Aroclor 1242	53469-21-9	2.00E+00	2.00E+00
Aroclor 1248	12672-29-6	4.00E-01	4.00E-01
Aroclor 1248	12672-29-6	2.00E+00	2.00E+00
Aroclor 1254	11097-69-1	4.00E-01	4.00E-01
Aroclor 1254	11097-69-1		2.00E+00
Aroclor 1260	11096-82-5	4.00E-01	4.00E-01
Aroclor 1260	11096-82-5	2.00E+00	2.00E+00
Arsenic, Inorganic	7440-38-2	1.50E+00	5.00E+01
Atrazine	1912-24-9	2.22E-01	
Azobenzene	103-33-3	1.10E-01	1.10E-01
Benz[a]anthracene	56-55-3	7.30E-01	3.10E-01
Benzene	71-43-2	5.50E-02	2.90E-02
Benzidine	92-87-5	2.30E+02	2.30E+02
Benzo[a]pyrene	50-32-8	7.30E+00	3.10E+00
Benzo[b]fluoranthene	205-99-2	7.30E-01	3.10E-01
Benzo[k]fluoranthene	207-08-9	7.30E-02	3.10E-02
Benzotrichloride	98-07-7	1.30E+01	
Benzyl Chloride	100-44-7	1.70E-01	
Beryllium and compounds	7440-41-7	4.30E+00	8.40E+00
Bis(2-chloro-1-methylethyl)ether (Technical)	108-60-1	7.00E-02	3.50E-02
Bis(2-chloroethyl)ether	111-44-4	1.10E+00	1.10E+00
Bis(2-ethylhexyl)phthalate	117-81-7	1.40E-02	

Table K-10. Chemicals used to calculate mean slope factor values for calculating carcinogenic hazard value

Chemical	CAS #	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$
Bis(chloromethyl)ether	542-88-1	2.20E+02	2.20E+02
Bromodichloromethane	75-27-4	6.20E-02	
Bromoform	75-25-2	7.90E-03	3.90E-03
Butadiene, 1,3-	106-99-0		1.80E+00
Cadmium (Diet)	7440-43-9		6.10E+00
Cadmium (Water)	7440-43-9		6.10E+00
Captafol	2425-06-1	8.60E-03	
Captan	133-06-2	3.50E-03	
Carbazole	86-74-8	2.00E-02	
Carbon Tetrachloride	56-23-5	1.30E-01	5.30E-02
Chloranil	118-75-2	4.03E-01	
Chlordane	057-74-9	3.50E-01	1.30E+00
Chloro-2-methylaniline HCl, 4-	3165-93-3	4.60E-01	
Chloro-2-methylaniline, 4-	95-69-2	5.80E-01	
Chlorobenzilate	510-15-6	2.70E-01	2.70E-01
Chlorodibromoethane	73506-94-2	8.40E-02	
Chloroform	67-66-3	6.10E-03	8.10E-02
Chloromethane	74-87-3	1.30E-02	6.30E-03
Chloronitrobenzene, o-	88-73-3	2.50E-02	
Chloronitrobenzene, p-	121-73-3	1.80E-02	
Chlorothalonil	1897-45-6	1.10E-02	
Chromium VI (chromic acid mists)	18540-29-9		4.10E+01
Chromium VI (particulates)	18540-29-9		4.10E+01
Chrysene	218-01-9	7.30E-03	3.10E-03
Coke Oven Emissions	8007-45-2		2.20E+00
Crotonaldehyde, trans-	123-73-9	1.90E+00	
Cyanazine	21725-46-2	8.40E-01	
Cyclohexane, 1,2,3,4,5-pentabromo-6-chloro-	87-84-3	2.30E-02	
DDD	72-54-8	2.40E-01	
DDE	72-55-9	3.40E-01	
DDT	50-29-3	3.40E-01	3.40E-01
Di(2-ethylhexyl)adipate	103-23-1	1.20E-03	
Diallate	2303-16-4	6.10E-02	
Dibenz[a,h]anthracene	53-70-3	7.30E+00	3.10E+00
Dibromo-3-chloropropane, 1,2-	96-12-8	1.40E+00	2.40E-03
Dibromochloromethane	124-48-1	8.40E-02	
Dibromoethane, 1,2-	106-93-4	8.50E+01	7.60E-01

Table K-10. Chemicals used to calculate mean slope factor values for calculating carcinogenic hazard value

Chemical	CAS #	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$
Dichloro-2-butene, 1,4-	764-41-0		9.30E+00
Dichlorobenzene, 1,4-	106-46-7	2.40E-02	
Dichlorobenzidine, 3,3'-	91-94-1	4.50E-01	
Dichloroethane, 1,2-	107-06-2	9.10E-02	9.10E-02
Dichloroethylene, 1,1-	75-35-4	6.00E-01	1.20E+00
Dichloropropane, 1,2-	78-87-5	6.80E-02	
Dichloropropene, 1,3-	542-75-6	1.00E-01	1.40E-02
Dichlorvos	62-73-7	2.90E-01	
Dieldrin	60-57-1	1.60E+01	1.60E+01
Diethylstilbesterol	56-53-1	4.70E+03	4.90E+02
Dimethoxybenzidine, 3,3'-	119-90-4	1.40E-02	
Dimethylaniline HCl, 2,4-	21436-96-4	5.80E-01	
Dimethylaniline, 2,4-	095-68-1	7.50E-01	
Dimethylbenzidine, 3,3'-	119-93-7	9.20E+00	
Dimethylhydrazine, 1,1-	57-14-7	3.00E+00	1.72E+01
Dinitrotoluene Mixture, 2,4/2,6-	25321-14-6	6.80E-01	
Dinitrotoluene, 2,4-	121-14-2	6.80E-01	
Dinitrotoluene, 2,6-	606-20-2	6.80E-01	
Dioxane, 1,4-	123-91-1	1.10E-02	
Diphenylhydrazine, 1,2-	122-66-7	8.00E-01	8.00E-01
Direct Black 38	1937-37-7	8.60E+00	
Direct Blue 6	2602-46-2	8.10E+00	
Direct Brown 95	16071-86-6	9.30E+00	
Epichlorohydrin	106-89-8	9.90E-03	4.20E-03
Ethyl Acrylate	140-88-5	4.80E-02	
Ethylbenzene	100-41-4		3.85E-03
Ethylene Oxide	75-21-8	1.02E+00	3.50E-01
Ethylene Thiourea	96-45-7	1.10E-01	
Folpet	133-07-3	3.50E-03	
Fomesafen	72178-02-0	1.90E-01	
Formaldehyde	50-00-0		4.50E-02
Furazolidone	67-45-8	3.80E+00	
Furium	531-82-8	5.00E+01	
Furmecyclox	60568-05-0	3.00E-02	
Heptachlor	76-44-8	4.50E+00	4.50E+00
Heptachlor Epoxide	1024-57-3	9.10E+00	9.10E+00
Hexachlorobenzene	118-74-1	1.60E+00	1.60E+00

Table K-10. Chemicals used to calculate mean slope factor values for calculating carcinogenic hazard value

Chemical	CAS #	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$
Hexachlorobutadiene	87-68-3	7.80E-02	7.80E-02
Hexachlorocyclohexane, Alpha-	319-84-6	6.30E+00	6.30E+00
Hexachlorocyclohexane, Beta-	319-85-7	1.80E+00	1.80E+00
Hexachlorocyclohexane, Gamma-	58-89-9	1.30E+00	
Hexachlorocyclohexane, Technical	608-73-1	1.80E+00	1.80E+00
Hexachlorodibenzo-p-dioxin, Mixture	19408-74-3	6.20E+03	4.55E+03
Hexachloroethane	67-72-1	1.40E-02	1.40E-02
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	1.10E-01	
HpCDD, 2,3,7,8-	37871-00-4	1.50E+03	1.50E+03
HpCDF, 2,3,7,8-	38998-75-3	1.50E+03	1.50E+03
HxCDD, 2,3,7,8-	34465-46-8	1.50E+04	1.50E+04
HxCDF, 2,3,7,8-	55684-94-1	1.50E+04	1.50E+04
Hydrazine	302-01-2	3.00E+00	1.70E+01
Hydrazine Sulfate	10034-93-2	3.00E+00	1.70E+01
Indeno[1,2,3-cd]pyrene	193-39-5	7.30E-01	3.10E-01
Isophorone	78-59-1	9.50E-04	
Methoxy-5-nitroaniline, 2-	99-59-2	4.60E-02	
Methyl Hydrazine	60-34-4	3.00E+00	1.72E+01
Methyl-5-Nitroaniline, 2-	99-55-8	3.30E-02	
Methylaniline Hydrochloride, 2-	636-21-5	1.80E-01	
Methylene Chloride	75-09-2	7.50E-03	1.65E-03
Methylene-bis(2-chloroaniline), 4,4'-	101-14-4	1.30E-01	1.30E-01
Methylene-bis(N,N-dimethyl) Aniline, 4,4'-	101-61-1	4.60E-02	
Methylenebisbenzenamine, 4,4'-	101-77-9	2.50E-01	
Mirex	2385-85-5	1.80E+00	
Nickel Refinery Dust	NA		8.40E-01
Nickel Subsulfide	12035-72-2		1.70E+00
Nitrofurazone	59-87-0	1.50E+00	
Nitropropane, 2-	79-46-9	9.50E+00	9.40E+00
Nitrosodiethanolamine, N-	1116-54-7	2.80E+00	
Nitrosodiethylamine, N-	55-18-5	1.50E+02	1.50E+02
Nitrosodimethylamine, N-	62-75-9	5.10E+01	5.10E+01
Nitroso-di-N-butylamine, N-	924-16-3	5.40E+00	5.40E+00
Nitroso-di-N-propylamine, N-	621-64-7	7.00E+00	
Nitrosodiphenylamine, N-	86-30-6	4.90E-03	
Nitrosomethylethylamine, N-	10595-95-6	2.20E+01	
Nitroso-N-ethylurea, N-	759-73-9	1.40E+02	

Table K-10. Chemicals used to calculate mean slope factor values for calculating carcinogenic hazard value

Chemical	CAS #	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$
Nitrosopyrrolidine, N-	930-55-2	2.10E+00	2.10E+00
OCDD	3268-87-9	1.50E+02	1.50E+02
OCDF	39001-02-0	1.50E+02	1.50E+02
PeCDD, 2,3,7,8-	36088-22-9	7.50E+04	7.50E+04
PeCDF, 1,2,3,7,8-	57117-41-6	7.50E+04	7.50E+04
PeCDF, 2,3,4,7,8-	57117-31-4	7.50E+03	7.50E+03
Pentachloronitrobenzene	82-68-8	2.60E-01	
Pentachlorophenol	87-86-5	1.20E-01	
Phenylenediamine, o-	95-54-5	4.70E-02	
Phenylphenol, 2-	90-43-7	1.94E-03	
Polybrominated Biphenyls	59536-65-1	8.90E+00	
Polychlorinated Biphenyls (high risk)	1336-36-3	2.00E+00	2.00E+00
Polychlorinated Biphenyls (low risk)	1336-36-3	4.00E-01	4.00E-01
Polychlorinated Biphenyls (lowest risk)	1336-36-3	7.00E-02	
Prochloraz	67747-09-5	1.50E-01	
Propylene Oxide	75-56-9	2.40E-01	1.30E-02
Quinoline	91-22-5	1.20E+01	
Simazine	122-34-9	1.20E-01	
Sodium Diethyldithiocarbamate	148-18-5	2.70E-01	
Stirofos (Tetrachlorovinphos)	961-11-5	2.40E-02	
TCDD, 2,3,7,8-	1746-01-6	1.50E+05	1.50E+05
TCDF, 2,3,7,8-	51207-31-9	1.50E+04	1.50E+04
Tetrachloroethane, 1,1,1,2-	630-20-6	2.60E-02	2.60E-02
Tetrachloroethane, 1,1,2,2-	79-34-5	2.00E-01	2.00E-01
Tetrachloroethylene	127-18-4	5.20E-02	2.00E-03
Tetrachlorotoluene, p- alpha, alpha, alpha-	5216-25-1	2.00E+01	
Toluene-2,4-diamine	95-80-7	3.20E+00	
Toluidine, o- (Methylaniline, 2-)	95-53-4	2.40E-01	
Toluidine, p-	106-49-0	1.90E-01	
Toxaphene	8001-35-2	1.10E+00	1.10E+00
Trichloroaniline HCl, 2,4,6-	33663-50-2	2.90E-02	
Trichloroaniline, 2,4,6-	634-93-5	3.40E-02	
Trichloroethane, 1,1,2-	79-00-5	5.70E-02	5.70E-02
Trichloroethylene	79-01-6	1.10E-02	6.00E-03
Trichlorophenol, 2,4,6-	88-06-2	1.10E-02	1.00E-02
Trichloropropane, 1,2,3-	96-18-4	7.00E+00	
Trifluralin	1582-09-8	7.70E-03	

Table K-10. Chemicals used to calculate mean slope factor values for calculating carcinogenic hazard value

Chemical	CAS #	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$
Trimethyl Phosphate	512-56-1	3.70E-02	
Trinitrotoluene, 2,4,6-	118-96-7	3.00E-02	
Vinyl Bromide	593-60-2		1.10E-01
Vinyl Chloride	75-01-4	1.40E+00	3.08E-02
geometric mean		0.71	1.70
count (n)		175	105

blank=no data
Source: Risk Assessment Information System (RAIS), http://risk.lsd.ornl.gov/cgi-bin/tox/TOX_9801 (downloaded 11/00): IRIS/HEAST Slope Factors.

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APPENDIX L

SECONDARY ISSUES TO THE USE LIFE-CYCLE STAGE OF COMPUTER DISPLAYS

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APPENDIX L

SECONDARY ISSUES TO THE USE LIFE-CYCLE STAGE OF COMPUTER DISPLAYS

1. ELECTRIC AND MAGNETIC FIELDS (EMFs)

Electric and magnetic fields (EMFs) are invisible lines of force that surround any electrical device, including power lines, electrical wiring, and electrical equipment. Electric fields are produced by voltage and increase in strength as the voltage increases. Magnetic fields result from the flow of current through wires and or electrical devices and increase in strength as the current increases. Most electrical equipment has to be turned on for a magnetic field to be produced, but electric fields are present even when equipment is switched off as long as it is connected to an electric power source. Electric fields are weakened or shielded by materials that conduct electricity (including human skin). Magnetic fields, on the other hand, pass through most materials and are therefore more difficult to shield and of greater concern. Both electric and magnetic fields decrease with distance from the source (NIOSH, et al 1996).

Most information on EMFs from video display units (VDUs) pertains to CRT monitors. The following is excerpted from the World Health Organization fact sheet, "Video Display Units (VDUs) and Human Health (1998):"

> *"The typical VDU creates images in a large evacuated cathode-ray-tube (CRT) by directing a beam of high-energy electrons from the cathode onto a special phosphor-coated glass screen. This coating emits light when struck by the fast-moving electrons. The electron beam creates the image from computer signals that control coils, at the back of the CRT, that sweep the electrons in the vertical and horizontal directions. These coils are called vertical and horizontal deflection coils. The electronic circuitry used to create the image gives rise to static electric and magnetic fields, as well as low and high frequency electromagnetic fields...*
>
> *Electric and magnetic fields are emitted in three different frequency ranges. The horizontal deflection coils emit fields operating predominantly in the frequency range 15-35kHz. Extremely low frequency (ELF) fields at 50 to 60 Hz come from the power supply, transformers and the vertical deflection coils. Finally, weak signals at higher radio frequencies (RF) come from the VDU's interior electronic circuitry and signals received from the computer."*

Very little information was found on the relative magnitude of EMFs emitted by CRTs and LCDs. However, typical household power operates at 50-60 Hz and 120 volts – these remain relatively constant no matter how much power in watts a piece of electrical equipment needs or draws. What fluctuates with power demand is current (in amperes, or amps). CRTs consume a greater quantity of power in watts, and therefore require a larger amount of electrical current in amps. Since magnetic fields increase in strength with increased current, it is assumed a CRT will

generate a larger magnetic field than an LCD. Additionally, some of the components discussed above, such as the horizontal and vertical deflection coils, are found in CRTs but not in LCDs. Thus, due to their power handling needs and capabilities, CRTs also generate EMFs that are not generated by LCDs. However, according to NoRad Corporation, a manufacturer and marketer of EMF shielding products for monitors, it is a common misconception that LCDs do not emit EMFs because of their smaller current draw; backlit LCD displays can emit significant levels of both magnetic fields and electric fields (NoRad, undated).

To address concerns about potential health effects from EMF exposure, in 1992 the U.S. Congress authorized the Electric and Magnetic Fields Research and Public Information Program (EMF-RAPID Program) and directed the National Institute of Environmental Health Sciences (NIEHS) and the Department of Energy (DOE) to direct and manage a program of research and analysis aimed at providing scientific evidence to clarify the potential for health risks from exposure to ELF-EMF (NIEHS, 1999). After several years of research, in 1999 NIEHS issued a report to Congress on the health effects from exposure to power-line frequency EMFs, which concluded the following (NIEHS, 1999):

> *"The scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak. The strongest evidence for health effects comes from associations observed in human populations with two forms of cancer: childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults. While the support from individual studies is weak, the epidemiological studies demonstrate, for some methods of measuring exposure, a fairly consistent pattern of a small, increased risk with increasing exposure that is somewhat weaker for chronic lymphocytic leukemia than for childhood leukemia. In contrast, the mechanistic studies and the animal toxicology literature fail to demonstrate any consistent pattern across studies although sporadic finding of biological effects (including increased cancers in animals) have been reported. No indication of increased leukemia in experimental animals has been observed.*
> *The lack of connection between the human data and the experimental data (animal and mechanistic) severely complicates the interpretation of these results. The human data are in the "right" species, are tied to "real-life" exposures and show some consistency that is difficult to ignore. This assessment is tempered by the observation that given the weak magnitude of these increased risks, some other factor or common source of error could explain these findings. However, no consistent explanation other than exposure to ELF-EMF has been identified.*
>
> *Epidemiological studies have serious limitations in their ability to demonstrate a cause and effect relationship whereas laboratory studies, by design, can clearly show that cause and effect are possible. Virtually all of the laboratory evidence in animals and humans and most of the mechanistic work done in cells fail to support a causal relationship between exposure to ELF-EMF at environmental levels and changes in biological function or disease status. The lack of consistent, positive findings in animal or mechanistic studies weakens the belief that this association is actually due to ELF-EMF, but it cannot completely discount the epidemiological findings.*
> *The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our*

opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers on non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern."

More recently, an expert scientific working group of the Monographs Programme of the International Agency for Research on Cancer (IARC) released its findings from a review of health effects of static and ELF EMFs. IARC concluded that ELF magnetic fields are possibly carcinogenic to humans, based on consistent statistical associations of high level residential magnetic fields with a doubling of risk of childhood leukemia. However, IARC also concluded that children who are exposed to residential ELF magnetic fields less than 0.4 microTesla (4 milligauss)[1] have no increased risk of leukemia (IARC, 2001). To help put this in perspective, Table L-1 presents the average magnetic field exposures for clerical workers with and without computers.[2] As shown in the table, clerical workers with computers have increased average daily exposures of about 0.07 μT (0.7 mG) over clerical workers without computers. The average daily median for workers with computers is 0.12 μT (1.2 mG) and the exposure range is 0.05 to 0.45 μT (0.5 to 4.5 mG). Only the upper end of the exposure range exceeds the exposure level that IARC concluded has an increased risk of childhood leukemia (0.4 μT).

Table L-1. Average magnetic field exposures for clerical workers*

Type of worker	Average daily median (μT)	Exposure range (μT)
Clerical workers with computers	0.12	0.05 to 0.45
Clerical workers without computers	0.05	0.02 to 0.2

Source: NIOSH Fact Sheet: EMFs in the Workplace

* The source does not give the distance at which measurements were taken. Monitor EMF emission measurements are often taken at a distance of 30 cm (approximately 12 inches) or 50 cm (approximately 20 inches).

In summary, no data were found on EMF measurements from LCDs. However, because of the lesser current requirements of LCDs compared to CRTs, it is assumed that LCDs also generate a lesser magnetic field. NIEHS has concluded that the evidence that ELF-EMF exposures pose any health risk is weak. However, since publication of the NIEHS report, IARC has classified ELF-EMFs as possibly carcinogenic to humans. Based on the data in Table L-3, it

[1]Magnetic field intensity is measured in units of tesla (T) or gauss (G). One tesla equals 10,000 gauss. Since most environmental EMF exposure involve magnetic field intensities that are only a fraction of a tesla or a gauss, they are commonly measured in units of microteslas (μT) or milligauss (mG). One μT is equal to 10 mG.

[2] Given the fact that desktop LCD monitors were only recently introduced into the marketplace, it is assumed that the computers used by clerical workers for whom measurements were taken were equipped with CRT monitors, although the data could also include clerical workers who used laptops with LCD displays.

appears most exposures to ELFs-EMFs from computer displays may be below the carcinogenicity concern level determined by IARC (0.4 μT).

2. ERGONOMIC ISSUES

Merriam-Webster's Online Dictionary defines ergonomics as "an applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely – also called human engineering." While CRT and LCD desktop monitors are both usable in the same environments (in most cases), there are differences in their sizes and the way they present information to the user in their working environment. Thus the potential exists for there to be differences in the way a user might physically interact with their CRT or LCD monitor. (Note that Eye Strain is addressed as a separate issue in this Appendix [see L.3], and issues related to image generation on the monitor surface are addressed there.)

In reviewing several documents on ergonomics and the placement of computer monitors in or around a user's working area, some sources discuss the differences in using a CRT versus an LCD monitor. It is assumed in most discussions that the user is able to move/adjust the monitor to within a recommended operating position for use (e.g., eye-to-screen distance, vertical monitor location [with respect to horizontal eye level]). Thus, with unlimited resources within which to setup a computing environment, it is expected that only viewing angle would potentially favor a CRT over an LCD. CRTs provide a horizontal viewing angle of 180˚ whereas early-model LCD monitors were limited to an almost straight on view. The most recent LCDs on the market have a 120˚ capability (EIZO 1999). Although less than the CRT horizontal viewing angle, these current viewing angles significantly diminish the differences in viewing ability between the two monitor types. The reduced viewing angle of the LCD appears to mainly be a factor when presenting information to users who are viewing the screen from the side, such as during presentations to multiple users.

However, the user's environment is often limited by physical constraints on where the monitor can be placed and user seated. With this in mind, the physical size and footprint of the monitor becomes more of an ergonomics issue. In cases where the footprint of a monitor dictates that the monitor not go directly in-front of the user, but to either the left or right side, an increased level of ergonomic stress may be realized (typically neck twist) if the user is unable to adjust his or her seated position accordingly. Even the smaller footprint CRTs being manufactured today have a much larger footprint than those of closely-equivalent LCD monitors, typically occupying almost six times the depth of LCDs (IBM 1999). Additionally, some LCD monitors can be wall-mounted, almost completely removing the monitor from the desktop. Thus, it appears that the smaller footprint of the LCD may offer benefits in more easily positioning the monitor for optimum user use.

3. EYE STRAIN

There are numerous sensations that can be interpreted to be eye strain in the use of monitors, including but not limited to burning, tightness, sharp pains, dull pains, watering, blurring, double vision and headaches. Many of the principal factors that cause eye strain can be corrected or improved by adequately setting up the computing environment (e.g., controlling the distance between the eyes and the screen, wearing corrective lenses, if needed, etc.). Others can be improved by adjusting the controls on the monitor (e.g., setting brightness or contrast). Of the factors identified in this study, glare and screen flicker are the two that appear to be most affected by the technology choice (e.g., CRT or LCD).

The distance between your eyes and the monitor should be at least 25" (Ankrum 1996), and using a CRT versus an LCD should have no effect on the necessary distance needed to clearly see the monitor screen, as long as the user is using an appropriately sized resolution for his or her monitor size. Both CRTs and LCDs should be equally readable, not considering the viewing of an LCD from outside its particular viewing angle. If the brightness levels of a CRT and LCD are set appropriately, then the contrast between what is being looked at and its immediate environment should be no different for the two monitor types. Lastly, a user has to have good or corrected vision before either monitor will be useful.

The only notable difference between CRTs and LCDs with respect to glare is their flatness. As LCDs have completely flat monitor surfaces or screens, versus most CRTs which have rounded screens, they significantly reduce the probability of reflected glare from overhead or nearby lights. There are two main types of CRT tube technology, shadow mask and aperture grill. Shadow masks are utilized in older, less flat monitors, and aperture grills are utilized in the more current variations that have flatter outside faces (IBM 1999). Flatter screens provide less opportunity for the occurrence of reflected glare.

CRTs, especially older models, may be prone to screen flicker, which contributes significantly to eye strain. CRT's use phosphor that has been excited by an electron beam to create light. After the phosphor is excited, it begins to decay. The electron beam needs to return to the phosphor in a specific amount of time to keep the phosphor from decaying to the point that the human eye can perceive it. The rate at which the electron beam returns to any given phosphor is called the refresh rate. If the refresh rate is too low, the decaying of the phosphor may be perceptible to the human eye as a flickering screen image. Because LCDs do not use phosphors to create the image they do not have a refresh rate and do not flicker.

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APPENDIX M

LIFE-CYCLE IMPACT ASSESSMENT RESULTS

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APPENDIX M

LIFE-CYCLE IMPACT ASSESSMENT RESULTS

Table M-1. CRT LCIA Results for the Renewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Renewable Resource Use (kg)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Water	secondary	4.69e+02	3.57e+00
Invar	Water	secondary	3.96e+01	3.02e-01
Lead	Water	secondary	1.40e+01	1.07e-01
Polycarbonate Production	Water	secondary	1.30e+01	9.93e-02
Ferrite mfg.	Water	secondary	1.11e+01	8.46e-02
ABS Production	Water	secondary	3.94e+00	3.00e-02
Styrene-butadiene Copolymer Prod.	Water	secondary	2.58e+00	1.97e-02
Polystyrene Prod., high-impact	Water	secondary	8.16e-01	6.22e-03
Polycarbonate Production	Sodium chloride (NaCl, in ground or in sea)	secondary	7.30e-01	5.56e-03
Steel Prod., cold-rolled, semi-finished	Limestone (CaCO3, in ground)	secondary	6.72e-01	5.12e-03
Aluminum Prod.	Limestone (CaCO3, in ground)	secondary	9.25e-02	7.05e-04
Lead	Limestone (CaCO3, in ground)	secondary	6.63e-02	5.05e-04
Lead	Sand (in ground)	secondary	4.79e-02	3.65e-04
Aluminum Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	2.56e-02	1.95e-04
Invar	Limestone (CaCO3, in ground)	secondary	9.08e-03	6.91e-05
ABS Production	Limestone (CaCO3, in ground)	secondary	7.62e-03	5.80e-05
Polycarbonate Production	Limestone (CaCO3, in ground)	secondary	6.00e-03	4.57e-05
Aluminum Prod.	Sand (in ground)	secondary	5.26e-03	4.00e-05
Polystyrene Prod., high-impact	Limestone (CaCO3, in ground)	secondary	3.78e-03	2.88e-05
Invar	Sand (in ground)	secondary	3.67e-03	2.80e-05
ABS Production	Gravel/Sand	secondary	3.60e-03	2.74e-05
Aluminum Prod.	Clay (in ground)	secondary	2.79e-03	2.13e-05
ABS Production	Sodium chloride (NaCl, in ground or in sea)	secondary	2.63e-03	2.00e-05
Steel Prod., cold-rolled, semi-finished	Gravel/Sand	secondary	2.05e-03	1.56e-05
Ferrite mfg.	Limestone (CaCO3, in ground)	secondary	1.58e-03	1.21e-05
Styrene-butadiene Copolymer Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	1.16e-03	8.82e-06
Styrene-butadiene Copolymer Prod.	Limestone (CaCO3, in ground)	secondary	1.13e-03	8.63e-06
Steel Prod., cold-rolled, semi-finished	Sodium chloride (NaCl, in ground or in sea)	secondary	1.02e-03	7.74e-06
Ferrite mfg.	Sand (in ground)	secondary	9.35e-04	7.12e-06
Invar	Clay (in ground)	secondary	8.67e-04	6.60e-06
Invar	Sodium chloride (NaCl, in ground or in sea)	secondary	6.95e-04	5.29e-06
Invar	Gravel/Sand	secondary	5.91e-04	4.50e-06
Ferrite mfg.	Gravel/Sand	secondary	5.77e-04	4.39e-06
Steel Prod., cold-rolled, semi-finished	Clay (in ground)	secondary	4.45e-04	3.39e-06
Polycarbonate Production	Sand (in ground)	secondary	3.79e-04	2.88e-06
Polystyrene Prod., high-impact	Sodium chloride (NaCl, in ground or in sea)	secondary	3.17e-04	2.42e-06
Ferrite mfg.	Sodium chloride (NaCl, in ground or in sea)	secondary	2.65e-04	2.02e-06
ABS Production	Sand (in ground)	secondary	2.54e-04	1.93e-06
Ferrite mfg.	Clay (in ground)	secondary	1.91e-04	1.45e-06
ABS Production	Clay (in ground)	secondary	1.25e-04	9.55e-07
Styrene-butadiene Copolymer Prod.	Sand (in ground)	secondary	6.21e-05	4.73e-07
Invar	Maize	secondary	5.75e-05	4.38e-07

Table M-1. CRT LCIA Results for the Renewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Renewable Resource Use (kg)	% of Total
Ferrite mfg.	Maize	secondary	5.62e-05	4.28e-07
Steel Prod., cold-rolled, semi-finished	Sand (in ground)	secondary	5.34e-05	4.07e-07
Polycarbonate Production	Clay (in ground)	secondary	4.62e-05	3.52e-07
Styrene-butadiene Copolymer Prod.	Clay (in ground)	secondary	2.44e-05	1.86e-07
Polystyrene Prod., high-impact	Sand (in ground)	secondary	2.42e-05	1.84e-07
Invar	Potatoes	secondary	1.55e-05	1.18e-07
Ferrite mfg.	Potatoes	secondary	1.51e-05	1.15e-07
Polycarbonate Production	Gravel/Sand	secondary	2.77e-06	2.11e-08
Styrene-butadiene Copolymer Prod.	Gravel/Sand	secondary	8.27e-07	6.30e-09
Total Materials Processing			**5.56e+02**	**4.23e+00**
Manufacturing Life-cycle Stage				
LPG Production	Water, unspecified	secondary	1.04e+04	7.94e+01
CRT tube mfg.	Water	primary	8.11e+02	6.18e+00
Japanese Electric Grid	Water	model/secondary	4.43e+01	3.37e-01
PWB Mfg.	Water	model/secondary	4.22e+01	3.21e-01
Fuel Oil #6 Prod.	Water, unspecified	secondary	3.56e+01	2.71e-01
Glass/frit	Water	primary	3.51e+01	2.67e-01
Fuel Oil #2 Prod.	Water, unspecified	secondary	2.93e+01	2.23e-01
US electric grid	Water	model/secondary	1.82e+01	1.38e-01
Glass/frit	Sand	primary	2.40e+00	1.83e-02
Fuel Oil #4 Prod.	Water, unspecified	secondary	2.39e+00	1.82e-02
LPG Production	Limestone (CaCO3, in ground)	secondary	1.06e+00	8.10e-03
Natural Gas Prod.	Water	secondary	2.12e-01	1.61e-03
US electric grid	Limestone	model/secondary	3.85e-02	2.93e-04
Japanese Electric Grid	Limestone	model/secondary	3.06e-02	2.33e-04
LPG Production	Sand (in ground)	secondary	2.72e-02	2.08e-04
LPG Production	Sodium chloride (NaCl, in ground or in sea)	secondary	1.25e-02	9.52e-05
Fuel Oil #6 Prod.	Limestone (CaCO3, in ground)	secondary	8.56e-03	6.52e-05
Fuel Oil #2 Prod.	Limestone (CaCO3, in ground)	secondary	3.34e-03	2.54e-05
Natural Gas Prod.	Limestone (CaCO3, in ground)	secondary	1.84e-03	1.40e-05
Fuel Oil #4 Prod.	Limestone (CaCO3, in ground)	secondary	3.55e-04	2.71e-06
Fuel Oil #6 Prod.	Sand (in ground)	secondary	9.22e-05	7.02e-07
Fuel Oil #2 Prod.	Sand (in ground)	secondary	7.65e-05	5.82e-07
Fuel Oil #6 Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	4.23e-05	3.22e-07
Fuel Oil #2 Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	3.51e-05	2.67e-07
Fuel Oil #4 Prod.	Sand (in ground)	secondary	6.21e-06	4.73e-08
Fuel Oil #4 Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	2.85e-06	2.17e-08
Natural Gas Prod.	Sand (in ground)	secondary	5.51e-07	4.19e-09
Natural Gas Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	2.53e-07	1.92e-09
Total Manufacturing			**1.15e+04**	**8.72e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Water	model/secondary	1.14e+03	8.67e+00
US electric grid	Limestone	model/secondary	2.41e+00	1.83e-02
Total Use, Maintenance and Repair			**1.14e+03**	**8.69e+00**
End-of-life Life-cycle Stage				
CRT Incineration	Clay (in ground)	secondary	4.24e+00	3.23e-02
CRT landfilling	Clay (in ground)	primary	3.95e+00	3.01e-02
CRT Incineration	Sand (in ground)	secondary	1.40e+00	1.07e-02
CRT landfilling	Sand (in ground)	primary	1.31e+00	9.97e-03
US electric grid	Water	model/secondary	1.14e-01	8.67e-04

Table M-1. CRT LCIA Results for the Renewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Renewable Resource Use (kg)	% of Total
LPG Production	Water, unspecified	secondary	9.00e-02	6.86e-04
CRT landfilling	Limestone (CaCO3, in ground)	primary	6.32e-04	4.81e-06
US electric grid	Limestone	model/secondary	2.41e-04	1.84e-06
LPG Production	Limestone (CaCO3, in ground)	secondary	9.18e-06	6.99e-08
LPG Production	Sand (in ground)	secondary	2.35e-07	1.79e-09
LPG Production	Sodium chloride (NaCl, in ground or in sea)	secondary	1.08e-07	8.22e-10
Natural Gas Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	-1.27e-07	-9.65e-10
Natural Gas Prod.	Sand (in ground)	secondary	-2.76e-07	-2.10e-09
Fuel Oil #4 Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	-3.06e-05	-2.33e-07
Fuel Oil #4 Prod.	Sand (in ground)	secondary	-6.68e-05	-5.09e-07
Natural Gas Prod.	Limestone (CaCO3, in ground)	secondary	-9.22e-04	-7.02e-06
Fuel Oil #4 Prod.	Limestone (CaCO3, in ground)	secondary	-3.82e-03	-2.91e-05
Natural Gas Prod.	Water	secondary	-1.06e-01	-8.09e-04
CRT Incineration	Limestone (CaCO3, in ground)	secondary	-2.35e-01	-1.79e-03
CRT Incineration	Water	secondary	-1.73e+00	-1.32e-02
Fuel Oil #4 Prod.	Water, unspecified	secondary	-2.57e+01	-1.95e-01
Total End-of-Life			**-1.66e+01**	**-1.27e-01**
Total All Life-cycle Stages			**1.31e+04**	**1.00e+02**

Table M-2. LCD LCIA Results for the Renewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Renewable Resource Use (kg)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Water	secondary	2.30e+02	8.21e+00
Natural Gas Prod.	Water	secondary	1.48e+01	5.29e-01
PMMA Sheet Prod.	Water	secondary	8.86e+00	3.17e-01
Polycarbonate Production	Water	secondary	7.28e+00	2.60e-01
Styrene-butadiene Copolymer Prod.	Water	secondary	1.13e+00	4.03e-02
PET Resin Production	Water	secondary	8.19e-01	2.92e-02
Polycarbonate Production	Sodium chloride (NaCl, in ground or in sea)	secondary	4.07e-01	1.46e-02
Steel Prod., cold-rolled, semi-finished	Limestone (CaCO3, in ground)	secondary	3.29e-01	1.18e-02
Natural Gas Prod.	Limestone (CaCO3, in ground)	secondary	1.28e-01	4.59e-03
Aluminum Prod.	Limestone (CaCO3, in ground)	secondary	3.44e-02	1.23e-03
PMMA Sheet Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	1.92e-02	6.85e-04
Aluminum Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	9.54e-03	3.41e-04
PMMA Sheet Prod.	Limestone (CaCO3, in ground)	secondary	8.44e-03	3.01e-04
PMMA Sheet Prod.	Sand (in ground)	secondary	7.29e-03	2.60e-04
Polycarbonate Production	Limestone (CaCO3, in ground)	secondary	3.35e-03	1.20e-04
Aluminum Prod.	Sand (in ground)	secondary	1.96e-03	6.99e-05
PET Resin Production	Limestone (CaCO3, in ground)	secondary	1.91e-03	6.81e-05
Aluminum Prod.	Clay (in ground)	secondary	1.04e-03	3.71e-05
Steel Prod., cold-rolled, semi-finished	Gravel/Sand	secondary	1.01e-03	3.60e-05
Styrene-butadiene Copolymer Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	5.06e-04	1.81e-05
Steel Prod., cold-rolled, semi-finished	Sodium chloride (NaCl, in ground or in sea)	secondary	4.98e-04	1.78e-05
Styrene-butadiene Copolymer Prod.	Limestone (CaCO3, in ground)	secondary	4.96e-04	1.77e-05
Steel Prod., cold-rolled, semi-finished	Clay (in ground)	secondary	2.18e-04	7.78e-06
Polycarbonate Production	Sand (in ground)	secondary	2.11e-04	7.55e-06
PET Resin Production	Sodium chloride (NaCl, in ground or in sea)	secondary	1.27e-04	4.54e-06
Natural Gas Prod.	Sand (in ground)	secondary	3.85e-05	1.37e-06
Styrene-butadiene Copolymer Prod.	Sand (in ground)	secondary	2.71e-05	9.69e-07
Steel Prod., cold-rolled, semi-finished	Sand (in ground)	secondary	2.62e-05	9.35e-07
Polycarbonate Production	Clay (in ground)	secondary	2.58e-05	9.21e-07
Natural Gas Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	1.77e-05	6.30e-07
Styrene-butadiene Copolymer Prod.	Clay (in ground)	secondary	1.07e-05	3.81e-07
PET Resin Production	Sand (in ground)	secondary	5.81e-06	2.07e-07
PMMA Sheet Prod.	Clay (in ground)	secondary	4.60e-06	1.64e-07
Polycarbonate Production	Gravel/Sand	secondary	1.55e-06	5.53e-08
PMMA Sheet Prod.	Gravel/Sand	secondary	1.15e-06	4.11e-08
Styrene-butadiene Copolymer Prod.	Gravel/Sand	secondary	3.62e-07	1.29e-08
PET Resin Production	Clay (in ground)	secondary	9.08e-08	3.24e-09
PET Resin Production	Gravel	secondary	9.08e-08	3.24e-09
Total Materials Processing			**2.64e+02**	**9.42e+00**
Manufacturing Life-cycle Stage				
Monitor/module	Water	primary	1.08e+03	3.85e+01
LPG Production	Water, unspecified	secondary	5.00e+02	1.79e+01
Panel components	Water	primary	1.79e+02	6.38e+00
Backlight	Water	primary	1.67e+02	5.95e+00
Japanese Electric Grid	Water	model/secondary	1.49e+02	5.32e+00
Backlight	Water	primary	2.16e+01	7.70e-01
PWB Mfg.	Water	model/secondary	1.86e+01	6.64e-01
Backlight	Water	primary	3.76e+00	1.34e-01
Fuel Oil #4 Prod.	Water, unspecified	secondary	3.68e+00	1.31e-01

Table M-2. LCD LCIA Results for the Renewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Renewable Resource Use (kg)	% of Total
US electric grid	Water	model/secondary	2.20e+00	7.87e-02
LCD glass mfg.	Water	primary	1.62e+00	5.80e-02
Fuel Oil #2 Prod.	Water, unspecified	secondary	1.37e+00	4.88e-02
Fuel Oil #6 Prod.	Water, unspecified	secondary	1.21e+00	4.33e-02
Natural Gas Prod.	Water	secondary	3.34e-01	1.19e-02
Panel components	Water	primary	3.03e-01	1.08e-02
Panel components	Water	primary	2.01e-01	7.19e-03
LCD glass mfg.	Sand	primary	1.11e-01	3.97e-03
Japanese Electric Grid	Limestone	model/secondary	1.03e-01	3.68e-03
LPG Production	Limestone (CaCO3, in ground)	secondary	5.10e-02	1.82e-03
US electric grid	Limestone	model/secondary	4.66e-03	1.67e-04
Natural Gas Prod.	Limestone (CaCO3, in ground)	secondary	2.90e-03	1.04e-04
LPG Production	Sand (in ground)	secondary	1.31e-03	4.67e-05
LPG Production	Sodium chloride (NaCl, in ground or in sea)	secondary	6.00e-04	2.14e-05
Fuel Oil #4 Prod.	Limestone (CaCO3, in ground)	secondary	5.48e-04	1.96e-05
Fuel Oil #6 Prod.	Limestone (CaCO3, in ground)	secondary	2.92e-04	1.04e-05
Fuel Oil #2 Prod.	Limestone (CaCO3, in ground)	secondary	1.56e-04	5.56e-06
Fuel Oil #4 Prod.	Sand (in ground)	secondary	9.58e-06	3.42e-07
Fuel Oil #4 Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	4.39e-06	1.57e-07
Fuel Oil #2 Prod.	Sand (in ground)	secondary	3.57e-06	1.27e-07
Fuel Oil #6 Prod.	Sand (in ground)	secondary	3.14e-06	1.12e-07
Fuel Oil #2 Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	1.64e-06	5.85e-08
Fuel Oil #6 Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	1.44e-06	5.14e-08
Natural Gas Prod.	Sand (in ground)	secondary	8.68e-07	3.10e-08
Natural Gas Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	3.98e-07	1.42e-08
Total Manufacturing			**2.13e+03**	**7.59e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Water	model/secondary	4.25e+02	1.52e+01
US electric grid	Limestone	model/secondary	8.99e-01	3.21e-02
Total Use, Maintenance, and Repair			**4.26e+02**	**1.52e+01**
End-of-life Life-cycle Stage				
LCD landfilling	Clay (in ground)	primary	9.52e-01	3.40e-02
LCD incineration	Clay (in ground)	secondary	7.38e-01	2.64e-02
LCD landfilling	Sand (in ground)	primary	3.15e-01	1.13e-02
LCD incineration	Sand (in ground)	secondary	2.45e-01	8.73e-03
US electric grid	Water	model/secondary	8.06e-02	2.88e-03
LPG Production	Water, unspecified	secondary	4.11e-02	1.47e-03
US electric grid	Limestone	model/secondary	1.71e-04	6.09e-06
LCD landfilling	Limestone (CaCO3, in ground)	primary	1.52e-04	5.44e-06
LCD landfilling	Sodium chloride (NaCl, in ground or in sea)	primary	1.82e-05	6.50e-07
LCD incineration	Sodium chloride (NaCl, in ground or in sea)	secondary	1.28e-05	4.59e-07
LPG Production	Limestone (CaCO3, in ground)	secondary	4.19e-06	1.50e-07
LPG Production	Sand (in ground)	secondary	1.07e-07	3.83e-09
LPG Production	Sodium chloride (NaCl, in ground or in sea)	secondary	4.92e-08	1.76e-09
Natural Gas Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	-8.37e-08	-2.99e-09
Natural Gas Prod.	Sand (in ground)	secondary	-1.82e-07	-6.51e-09
Fuel Oil #4 Prod.	Sodium chloride (NaCl, in ground or in sea)	secondary	-2.02e-05	-7.23e-07
Fuel Oil #4 Prod.	Sand (in ground)	secondary	-4.41e-05	-1.58e-06
Natural Gas Prod.	Limestone (CaCO3, in ground)	secondary	-6.09e-04	-2.17e-05

Table M-2. LCD LCIA Results for the Renewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Renewable Resource Use (kg)	% of Total
Fuel Oil #4 Prod.	Limestone (CaCO3, in ground)	secondary	-2.52e-03	-9.01e-05
Natural Gas Prod.	Water	secondary	-7.02e-02	-2.51e-03
LCD incineration	Limestone (CaCO3, in ground)	secondary	-1.52e-01	-5.44e-03
LCD incineration	Water	secondary	-1.12e+00	-4.01e-02
Fuel Oil #4 Prod.	Water, unspecified	secondary	-1.69e+01	-6.05e-01
Total End-of-life			**-1.59e+01**	**-5.68e-01**
Total All Life-cycle Stages			**2.80e+03**	**1.00e+02**

Table M-3. CRT LCIA Results for the Nonrenewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Nonrenewable Resource Use (kg)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Iron (Fe, ore)	secondary	6.65e+00	9.95e-01
Steel Prod., cold-rolled, semi-finished	Coal, average (in ground)	secondary	3.98e+00	5.96e-01
Aluminum Prod.	Bauxite (Al2O3, ore)	secondary	1.37e+00	2.05e-01
Polycarbonate Production	Natural gas (in ground)	secondary	1.29e+00	1.92e-01
Styrene-butadiene Copolymer Prod.	Petroleum (in ground)	secondary	1.03e+00	1.54e-01
Aluminum Prod.	Coal, average (in ground)	secondary	9.83e-01	1.47e-01
Lead	Lead (Pb, ore)	secondary	4.96e-01	7.42e-02
Steel Prod., cold-rolled, semi-finished	Petroleum (in ground)	secondary	4.89e-01	7.32e-02
Aluminum Prod.	Petroleum (in ground)	secondary	4.64e-01	6.95e-02
Steel Prod., cold-rolled, semi-finished	Natural gas (in ground)	secondary	4.58e-01	6.86e-02
ABS Production	Natural gas (in ground)	secondary	4.42e-01	6.62e-02
Polycarbonate Production	Petroleum (in ground)	secondary	4.34e-01	6.49e-02
Styrene-butadiene Copolymer Prod.	Natural gas (in ground)	secondary	4.30e-01	6.44e-02
Steel Prod., cold-rolled, semi-finished	Coal, lignite (in ground)	secondary	4.16e-01	6.23e-02
Polycarbonate Production	Coal, average (in ground)	secondary	3.90e-01	5.85e-02
Invar	Petroleum (in ground)	secondary	3.70e-01	5.55e-02
Invar	Natural gas (in ground)	secondary	3.51e-01	5.25e-02
ABS Production	Petroleum (in ground)	secondary	2.98e-01	4.45e-02
Lead	Coal, average (in ground)	secondary	2.88e-01	4.30e-02
Invar	Iron (Fe, ore)	secondary	2.52e-01	3.77e-02
Polycarbonate Production	Coal, lignite (in ground)	secondary	2.46e-01	3.69e-02
Ferrite mfg.	Iron ore	secondary	2.37e-01	3.55e-02
Aluminum Prod.	Natural gas (in ground)	secondary	2.14e-01	3.20e-02
Aluminum Prod.	Coal, lignite (in ground)	secondary	1.83e-01	2.73e-02
Ferrite mfg.	Coal, average (in ground)	secondary	1.74e-01	2.60e-02
Lead	Natural gas (in ground)	secondary	1.56e-01	2.34e-02
Polystyrene Prod., high-impact	Natural gas (in ground)	secondary	1.39e-01	2.08e-02
Ferrite mfg.	Coal, lignite (in ground)	secondary	1.28e-01	1.92e-02
Ferrite mfg.	Natural gas (in ground)	secondary	1.24e-01	1.85e-02
Polystyrene Prod., high-impact	Petroleum (in ground)	secondary	1.18e-01	1.76e-02
Aluminum Prod.	Pyrite (FeS2, ore)	secondary	1.01e-01	1.51e-02
Invar	Nickel (Ni, ore)	secondary	9.80e-02	1.47e-02
Lead	Petroleum (in ground)	secondary	8.74e-02	1.31e-02
Lead	Iron (Fe, ore)	secondary	5.30e-02	7.93e-03
Lead	Pyrite (FeS2, ore)	secondary	5.09e-02	7.62e-03
Ferrite mfg.	Petroleum (in ground)	secondary	4.90e-02	7.34e-03
Invar	Pyrite (FeS2, ore)	secondary	3.94e-02	5.89e-03
Steel Prod., cold-rolled, semi-finished	Tin (Sn, ore)	secondary	2.43e-02	3.64e-03
Invar	Zinc (Zn, ore)	secondary	1.92e-02	2.87e-03
Ferrite mfg.	Zinc (Zn, ore)	secondary	1.87e-02	2.80e-03
Aluminum Prod.	Iron (Fe, ore)	secondary	1.75e-02	2.62e-03
ABS Production	Talcum (ore)	secondary	8.89e-03	1.33e-03
Steel Prod., cold-rolled, semi-finished	Raw materials (unspecified)	secondary	7.11e-03	1.06e-03
Polycarbonate Production	Sulfur (S, in ground)	secondary	5.31e-03	7.95e-04
Ferrite mfg.	Pyrite (FeS2, ore)	secondary	2.19e-03	3.27e-04
ABS Production	Potassium chloride (KCl, as K2O, in ground)	secondary	1.91e-03	2.85e-04
Polycarbonate Production	Bentonite (in ground)	secondary	1.29e-03	1.94e-04
Invar	Barium sulfate (BaSO4, in ground)	secondary	1.10e-03	1.65e-04

Table M-3. CRT LCIA Results for the Nonrenewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Nonrenewable Resource Use (kg)	% of Total
Polycarbonate Production	Iron (Fe, ore)	secondary	8.68e-04	1.30e-04
Aluminum Prod.	Copper (Cu, ore)	secondary	7.06e-04	1.06e-04
Aluminum Prod.	Bentonite (in ground)	secondary	6.62e-04	9.92e-05
Styrene-butadiene Copolymer Prod.	Iron (Fe, ore)	secondary	5.83e-04	8.73e-05
Invar	Raw materials (unspecified)	secondary	5.29e-04	7.91e-05
Invar	Bauxite (Al2O3, ore)	secondary	5.27e-04	7.90e-05
Ferrite mfg.	Raw materials (unspecified)	secondary	5.16e-04	7.72e-05
Styrene-butadiene Copolymer Prod.	Bauxite	secondary	4.80e-04	7.19e-05
ABS Production	Iron (Fe, ore)	secondary	3.81e-04	5.71e-05
Invar	Bentonite (in ground)	secondary	3.24e-04	4.85e-05
Steel Prod., cold-rolled, semi-finished	Pyrite (FeS2, ore)	secondary	3.04e-04	4.55e-05
Polycarbonate Production	Bauxite (Al2O3, ore)	secondary	2.77e-04	4.15e-05
ABS Production	Bauxite (Al2O3, ore)	secondary	2.54e-04	3.80e-05
Invar	Copper (Cu, ore)	secondary	1.61e-04	2.41e-05
Polystyrene Prod., high-impact	Bauxite	secondary	1.51e-04	2.26e-05
Polystyrene Prod., high-impact	Iron ore	secondary	1.27e-04	1.90e-05
ABS Production	Bentonite (in ground)	secondary	8.47e-05	1.27e-05
Styrene-butadiene Copolymer Prod.	Sulfur (S, in ground)	secondary	8.15e-05	1.22e-05
Aluminum Prod.	Lead (Pb, ore)	secondary	6.30e-05	9.43e-06
Styrene-butadiene Copolymer Prod.	Bentonite (in ground)	secondary	5.79e-05	8.67e-06
Steel Prod., cold-rolled, semi-finished	Uranium (U, ore)	secondary	4.27e-05	6.39e-06
Ferrite mfg.	Bentonite (in ground)	secondary	3.82e-05	5.72e-06
Ferrite mfg.	Bauxite (Al2O3, ore)	secondary	3.37e-05	5.05e-06
Polycarbonate Production	Uranium (U, ore)	secondary	3.13e-05	4.68e-06
Aluminum Prod.	Uranium (U, ore)	secondary	2.86e-05	4.28e-06
Steel Prod., cold-rolled, semi-finished	Bentonite (in ground)	secondary	1.79e-05	2.68e-06
Steel Prod., cold-rolled, semi-finished	Iron sulfate (FeSO4, ore)	secondary	1.63e-05	2.44e-06
Polycarbonate Production	Calcium sulfate (CaSO4, ore)	secondary	1.29e-05	1.94e-06
Ferrite mfg.	Uranium (U, ore)	secondary	1.23e-05	1.85e-06
Steel Prod., cold-rolled, semi-finished	Bauxite (Al2O3, ore)	secondary	1.18e-05	1.77e-06
Polycarbonate Production	Dolomite (in ground)	secondary	9.23e-06	1.38e-06
Styrene-butadiene Copolymer Prod.	Potassium chloride (KCl, as K2O, in ground)	secondary	8.69e-06	1.30e-06
Polycarbonate Production	Olivine ore	secondary	7.39e-06	1.11e-06
Lead	Uranium (U, ore)	secondary	6.08e-06	9.10e-07
Styrene-butadiene Copolymer Prod.	Calcium sulfate (CaSO4, ore)	secondary	5.79e-06	8.67e-07
Polycarbonate Production	Potassium chloride (KCl, as K2O, in ground)	secondary	5.54e-06	8.29e-07
Invar	Iron sulfate (FeSO4, ore)	secondary	4.68e-06	7.01e-07
Ferrite mfg.	Iron sulfate (FeSO4, ore)	secondary	4.57e-06	6.84e-07
Invar	Calcium sulfate (CaSO4, ore)	secondary	4.32e-06	6.47e-07
ABS Production	Dolomite (in ground)	secondary	4.24e-06	6.34e-07
ABS Production	Olivine ore	secondary	3.39e-06	5.07e-07
Styrene-butadiene Copolymer Prod.	Dolomite (in ground)	secondary	2.48e-06	3.72e-07
Polycarbonate Production	Lead (Pb, ore)	secondary	1.85e-06	2.76e-07
ABS Production	Fluorspar (CaF2, ore)	secondary	1.69e-06	2.54e-07
Styrene-butadiene Copolymer Prod.	Olivine ore	secondary	1.65e-06	2.48e-07
Invar	Sulfur (S, in ground)	secondary	1.62e-06	2.42e-07
Ferrite mfg.	Sulfur (S, in ground)	secondary	1.58e-06	2.37e-07
Invar	Borax	secondary	2.63e-07	3.94e-08
Ferrite mfg.	Borax	secondary	2.57e-07	3.85e-08
Steel Prod., cold-rolled, semi-finished	Copper (Cu, ore)	secondary	1.86e-07	2.78e-08
Ferrite mfg.	Copper (Cu, ore)	secondary	1.82e-07	2.73e-08

Table M-3. CRT LCIA Results for the Nonrenewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Nonrenewable Resource Use (kg)	% of Total
Invar	Lead (Pb, ore)	secondary	5.84e-08	8.74e-09
Steel Prod., cold-rolled, semi-finished	Lead (Pb, ore)	secondary	5.79e-08	8.67e-09
Ferrite mfg.	Lead (Pb, ore)	secondary	5.70e-08	8.53e-09
Invar	Chromium ore	secondary	3.67e-08	5.50e-09
Steel Prod., cold-rolled, semi-finished	Chromium ore	secondary	3.65e-08	5.46e-09
Ferrite mfg.	Chromium ore	secondary	3.59e-08	5.37e-09
Invar	Manganese (Mn, ore)	secondary	2.14e-08	3.20e-09
Steel Prod., cold-rolled, semi-finished	Manganese (Mn, ore)	secondary	2.13e-08	3.18e-09
Ferrite mfg.	Manganese (Mn, ore)	secondary	2.09e-08	3.13e-09
Steel Prod., cold-rolled, semi-finished	Nickel (Ni, ore)	secondary	1.24e-08	1.85e-09
Ferrite mfg.	Nickel (Ni, ore)	secondary	1.21e-08	1.82e-09
Steel Prod., cold-rolled, semi-finished	Zinc (Zn, ore)	secondary	1.35e-09	2.02e-10
Invar	Silver (Ag, ore)	secondary	9.27e-10	1.39e-10
Steel Prod., cold-rolled, semi-finished	Silver (Ag, ore)	secondary	9.20e-10	1.38e-10
Ferrite mfg.	Silver (Ag, ore)	secondary	9.05e-10	1.35e-10
Invar	Dolomite	secondary	7.26e-11	1.09e-11
Ferrite mfg.	Dolomite	secondary	7.08e-11	1.06e-11
Invar	Olivine	secondary	5.44e-11	8.15e-12
Ferrite mfg.	Olivine	secondary	5.31e-11	7.95e-12
Total Materials Processing			**2.32e+01**	**3.47e+00**
Manufacturing Life-cycle Stage				
LPG Production	Petroleum (in ground)	secondary	3.75e+02	5.61e+01
LPG Production	Natural gas (in ground)	secondary	4.51e+01	6.75e+00
LPG Production	Coal, average (in ground)	secondary	1.34e+01	2.01e+00
Fuel Oil #6 Prod.	Petroleum (in ground)	secondary	3.88e+00	5.81e-01
Natural Gas Prod.	Natural gas (in ground)	secondary	3.40e+00	5.09e-01
US electric grid	Coal, average (in ground)	model/secondary	2.86e+00	4.29e-01
Japanese Electric Grid	Coal, average (in ground)	model/secondary	2.28e+00	3.42e-01
Japanese Electric Grid	Petroleum (in ground)	model/secondary	1.29e+00	1.93e-01
Japanese Electric Grid	Natural gas	model/secondary	1.25e+00	1.87e-01
Fuel Oil #2 Prod.	Petroleum (in ground)	secondary	1.24e+00	1.85e-01
Glass/frit	Lead	primary	4.47e-01	6.70e-02
Fuel Oil #6 Prod.	Natural gas (in ground)	secondary	2.88e-01	4.31e-02
US electric grid	Natural gas	model/secondary	2.23e-01	3.34e-02
Fuel Oil #4 Prod.	Petroleum (in ground)	secondary	1.47e-01	2.19e-02
Fuel Oil #2 Prod.	Natural gas (in ground)	secondary	1.36e-01	2.04e-02
Fuel Oil #6 Prod.	Coal, average (in ground)	secondary	1.08e-01	1.62e-02
US electric grid	Petroleum (in ground)	model/secondary	6.07e-02	9.08e-03
Glass/frit	Lead	primary	4.67e-02	6.99e-03
LPG Production	Bauxite (Al2O3, ore)	secondary	4.45e-02	6.66e-03
Fuel Oil #2 Prod.	Coal, average (in ground)	secondary	4.21e-02	6.30e-03
Natural Gas Prod.	Coal, average (in ground)	secondary	2.33e-02	3.49e-03
Fuel Oil #4 Prod.	Natural gas (in ground)	secondary	1.34e-02	2.00e-03
Natural Gas Prod.	Petroleum (in ground)	secondary	8.39e-03	1.26e-03
Glass/frit	Borax	primary	8.00e-03	1.20e-03
Glass/frit	Silica	primary	5.33e-03	7.98e-04
Japanese Electric Grid	Uranium, yellowcake	model/secondary	3.04e-04	4.55e-05
LPG Production	Uranium (U, ore)	secondary	2.26e-04	3.38e-05
Fuel Oil #6 Prod.	Bauxite (Al2O3, ore)	secondary	1.50e-04	2.25e-05

Table M-3. CRT LCIA Results for the Nonrenewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Nonrenewable Resource Use (kg)	% of Total
Fuel Oil #2 Prod.	Bauxite (Al2O3, ore)	secondary	1.25e-04	1.87e-05
US electric grid	Uranium, yellowcake	model/secondary	7.74e-05	1.16e-05
Fuel Oil #4 Prod.	Bauxite (Al2O3, ore)	secondary	1.01e-05	1.52e-06
Fuel Oil #6 Prod.	Uranium (U, ore)	secondary	1.82e-06	2.73e-07
Natural Gas Prod.	Bauxite (Al2O3, ore)	secondary	8.99e-07	1.35e-07
Fuel Oil #2 Prod.	Uranium (U, ore)	secondary	7.08e-07	1.06e-07
Natural Gas Prod.	Uranium (U, ore)	secondary	4.00e-07	5.99e-08
Total Manufacturing			**4.51e+02**	**6.75e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Coal, average (in ground)	model/secondary	1.79e+02	2.69e+01
US electric grid	Natural gas	model/secondary	1.40e+01	2.09e+00
US electric grid	Petroleum (in ground)	model/secondary	3.80e+00	5.69e-01
US electric grid	Uranium, yellowcake	model/secondary	4.85e-03	7.26e-04
Total Use, Maintenance and Repair			**1.97e+02**	**2.95e+01**
End-of-life Life-cycle Stage				
CRT landfilling	Oil (in ground)	primary	3.35e-02	5.01e-03
US electric grid	Coal, average (in ground)	model/secondary	1.79e-02	2.69e-03
CRT landfilling	Natural gas (in ground)	primary	4.52e-03	6.76e-04
LPG Production	Petroleum (in ground)	secondary	3.24e-03	4.84e-04
CRT landfilling	Coal, average (in ground)	primary	3.06e-03	4.59e-04
CRT Incineration	Iron (Fe, ore)	secondary	1.76e-03	2.64e-04
CRT landfilling	Iron (Fe, ore)	primary	1.65e-03	2.46e-04
US electric grid	Natural gas	model/secondary	1.40e-03	2.10e-04
LPG Production	Natural gas (in ground)	secondary	3.89e-04	5.82e-05
US electric grid	Petroleum (in ground)	model/secondary	3.80e-04	5.69e-05
LPG Production	Coal, average (in ground)	secondary	1.16e-04	1.73e-05
CRT landfilling	Bauxite (Al2O3, ore)	primary	8.81e-07	1.32e-07
US electric grid	Uranium, yellowcake	model/secondary	4.85e-07	7.27e-08
LPG Production	Bauxite (Al2O3, ore)	secondary	3.84e-07	5.75e-08
CRT landfilling	Uranium (U, ore)	primary	4.16e-08	6.23e-09
LPG Production	Uranium (U, ore)	secondary	1.95e-09	2.91e-10
Natural Gas Prod.	Uranium (U, ore)	secondary	-2.01e-07	-3.00e-08
Natural Gas Prod.	Bauxite (Al2O3, ore)	secondary	-4.51e-07	-6.75e-08
CRT Incineration	Bauxite (Al2O3, ore)	secondary	-6.05e-06	-9.06e-07
Fuel Oil #4 Prod.	Bauxite (Al2O3, ore)	secondary	-1.09e-04	-1.63e-05
Natural Gas Prod.	Petroleum (in ground)	secondary	-4.21e-03	-6.30e-04
Natural Gas Prod.	Coal, average (in ground)	secondary	-1.17e-02	-1.75e-03
CRT Incineration	Natural gas	secondary	-9.02e-02	-1.35e-02
Fuel Oil #4 Prod.	Natural gas (in ground)	secondary	-1.44e-01	-2.15e-02
Fuel Oil #4 Prod.	Petroleum (in ground)	secondary	-1.58e+00	-2.36e-01
Natural Gas Prod.	Natural gas (in ground)	secondary	-1.71e+00	-2.55e-01
Total End-of-life			**-3.46e+00**	**-5.18e-01**
Total All Life-cycle Stages			**6.68e+02**	**1.00e+02**

Table M-4. LCD LCIA Results for the Nonrenewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Nonrenewable Resource Use (kg)	% of Total
Materials Processing Life-cycle Stage				
Natural Gas Prod.	Natural gas (in ground)	secondary	2.38e+02	6.52e+01
Steel Prod., cold-rolled, semi-finished	Iron (Fe, ore)	secondary	3.26e+00	8.94e-01
Steel Prod., cold-rolled, semi-finished	Coal, average (in ground)	secondary	1.95e+00	5.36e-01
Natural Gas Prod.	Coal, average (in ground)	secondary	1.63e+00	4.47e-01
Polycarbonate Production	Natural gas (in ground)	secondary	7.18e-01	1.97e-01
Natural Gas Prod.	Petroleum (in ground)	secondary	5.86e-01	1.61e-01
Aluminum Prod.	Bauxite (Al2O3, ore)	secondary	5.09e-01	1.40e-01
Styrene-butadiene Copolymer Prod.	Petroleum (in ground)	secondary	4.48e-01	1.23e-01
PMMA Sheet Prod.	Petroleum (in ground)	secondary	4.43e-01	1.21e-01
PMMA Sheet Prod.	Natural gas (in ground)	secondary	4.19e-01	1.15e-01
Aluminum Prod.	Coal, average (in ground)	secondary	3.66e-01	1.00e-01
Polycarbonate Production	Petroleum (in ground)	secondary	2.42e-01	6.65e-02
Steel Prod., cold-rolled, semi-finished	Petroleum (in ground)	secondary	2.40e-01	6.58e-02
Steel Prod., cold-rolled, semi-finished	Natural gas (in ground)	secondary	2.24e-01	6.16e-02
Polycarbonate Production	Coal, average (in ground)	secondary	2.18e-01	5.98e-02
Steel Prod., cold-rolled, semi-finished	Coal, lignite (in ground)	secondary	2.04e-01	5.60e-02
Styrene-butadiene Copolymer Prod.	Natural gas (in ground)	secondary	1.88e-01	5.16e-02
Aluminum Prod.	Petroleum (in ground)	secondary	1.73e-01	4.74e-02
Polycarbonate Production	Coal, lignite (in ground)	secondary	1.38e-01	3.77e-02
PET Resin Production	Petroleum (in ground)	secondary	9.30e-02	2.55e-02
Aluminum Prod.	Natural gas (in ground)	secondary	7.95e-02	2.18e-02
Aluminum Prod.	Coal, lignite (in ground)	secondary	6.80e-02	1.86e-02
PET Resin Production	Coal, average (in ground)	secondary	3.84e-02	1.05e-02
Aluminum Prod.	Pyrite (FeS2, ore)	secondary	3.75e-02	1.03e-02
PET Resin Production	Natural gas (in ground)	secondary	2.78e-02	7.64e-03
PMMA Sheet Prod.	Sulfur (S, in ground)	secondary	1.23e-02	3.37e-03
Steel Prod., cold-rolled, semi-finished	Tin (Sn, ore)	secondary	1.19e-02	3.27e-03
Aluminum Prod.	Iron (Fe, ore)	secondary	6.53e-03	1.79e-03
Steel Prod., cold-rolled, semi-finished	Raw materials (unspecified)	secondary	3.49e-03	9.56e-04
Polycarbonate Production	Sulfur (S, in ground)	secondary	2.97e-03	8.14e-04
PMMA Sheet Prod.	Dolomite (in ground)	secondary	2.07e-03	5.68e-04
Polycarbonate Production	Bentonite (in ground)	secondary	7.22e-04	1.98e-04
PMMA Sheet Prod.	Raw materials (unspecified)	secondary	5.75e-04	1.58e-04
Polycarbonate Production	Iron (Fe, ore)	secondary	4.85e-04	1.33e-04
PMMA Sheet Prod.	Iron (Fe, ore)	secondary	3.53e-04	9.68e-05
PMMA Sheet Prod.	Bauxite (Al2O3, ore)	secondary	3.07e-04	8.42e-05
Aluminum Prod.	Copper (Cu, ore)	secondary	2.63e-04	7.21e-05
Styrene-butadiene Copolymer Prod.	Iron (Fe, ore)	secondary	2.55e-04	7.00e-05
Aluminum Prod.	Bentonite (in ground)	secondary	2.47e-04	6.77e-05
Styrene-butadiene Copolymer Prod.	Bauxite	secondary	2.10e-04	5.76e-05
Polycarbonate Production	Bauxite (Al2O3, ore)	secondary	1.55e-04	4.25e-05
Steel Prod., cold-rolled, semi-finished	Pyrite (FeS2, ore)	secondary	1.49e-04	4.09e-05
PET Resin Production	Coal, lignite (in ground)	secondary	1.21e-04	3.32e-05
Natural Gas Prod.	Bauxite (Al2O3, ore)	secondary	6.28e-05	1.72e-05
Styrene-butadiene Copolymer Prod.	Sulfur (S, in ground)	secondary	3.56e-05	9.78e-06
PET Resin Production	Bauxite (Al2O3, ore)	secondary	2.90e-05	7.97e-06
Natural Gas Prod.	Uranium (U, ore)	secondary	2.79e-05	7.67e-06
PET Resin Production	Iron (Fe, ore)	secondary	2.63e-05	7.22e-06

Table M-4. LCD LCIA Results for the Nonrenewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Nonrenewable Resource Use (kg)	% of Total
Styrene-butadiene Copolymer Prod.	Bentonite (in ground)	secondary	2.53e-05	6.95e-06
Aluminum Prod.	Lead (Pb, ore)	secondary	2.35e-05	6.44e-06
PMMA Sheet Prod.	Potassium chloride (KCl, as K2O, in ground)	secondary	2.34e-05	6.42e-06
Steel Prod., cold-rolled, semi-finished	Uranium (U, ore)	secondary	2.09e-05	5.74e-06
Polycarbonate Production	Uranium (U, ore)	secondary	1.75e-05	4.79e-06
Aluminum Prod.	Uranium (U, ore)	secondary	1.07e-05	2.92e-06
Steel Prod., cold-rolled, semi-finished	Bentonite (in ground)	secondary	8.78e-06	2.41e-06
Steel Prod., cold-rolled, semi-finished	Iron sulfate (FeSO4, ore)	secondary	7.99e-06	2.19e-06
Polycarbonate Production	Calcium sulfate (CaSO4, ore)	secondary	7.22e-06	1.98e-06
Steel Prod., cold-rolled, semi-finished	Bauxite (Al2O3, ore)	secondary	5.79e-06	1.59e-06
PMMA Sheet Prod.	Fluorspar (CaF2, ore)	secondary	5.37e-06	1.47e-06
Polycarbonate Production	Dolomite (in ground)	secondary	5.16e-06	1.42e-06
Polycarbonate Production	Olivine ore	secondary	4.13e-06	1.13e-06
Styrene-butadiene Copolymer Prod.	Potassium chloride (KCl, as K2O, in ground)	secondary	3.80e-06	1.04e-06
Polycarbonate Production	Potassium chloride (KCl, as K2O, in ground)	secondary	3.09e-06	8.49e-07
PMMA Sheet Prod.	Olivine ore	secondary	3.07e-06	8.42e-07
PET Resin Production	Sulfur (S, in ground)	secondary	2.81e-06	7.72e-07
Styrene-butadiene Copolymer Prod.	Calcium sulfate (CaSO4, ore)	secondary	2.53e-06	6.95e-07
PET Resin Production	Uranium (U, ore)	secondary	1.66e-06	4.56e-07
Styrene-butadiene Copolymer Prod.	Dolomite (in ground)	secondary	1.09e-06	2.98e-07
Polycarbonate Production	Lead (Pb, ore)	secondary	1.03e-06	2.83e-07
PMMA Sheet Prod.	Bentonite (in ground)	secondary	7.67e-07	2.10e-07
Styrene-butadiene Copolymer Prod.	Olivine ore	secondary	7.23e-07	1.98e-07
PET Resin Production	Bentonite (in ground)	secondary	3.63e-07	9.96e-08
PET Resin Production	Dolomite (in ground)	secondary	3.63e-07	9.96e-08
PET Resin Production	Olivine	secondary	2.72e-07	7.47e-08
PET Resin Production	Lead (Pb, ore)	secondary	1.82e-07	4.98e-08
Steel Prod., cold-rolled, semi-finished	Copper (Cu, ore)	secondary	9.10e-08	2.50e-08
Steel Prod., cold-rolled, semi-finished	Lead (Pb, ore)	secondary	2.84e-08	7.79e-09
Steel Prod., cold-rolled, semi-finished	Chromium ore	secondary	1.79e-08	4.91e-09
Steel Prod., cold-rolled, semi-finished	Manganese (Mn, ore)	secondary	1.04e-08	2.86e-09
Steel Prod., cold-rolled, semi-finished	Nickel (Ni, ore)	secondary	6.05e-09	1.66e-09
Steel Prod., cold-rolled, semi-finished	Zinc (Zn, ore)	secondary	6.61e-10	1.81e-10
Steel Prod., cold-rolled, semi-finished	Silver (Ag, ore)	secondary	4.51e-10	1.24e-10
Total Materials Processing			**2.50e+02**	**6.86e+01**
Manufacturing Life-cycle Stage				
LPG Production	Petroleum (in ground)	secondary	1.80e+01	4.93e+00
Japanese Electric Grid	Coal, average (in ground)	model/secondary	7.68e+00	2.11e+00
Natural Gas Prod.	Natural gas (in ground)	secondary	5.36e+00	1.47e+00
Japanese Electric Grid	Petroleum (in ground)	model/secondary	4.33e+00	1.19e+00
Japanese Electric Grid	Natural gas	model/secondary	4.20e+00	1.15e+00
LPG Production	Natural gas (in ground)	secondary	2.16e+00	5.93e-01
LPG Production	Coal, average (in ground)	secondary	6.44e-01	1.77e-01
US electric grid	Coal, average (in ground)	model/secondary	3.47e-01	9.53e-02
Fuel Oil #4 Prod.	Petroleum (in ground)	secondary	2.26e-01	6.20e-02
Fuel Oil #6 Prod.	Petroleum (in ground)	secondary	1.32e-01	3.63e-02
Fuel Oil #2 Prod.	Petroleum (in ground)	secondary	5.77e-02	1.58e-02
Natural Gas Prod.	Coal, average (in ground)	secondary	3.67e-02	1.01e-02
US electric grid	Natural gas	model/secondary	2.71e-02	7.43e-03
Fuel Oil #4 Prod.	Natural gas (in ground)	secondary	2.06e-02	5.64e-03
Natural Gas Prod.	Petroleum (in ground)	secondary	1.32e-02	3.63e-03

Table M-4. LCD LCIA Results for the Nonrenewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Nonrenewable Resource Use (kg)	% of Total
Fuel Oil #6 Prod.	Natural gas (in ground)	secondary	9.80e-03	2.69e-03
US electric grid	Petroleum (in ground)	model/secondary	7.36e-03	2.02e-03
Fuel Oil #2 Prod.	Natural gas (in ground)	secondary	6.35e-03	1.74e-03
Fuel Oil #6 Prod.	Coal, average (in ground)	secondary	3.69e-03	1.01e-03
LPG Production	Bauxite (Al2O3, ore)	secondary	2.13e-03	5.85e-04
Fuel Oil #2 Prod.	Coal, average (in ground)	secondary	1.96e-03	5.39e-04
Japanese Electric Grid	Uranium, yellowcake	model/secondary	1.02e-03	2.80e-04
Panel components	Borax	primary	9.13e-05	2.51e-05
Fuel Oil #4 Prod.	Bauxite (Al2O3, ore)	secondary	1.56e-05	4.29e-06
LPG Production	Uranium (U, ore)	secondary	1.08e-05	2.97e-06
US electric grid	Uranium, yellowcake	model/secondary	9.39e-06	2.58e-06
Fuel Oil #2 Prod.	Bauxite (Al2O3, ore)	secondary	5.82e-06	1.60e-06
Fuel Oil #6 Prod.	Bauxite (Al2O3, ore)	secondary	5.12e-06	1.41e-06
Natural Gas Prod.	Bauxite (Al2O3, ore)	secondary	1.42e-06	3.89e-07
Natural Gas Prod.	Uranium (U, ore)	secondary	6.31e-07	1.73e-07
Fuel Oil #6 Prod.	Uranium (U, ore)	secondary	6.21e-08	1.70e-08
Fuel Oil #2 Prod.	Uranium (U, ore)	secondary	3.31e-08	9.07e-09
Total Manufacturing			**4.33e+01**	**1.19e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Coal, average (in ground)	model/secondary	6.69e+01	1.84e+01
US electric grid	Natural gas	model/secondary	5.22e+00	1.43e+00
US electric grid	Petroleum (in ground)	model/secondary	1.42e+00	3.89e-01
US electric grid	Uranium, yellowcake	model/secondary	1.81e-03	4.97e-04
Total Use, Maintenance and Repair			**7.36e+01**	**2.02e+01**
End-of-life Life-cycle Stage				
US electric grid	Coal, average (in ground)	model/secondary	1.27e-02	3.49e-03
LCD landfilling	Oil (in ground)	primary	8.06e-03	2.21e-03
LPG Production	Petroleum (in ground)	secondary	1.48e-03	4.05e-04
LCD landfilling	Natural gas (in ground)	primary	1.09e-03	2.98e-04
US electric grid	Natural gas	model/secondary	9.91e-04	2.72e-04
LCD landfilling	Coal, average (in ground)	primary	7.38e-04	2.02e-04
LCD landfilling	Iron (Fe, ore)	primary	3.96e-04	1.09e-04
LCD incineration	Iron (Fe, ore)	secondary	3.07e-04	8.43e-05
US electric grid	Petroleum (in ground)	model/secondary	2.69e-04	7.39e-05
LPG Production	Natural gas (in ground)	secondary	1.78e-04	4.87e-05
LPG Production	Coal, average (in ground)	secondary	5.28e-05	1.45e-05
US electric grid	Uranium, yellowcake	model/secondary	3.44e-07	9.43e-08
LCD landfilling	Bauxite (Al2O3, ore)	primary	2.12e-07	5.82e-08
LPG Production	Bauxite (Al2O3, ore)	secondary	1.75e-07	4.81e-08
LCD landfilling	Uranium (U, ore)	primary	1.00e-08	2.75e-09
LPG Production	Uranium (U, ore)	secondary	8.88e-10	2.44e-10
Natural Gas Prod.	Uranium (U, ore)	secondary	-1.32e-07	-3.63e-08
Natural Gas Prod.	Bauxite (Al2O3, ore)	secondary	-2.98e-07	-8.16e-08
LCD incineration	Bauxite (Al2O3, ore)	secondary	-4.37e-06	-1.20e-06
Fuel Oil #4 Prod.	Bauxite (Al2O3, ore)	secondary	-7.20e-05	-1.98e-05
Natural Gas Prod.	Petroleum (in ground)	secondary	-2.78e-03	-7.62e-04
Natural Gas Prod.	Coal, average (in ground)	secondary	-7.71e-03	-2.12e-03
LCD incineration	Natural gas	secondary	-5.85e-02	-1.60e-02
Fuel Oil #4 Prod.	Natural gas (in ground)	secondary	-9.48e-02	-2.60e-02
Fuel Oil #4 Prod.	Petroleum (in ground)	secondary	-1.04e+00	-2.86e-01

Table M-4. LCD LCIA Results for the Nonrenewable Resource Use Impact Category

Process Group	Material	LCI Data Type	Nonrenewable Resource Use (kg)	% of Total
Natural Gas Prod.	Natural gas (in ground)	secondary	-1.13e+00	-3.09e-01
Total End-of-Life			**-2.30e+00**	**-6.32e-01**
Total All Life-cycle Stages			**3.64e+02**	**1.00e+02**

Table M-5. CRT LCIA Results for the Energy Use Impact Category

Process Group	Material	LCI Data Type	Energy Use (MJ)	% of Total
Materials Processing Life-cycle Stage				
Polycarbonate Production	Natural gas (in ground)	secondary	3.42e+01	1.64e-01
Aluminum Prod.	Coal, average (in ground)	secondary	2.20e+01	1.05e-01
Steel Prod., cold-rolled, semi-finished	Petroleum (in ground)	secondary	2.10e+01	1.01e-01
Steel Prod., cold-rolled, semi-finished	Natural gas (in ground)	secondary	2.04e+01	9.79e-02
Aluminum Prod.	Electricity	secondary	2.03e+01	9.76e-02
Aluminum Prod.	Petroleum (in ground)	secondary	1.99e+01	9.54e-02
Styrene-butadiene Copolymer Prod.	Natural gas (in ground)	secondary	1.91e+01	9.19e-02
Steel Prod., cold-rolled, semi-finished	Electricity	secondary	1.81e+01	8.71e-02
Invar	Petroleum (in ground)	secondary	1.59e+01	7.64e-02
Invar	Natural gas (in ground)	secondary	1.56e+01	7.50e-02
Polycarbonate Production	Electricity	secondary	1.39e+01	6.68e-02
Steel Prod., cold-rolled, semi-finished	Coal, average (in ground)	secondary	1.08e+01	5.19e-02
Aluminum Prod.	Natural gas (in ground)	secondary	9.51e+00	4.57e-02
Polycarbonate Production	Petroleum (in ground)	secondary	9.49e+00	4.56e-02
Polycarbonate Production	Coal, average (in ground)	secondary	8.73e+00	4.19e-02
ABS Production	Natural gas (in ground)	secondary	8.71e+00	4.18e-02
Invar	Electricity	secondary	8.06e+00	3.87e-02
Styrene-butadiene Copolymer Prod.	Petroleum (in ground)	secondary	8.04e+00	3.86e-02
Lead	Natural gas (in ground)	secondary	6.96e+00	3.34e-02
Steel Prod., cold-rolled, semi-finished	Uranium (U, ore)	secondary	6.44e+00	3.09e-02
Lead	Coal, average (in ground)	secondary	6.43e+00	3.08e-02
Steel Prod., cold-rolled, semi-finished	Coal, lignite (in ground)	secondary	6.17e+00	2.96e-02
ABS Production	Petroleum (in ground)	secondary	5.91e+00	2.84e-02
Ferrite mfg.	Natural gas (in ground)	secondary	5.51e+00	2.64e-02
Polycarbonate Production	Uranium (U, ore)	secondary	4.72e+00	2.27e-02
Ferrite mfg.	Electricity	secondary	4.43e+00	2.13e-02
Aluminum Prod.	Uranium (U, ore)	secondary	4.32e+00	2.07e-02
Polycarbonate Production	Coal, lignite (in ground)	secondary	3.65e+00	1.75e-02
Lead	Electricity	secondary	3.14e+00	1.51e-02
ABS Production	Electricity	secondary	3.00e+00	1.44e-02
Polystyrene Prod., high-impact	Natural gas (in ground)	secondary	2.81e+00	1.35e-02
Aluminum Prod.	Coal, lignite (in ground)	secondary	2.71e+00	1.30e-02
Lead	Petroleum (in ground)	secondary	2.69e+00	1.29e-02
Ferrite mfg.	Coal, average (in ground)	secondary	2.39e+00	1.15e-02
Ferrite mfg.	Petroleum (in ground)	secondary	2.10e+00	1.01e-02
Ferrite mfg.	Coal, lignite (in ground)	secondary	1.90e+00	9.12e-03
Ferrite mfg.	Uranium (U, ore)	secondary	1.86e+00	8.93e-03
Polystyrene Prod., high-impact	Petroleum (in ground)	secondary	1.61e+00	7.72e-03
Styrene-butadiene Copolymer Prod.	Electricity	secondary	1.39e+00	6.67e-03
Lead	Uranium (U, ore)	secondary	9.17e-01	4.40e-03
Polystyrene Prod., high-impact	Electricity	secondary	7.29e-01	3.50e-03
Total Materials Processing			**3.66e+02**	**1.75e+00**
Manufacturing Life-cycle Stage				
Glass/frit	Liquified petroleum gas ("propane")	primary	1.51e+04	7.23e+01
LPG Production	Natural gas (in ground)	secondary	2.01e+03	9.63e+00
LPG Production	Petroleum (in ground)	secondary	4.10e+02	1.97e+00
LPG Production	Coal, average (in ground)	secondary	3.00e+02	1.44e+00
CRT tube mfg.	Fuel oil #6	primary	1.51e+02	7.23e-01
Glass/frit	Natural gas	primary	5.41e+01	2.60e-01
Glass/frit	Fuel oil #2	primary	5.06e+01	2.43e-01

Table M-5. CRT LCIA Results for the Energy Use Impact Category

Process Group	Material	LCI Data Type	Energy Use (MJ)	% of Total
Glass/frit	Elec-nonlink	primary	4.75e+01	2.28e-01
CRT tube mfg.	Natural gas	primary	3.73e+01	1.79e-01
LPG Production	Uranium (U, ore)	secondary	3.40e+01	1.63e-01
CRT tube mfg.	Elec-nonlink	primary	3.19e+01	1.53e-01
Glass/frit	Elec-nonlink	primary	2.65e+01	1.27e-01
PWB Mfg.	Natural gas	model/secondary	1.74e+01	8.34e-02
CRT tube mfg.	LNG	primary	1.72e+01	8.26e-02
CRT monitor assembly	Elec-nonlink	primary	1.33e+01	6.37e-02
Fuel Oil #6 Prod.	Natural gas (in ground)	secondary	1.28e+01	6.15e-02
PWB Mfg.	Elec-nonlink	model/secondary	1.00e+01	4.82e-02
Fuel Oil #2 Prod.	Natural gas (in ground)	secondary	6.06e+00	2.91e-02
Natural Gas Prod.	Natural gas (in ground)	secondary	5.83e+00	2.80e-02
Fuel Oil #6 Prod.	Petroleum (in ground)	secondary	5.78e+00	2.78e-02
Monitor/module	Fuel oil #4	primary	5.76e+00	2.77e-02
Fuel Oil #6 Prod.	Coal, average (in ground)	secondary	2.42e+00	1.16e-02
Fuel Oil #2 Prod.	Coal, average (in ground)	secondary	9.41e-01	4.51e-03
Fuel Oil #4 Prod.	Natural gas (in ground)	secondary	5.95e-01	2.85e-03
Fuel Oil #2 Prod.	Petroleum (in ground)	secondary	5.78e-01	2.77e-03
Natural Gas Prod.	Coal, average (in ground)	secondary	5.21e-01	2.50e-03
Natural Gas Prod.	Petroleum (in ground)	secondary	3.60e-01	1.73e-03
Fuel Oil #6 Prod.	Uranium (U, ore)	secondary	2.75e-01	1.32e-03
Fuel Oil #4 Prod.	Petroleum (in ground)	secondary	2.14e-01	1.03e-03
Fuel Oil #2 Prod.	Uranium (U, ore)	secondary	1.07e-01	5.13e-04
Natural Gas Prod.	Uranium (U, ore)	secondary	6.04e-02	2.90e-04
Total Manufacturing			**1.83e+04**	**8.79e+01**
Use, Maintenance and Repair Life-cycle Stage				
CRT monitor use	Elec-nonlink	primary	2.29e+03	1.10e+01
Total Use, Maintenance and Repair			**2.29e+03**	**1.10e+01**
End-of-life Manufacturing Stage				
CRT landfilling	Fuel oil #4	primary	8.13e-01	3.90e-03
CRT landfilling	Natural gas	primary	7.71e-01	3.70e-03
CRT Recycling	Elec-nonlink	primary	2.29e-01	1.10e-03
CRT Recycling	Liquified petroleum gas ("propane")	primary	1.30e-01	6.24e-04
LPG Production	Natural gas (in ground)	secondary	1.73e-02	8.32e-05
LPG Production	Petroleum (in ground)	secondary	3.54e-03	1.70e-05
LPG Production	Coal, average (in ground)	secondary	2.59e-03	1.24e-05
LPG Production	Uranium (U, ore)	secondary	2.94e-04	1.41e-06
Natural Gas Prod.	Uranium (U, ore)	secondary	-3.03e-02	-1.45e-04
Natural Gas Prod.	Petroleum (in ground)	secondary	-1.81e-01	-8.67e-04
Natural Gas Prod.	Coal, average (in ground)	secondary	-2.61e-01	-1.25e-03
Fuel Oil #4 Prod.	Petroleum (in ground)	secondary	-2.30e+00	-1.10e-02
Natural Gas Prod.	Natural gas (in ground)	secondary	-2.92e+00	-1.40e-02
Fuel Oil #4 Prod.	Natural gas (in ground)	secondary	-6.39e+00	-3.07e-02
CRT Incineration	Natural gas	secondary	-5.88e+01	-2.82e-01
CRT Incineration	Fuel oil #4	secondary	-5.88e+01	-2.82e-01
Total End-of-life			**-1.28e+02**	**-6.13e-01**
Total All Life-cycle Stages			**2.08e+04**	**1.00e+02**

Table M-6. LCD LCIA Results for the Energy Use Impact Category

Process Group	Material	LCI Data Type	Energy Use (MJ)	% of Total
Materials processing Life-cycle Stage				
Natural Gas Prod.	Natural gas (in ground)	secondary	4.07e+02	1.43e+01
Natural Gas Prod.	Coal, average (in ground)	secondary	3.64e+01	1.28e+00
Natural Gas Prod.	Petroleum (in ground)	secondary	2.52e+01	8.86e-01
Polycarbonate Production	Natural gas (in ground)	secondary	1.91e+01	6.72e-01
PMMA Sheet Prod.	Petroleum (in ground)	secondary	1.18e+01	4.17e-01
PMMA Sheet Prod.	Natural gas (in ground)	secondary	1.16e+01	4.09e-01
Steel Prod., cold-rolled, semi-finished	Petroleum (in ground)	secondary	1.03e+01	3.63e-01
Steel Prod., cold-rolled, semi-finished	Natural gas (in ground)	secondary	9.99e+00	3.52e-01
PMMA Sheet Prod.	Electricity	secondary	8.96e+00	3.16e-01
Steel Prod., cold-rolled, semi-finished	Electricity	secondary	8.89e+00	3.13e-01
Styrene-butadiene Copolymer Prod.	Natural gas (in ground)	secondary	8.37e+00	2.95e-01
Aluminum Prod.	Coal, average (in ground)	secondary	8.18e+00	2.88e-01
Polycarbonate Production	Electricity	secondary	7.77e+00	2.74e-01
Aluminum Prod.	Electricity	secondary	7.57e+00	2.67e-01
Aluminum Prod.	Petroleum (in ground)	secondary	7.40e+00	2.61e-01
Polycarbonate Production	Petroleum (in ground)	secondary	5.30e+00	1.87e-01
Steel Prod., cold-rolled, semi-finished	Coal, average (in ground)	secondary	5.30e+00	1.87e-01
Polycarbonate Production	Coal, average (in ground)	secondary	4.87e+00	1.72e-01
Natural Gas Prod.	Uranium (U, ore)	secondary	4.22e+00	1.48e-01
Aluminum Prod.	Natural gas (in ground)	secondary	3.54e+00	1.25e-01
Styrene-butadiene Copolymer Prod.	Petroleum (in ground)	secondary	3.51e+00	1.24e-01
Steel Prod., cold-rolled, semi-finished	Uranium (U, ore)	secondary	3.16e+00	1.11e-01
Steel Prod., cold-rolled, semi-finished	Coal, lignite (in ground)	secondary	3.02e+00	1.07e-01
Polycarbonate Production	Uranium (U, ore)	secondary	2.64e+00	9.28e-02
Polycarbonate Production	Coal, lignite (in ground)	secondary	2.04e+00	7.18e-02
Aluminum Prod.	Uranium (U, ore)	secondary	1.61e+00	5.66e-02
PET Resin Production	Petroleum (in ground)	secondary	1.57e+00	5.54e-02
Aluminum Prod.	Coal, lignite (in ground)	secondary	1.01e+00	3.55e-02
PET Resin Production	Coal, average (in ground)	secondary	8.58e-01	3.02e-02
PET Resin Production	Electricity	secondary	7.72e-01	2.72e-02
Styrene-butadiene Copolymer Prod.	Electricity	secondary	6.07e-01	2.14e-02
PET Resin Production	Natural gas (in ground)	secondary	3.16e-01	1.11e-02
PET Resin Production	Uranium (U, ore)	secondary	2.51e-01	8.82e-03
PET Resin Production	Coal, lignite (in ground)	secondary	1.79e-03	6.32e-05
Total Materials Processing			**6.33e+02**	**2.23e+01**
Manufacturing Life-cycle Stage				
LCD glass mfg.	Liquified petroleum gas ("propane")	primary	6.98e+02	2.46e+01
Monitor/module	Elec-nonlink	primary	2.54e+02	8.93e+00
Monitor/module	LNG	primary	1.65e+02	5.81e+00
LPG Production	Natural gas (in ground)	secondary	9.63e+01	3.39e+00
Panel components	Elec-nonlink	primary	4.08e+01	1.44e+00
Monitor/module	Natural gas	primary	3.77e+01	1.33e+00
Monitor/module	Liquified petroleum gas ("propane")	primary	2.50e+01	8.81e-01
LPG Production	Petroleum (in ground)	secondary	1.97e+01	6.93e-01
LPG Production	Coal, average (in ground)	secondary	1.44e+01	5.07e-01
Monitor/module	Kerosene	primary	1.31e+01	4.60e-01
Natural Gas Prod.	Natural gas (in ground)	secondary	9.19e+00	3.24e-01
Monitor/module	Fuel oil #4	primary	8.88e+00	3.13e-01
PWB Mfg.	Natural gas	model/secondary	7.67e+00	2.70e-01

Table M-6. LCD LCIA Results for the Energy Use Impact Category

Process Group	Material	LCI Data Type	Energy Use (MJ)	% of Total
Panel components	Kerosene	primary	7.36e+00	2.59e-01
Panel components	Elec-nonlink	primary	5.13e+00	1.81e-01
Panel components	Fuel oil #6	primary	5.13e+00	1.81e-01
Monitor/module	Elec-nonlink	primary	4.92e+00	1.73e-01
PWB Mfg.	Elec-nonlink	model/secondary	4.43e+00	1.56e-01
Panel components	Natural gas	primary	3.85e+00	1.35e-01
Backlight	Elec-nonlink	primary	2.62e+00	9.23e-02
LCD glass mfg.	Natural gas	primary	2.50e+00	8.82e-02
LCD glass mfg.	Fuel oil #2	primary	2.34e+00	8.26e-02
LCD glass mfg.	Elec-nonlink	primary	2.20e+00	7.75e-02
LPG Production	Uranium (U, ore)	secondary	1.63e+00	5.75e-02
Backlight	Elec-nonlink	primary	1.24e+00	4.36e-02
Fuel Oil #4 Prod.	Natural gas (in ground)	secondary	9.16e-01	3.23e-02
Natural Gas Prod.	Coal, average (in ground)	secondary	8.21e-01	2.89e-02
Backlight	Elec-nonlink	primary	6.01e-01	2.12e-02
Natural Gas Prod.	Petroleum (in ground)	secondary	5.68e-01	2.00e-02
Panel components	Elec-nonlink	primary	5.04e-01	1.77e-02
Fuel Oil #6 Prod.	Natural gas (in ground)	secondary	4.36e-01	1.54e-02
Fuel Oil #4 Prod.	Petroleum (in ground)	secondary	3.30e-01	1.16e-02
Fuel Oil #2 Prod.	Natural gas (in ground)	secondary	2.83e-01	9.96e-03
Fuel Oil #6 Prod.	Petroleum (in ground)	secondary	1.97e-01	6.93e-03
Panel components	Steam (100 psig)	primary	1.04e-01	3.66e-03
Natural Gas Prod.	Uranium (U, ore)	secondary	9.51e-02	3.35e-03
Fuel Oil #6 Prod.	Coal, average (in ground)	secondary	8.24e-02	2.90e-03
Fuel Oil #2 Prod.	Coal, average (in ground)	secondary	4.39e-02	1.55e-03
Fuel Oil #2 Prod.	Petroleum (in ground)	secondary	2.70e-02	9.50e-04
Panel components	Fuel oil #2	primary	1.78e-02	6.25e-04
Fuel Oil #6 Prod.	Uranium (U, ore)	secondary	9.37e-03	3.30e-04
Fuel Oil #2 Prod.	Uranium (U, ore)	secondary	4.99e-03	1.76e-04
Backlight	LNG	primary	2.14e-04	7.53e-06
Backlight	Natural gas	primary	1.85e-04	6.53e-06
Panel components	Natural gas	primary	5.24e-06	1.85e-07
Total Manufacturing			**1.44e+03**	**5.06e+01**
Use, Maintenance and Repair Life-cycle Stage				
LCD monitor use	Elec-nonlink	primary	8.53e+02	3.00e+01
Total use, Maintenance and Repair			**8.53e+02**	**3.00e+01**
End-of-life Life-cycle Stage				
LCD landfilling	Fuel oil #4	primary	1.96e-01	6.90e-03
LCD landfilling	Natural gas	primary	1.86e-01	6.54e-03
LCD recycling	Elec-nonlink	primary	1.62e-01	5.70e-03
LCD recycling	Liquified petroleum gas ("propane")	primary	5.93e-02	2.09e-03
LPG Production	Natural gas (in ground)	secondary	7.91e-03	2.78e-04
LPG Production	Petroleum (in ground)	secondary	1.61e-03	5.69e-05
LPG Production	Coal, average (in ground)	secondary	1.18e-03	4.16e-05
LPG Production	Uranium (U, ore)	secondary	1.34e-04	4.72e-06
Natural Gas Prod.	Uranium (U, ore)	secondary	-2.00e-02	-7.04e-04
Natural Gas Prod.	Petroleum (in ground)	secondary	-1.19e-01	-4.20e-03
Natural Gas Prod.	Coal, average (in ground)	secondary	-1.72e-01	-6.07e-03
Fuel Oil #4 Prod.	Petroleum (in ground)	secondary	-1.52e+00	-5.35e-02
Natural Gas Prod.	Natural gas (in ground)	secondary	-1.93e+00	-6.80e-02
Fuel Oil #4 Prod.	Natural gas (in ground)	secondary	-4.22e+00	-1.49e-01

Table M-6. LCD LCIA Results for the Energy Use Impact Category

Process Group	Material	LCI Data Type	Energy Use (MJ)	% of Total
LCD incineration	Natural gas	secondary	-3.85e+01	-1.36e+00
LCD incineration	Fuel oil #4	secondary	-3.85e+01	-1.36e+00
Total End-of-life			**-8.44e+01**	**-2.97e+00**
Total All Life-cycle Stages			**2.84e+03**	**1.00e+02**

Table M-7. CRT LCIA Results for the Solid Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Solid Waste Landfill Use (m3)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Unspecified solid waste	secondary	1.09e-02	6.56e+00
Steel Prod., cold-rolled, semi-finished	Mining waste	secondary	6.41e-04	3.85e-01
Invar	Mining waste	secondary	1.82e-04	1.09e-01
Ferrite mfg.	Mining waste	secondary	1.77e-04	1.06e-01
Steel Prod., cold-rolled, semi-finished	Mineral waste	secondary	6.34e-05	3.81e-02
Polycarbonate Production	Mineral waste	secondary	5.41e-05	3.25e-02
Steel Prod., cold-rolled, semi-finished	Mixed industrial (waste)	secondary	4.50e-05	2.70e-02
Invar	Unspecified solid waste	secondary	3.53e-05	2.12e-02
Ferrite mfg.	Unspecified solid waste	secondary	3.45e-05	2.07e-02
Steel Prod., cold-rolled, semi-finished	Slag and ash	secondary	1.83e-05	1.10e-02
Invar	Mineral waste	secondary	1.82e-05	1.09e-02
Polycarbonate Production	Slag and ash	secondary	1.80e-05	1.08e-02
Ferrite mfg.	Mineral waste	secondary	1.78e-05	1.07e-02
ABS Production	Mineral waste	secondary	1.27e-05	7.64e-03
ABS Production	Unspecified solid waste	secondary	1.09e-05	6.57e-03
Polycarbonate Production	Mixed industrial (waste)	secondary	9.93e-06	5.96e-03
Invar	Slag and ash	secondary	5.24e-06	3.15e-03
Ferrite mfg.	Slag and ash	secondary	5.12e-06	3.07e-03
Styrene-butadiene Copolymer Prod.	Mineral waste	secondary	4.52e-06	2.72e-03
ABS Production	Non toxic chemical waste (unspecified)	secondary	3.21e-06	1.93e-03
ABS Production	Slag and ash	secondary	2.68e-06	1.61e-03
ABS Production	Mixed industrial (waste)	secondary	2.22e-06	1.34e-03
Steel Prod., cold-rolled, semi-finished	Non toxic chemical waste (unspecified)	secondary	2.02e-06	1.21e-03
Polycarbonate Production	Non toxic chemical waste (unspecified)	secondary	1.79e-06	1.08e-03
Polystyrene Prod., high-impact	Mineral waste	secondary	1.59e-06	9.56e-04
Styrene-butadiene Copolymer Prod.	Non toxic chemical waste (unspecified)	secondary	1.35e-06	8.09e-04
Invar	Mixed industrial (waste)	secondary	1.16e-06	6.96e-04
Ferrite mfg.	Mixed industrial (waste)	secondary	1.13e-06	6.80e-04
Styrene-butadiene Copolymer Prod.	Slag and ash	secondary	1.09e-06	6.54e-04
Styrene-butadiene Copolymer Prod.	Mixed industrial (waste)	secondary	1.00e-06	6.03e-04
Polystyrene Prod., high-impact	Non toxic chemical waste (unspecified)	secondary	6.74e-07	4.05e-04
Polystyrene Prod., high-impact	Mixed industrial (waste)	secondary	4.16e-07	2.50e-04
Aluminum Prod.	Calcium	secondary	3.72e-07	2.23e-04
Polystyrene Prod., high-impact	Slag and ash	secondary	3.66e-07	2.20e-04
Styrene-butadiene Copolymer Prod.	Unspecified solid waste	secondary	2.62e-07	1.57e-04
Invar	Calcium	secondary	1.79e-07	1.07e-04
Polycarbonate Production	Unspecified solid waste	secondary	1.09e-07	6.55e-05
Lead	Calcium	secondary	9.31e-08	5.59e-05
Steel Prod., cold-rolled, semi-finished	Sewage sludge (unspecified)	secondary	6.64e-08	3.99e-05
Aluminum Prod.	Carbon	secondary	5.48e-08	3.29e-05
Steel Prod., cold-rolled, semi-finished	Waste oil	secondary	5.37e-08	3.23e-05
Steel Prod., cold-rolled, semi-finished	Non mineral waste (inert)	secondary	4.46e-08	2.68e-05
Ferrite mfg.	Calcium	secondary	3.41e-08	2.05e-05
Steel Prod., cold-rolled, semi-finished	Calcium	secondary	3.02e-08	1.81e-05
Invar	Carbon	secondary	2.62e-08	1.57e-05

Table M-7. CRT LCIA Results for the Solid Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Solid Waste Landfill Use (m3)	% of Total
Aluminum Prod.	Waste oil	secondary	2.25e-08	1.35e-05
Polystyrene Prod., high-impact	Unspecified solid waste	secondary	2.02e-08	1.21e-05
Invar	Non toxic chemical waste (unspecified)	secondary	1.54e-08	9.25e-06
Ferrite mfg.	Non toxic chemical waste (unspecified)	secondary	1.50e-08	9.03e-06
Lead	Carbon	secondary	1.36e-08	8.19e-06
Invar	Non mineral waste (inert)	secondary	1.08e-08	6.46e-06
Ferrite mfg.	Non mineral waste (inert)	secondary	1.05e-08	6.30e-06
Invar	Waste oil	secondary	8.51e-09	5.11e-06
Ferrite mfg.	Carbon	secondary	4.90e-09	2.94e-06
Steel Prod., cold-rolled, semi-finished	Carbon	secondary	4.32e-09	2.59e-06
Lead	Waste oil	secondary	4.30e-09	2.58e-06
Ferrite mfg.	Waste oil	secondary	2.72e-10	1.63e-07
Total Materials Processing			**1.23e-02**	**7.39e+00**
Manufacturing Life-cycle Stage				
LPG Production	Slag and ash	secondary	3.46e-02	2.08e+01
LPG Production	Unspecified waste	secondary	7.44e-03	4.47e+00
Glass/frit	Waste water treatment (WWT) sludge	primary	7.28e-03	4.37e+00
CRT tube mfg.	Waste water treatment (WWT) sludge	primary	2.37e-03	1.42e+00
LPG Production	Mixed industrial (waste)	secondary	1.24e-03	7.47e-01
US electric grid	Coal waste	model/secondary	1.01e-03	6.09e-01
Japanese Electric Grid	Coal waste	model/secondary	8.10e-04	4.86e-01
US electric grid	Dust/sludge	model/secondary	3.14e-04	1.89e-01
Fuel Oil #6 Prod.	Slag and ash	secondary	2.79e-04	1.68e-01
US electric grid	Fly/bottom ash	model/secondary	2.54e-04	1.52e-01
Japanese Electric Grid	Dust/sludge	model/secondary	2.51e-04	1.50e-01
Japanese Electric Grid	Fly/bottom ash	model/secondary	2.02e-04	1.22e-01
Fuel Oil #2 Prod.	Slag and ash	secondary	1.09e-04	6.52e-02
Natural Gas Prod.	Slag and ash	secondary	6.01e-05	3.61e-02
Fuel Oil #6 Prod.	Unspecified waste	secondary	6.00e-05	3.60e-02
Fuel Oil #2 Prod.	Unspecified waste	secondary	2.33e-05	1.40e-02
Natural Gas Prod.	Unspecified waste	secondary	1.29e-05	7.76e-03
Fuel Oil #4 Prod.	Slag and ash	secondary	1.16e-05	6.96e+00
Glass/frit	Potassium Carbonate	primary	1.08e-05	6.48e-03
CRT tube mfg.	Wood, average	primary	9.89e-06	5.94e-03
Glass/frit	Sodium Carbonate	primary	9.74e-06	5.85e-03
Glass/frit	CRT glass, faceplate	primary	9.73e-06	5.84e-03
Glass/frit	Unspecified sludge	primary	7.69e-06	4.62e-03
CRT tube mfg.	Sludge (phosphor)	primary	4.31e-06	2.59e-03
Fuel Oil #6 Prod.	Mixed industrial (waste)	secondary	4.23e-06	2.54e-03
Fuel Oil #2 Prod.	Mixed industrial (waste)	secondary	3.49e-06	2.10e-03
Fuel Oil #4 Prod.	Unspecified waste	secondary	2.49e-06	1.49e-03
CRT tube mfg.	Sludge (aquadag)	primary	2.22e-06	1.34e-03
LPG Production	Non toxic chemical waste (unspecified)	secondary	1.35e-06	8.13e-04
LPG Production	Mineral waste	secondary	1.01e-06	6.07e-04
Glass/frit	Waste refractory	primary	9.52e-07	5.72e-04
Glass/frit	blasting media	primary	8.16e-07	4.90e-04
Glass/frit	Oily rags & filter media	primary	7.25e-07	4.36e-04

Table M-7. CRT LCIA Results for the Solid Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Solid Waste Landfill Use (m3)	% of Total
Glass/frit	Plating process sludge	primary	2.98e-07	1.79e-04
Fuel Oil #4 Prod.	Mixed industrial (waste)	secondary	2.84e-07	1.71e-04
Glass/frit	acid absorbent	primary	1.02e-07	6.11e-05
Natural Gas Prod.	Mixed industrial (waste)	secondary	2.51e-08	1.51e-05
Fuel Oil #6 Prod.	Non toxic chemical waste (unspecified)	secondary	4.58e-09	2.75e-06
Fuel Oil #2 Prod.	Non toxic chemical waste (unspecified)	secondary	3.80e-09	2.28e-06
Fuel Oil #6 Prod.	Mineral waste	secondary	3.42e-09	2.05e-06
Fuel Oil #2 Prod.	Mineral waste	secondary	2.84e-09	1.70e-06
Fuel Oil #4 Prod.	Non toxic chemical waste (unspecified)	secondary	3.09e-10	1.85e-07
Fuel Oil #4 Prod.	Mineral waste	secondary	2.30e-10	1.38e-07
Natural Gas Prod.	Non toxic chemical waste (unspecified)	secondary	2.74e-11	1.64e-08
Natural Gas Prod.	Mineral waste	secondary	2.04e-11	1.23e-08
Total Manufacturing			**5.64e-02**	**3.39e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Coal waste	model/secondary	6.35e-02	3.82e+01
US electric grid	Dust/sludge	model/secondary	1.97e-02	1.18e+01
US electric grid	Fly/bottom ash	model/secondary	1.59e-02	9.54e+00
Total Use, Maintenance and Repair			**9.91e-02**	**5.95e+01**
End-of-life Life-cycle Stage				
CRT landfilling	EOL CRT Monitor, landfilled	primary	8.31e-03	4.99e+00
US electric grid	Coal waste	model/secondary	6.36e-06	3.82e-03
CRT landfilling	Unspecified solid waste	primary	4.34e-06	2.61e-03
CRT Incineration	Mixed industrial (waste)	secondary	2.41e-06	1.45e-03
US electric grid	Dust/sludge	model/secondary	1.97e-06	1.18e-03
US electric grid	Fly/bottom ash	model/secondary	1.59e-06	9.54e-04
LPG Production	Slag and ash	secondary	2.99e-07	1.79e-04
LPG Production	Unspecified waste	secondary	6.42e-08	3.85e-05
LPG Production	Mixed industrial (waste)	secondary	1.07e-08	6.44e-06
LPG Production	Non toxic chemical waste (unspecified)	secondary	1.17e-11	7.01e-09
LPG Production	Mineral waste	secondary	8.72e-12	5.24e-09
Natural Gas Prod.	Mineral waste	secondary	-1.02e-11	-6.15e-09
Natural Gas Prod.	Non toxic chemical waste (unspecified)	secondary	-1.37e-11	-8.24e-09
CRT Incineration	Mineral waste	secondary	-1.59e-10	-9.55e-08
CRT Incineration	Non toxic chemical waste (unspecified)	secondary	-2.13e-10	-1.28e-07
Fuel Oil #4 Prod.	Mineral waste	secondary	-2.48e-09	-1.49e-06
Fuel Oil #4 Prod.	Non toxic chemical waste (unspecified)	secondary	-3.32e-09	-1.99e-06
CRT Incineration	Mining waste	secondary	-4.23e-09	-2.54e-06
Natural Gas Prod.	Mixed industrial (waste)	secondary	-1.26e-08	-7.57e-06
Fuel Oil #4 Prod.	Mixed industrial (waste)	secondary	-3.05e-06	-1.83e-03
Natural Gas Prod.	Unspecified waste	secondary	-6.48e-06	-3.89e-03
Fuel Oil #4 Prod.	Unspecified waste	secondary	-2.67e-05	-1.61e-02
Natural Gas Prod.	Slag and ash	secondary	-3.01e-05	-1.81e-02
Fuel Oil #4 Prod.	Slag and ash	secondary	-1.25e-04	-7.48e-02

Table M-7. CRT LCIA Results for the Solid Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Solid Waste Landfill Use (m3)	% of Total
CRT Incineration	Unspecified solid waste	secondary	-1.76e-03	-1.06e+00
CRT Incineration	Slag and ash	secondary	-7.70e-03	-4.62e+00
Total End-of-life			**-1.32e-03**	**-7.95e-01**
Total All Life-cycle Stages	Total		**1.67e-01**	**1.00e+02**

Table M-8. LCD LCIA Results for the Solid Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Solid Waste landfill Use (m3)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Unspecified solid waste	secondary	5.36e-03	9.87e+00
Natural Gas Prod.	Slag and ash	secondary	4.20e-03	7.74e+00
Natural Gas Prod.	Unspecified waste	secondary	9.03e-04	1.66e+00
Steel Prod., cold-rolled, semi-finished	Mining waste	secondary	3.14e-04	5.79e-01
Steel Prod., cold-rolled, semi-finished	Mineral waste	secondary	3.11e-05	5.73e-02
Polycarbonate Production	Mineral waste	secondary	3.02e-05	5.56e-02
PMMA Sheet Prod.	Mixed industrial (waste)	secondary	2.45e-05	4.51e-02
Steel Prod., cold-rolled, semi-finished	Mixed industrial (waste)	secondary	2.21e-05	4.06e-02
PMMA Sheet Prod.	Mineral waste	secondary	1.99e-05	3.67e-02
Polycarbonate Production	Slag and ash	secondary	1.00e-05	1.85e-02
PMMA Sheet Prod.	Non toxic chemical waste (unspecified)	secondary	9.41e-06	1.73e-02
Steel Prod., cold-rolled, semi-finished	Slag and ash	secondary	8.99e-06	1.66e-02
PMMA Sheet Prod.	Slag and ash	secondary	6.26e-06	1.15e-02
Polycarbonate Production	Mixed industrial (waste)	secondary	5.55e-06	1.02e-02
PET Resin Production	Mineral waste	secondary	2.87e-06	5.29e-03
Styrene-butadiene Copolymer Prod.	Mineral waste	secondary	1.98e-06	3.64e-03
Natural Gas Prod.	Mixed industrial (waste)	secondary	1.76e-06	3.24e-03
PET Resin Production	Slag and ash	secondary	1.24e-06	2.29e-03
Polycarbonate Production	Non toxic chemical waste (unspecified)	secondary	1.00e-06	1.84e-03
Steel Prod., cold-rolled, semi-finished	Non toxic chemical waste (unspecified)	secondary	9.88e-07	1.82e-03
PET Resin Production	Non toxic chemical waste (unspecified)	secondary	7.69e-07	1.42e-03
Styrene-butadiene Copolymer Prod.	Non toxic chemical waste (unspecified)	secondary	5.89e-07	1.09e-03
Styrene-butadiene Copolymer Prod.	Slag and ash	secondary	4.76e-07	8.77e-04
Styrene-butadiene Copolymer Prod.	Mixed industrial (waste)	secondary	4.39e-07	8.08e-04
PET Resin Production	Unspecified solid waste	secondary	3.65e-07	6.73e-04
Aluminum Prod.	Calcium	secondary	1.38e-07	2.55e-04
Styrene-butadiene Copolymer Prod.	Unspecified solid waste	secondary	1.15e-07	2.11e-04
PMMA Sheet Prod.	Unspecified solid waste	secondary	7.91e-08	1.46e-04
Polycarbonate Production	Unspecified solid waste	secondary	6.10e-08	1.12e-04
Steel Prod., cold-rolled, semi-finished	Sewage sludge (unspecified)	secondary	3.25e-08	6.00e-05
Steel Prod., cold-rolled, semi-finished	Waste oil	secondary	2.63e-08	4.85e-05
Steel Prod., cold-rolled, semi-finished	Non mineral waste (inert)	secondary	2.19e-08	4.03e-05
Aluminum Prod.	Carbon	secondary	2.04e-08	3.76e-05
Steel Prod., cold-rolled, semi-finished	Calcium	secondary	1.48e-08	2.73e-05
Aluminum Prod.	Waste oil	secondary	8.38e-09	1.54e-05
Steel Prod., cold-rolled, semi-finished	Carbon	secondary	2.12e-09	3.90e-06
Natural Gas Prod.	Non toxic chemical waste (unspecified)	secondary	1.91e-09	3.52e-06
Natural Gas Prod.	Mineral waste	secondary	1.43e-09	2.63e-06
Total Materials Processing			**1.10e-02**	**2.02e+01**
Manufacturing Life-cycle Stage				
Monitor/module	Waste water treatment (WWT) sludge	primary	3.06e-03	5.65e+00
Japanese Electric Grid	Coal waste	model/secondary	2.72e-03	5.02e+00
LPG Production	Slag and ash	secondary	1.66e-03	3.06e+00
Japanese Electric Grid	Dust/sludge	model/secondary	8.43e-04	1.55e+00
Japanese Electric Grid	Fly/bottom ash	model/secondary	6.81e-04	1.25e+00
LPG Production	Unspecified waste	secondary	3.57e-04	6.57e-01
LCD glass mfg.	Waste water treatment (WWT) sludge	primary	3.39e-04	6.25e-01
Monitor/module	Waste plastics from LCD monitor	primary	2.89e-04	5.33e-01
Monitor/module	Waste acid (containing F and detergents)	primary	1.80e-04	3.31e-01

Table M-8. LCD LCIA Results for the Solid Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Solid Waste landfill Use (m3)	% of Total
US electric grid	Coal waste	model/secondary	1.23e-04	2.27e-01
Natural Gas Prod.	Slag and ash	secondary	9.47e-05	1.75e-01
Monitor/module	Waste LCD glass	primary	8.23e-05	1.52e-01
LPG Production	Mixed industrial (waste)	secondary	5.97e-05	1.10e-01
US electric grid	Dust/sludge	model/secondary	3.81e-05	7.03e-02
US electric grid	Fly/bottom ash	model/secondary	3.08e-05	5.67e-02
Panel components	Waste LCD glass	primary	2.30e-05	4.23e-02
Natural Gas Prod.	Unspecified waste	secondary	2.04e-05	3.75e-02
Fuel Oil #4 Prod.	Slag and ash	secondary	1.78e-05	3.29e-02
Fuel Oil #6 Prod.	Slag and ash	secondary	9.52e-06	1.75e-02
Monitor/module	Printed wiring board (PWB)	primary	9.38e-06	1.73e-02
Fuel Oil #2 Prod.	Slag and ash	secondary	5.07e-06	9.34e-03
Fuel Oil #4 Prod.	Unspecified waste	secondary	3.83e-06	7.07e-03
Monitor/module	LCD panel waste	primary	3.79e-06	6.98e-03
Panel components	Used silica gel	primary	2.14e-06	3.94e-03
Fuel Oil #6 Prod.	Unspecified waste	secondary	2.04e-06	3.77e-03
Backlight	Waste backlight light guide (PMMA)	primary	1.28e-06	2.35e-03
Fuel Oil #2 Prod.	Unspecified waste	secondary	1.09e-06	2.01e-03
LCD glass mfg.	Potassium Carbonate	primary	4.99e-07	9.19e-04
LCD glass mfg.	Sodium Carbonate	primary	4.51e-07	8.31e-04
Fuel Oil #4 Prod.	Mixed industrial (waste)	secondary	4.38e-07	8.07e-04
LCD glass mfg.	Unspecified sludge	primary	3.56e-07	6.56e-04
LCD glass mfg.	Cinders from LCD glass mfg	primary	3.19e-07	5.87e-04
Fuel Oil #2 Prod.	Mixed industrial (waste)	secondary	1.63e-07	3.00e-04
Fuel Oil #6 Prod.	Mixed industrial (waste)	secondary	1.44e-07	2.65e-04
LCD glass mfg.	LCD glass EP dust	primary	9.94e-08	1.83e-04
LPG Production	Non toxic chemical waste (unspecified)	secondary	6.49e-08	1.20e-04
LPG Production	Mineral waste	secondary	4.85e-08	8.94e-05
LCD glass mfg.	Waste refractory	primary	4.41e-08	8.13e-05
Natural Gas Prod.	Mixed industrial (waste)	secondary	3.96e-08	7.30e-05
LCD glass mfg.	blasting media	primary	3.78e-08	6.97e-05
LCD glass mfg.	Waste LCD glass	primary	3.48e-08	6.41e-05
LCD glass mfg.	Oily rags & filter media	primary	3.36e-08	6.19e-05
LCD glass mfg.	Sludge from LCD glass mfg	primary	2.99e-08	5.51e-05
LCD glass mfg.	Plating process sludge	primary	1.38e-08	2.54e-05
Backlight	Waste backlight casing (PC)	primary	5.41e-09	9.97e-06
LCD glass mfg.	acid absorbent	primary	4.71e-09	8.68e-06
Fuel Oil #4 Prod.	Non toxic chemical waste (unspecified)	secondary	4.76e-10	8.76e-07
Fuel Oil #4 Prod.	Mineral waste	secondary	3.55e-10	6.54e-07
Fuel Oil #2 Prod.	Non toxic chemical waste (unspecified)	secondary	1.77e-10	3.27e-07
Fuel Oil #6 Prod.	Non toxic chemical waste (unspecified)	secondary	1.56e-10	2.87e-07
Fuel Oil #2 Prod.	Mineral waste	secondary	1.32e-10	2.44e-07
Fuel Oil #6 Prod.	Mineral waste	secondary	1.16e-10	2.14e-07
Natural Gas Prod.	Non toxic chemical waste (unspecified)	secondary	4.31e-11	7.95e-08
Natural Gas Prod.	Mineral waste	secondary	3.22e-11	5.93e-08
Backlight	Broken CCFL	primary	1.98e-11	3.65e-08
Total Manufacturing			**1.07e-02**	**1.97e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Coal waste	model/secondary	2.37e-02	4.37e+01
US electric grid	Dust/sludge	model/secondary	7.35e-03	1.35e+01

Table M-8. LCD LCIA Results for the Solid Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Solid Waste landfill Use (m3)	% of Total
US electric grid	Fly/bottom ash	model/secondary	5.93e-03	1.09e+01
Total Use, Maintenance and Repair			**3.70e-02**	**6.82e+01**
End-of-life Life-cycle Stage				
LCD landfilling	EOL LCD Monitor, landfilled	primary	1.90e-03	3.50e+00
US electric grid	Coal waste	model/secondary	4.50e-06	8.29e-03
US electric grid	Dust/sludge	model/secondary	1.39e-06	2.57e-03
US electric grid	Fly/bottom ash	model/secondary	1.12e-06	2.07e-03
LCD landfilling	Unspecified solid waste	primary	1.05e-06	1.93e-03
LCD incineration	Mixed industrial (waste)	secondary	3.28e-07	6.04e-04
LPG Production	Slag and ash	secondary	1.36e-07	2.51e-04
LPG Production	Unspecified waste	secondary	2.93e-08	5.40e-05
LPG Production	Mixed industrial (waste)	secondary	4.90e-09	9.02e-06
LPG Production	Non toxic chemical waste (unspecified)	secondary	5.33e-12	9.82e-09
LPG Production	Mineral waste	secondary	3.98e-12	7.34e-09
Natural Gas Prod.	Mineral waste	secondary	-6.76e-12	-1.25e-08
Natural Gas Prod.	Non toxic chemical waste (unspecified)	secondary	-9.06e-12	-1.67e-08
LCD incineration	Mineral waste	secondary	-1.03e-10	-1.90e-07
LCD incineration	Non toxic chemical waste (unspecified)	secondary	-1.38e-10	-2.54e-07
Fuel Oil #4 Prod.	Mineral waste	secondary	-1.64e-09	-3.02e-06
Fuel Oil #4 Prod.	Non toxic chemical waste (unspecified)	secondary	-2.19e-09	-4.04e-06
LCD incineration	Mining waste	secondary	-2.74e-09	-5.06e-06
Natural Gas Prod.	Mixed industrial (waste)	secondary	-8.32e-09	-1.53e-05
Fuel Oil #4 Prod.	Mixed industrial (waste)	secondary	-2.02e-06	-3.72e-03
Natural Gas Prod.	Unspecified waste	secondary	-4.28e-06	-7.88e-03
Fuel Oil #4 Prod.	Unspecified waste	secondary	-1.77e-05	-3.26e-02
Natural Gas Prod.	Slag and ash	secondary	-1.99e-05	-3.67e-02
Fuel Oil #4 Prod.	Slag and ash	secondary	-8.22e-05	-1.52e-01
LCD incineration	Unspecified solid waste	secondary	-1.14e-03	-2.10e+00
LCD incineration	Slag and ash	secondary	-4.99e-03	-9.19e+00
Total End-of-life			**-4.35e-03**	**-8.01e+00**
Total All Life-cycle Stages			**5.43e-02**	**1.00e+02**

Table M-9. CRT LCIA Results for the Hazardous Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Hazardous Waste Landfill Use (m3)	% of Total
Materials Processing Life-cycle Stage				
Invar	General Hazardous Waste	secondary	3.92e-05	2.33e-01
Ferrite mfg.	General Hazardous Waste	secondary	3.82e-05	2.28e-01
Polycarbonate Production	General Hazardous Waste	secondary	2.06e-05	1.23e-01
ABS Production	General Hazardous Waste	secondary	9.45e-06	5.62e-02
Styrene-butadiene Copolymer Prod.	Hazardous waste	secondary	8.58e-07	5.11e-03
Steel Prod., cold-rolled, semi-finished	General Hazardous Waste	secondary	4.35e-07	2.59e-03
Polystyrene Prod., high-impact	General Hazardous Waste	secondary	2.70e-07	1.60e-03
Total Materials Processing			**1.09e-04**	**6.49e-01**
Manufacturing Life-cycle Stage				
LPG Production	Hazardous waste	secondary	1.36e-03	8.11e+00
Glass/frit	Hydrofluoric acid	primary	1.34e-05	7.98e-02
Glass/frit	cinders from CRT glass mfg (70% PbO)	primary	6.88e-06	4.09e-02
CRT tube mfg.	Unspecified sludge	primary	5.22e-06	3.11e-02
Fuel Oil #6 Prod.	Hazardous waste	secondary	4.61e-06	2.74e-02
Fuel Oil #2 Prod.	Hazardous waste	secondary	3.82e-06	2.27e-02
CRT tube mfg.	Frit	primary	3.04e-06	1.81e-02
CRT tube mfg.	Carbon and filmer waste	primary	2.30e-06	1.37e-02
Glass/frit	CRT glass faceplate EP dust (Pb) (D008 waste)	primary	2.15e-06	1.28e-02
CRT tube mfg.	Slurry scrap (chromium-based)	primary	1.60e-06	9.52e-03
Glass/frit	Hazardous sludge (Pb) (D008)	primary	1.38e-06	8.21e-03
CRT tube mfg.	Slag and ash	primary	1.30e-06	7.74e-03
CRT tube mfg.	Waste water treatment (WWT) filters	primary	7.59e-07	4.52e-03
Glass/frit	sludge from CRT glass mfg (1% PbO)	primary	6.45e-07	3.84e-03
Glass/frit	Broken CRT glass	primary	6.22e-07	3.70e-03
Glass/frit	Barium debris (D008 waste)	primary	4.58e-07	2.72e-03
Fuel Oil #4 Prod.	Hazardous waste	secondary	3.11e-07	1.85e-03
Glass/frit	Waste finishing sludge (Pb) (D008 waste)	primary	2.32e-07	1.38e-03
Glass/frit	Waste Batch (Ba, Pb) (D008 waste)	primary	1.22e-07	7.28e-04
CRT tube mfg.	Lead sulfate cake	primary	3.03e-08	1.80e-04
Natural Gas Prod.	Hazardous waste	secondary	2.75e-08	1.64e-04
Glass/frit	Lead debris (D008 waste)	primary	1.85e-08	1.10e-04
Glass/frit	Lead contaminated grit (D008 waste)	primary	2.99e-09	1.78e-05
Total Manufacturing			**1.41e-03**	**8.40e+00**
Use, Maintenance and Repair Life-cycle Stage				
Total Use, Maintenance and Repair			**0.00e+00**	**0.00e+00**
End-of-life Life-cycle Stage				
CRT landfilling	EOL CRT Monitor, landfilled	primary	1.53e-02	9.10e+01
LPG Production	Hazardous waste	secondary	1.18e-08	7.00e-05
Natural Gas Prod.	Hazardous waste	secondary	-1.38e-08	-8.22e-05
CRT Incineration	General Hazardous Waste	secondary	-2.14e-07	-1.28e-03
Fuel Oil #4 Prod.	Hazardous waste	secondary	-3.34e-06	-1.99e-02
Total End-of-life			**1.53e-02**	**9.10e+01**
Total All Life-cycle Stages			**1.68e-02**	**1.00e+02**

Table M-10. LCD LCIA Results for the Hazardous Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Hazardous Waste Landfill Use (m3)	% of Total
Materials Processing Life-cycle Stage				
Polycarbonate Production	General Hazardous Waste	secondary	1.15e-05	3.18e-01
Natural Gas Prod.	Hazardous waste	secondary	1.92e-06	5.33e-02
PMMA Sheet Prod.	General Hazardous Waste	secondary	9.41e-07	2.60e-02
Styrene-butadiene Copolymer Prod.	Hazardous waste	secondary	3.75e-07	1.04e-02
Steel Prod., cold-rolled, semi-finished	General Hazardous Waste	secondary	2.13e-07	5.90e-03
PET Resin Production	Unspecified hazardous waste	secondary	3.24e-08	8.96e-04
Total Materials Processing			**1.50e-05**	**4.15e-01**
Manufacturing Life-cycle Stage				
LPG Production	Hazardous waste	secondary	6.54e-05	1.81e+00
Monitor/module	Acetic acid	primary	3.18e-05	8.80e-01
Monitor/module	Phosphoric acid	primary	8.55e-06	2.37e-01
LCD glass mfg.	Hydrofluoric acid	primary	6.21e-07	1.72e-02
Fuel Oil #4 Prod.	Hazardous waste	secondary	4.79e-07	1.33e-02
Monitor/module	Nitric acid	primary	2.48e-07	6.87e-03
Fuel Oil #2 Prod.	Hazardous waste	secondary	1.78e-07	4.94e-03
Fuel Oil #6 Prod.	Hazardous waste	secondary	1.57e-07	4.34e-03
Natural Gas Prod.	Hazardous waste	secondary	4.34e-08	1.20e-03
LCD glass mfg.	Barium debris (D008 waste)	primary	2.12e-08	5.87e-04
LCD glass mfg.	Waste Batch (Ba, Pb) (D008 waste)	primary	5.67e-09	1.57e-04
Backlight	Waste glass, with mercury	primary	7.73e-15	2.14e-10
Total Manufacturing			**1.07e-04**	**2.98e+00**
Use, Maintenance and Repair Life-cycle Stage				
Total Use, Maintenance and Repair			**0.00e+00**	**0.00e+00**
End-of-life Life-cycle Stage				
LCD landfilling	EOL LCD Monitor, landfilled	primary	3.49e-03	9.67e+01
LPG Production	Hazardous waste	secondary	5.37e-09	1.49e-04
Natural Gas Prod.	Hazardous waste	secondary	-9.12e-09	-2.52e-04
LCD incineration	General Hazardous Waste	secondary	-1.39e-07	-3.84e-03
Fuel Oil #4 Prod.	Hazardous waste	secondary	-2.21e-06	-6.11e-02
Total End-of-life			**3.49e-03**	**9.66e+01**
Total All Life-cycle Stages			**3.61e-03**	**1.00e+02**

Table M-11. CRT LCIA Results for the Radioactive Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Radioactive Waste Landfill Use (m3)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Low-level radioactive waste	secondary	1.64e-05	9.03e+00
Invar	Low-level radioactive waste	secondary	4.72e-06	2.60e+00
Ferrite mfg.	Low-level radioactive waste	secondary	4.61e-06	2.54e+00
Steel Prod., cold-rolled, semi-finished	Radioactive waste (unspecified)	secondary	7.36e-07	4.06e-01
Steel Prod., cold-rolled, semi-finished	Highly radioactive waste (Class C)	secondary	3.46e-07	1.91e-01
Invar	Radioactive waste (unspecified)	secondary	2.20e-07	1.22e-01
Ferrite mfg.	Radioactive waste (unspecified)	secondary	2.15e-07	1.19e-01
Invar	Highly radioactive waste (Class C)	secondary	9.80e-08	5.41e-02
Ferrite mfg.	Highly radioactive waste (Class C)	secondary	9.57e-08	5.28e-02
Total Materials Processing			**2.74e-05**	**1.51e+01**
Manufacturing Life-cycle Stage				
Japanese Electric Grid	Low-level radioactive waste	model/secondary	6.89e-06	3.80e+00
Japanese Electric Grid	Uranium, depleted	model/secondary	2.07e-06	1.14e+00
US electric grid	Low-level radioactive waste	model/secondary	1.75e-06	9.66e-01
US electric grid	Uranium, depleted	model/secondary	5.25e-07	2.90e-01
Total Manufacturing			**1.12e-05**	**6.19e+00**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Low-level radioactive waste	model/secondary	1.10e-04	6.05e+01
US electric grid	Uranium, depleted	model/secondary	3.29e-05	1.82e+01
Total use, Maintenance and Repair			**1.43e-04**	**7.87e+01**
End-of-life Life-cycle Stage				
US electric grid	Low-level radioactive waste	model/secondary	1.10e-08	6.06e-03
US electric grid	Uranium, depleted	model/secondary	3.29e-09	1.82e-03
Total End-of-life			**1.43e-08**	**7.87e-03**
Total All Life-cycle Stages			**1.81e-04**	**1.00e+02**

Table M-12. LCD LCIA Results for the Radioactive Waste Landfill Use Impact Category

Process Group	Material	LCI Data Type	Radioactive Waste Landfill Use (m3)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Low-level radioactive waste	secondary	8.02e-06	8.70e+00
Steel Prod., cold-rolled, semi-finished	Radioactive waste (unspecified)	secondary	3.61e-07	3.91e-01
Steel Prod., cold-rolled, semi-finished	Highly radioactive waste (Class C)	secondary	1.70e-07	1.84e-01
Total Materials Processing			**8.55e-06**	**9.28e+00**
Manufacturing Life-cycle Stage				
Japanese Electric Grid	Low-level radioactive waste	model/secondary	2.32e-05	2.51e+01
Japanese Electric Grid	Uranium, depleted	model/secondary	6.95e-06	7.54e+00
US electric grid	Low-level radioactive waste	model/secondary	2.12e-07	2.30e-01
US electric grid	Uranium, depleted	model/secondary	6.37e-08	6.91e-02
Total Manufacturing			**3.04e-05**	**3.30e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Low-level radioactive waste	model/secondary	4.10e-05	4.44e+01
US electric grid	Uranium, depleted	model/secondary	1.23e-05	1.33e+01
Total use, Maintenance and Repair			**5.32e-05**	**5.77e+01**
End-of-life Life-cycle Stage				
US electric grid	Low-level radioactive waste	model/secondary	7.77e-09	8.43e-03
US electric grid	Uranium, depleted	model/secondary	2.33e-09	2.53e-03
Total End-of-life			**1.01e-08**	**1.10e-02**
Total All Life-cycle Stages			**9.22e-05**	**1.00e+02**

Table M-13. CRT LCIA Results for the Global Warming Impact Category

Process Group	Material	LCI Data Type	Global Warming Potential (kg-Co2 Equivalents)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Carbon dioxide	secondary	1.34e+01	1.93e+00
Polycarbonate Production	Carbon dioxide	secondary	4.62e+00	6.64e-01
Aluminum Prod.	Carbon dioxide	secondary	3.59e+00	5.16e-01
Invar	Carbon dioxide	secondary	2.26e+00	3.25e-01
Styrene-butadiene Copolymer Prod.	Carbon dioxide	secondary	1.65e+00	2.38e-01
ABS Production	Carbon dioxide	secondary	1.31e+00	1.89e-01
Lead	Carbon dioxide	secondary	1.07e+00	1.54e-01
Aluminum Prod.	Perfluoromethane	secondary	8.42e-01	1.21e-01
Ferrite mfg.	Carbon dioxide	secondary	8.32e-01	1.20e-01
Polycarbonate Production	Methane	secondary	4.27e-01	6.13e-02
Polystyrene Prod., high-impact	Carbon dioxide	secondary	4.23e-01	6.09e-02
Steel Prod., cold-rolled, semi-finished	Nitrous oxide	secondary	2.41e-01	3.46e-02
Steel Prod., cold-rolled, semi-finished	Methane	secondary	2.29e-01	3.29e-02
Aluminum Prod.	Methane	secondary	1.69e-01	2.43e-02
Styrene-butadiene Copolymer Prod.	Methane	secondary	1.44e-01	2.07e-02
Aluminum Prod.	Perfluoroethane	secondary	1.32e-01	1.90e-02
Invar	Methane	secondary	1.21e-01	1.74e-02
ABS Production	Methane	secondary	1.07e-01	1.53e-02
Ferrite mfg.	Methane	secondary	5.99e-02	8.62e-03
Lead	Methane	secondary	5.29e-02	7.61e-03
Aluminum Prod.	Nitrous oxide	secondary	4.28e-02	6.16e-03
Polystyrene Prod., high-impact	Methane	secondary	3.49e-02	5.02e-03
Lead	Nitrous oxide	secondary	6.29e-03	9.05e-04
Ferrite mfg.	Nitrous oxide	secondary	3.29e-03	4.73e-04
Polycarbonate Production	Nitrous oxide	secondary	1.43e-04	2.06e-03
ABS Production	Nitrous oxide	secondary	6.56e-05	9.44e-06
Styrene-butadiene Copolymer Prod.	Nitrous oxide	secondary	6.41e-05	9.22e-06
Invar	Perfluoromethane	secondary	1.85e-05	2.67e-06
Ferrite mfg.	Perfluoromethane	secondary	1.81e-05	2.60e-06
Invar	Nitrous oxide	secondary	1.50e-05	2.16e-06
Invar	HFC-125	secondary	6.43e-06	9.25e-07
Ferrite mfg.	HFC-125	secondary	6.28e-06	9.03e-07
Steel Prod., cold-rolled, semi-finished	Perfluoromethane	secondary	2.92e-07	4.20e-08
Invar	Perfluoroethane	secondary	4.92e-08	7.08e-09
Total Materials Processing			**3.18e+01**	**4.57e+00**
Manufacturing Life-cycle Stage				
LPG Production	Carbon dioxide	secondary	1.51e+02	2.17e+01
LPG Production	Methane	secondary	1.76e+01	2.53e+00
Japanese Electric Grid	Carbon dioxide	model/secondary	1.54e+01	2.21e+00
US electric grid	Carbon dioxide	model/secondary	7.10e+00	1.02e+00
LPG Production	Nitrous oxide	secondary	5.03e+00	7.23e-01
Glass/frit	Carbon dioxide	primary	2.81e+00	4.04e-01
Natural Gas Prod.	Carbon dioxide	secondary	1.32e+00	1.90e-01
Natural Gas Prod.	Methane	secondary	1.05e+00	1.51e-01
Fuel Oil #6 Prod.	Carbon dioxide	secondary	8.51e-01	1.22e-01
Fuel Oil #2 Prod.	Carbon dioxide	secondary	4.48e-01	6.44e-02
US electric grid	Methane	model/secondary	2.16e-01	3.11e-02
Fuel Oil #6 Prod.	Methane	secondary	1.24e-01	1.78e-02
Fuel Oil #2 Prod.	Methane	secondary	5.40e-02	7.76e-03

Table M-13. CRT LCIA Results for the Global Warming Impact Category

Process Group	Material	LCI Data Type	Global Warming Potential (kg-Co2 Equivalents)	% of Total
Fuel Oil #6 Prod.	Nitrous oxide	secondary	4.50e-02	6.47e-03
Glass/frit	Carbon dioxide	primary	4.33e-02	6.23e-03
Fuel Oil #4 Prod.	Carbon dioxide	secondary	4.22e-02	6.06e-03
Japanese Electric Grid	Nitrous oxide	model/secondary	3.46e-02	4.98e-03
US electric grid	Nitrous oxide	model/secondary	1.68e-02	2.42e-03
Fuel Oil #2 Prod.	Nitrous oxide	secondary	1.61e-02	2.31e-03
Fuel Oil #4 Prod.	Methane	secondary	5.47e-03	7.87e-04
Natural Gas Prod.	Nitrous oxide	secondary	3.58e-03	5.15e-04
Fuel Oil #4 Prod.	Nitrous oxide	secondary	1.78e-03	2.56e-04
Japanese Electric Grid	Methane	model/secondary	1.71e-03	2.46e-04
Total Manufacturing			**2.03e+02**	**2.92e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Carbon dioxide	model/secondary	4.45e+02	6.39e+01
US electric grid	Methane	model/secondary	1.35e+01	1.95e+00
US electric grid	Nitrous oxide	model/secondary	1.05e+00	1.51e-01
Total Use, Maintenance and Repair			**4.59e+02**	**6.60e+01**
End-of-life Life-cycle Stage				
CRT Incineration	Carbon dioxide	secondary	3.55e+00	5.11e-01
CRT landfilling	Carbon dioxide	primary	1.03e-01	1.49e-02
US electric grid	Carbon dioxide	model/secondary	4.45e-02	6.40e-03
US electric grid	Methane	model/secondary	1.35e-03	1.95e-04
LPG Production	Carbon dioxide	secondary	1.30e-03	1.87e-04
CRT landfilling	Methane	primary	1.14e-03	1.64e-04
LPG Production	Methane	secondary	1.52e-04	2.19e-05
US electric grid	Nitrous oxide	model/secondary	1.05e-04	1.52e-05
LPG Production	Nitrous oxide	secondary	4.34e-05	6.24e-06
Natural Gas Prod.	Nitrous oxide	secondary	-1.80e-03	-2.58e-04
Fuel Oil #4 Prod.	Nitrous oxide	secondary	-1.92e-02	-2.75e-03
Fuel Oil #4 Prod.	Methane	secondary	-5.88e-02	-8.46e-03
CRT Incineration	Methane	secondary	-3.18e-01	-4.57e-02
CRT Incineration	Nitrous oxide	secondary	-3.23e-01	-4.64e-02
Fuel Oil #4 Prod.	Carbon dioxide	secondary	-4.53e-01	-6.52e-02
Natural Gas Prod.	Methane	secondary	-5.28e-01	-7.60e-02
Natural Gas Prod.	Carbon dioxide	secondary	-6.63e-01	-9.54e-02
Total End-of-life			**1.34e+00**	**1.93e-01**
Total All Life-cycle Stages			**6.95e+02**	**1.00e+02**

Table M-14. LCD LCIA Results for the Global Warming Impact Category

Process Group	Material	LCI Data Type	Global Warming Potential (kg-Co2 Equivalents)	% of Total
Materials Processing Life-cycle Stage				
Natural Gas Prod.	Carbon dioxide	secondary	9.24e+01	1.56e+01
Natural Gas Prod.	Methane	secondary	7.36e+01	1.24e+01
Steel Prod., cold-rolled, semi-finished	Carbon dioxide	secondary	6.58e+00	1.11e+00
PMMA Sheet Prod.	Carbon dioxide	secondary	2.65e+00	4.46e-01
Polycarbonate Production	Carbon dioxide	secondary	2.58e+00	4.35e-01
Aluminum Prod.	Carbon dioxide	secondary	1.34e+00	2.25e-01
Styrene-butadiene Copolymer Prod.	Carbon dioxide	secondary	7.23e-01	1.22e-01
PET Resin Production	Carbon dioxide	secondary	3.90e-01	6.58e-02
Aluminum Prod.	Perfluoromethane	secondary	3.14e-01	5.29e-02
Natural Gas Prod.	Nitrous oxide	secondary	2.50e-01	4.22e-02
PMMA Sheet Prod.	Methane	secondary	2.42e-01	4.07e-02
Polycarbonate Production	Methane	secondary	2.38e-01	4.02e-02
Steel Prod., cold-rolled, semi-finished	Nitrous oxide	secondary	1.18e-01	1.99e-02
Steel Prod., cold-rolled, semi-finished	Methane	secondary	1.12e-01	1.89e-02
Styrene-butadiene Copolymer Prod.	Methane	secondary	6.30e-02	1.06e-02
Aluminum Prod.	Methane	secondary	6.29e-02	1.06e-02
Aluminum Prod.	Perfluoroethane	secondary	4.93e-02	8.31e-03
PET Resin Production	Methane	secondary	2.10e-02	3.53e-03
Aluminum Prod.	Nitrous oxide	secondary	1.59e-02	2.69e-03
Polycarbonate Production	Nitrous oxide	secondary	7.99e-05	1.35e-05
PMMA Sheet Prod.	Nitrous oxide	secondary	5.94e-05	1.00e-05
PET Resin Production	Nitrous oxide	secondary	2.81e-05	4.74e-06
Styrene-butadiene Copolymer Prod.	Nitrous oxide	secondary	2.80e-05	4.73e-06
Steel Prod., cold-rolled, semi-finished	Perfluoromethane	secondary	1.43e-07	2.41e-08
Total Materials Processing			**1.82e+02**	**3.06e+01**
Manufacturing Life-cycle Stage				
Monitor/module	Sulfur hexafluoride	primary	1.74e+02	2.94e+01
Japanese Electric Grid	Carbon dioxide	model/secondary	5.18e+01	8.72e+00
LPG Production	Carbon dioxide	secondary	7.24e+00	1.22e+00
Natural Gas Prod.	Carbon dioxide	secondary	2.09e+00	3.51e-01
Natural Gas Prod.	Methane	secondary	1.66e+00	2.80e-01
US electric grid	Carbon dioxide	model/secondary	8.61e-01	1.45e-01
LPG Production	Methane	secondary	8.45e-01	1.42e-01
LPG Production	Nitrous oxide	secondary	2.41e-01	4.07e-02
LCD glass mfg.	Carbon dioxide	primary	1.30e-01	2.19e-02
Japanese Electric Grid	Nitrous oxide	model/secondary	1.17e-01	1.96e-02
Fuel Oil #4 Prod.	Carbon dioxide	secondary	6.50e-02	1.10e-02
Fuel Oil #6 Prod.	Carbon dioxide	secondary	2.90e-02	4.88e-03
US electric grid	Methane	model/secondary	2.62e-02	4.42e-03
Fuel Oil #2 Prod.	Carbon dioxide	secondary	2.09e-02	3.52e-03
Fuel Oil #4 Prod.	Methane	secondary	8.43e-03	1.42e-03
Japanese Electric Grid	Methane	model/secondary	5.74e-03	9.68e-04
Natural Gas Prod.	Nitrous oxide	secondary	5.64e-03	9.51e-04
Panel components	Carbon dioxide	primary	4.82e-03	8.12e-04
Fuel Oil #6 Prod.	Methane	secondary	4.21e-03	7.10e-04
Fuel Oil #4 Prod.	Nitrous oxide	secondary	2.75e-03	4.63e-04
Fuel Oil #2 Prod.	Methane	secondary	2.52e-03	4.24e-04
Monitor/module	Carbon dioxide	primary	2.16e-03	3.64e-04

Table M-14. LCD LCIA Results for the Global Warming Impact Category

Process Group	Material	LCI Data Type	Global Warming Potential (kg-Co2 Equivalents)	% of Total
US electric grid	Nitrous oxide	model/secondary	2.04e-03	3.44e-04
Fuel Oil #6 Prod.	Nitrous oxide	secondary	1.53e-03	2.58e-04
Fuel Oil #2 Prod.	Nitrous oxide	secondary	7.50e-04	1.26e-04
Total Manufacturing			**2.40e+02**	**4.04e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Carbon dioxide	model/secondary	1.66e+02	2.80e+01
US electric grid	Methane	model/secondary	5.05e+00	8.52e-01
US electric grid	Nitrous oxide	model/secondary	3.93e-01	6.63e-02
Total Use, Maintenance and Repair			**1.71e+02**	**2.89e+01**
End-of-life Life-cycle Stage				
LCD incineration	Carbon dioxide	secondary	2.07e+00	3.48e-01
US electric grid	Carbon dioxide	model/secondary	3.15e-02	5.31e-03
LCD landfilling	Carbon dioxide	primary	2.49e-02	4.20e-03
US electric grid	Methane	model/secondary	9.59e-04	1.62e-04
LPG Production	Carbon dioxide	secondary	5.95e-04	1.00e-04
LCD landfilling	Methane	primary	2.75e-04	4.64e-05
US electric grid	Nitrous oxide	model/secondary	7.46e-05	1.26e-05
LPG Production	Methane	secondary	6.94e-05	1.17e-05
LPG Production	Nitrous oxide	secondary	1.98e-05	3.34e-06
Natural Gas Prod.	Nitrous oxide	secondary	-1.19e-03	-2.00e-04
Fuel Oil #4 Prod.	Nitrous oxide	secondary	-1.27e-02	-2.13e-03
Fuel Oil #4 Prod.	Methane	secondary	-3.89e-02	-6.55e-03
LCD incineration	Methane	secondary	-2.07e-01	-3.49e-02
LCD incineration	Nitrous oxide	secondary	-2.09e-01	-3.53e-02
Fuel Oil #4 Prod.	Carbon dioxide	secondary	-2.99e-01	-5.05e-02
Natural Gas Prod.	Methane	secondary	-3.49e-01	-5.88e-02
Natural Gas Prod.	Carbon dioxide	secondary	-4.38e-01	-7.38e-02
Total End-of-life			**5.70e-01**	**9.60e-02**
Total All Life-cycle Stages			**5.93e+02**	**1.00e+02**

Table M-15. CRT LCIA Results for the Stratospheric Ozone Depletion Impact Category

Process Group	Materials	LCI Data Type	Ozone Depletion (kg CFC-11 Equivalents)	% of Total
Materials Processing Life-cycle Stage				
ABS Production	HALON-1301	secondary	4.10e-06	2.00e+01
Aluminum Prod.	HALON-1301	secondary	2.89e-06	1.41e+01
Invar	HALON-1301	secondary	1.22e-06	5.93e+00
Lead	HALON-1301	secondary	5.42e-07	2.65e+00
Steel Prod., cold-rolled, semi-finished	HALON-1301	secondary	4.03e-07	1.97e+00
Ferrite mfg.	HALON-1301	secondary	1.52e-07	7.43e-01
Invar	Dichlorodifluoromethane	secondary	8.02e-10	3.92e-03
Invar	CFC-13	secondary	5.04e-10	2.46e-03
ABS Production	HCFC-22	secondary	1.46e-10	7.14e-04
Ferrite mfg.	Dichlorodifluoromethane	secondary	5.94e-17	2.90e-10
Ferrite mfg.	CFC-13	secondary	3.74e-17	1.83e-10
Invar	HCFC-22	secondary	3.68e-18	1.80e-11
Ferrite mfg.	HCFC-22	secondary	3.59e-18	1.75e-11
Total Materials Processing			**9.30e-06**	**4.54e+01**
Manufacturing Life-cycle Stage				
LPG Production	Bromomethane	secondary	7.49e-07	3.66e+00
US electric grid	Bromomethane	model/secondary	1.60e-07	7.83e-01
Japanese Electric Grid	Bromomethane	model/secondary	1.28e-07	6.25e-01
LPG Production	1,1,1-Trichloroethane	secondary	1.61e-08	7.84e-02
LPG Production	HALON-1301	secondary	8.12e-09	3.96e-02
Japanese Electric Grid	1,1,1-Trichloroethane	model/secondary	7.76e-09	3.79e-02
Fuel Oil #6 Prod.	Bromomethane	secondary	6.05e-09	2.95e-02
US electric grid	1,1,1-Trichloroethane	model/secondary	3.67e-09	1.79e-02
Fuel Oil #2 Prod.	Bromomethane	secondary	2.35e-09	1.15e-02
Natural Gas Prod.	Bromomethane	secondary	1.30e-09	6.34e-03
Fuel Oil #4 Prod.	Bromomethane	secondary	2.51e-10	1.22e-03
Fuel Oil #6 Prod.	1,1,1-Trichloroethane	secondary	1.30e-10	6.32e-04
Fuel Oil #2 Prod.	1,1,1-Trichloroethane	secondary	5.04e-11	2.46e-04
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	2.79e-11	1.36e-04
Fuel Oil #6 Prod.	HALON-1301	secondary	2.75e-11	1.34e-04
Fuel Oil #2 Prod.	HALON-1301	secondary	2.28e-11	1.11e-04
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	5.37e-12	2.62e-05
Fuel Oil #4 Prod.	HALON-1301	secondary	1.85e-12	9.04e-06
Natural Gas Prod.	HALON-1301	secondary	1.64e-13	8.01e-07
Total Manufacturing			**1.08e-06**	**5.29e+00**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Bromomethane	model/secondary	1.00e-05	4.90e+01
US electric grid	1,1,1-Trichloroethane	model/secondary	2.30e-07	1.12e+00
Total Use, Maintenance and Repair			**1.03e-05**	**5.01e+01**
End-of-life Life-cycle Stage				
CRT Incineration	Carbon tetrachloride	secondary	1.61e-09	7.88e-03
CRT landfilling	Carbon tetrachloride	primary	1.51e-09	7.35e-03
US electric grid	Bromomethane	model/secondary	1.00e-09	4.91e-03
US electric grid	1,1,1-Trichloroethane	model/secondary	2.30e-11	1.12e-04
LPG Production	Bromomethane	secondary	6.47e-12	3.16e-05
LPG Production	1,1,1-Trichloroethane	secondary	1.39e-13	6.77e-07
LPG Production	HALON-1301	secondary	7.01e-14	3.42e-07
Natural Gas Prod.	HALON-1301	secondary	-8.23e-14	-4.02e-07

Table M-15. CRT LCIA Results for the Stratospheric Ozone Depletion Impact Category

Process Group	Materials	LCI Data Type	Ozone Depletion (kg CFC-11 Equivalents)	% of Total
CRT Incineration	HALON-1301	secondary	-1.28e-12	-6.24e-06
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	-1.40e-11	-6.82e-05
Fuel Oil #4 Prod.	HALON-1301	secondary	-1.99e-11	-9.72e-05
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	-5.77e-11	-2.82e-04
Natural Gas Prod.	Bromomethane	secondary	-6.52e-10	-3.18e-03
Fuel Oil #4 Prod.	Bromomethane	secondary	-2.69e-09	-1.32e-02
CRT Incineration	1,1,1-Trichloroethane	secondary	-3.57e-09	-1.74e-02
CRT Incineration	Bromomethane	secondary	-1.67e-07	-8.13e-01
Total End-of-life			**-1.69e-07**	**-8.27e-01**
Total All Life-cycle Stages			**2.05e-05**	**1.00e+02**

Table M-16. LCD LCIA Results for the Stratospheric Ozone Depletion Impact Category

Process Group	Material	LCI Data Type	Ozone Depletion (kg CFC-11 Equivalents)	% of Total
Materials Processing Life-cycle Stage				
Aluminum Prod.	HALON-1301	secondary	1.07e-06	7.83e+00
Steel Prod., cold-rolled, semi-finished	HALON-1301	secondary	1.98e-07	1.44e+00
Natural Gas Prod.	Bromomethane	secondary	9.08e-08	6.62e-01
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	1.95e-09	1.42e-02
Natural Gas Prod.	HALON-1301	secondary	1.15e-11	8.36e-05
Total Materials Processing			**1.36e-06**	**9.95e+00**
Manufacturing Life-cycle Stage				
Panel components	HCFC-225cb	primary	4.62e-06	3.37e+01
Panel components	HCFC-225ca	primary	3.50e-06	2.55e+01
Japanese Electric Grid	Bromomethane	model/secondary	4.31e-07	3.14e+00
LPG Production	Bromomethane	secondary	3.60e-08	2.62e-01
Japanese Electric Grid	1,1,1-Trichloroethane	model/secondary	2.61e-08	1.90e-01
US electric grid	Bromomethane	model/secondary	1.94e-08	1.42e-01
Natural Gas Prod.	Bromomethane	secondary	2.05e-09	1.49e-02
LPG Production	1,1,1-Trichloroethane	secondary	7.71e-10	5.62e-03
US electric grid	1,1,1-Trichloroethane	model/secondary	4.45e-10	3.25e-03
LPG Production	HALON-1301	secondary	3.90e-10	2.84e-03
Fuel Oil #4 Prod.	Bromomethane	secondary	3.86e-10	2.82e-03
Fuel Oil #6 Prod.	Bromomethane	secondary	2.06e-10	1.50e-03
Fuel Oil #2 Prod.	Bromomethane	secondary	1.10e-10	8.00e-04
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	4.39e-11	3.20e-04
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	8.28e-12	6.03e-05
Fuel Oil #6 Prod.	1,1,1-Trichloroethane	secondary	4.41e-12	3.22e-05
Fuel Oil #4 Prod.	HALON-1301	secondary	2.85e-12	2.08e-05
Fuel Oil #2 Prod.	1,1,1-Trichloroethane	secondary	2.35e-12	1.71e-05
Fuel Oil #2 Prod.	HALON-1301	secondary	1.06e-12	7.75e-06
Fuel Oil #6 Prod.	HALON-1301	secondary	9.35e-13	6.82e-06
Natural Gas Prod.	HALON-1301	secondary	2.59e-13	1.89e-06
Total Manufacturing			**8.63e-06**	**6.29e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Bromomethane	model/secondary	3.75e-06	2.73e+01
US electric grid	1,1,1-Trichloroethane	model/secondary	8.59e-08	6.26e-01
Total use, Maintenance and Repair			**3.83e-06**	**2.79e+01**
End-of-life Life-cycle Stage				
US electric grid	Bromomethane	model/secondary	7.11e-10	5.18e-03
LCD landfilling	Carbon tetrachloride	primary	3.63e-10	2.64e-03
LCD incineration	Carbon tetrachloride	secondary	2.81e-10	2.05e-03
US electric grid	1,1,1-Trichloroethane	model/secondary	1.63e-11	1.19e-04
LPG Production	Bromomethane	secondary	2.95e-12	2.15e-05
LPG Production	1,1,1-Trichloroethane	secondary	6.33e-14	4.61e-07
LPG Production	HALON-1301	secondary	3.20e-14	2.33e-07
Natural Gas Prod.	HALON-1301	secondary	-5.44e-14	-3.96e-07
LCD incineration	HALON-1301	secondary	-8.28e-13	-6.03e-06
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	-9.22e-12	-6.72e-05
Fuel Oil #4 Prod.	HALON-1301	secondary	-1.32e-11	-9.58e-05
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	-3.81e-11	-2.78e-04
Natural Gas Prod.	Bromomethane	secondary	-4.30e-10	-3.14e-03
Fuel Oil #4 Prod.	Bromomethane	secondary	-1.78e-09	-1.30e-02

Table M-16. LCD LCIA Results for the Stratospheric Ozone Depletion Impact Category

Process Group	Material	LCI Data Type	Ozone Depletion (kg CFC-11 Equivalents)	% of Total
LCD incineration	1,1,1-Trichloroethane	secondary	-2.31e-09	-1.69e-02
LCD incineration	Bromomethane	secondary	-1.08e-07	-7.86e-01
Total End-of-life			**-1.11e-07**	**-8.10e-01**
Total All Life-cycle Stages			**1.37e-05**	**1.00e+02**

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Nonmethane hydrocarbons, remaining unspeciated	secondary	3.32e-02	1.94e+01
Steel Prod., cold-rolled, semi-finished	Hydrocarbons, remaining unspeciated	secondary	3.44e-03	2.01e+00
ABS Production	Nonmethane hydrocarbons, remaining unspeciated	secondary	2.14e-03	1.25e+00
Polycarbonate Production	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.84e-03	1.07e+00
Aluminum Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.47e-03	8.60e-01
ABS Production	Hydrocarbons, remaining unspeciated	secondary	7.08e-04	4.14e-01
Styrene-butadiene Copolymer Prod.	Hydrocarbons, remaining unspeciated	secondary	6.59e-04	3.85e-01
Invar	Nonmethane hydrocarbons, remaining unspeciated	secondary	5.46e-04	3.19e-01
Lead	Nonmethane hydrocarbons, remaining unspeciated	secondary	3.66e-04	2.14e-01
Invar	VOCs, remaining unspeciated	secondary	2.31e-04	1.35e-01
Polystyrene Prod., high-impact	Hydrocarbons, remaining unspeciated	secondary	2.29e-04	1.34e-01
Ferrite mfg.	VOCs, remaining unspeciated	secondary	2.25e-04	1.32e-01
Steel Prod., cold-rolled, semi-finished	Ethylene	secondary	2.07e-04	1.21e-01
Ferrite mfg.	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.84e-04	1.08e-01
ABS Production	Aromatic hydrocarbons	secondary	1.45e-04	8.48e-02
Polycarbonate Production	Methane	secondary	1.42e-04	8.31e-02
Invar	Ethylene	secondary	1.01e-04	5.93e-02
Steel Prod., cold-rolled, semi-finished	Ethane	secondary	9.79e-05	5.72e-02
Ferrite mfg.	Ethylene	secondary	9.77e-05	5.71e-02
Steel Prod., cold-rolled, semi-finished	Methane	secondary	7.63e-05	4.46e-02
Polycarbonate Production	Aromatic hydrocarbons	secondary	6.25e-05	3.66e-02
Aluminum Prod.	Methane	secondary	5.63e-05	3.29e-02
Styrene-butadiene Copolymer Prod.	Aromatic hydrocarbons	secondary	5.16e-05	3.02e-02
Styrene-butadiene Copolymer Prod.	Methane	secondary	4.81e-05	2.81e-02
ABS Production	Ethane	secondary	4.72e-05	2.76e-02
Invar	Methane	secondary	4.03e-05	2.36e-02
Steel Prod., cold-rolled, semi-finished	n-Propane	secondary	3.83e-05	2.24e-02
ABS Production	Methane	secondary	3.56e-05	2.08e-02
Invar	Ethane	secondary	3.29e-05	1.92e-02
Ferrite mfg.	Ethane	secondary	3.21e-05	1.88e-02
Polycarbonate Production	Aldehydes	secondary	2.62e-05	1.53e-02
ABS Production	Ethylene	secondary	2.57e-05	1.50e-02
Steel Prod., cold-rolled, semi-finished	Propylene	secondary	2.49e-05	1.45e-02
Polystyrene Prod., high-impact	Aromatic hydrocarbons	secondary	2.30e-05	1.35e-02
Invar	Hydrocarbons, remaining unspeciated	secondary	2.21e-05	1.29e-02
Ferrite mfg.	Hydrocarbons, remaining unspeciated	secondary	2.16e-05	1.26e-02
Ferrite mfg.	Methane	secondary	2.00e-05	1.17e-02
Steel Prod., cold-rolled, semi-finished	Aldehydes	secondary	1.89e-05	1.10e-02
Lead	Methane	secondary	1.76e-05	1.03e-02
Lead	Ethylene	secondary	1.59e-05	9.31e-03
Aluminum Prod.	Xylene (mixed isomers)	secondary	1.41e-05	8.23e-03
Aluminum Prod.	Polycyclic aromatic hydrocarbons	secondary	1.38e-05	8.06e-03
Lead	Ethane	secondary	1.26e-05	7.35e-03
Invar	n-Propane	secondary	1.24e-05	7.26e-03
Ferrite mfg.	n-Propane	secondary	1.21e-05	7.09e-03
Polystyrene Prod., high-impact	Methane	secondary	1.16e-05	6.80e-03
Steel Prod., cold-rolled, semi-finished	Butane	secondary	9.05e-06	5.29e-03
Invar	Propylene	secondary	7.07e-06	4.14e-03

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Steel Prod., cold-rolled, semi-finished	Pentane	secondary	6.92e-06	4.04e-03
Ferrite mfg.	Propylene	secondary	6.90e-06	4.04e-03
ABS Production	Formaldehyde	secondary	5.89e-06	3.44e-03
Invar	Xylene (mixed isomers)	secondary	5.53e-06	3.24e-03
Steel Prod., cold-rolled, semi-finished	Benzene	secondary	5.26e-06	3.07e-03
ABS Production	Heptane	secondary	4.74e-06	2.77e-03
Aluminum Prod.	Toluene	secondary	4.67e-06	2.73e-03
Aluminum Prod.	Aldehydes	secondary	4.59e-06	2.69e-03
Steel Prod., cold-rolled, semi-finished	Toluene	secondary	4.37e-06	2.55e-03
Steel Prod., cold-rolled, semi-finished	Xylene (mixed isomers)	secondary	4.16e-06	2.43e-03
Steel Prod., cold-rolled, semi-finished	Acetylene	secondary	3.91e-06	2.29e-03
Invar	Butane	secondary	3.80e-06	2.22e-03
Ferrite mfg.	Butane	secondary	3.71e-06	2.17e-03
Invar	Pentane	secondary	3.66e-06	2.14e-03
Ferrite mfg.	Pentane	secondary	3.57e-06	2.09e-03
Invar	Benzene	secondary	2.59e-06	1.52e-03
Lead	Xylene (mixed isomers)	secondary	2.59e-06	1.51e-03
Steel Prod., cold-rolled, semi-finished	Hexane	secondary	1.84e-06	1.08e-03
Ferrite mfg.	Benzene	secondary	1.76e-06	1.03e-03
Invar	Toluene	secondary	1.60e-06	9.33e-04
Ferrite mfg.	Toluene	secondary	1.56e-06	9.11e-04
Steel Prod., cold-rolled, semi-finished	Formaldehyde	secondary	1.53e-06	8.92e-04
Aluminum Prod.	Alcohols	secondary	1.50e-06	8.76e-04
Ferrite mfg.	Xylene (mixed isomers)	secondary	1.43e-06	8.39e-04
Steel Prod., cold-rolled, semi-finished	Phenol	secondary	1.43e-06	8.35e-04
ABS Production	Ethanol	secondary	1.40e-06	8.17e-04
Aluminum Prod.	Benzene	secondary	1.22e-06	7.14e-04
Invar	Acetylene	secondary	1.11e-06	6.50e-04
Ferrite mfg.	Acetylene	secondary	1.08e-06	6.34e-04
Invar	Ethylbenzene	secondary	9.65e-07	5.64e-04
Invar	Benzo[a]pyrene	secondary	9.36e-07	5.48e-04
Steel Prod., cold-rolled, semi-finished	Heptane	secondary	8.81e-07	5.15e-04
Lead	Benzene	secondary	8.32e-07	4.87e-04
Invar	Aromatic hydrocarbons	secondary	7.76e-07	4.54e-04
Invar	Methanol	secondary	6.92e-07	4.05e-04
Invar	Ethanol	secondary	6.13e-07	3.58e-04
Invar	Formaldehyde	secondary	5.89e-07	3.44e-04
Ferrite mfg.	Formaldehyde	secondary	5.74e-07	3.36e-04
Invar	Hexane	secondary	5.36e-07	3.13e-04
Ferrite mfg.	Hexane	secondary	5.23e-07	3.06e-04
Invar	Acetaldehyde	secondary	5.10e-07	2.98e-04
Steel Prod., cold-rolled, semi-finished	Aromatic hydrocarbons	secondary	5.05e-07	2.95e-04
Steel Prod., cold-rolled, semi-finished	Methanol	secondary	4.42e-07	2.59e-04
Lead	Ethylbenzene	secondary	4.11e-07	2.40e-04
Invar	Phenol	secondary	4.05e-07	2.37e-04
Ferrite mfg.	Phenol	secondary	3.95e-07	2.31e-04
Steel Prod., cold-rolled, semi-finished	Ethanol	secondary	3.56e-07	2.08e-04
Polystyrene Prod., high-impact	Polycyclic aromatic hydrocarbons	secondary	3.45e-07	2.02e-04
Steel Prod., cold-rolled, semi-finished	Acetaldehyde	secondary	2.96e-07	1.73e-04

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Invar	Heptane	secondary	2.67e-07	1.56e-04
Ferrite mfg.	Heptane	secondary	2.61e-07	1.53e-04
Steel Prod., cold-rolled, semi-finished	Ethylbenzene	secondary	2.35e-07	1.37e-04
Invar	Acetone	secondary	2.04e-07	1.19e-04
Polycarbonate Production	Ethanethiol	secondary	1.84e-07	1.07e-04
Ferrite mfg.	Aromatic hydrocarbons	secondary	1.62e-07	9.45e-05
Ferrite mfg.	Methanol	secondary	1.24e-07	7.28e-05
Invar	Aldehydes	secondary	1.21e-07	7.05e-05
Steel Prod., cold-rolled, semi-finished	Acetone	secondary	1.18e-07	6.91e-05
Ferrite mfg.	Aldehydes	secondary	1.14e-07	6.64e-05
Ferrite mfg.	Ethylbenzene	secondary	1.03e-07	6.03e-05
Ferrite mfg.	Ethanol	secondary	1.00e-07	5.86e-05
ABS Production	Aldehydes	secondary	9.38e-08	5.48e-05
Styrene-butadiene Copolymer Prod.	Aldehydes	secondary	9.16e-08	5.36e-05
Ferrite mfg.	Acetaldehyde	secondary	8.48e-08	4.96e-05
ABS Production	Ethanethiol	secondary	8.43e-08	4.93e-05
Lead	Ethanol	secondary	7.77e-08	4.54e-05
Steel Prod., cold-rolled, semi-finished	Benzo[a]pyrene	secondary	6.79e-08	3.97e-05
Lead	Acetaldehyde	secondary	6.57e-08	3.84e-05
Lead	Methanol	secondary	6.02e-08	3.52e-05
Lead	Aromatic hydrocarbons	secondary	5.16e-08	3.02e-05
Steel Prod., cold-rolled, semi-finished	Polycyclic aromatic hydrocarbons	secondary	3.72e-08	2.18e-05
Invar	Polycyclic aromatic hydrocarbons	secondary	3.63e-08	2.12e-05
Ferrite mfg.	Polycyclic aromatic hydrocarbons	secondary	3.54e-08	2.07e-05
Ferrite mfg.	Acetone	secondary	3.34e-08	1.95e-05
Lead	Acetone	secondary	2.57e-08	1.50e-05
Invar	Alcohols	secondary	2.38e-08	1.39e-05
Ferrite mfg.	Alcohols	secondary	2.33e-08	1.36e-05
Ferrite mfg.	Benzo[a]pyrene	secondary	1.88e-08	1.10e-05
Steel Prod., cold-rolled, semi-finished	Naphthalene	secondary	1.13e-08	6.62e-06
Aluminum Prod.	1,2-Dichlorotetrafluoroethane	secondary	5.02e-09	2.93e-06
Aluminum Prod.	Phenol	secondary	3.04e-09	1.78e-06
Lead	Aldehydes	secondary	2.15e-09	1.26e-06
Invar	1,2-Dichlorotetrafluoroethane	secondary	2.08e-09	1.22e-06
Lead	Benzo[a]pyrene	secondary	1.49e-09	8.73e-07
Invar	Trichlorofluoromethane	secondary	1.27e-10	7.40e-08
ABS Production	HCFC-22	secondary	5.59e-11	3.27e-08
Ferrite mfg.	Trichlorofluoromethane	secondary	4.71e-11	2.75e-08
Invar	Ethanethiol	secondary	3.47e-11	2.03e-08
Ferrite mfg.	Ethanethiol	secondary	3.38e-11	1.98e-08
Invar	Dichlorodifluoromethane	secondary	1.69e-11	9.85e-09
Lead	Acrolein	secondary	1.05e-11	6.17e-09
Lead	Benzaldehyde	secondary	5.52e-12	3.22e-09
Invar	Propionaldehyde	secondary	9.34e-14	5.46e-11
Steel Prod., cold-rolled, semi-finished	Propionaldehyde	secondary	9.34e-14	5.46e-11
Ferrite mfg.	Propionaldehyde	secondary	9.12e-14	5.33e-11
Steel Prod., cold-rolled, semi-finished	Benzaldehyde	secondary	2.51e-14	1.47e-11
Invar	Benzaldehyde	secondary	2.50e-14	1.46e-11
Ferrite mfg.	Benzaldehyde	secondary	2.43e-14	1.42e-11

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Invar	Acrolein	secondary	4.38e-15	2.56e-12
Ferrite mfg.	1,2-Dichlorotetrafluoroethane	secondary	1.54e-16	8.98e-14
Invar	HCFC-22	secondary	1.41e-18	8.22e-16
Ferrite mfg.	HCFC-22	secondary	1.37e-18	8.02e-16
Ferrite mfg.	Dichlorodifluoromethane	secondary	1.25e-18	7.30e-16
Total Materials Processing			**4.69e-02**	**2.74e+01**
Manufacturing Life-cycle Stage				
LPG Production	Hydrocarbons, remaining unspeciated	secondary	6.22e-02	3.64e+01
LPG Production	Nonmethane hydrocarbons, remaining unspeciated	secondary	4.24e-02	2.48e+01
LPG Production	Methane	secondary	5.87e-03	3.43e+00
LPG Production	Benzene	secondary	2.71e-03	1.59e+00
CRT tube mfg.	Toluene	primary	2.16e-03	1.26e+00
Natural Gas Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	9.01e-04	5.27e-01
LPG Production	Aldehydes	secondary	6.61e-04	3.87e-01
Fuel Oil #6 Prod.	Hydrocarbons, remaining unspeciated	secondary	5.36e-04	3.13e-01
LPG Production	Formaldehyde	secondary	4.93e-04	2.88e-01
Fuel Oil #6 Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	3.55e-04	2.08e-01
Natural Gas Prod.	Methane	secondary	3.51e-04	2.05e-01
LPG Production	Ethane	secondary	3.09e-04	1.81e-01
CRT tube mfg.	Xylene (mixed isomers)	primary	2.92e-04	1.71e-01
LPG Production	Pentane	secondary	2.65e-04	1.55e-01
Natural Gas Prod.	Benzene	secondary	2.39e-04	1.40e-01
LPG Production	Butane	secondary	2.09e-04	1.22e-01
Fuel Oil #2 Prod.	Hydrocarbons, remaining unspeciated	secondary	1.97e-04	1.15e-01
LPG Production	Hexane	secondary	1.88e-04	1.10e-01
Fuel Oil #2 Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.34e-04	7.84e-02
US electric grid	Methane	model/secondary	7.20e-05	4.21e-02
CRT tube mfg.	Nonmethane hydrocarbons, remaining unspeciated	primary	6.33e-05	3.70e-02
Fuel Oil #6 Prod.	Methane	secondary	4.12e-05	2.41e-02
Natural Gas Prod.	Hydrocarbons, remaining unspeciated	secondary	2.48e-05	1.45e-02
Fuel Oil #4 Prod.	Hydrocarbons, remaining unspeciated	secondary	2.16e-05	1.26e-02
Fuel Oil #2 Prod.	Methane	secondary	1.80e-05	1.05e-02
PWB Mfg.	Formaldehyde	model/secondary	1.63e-05	9.55e-03
Fuel Oil #6 Prod.	Benzene	secondary	1.55e-05	9.06e-03
Fuel Oil #4 Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.45e-05	8.47e-03
Fuel Oil #2 Prod.	Benzene	secondary	8.06e-06	4.71e-03
Fuel Oil #6 Prod.	Formaldehyde	secondary	5.03e-06	2.94e-03
Natural Gas Prod.	Aldehydes	secondary	4.77e-06	2.79e-03
Japanese Electric Grid	Formaldehyde	model/secondary	4.30e-06	2.51e-03
Fuel Oil #6 Prod.	Aldehydes	secondary	3.77e-06	2.20e-03
LPG Production	Isophorone	secondary	2.95e-06	1.73e-03
Natural Gas Prod.	Ethane	secondary	2.78e-06	1.63e-03
Natural Gas Prod.	Pentane	secondary	2.39e-06	1.40e-03
LPG Production	Toluene	secondary	2.09e-06	1.22e-03
Fuel Oil #2 Prod.	Aldehydes	secondary	1.96e-06	1.15e-03
Natural Gas Prod.	Butane	secondary	1.88e-06	1.10e-03
Fuel Oil #4 Prod.	Methane	secondary	1.82e-06	1.07e-03
Fuel Oil #6 Prod.	Ethane	secondary	1.76e-06	1.03e-03
LPG Production	Acetaldehyde	secondary	1.69e-06	9.88e-04

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Natural Gas Prod.	Hexane	secondary	1.69e-06	9.87e-04
Fuel Oil #2 Prod.	Formaldehyde	secondary	1.62e-06	9.47e-04
LPG Production	Propionaldehyde	secondary	1.53e-06	8.96e-04
Fuel Oil #6 Prod.	Pentane	secondary	1.52e-06	8.87e-04
LPG Production	Methyl ethyl ketone	secondary	1.23e-06	7.22e-04
Fuel Oil #6 Prod.	Butane	secondary	1.20e-06	6.99e-04
Fuel Oil #6 Prod.	Hexane	secondary	1.07e-06	6.27e-04
Fuel Oil #2 Prod.	Ethane	secondary	9.17e-07	5.36e-04
LPG Production	Acrolein	secondary	8.60e-07	5.03e-04
Japanese Electric Grid	Toluene	model/secondary	8.05e-07	4.71e-04
Fuel Oil #2 Prod.	Pentane	secondary	7.89e-07	4.61e-04
LPG Production	o-xylene	secondary	7.85e-07	4.59e-04
Fuel Oil #4 Prod.	Benzene	secondary	7.62e-07	4.46e-04
LPG Production	n-Propane	secondary	7.01e-07	4.10e-04
US electric grid	Isophorone	model/secondary	6.32e-07	3.69e-04
Fuel Oil #2 Prod.	Butane	secondary	6.21e-07	3.63e-04
Japanese Electric Grid	Methane	model/secondary	5.69e-07	3.33e-04
US electric grid	Formaldehyde	model/secondary	5.69e-07	3.33e-04
Fuel Oil #2 Prod.	Hexane	secondary	5.57e-07	3.26e-04
Japanese Electric Grid	Isophorone	model/secondary	5.05e-07	2.95e-04
LPG Production	Ethylbenzene	secondary	4.83e-07	2.83e-04
LPG Production	Bromomethane	secondary	4.26e-07	2.49e-04
US electric grid	Acetaldehyde	model/secondary	3.61e-07	2.11e-04
US electric grid	Benzene	model/secondary	3.52e-07	2.06e-04
US electric grid	Propionaldehyde	model/secondary	3.28e-07	1.92e-04
Japanese Electric Grid	Acetaldehyde	model/secondary	2.89e-07	1.69e-04
Japanese Electric Grid	Benzene	model/secondary	2.88e-07	1.68e-04
LPG Production	Naphthalene	secondary	2.66e-07	1.55e-04
US electric grid	Methyl ethyl ketone	model/secondary	2.64e-07	1.54e-04
Japanese Electric Grid	Propionaldehyde	model/secondary	2.62e-07	1.53e-04
US electric grid	Toluene	model/secondary	2.28e-07	1.34e-04
Japanese Electric Grid	Methyl ethyl ketone	model/secondary	2.11e-07	1.23e-04
Fuel Oil #4 Prod.	Formaldehyde	secondary	1.89e-07	1.10e-04
Fuel Oil #4 Prod.	Aldehydes	secondary	1.86e-07	1.09e-04
US electric grid	Acrolein	model/secondary	1.84e-07	1.08e-04
Japanese Electric Grid	Naphthalene	model/secondary	1.68e-07	9.84e-05
Japanese Electric Grid	Acrolein	model/secondary	1.47e-07	8.59e-05
LPG Production	Styrene	secondary	1.27e-07	7.44e-05
US electric grid	Ethylbenzene	model/secondary	1.03e-07	6.01e-05
Natural Gas Prod.	Formaldehyde	secondary	1.02e-07	5.95e-05
LPG Production	Benzyl chloride	secondary	9.84e-08	5.75e-05
LPG Production	Methyl tert-butyl ether	secondary	9.32e-08	5.45e-05
US electric grid	Bromomethane	model/secondary	9.12e-08	5.33e-05
Japanese Electric Grid	Ethylbenzene	model/secondary	9.03e-08	5.28e-05
Fuel Oil #4 Prod.	Ethane	secondary	8.68e-08	5.07e-05
LPG Production	Phenol	secondary	8.15e-08	4.76e-05
LPG Production	Acetophenone	secondary	7.64e-08	4.47e-05
Fuel Oil #4 Prod.	Pentane	secondary	7.46e-08	4.36e-05
LPG Production	Methyl chloride	secondary	7.45e-08	4.35e-05

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Japanese Electric Grid	Bromomethane	model/secondary	7.28e-08	4.26e-05
Fuel Oil #4 Prod.	Butane	secondary	5.88e-08	3.44e-05
Fuel Oil #4 Prod.	Hexane	secondary	5.27e-08	3.08e-05
Natural Gas Prod.	o-xylene	secondary	5.27e-08	3.08e-05
LPG Production	Dichloromethane	secondary	4.07e-08	2.38e-05
US electric grid	Xylene (mixed isomers)	model/secondary	4.03e-08	2.36e-05
LPG Production	Aromatic hydrocarbons	secondary	4.00e-08	2.34e-05
US electric grid	Hexane	model/secondary	3.99e-08	2.33e-05
Japanese Electric Grid	Xylene (mixed isomers)	model/secondary	3.22e-08	1.88e-05
Japanese Electric Grid	Hexane	model/secondary	3.19e-08	1.86e-05
Natural Gas Prod.	Toluene	secondary	2.91e-08	1.70e-05
US electric grid	Styrene	model/secondary	2.72e-08	1.59e-05
LPG Production	Cumene	secondary	2.70e-08	1.58e-05
Fuel Oil #6 Prod.	Isophorone	secondary	2.38e-08	1.39e-05
US electric grid	Naphthalene	model/secondary	2.22e-08	1.30e-05
Japanese Electric Grid	Styrene	model/secondary	2.17e-08	1.27e-05
US electric grid	Benzyl chloride	model/secondary	2.10e-08	1.23e-05
US electric grid	Methyl tert-butyl ether	model/secondary	1.99e-08	1.17e-05
US electric grid	Phenol	model/secondary	1.74e-08	1.02e-05
LPG Production	Phenanthrene	secondary	1.72e-08	1.01e-05
Japanese Electric Grid	Benzyl chloride	model/secondary	1.68e-08	9.82e-06
US electric grid	Acetophenone	model/secondary	1.63e-08	9.55e-06
US electric grid	Methyl chloride	model/secondary	1.59e-08	9.32e-06
Japanese Electric Grid	Methyl tert-butyl ether	model/secondary	1.59e-08	9.28e-06
Japanese Electric Grid	o-xylene	model/secondary	1.47e-08	8.59e-06
Fuel Oil #6 Prod.	Toluene	secondary	1.41e-08	8.25e-06
Japanese Electric Grid	Phenol	model/secondary	1.39e-08	8.14e-06
Fuel Oil #6 Prod.	Acetaldehyde	secondary	1.36e-08	7.97e-06
Japanese Electric Grid	Acetophenone	model/secondary	1.30e-08	7.63e-06
Japanese Electric Grid	Methyl chloride	model/secondary	1.27e-08	7.44e-06
Fuel Oil #6 Prod.	Propionaldehyde	secondary	1.24e-08	7.23e-06
LPG Production	Vinyl acetate	secondary	1.13e-08	6.63e-06
Fuel Oil #6 Prod.	Methyl ethyl ketone	secondary	9.96e-09	5.82e-06
Fuel Oil #2 Prod.	Isophorone	secondary	9.26e-09	5.42e-06
US electric grid	Dichloromethane	model/secondary	8.72e-09	5.10e-06
LPG Production	Biphenyl	secondary	8.66e-09	5.06e-06
LPG Production	Chloroform	secondary	8.29e-09	4.85e-06
Japanese Electric Grid	Dichloromethane	model/secondary	6.96e-09	4.07e-06
Fuel Oil #6 Prod.	Acrolein	secondary	6.94e-09	4.06e-06
Fuel Oil #2 Prod.	Toluene	secondary	6.37e-09	3.72e-06
LPG Production	1,4-Dichlorobenzene	secondary	6.31e-09	3.69e-06
LPG Production	Tetrachloroethylene	secondary	6.04e-09	3.53e-06
LPG Production	Ethyl Chloride	secondary	5.90e-09	3.45e-06
US electric grid	Cumene	model/secondary	5.77e-09	3.38e-06
LPG Production	1,2-Dichloroethane	secondary	5.62e-09	3.29e-06
Fuel Oil #6 Prod.	n-Propane	secondary	5.62e-09	3.29e-06
Fuel Oil #2 Prod.	Acetaldehyde	secondary	5.30e-09	3.10e-06
LPG Production	Fluorene	secondary	5.28e-09	3.09e-06
Natural Gas Prod.	Isophorone	secondary	5.12e-09	3.00e-06

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Fuel Oil #6 Prod.	o-xylene	secondary	4.91e-09	2.87e-06
Fuel Oil #2 Prod.	Propionaldehyde	secondary	4.81e-09	2.81e-06
Japanese Electric Grid	Cumene hydroperoxide	model/secondary	4.61e-09	2.69e-06
LPG Production	2-Methylnaphthalene	secondary	4.57e-09	2.67e-06
LPG Production	Fluoranthene	secondary	4.31e-09	2.52e-06
LPG Production	Acenaphthene	secondary	3.99e-09	2.33e-06
Japanese Electric Grid	Phenanthrene	model/secondary	3.96e-09	2.32e-06
Fuel Oil #6 Prod.	Ethylbenzene	secondary	3.89e-09	2.27e-06
Fuel Oil #2 Prod.	Methyl ethyl ketone	secondary	3.87e-09	2.26e-06
Fuel Oil #6 Prod.	Bromomethane	secondary	3.44e-09	2.01e-06
Japanese Electric Grid	Acenaphthene	model/secondary	3.29e-09	1.92e-06
LPG Production	Ethylene dibromide	secondary	3.20e-09	1.87e-06
LPG Production	Chlorobenzene	secondary	3.09e-09	1.81e-06
US electric grid	Phenanthrene	model/secondary	3.04e-09	1.78e-06
Natural Gas Prod.	Acetaldehyde	secondary	2.93e-09	1.71e-06
LPG Production	1,1,1-Trichloroethane	secondary	2.81e-09	1.64e-06
LPG Production	Pyrene	secondary	2.74e-09	1.60e-06
Fuel Oil #2 Prod.	Acrolein	secondary	2.70e-09	1.58e-06
Natural Gas Prod.	Propionaldehyde	secondary	2.66e-09	1.55e-06
US electric grid	Vinyl acetate	model/secondary	2.43e-09	1.42e-06
Fuel Oil #2 Prod.	o-xylene	secondary	2.36e-09	1.38e-06
Fuel Oil #2 Prod.	n-Propane	secondary	2.20e-09	1.28e-06
Natural Gas Prod.	Methyl ethyl ketone	secondary	2.14e-09	1.25e-06
Japanese Electric Grid	Vinyl acetate	model/secondary	1.93e-09	1.13e-06
US electric grid	Biphenyl	model/secondary	1.85e-09	1.08e-06
US electric grid	Chloroform	model/secondary	1.77e-09	1.04e-06
LPG Production	Acenaphthylene	secondary	1.63e-09	9.52e-07
Fuel Oil #6 Prod.	Naphthalene	secondary	1.61e-09	9.41e-07
LPG Production	Anthracene	secondary	1.59e-09	9.28e-07
Fuel Oil #2 Prod.	Ethylbenzene	secondary	1.52e-09	8.86e-07
Natural Gas Prod.	Acrolein	secondary	1.49e-09	8.72e-07
Japanese Electric Grid	Biphenyl	model/secondary	1.48e-09	8.64e-07
LPG Production	2,4-Dinitrotoluene	secondary	1.43e-09	8.34e-07
Japanese Electric Grid	Chloroform	model/secondary	1.42e-09	8.28e-07
Japanese Electric Grid	Fluorene	model/secondary	1.39e-09	8.14e-07
Japanese Electric Grid	1,1,1-Trichloroethane	model/secondary	1.36e-09	7.94e-07
Natural Gas Prod.	Naphthalene	secondary	1.34e-09	7.84e-07
Natural Gas Prod.	n-Propane	secondary	1.34e-09	7.83e-07
Fuel Oil #2 Prod.	Bromomethane	secondary	1.34e-09	7.82e-07
Japanese Electric Grid	Fluoranthene	model/secondary	1.33e-09	7.77e-07
US electric grid	Tetrachloroethylene	model/secondary	1.29e-09	7.56e-07
US electric grid	Ethyl Chloride	model/secondary	1.26e-09	7.38e-07
US electric grid	1,2-Dichloroethane	model/secondary	1.20e-09	7.03e-07
Japanese Electric Grid	Tetrachloroethylene	model/secondary	1.03e-09	6.03e-07
Fuel Oil #6 Prod.	Styrene	secondary	1.03e-09	6.01e-07
US electric grid	Fluorene	model/secondary	1.02e-09	5.96e-07
Japanese Electric Grid	Ethyl Chloride	model/secondary	1.01e-09	5.89e-07
Fuel Oil #4 Prod.	Isophorone	secondary	9.88e-10	5.78e-07
LPG Production	2-Chloroacetophenone	secondary	9.84e-10	5.75e-07

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Japanese Electric Grid	1,2-Dichloroethane	model/secondary	9.60e-10	5.61e-07
Japanese Electric Grid	Pyrene	model/secondary	9.59e-10	5.61e-07
LPG Production	Benzo[a]anthracene	secondary	9.50e-10	5.55e-07
LPG Production	Chrysene	secondary	9.11e-10	5.33e-07
Natural Gas Prod.	Ethylbenzene	secondary	8.40e-10	4.91e-07
US electric grid	Fluoranthene	model/secondary	8.15e-10	4.77e-07
Fuel Oil #2 Prod.	Naphthalene	secondary	7.96e-10	4.65e-07
Fuel Oil #6 Prod.	Benzyl chloride	secondary	7.94e-10	4.64e-07
Fuel Oil #6 Prod.	Methyl tert-butyl ether	secondary	7.52e-10	4.40e-07
Natural Gas Prod.	Bromomethane	secondary	7.39e-10	4.32e-07
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	7.07e-10	4.13e-07
US electric grid	o-xylene	model/secondary	6.93e-10	4.05e-07
US electric grid	Acenaphthene	model/secondary	6.90e-10	4.03e-07
US electric grid	Ethylene dibromide	model/secondary	6.84e-10	4.00e-07
US electric grid	Chlorobenzene	model/secondary	6.61e-10	3.87e-07
Fuel Oil #6 Prod.	Phenol	secondary	6.57e-10	3.84e-07
US electric grid	1,1,1-Trichloroethane	model/secondary	6.43e-10	3.76e-07
Fuel Oil #4 Prod.	Toluene	secondary	6.37e-10	3.72e-07
Fuel Oil #6 Prod.	Acetophenone	secondary	6.16e-10	3.60e-07
Japanese Electric Grid	Benzo[a]anthracene	model/secondary	6.09e-10	3.56e-07
Fuel Oil #6 Prod.	Methyl chloride	secondary	6.01e-10	3.51e-07
Fuel Oil #4 Prod.	Acetaldehyde	secondary	5.65e-10	3.30e-07
LPG Production	Benzo[b,j,k]fluoranthene	secondary	5.60e-10	3.27e-07
Japanese Electric Grid	Ethylene dibromide	model/secondary	5.46e-10	3.19e-07
Japanese Electric Grid	Chlorobenzene	model/secondary	5.28e-10	3.09e-07
LPG Production	Benzo[a]pyrene	secondary	5.20e-10	3.04e-07
Fuel Oil #4 Prod.	Propionaldehyde	secondary	5.13e-10	3.00e-07
LPG Production	Benzo[g,h,i]perylene	secondary	4.22e-10	2.47e-07
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	4.13e-10	2.41e-07
Japanese Electric Grid	Chrysene	model/secondary	4.07e-10	2.38e-07
US electric grid	Pyrene	model/secondary	4.05e-10	2.37e-07
Fuel Oil #2 Prod.	Styrene	secondary	3.99e-10	2.33e-07
Japanese Electric Grid	Anthracene	model/secondary	3.47e-10	2.03e-07
Japanese Electric Grid	Indeno(1,2,3-cd)pyrene	model/secondary	3.41e-10	1.99e-07
Fuel Oil #6 Prod.	Dichloromethane	secondary	3.29e-10	1.92e-07
Japanese Electric Grid	Benzo[g,h,i]perylene	model/secondary	3.27e-10	1.91e-07
Fuel Oil #2 Prod.	Benzyl chloride	secondary	3.09e-10	1.80e-07
US electric grid	2,4-Dinitrotoluene	model/secondary	3.05e-10	1.78e-07
Japanese Electric Grid	Benzo[b,j,k]fluoranthene	model/secondary	2.96e-10	1.73e-07
Fuel Oil #2 Prod.	Methyl tert-butyl ether	secondary	2.92e-10	1.71e-07
Fuel Oil #4 Prod.	Acrolein	secondary	2.88e-10	1.68e-07
US electric grid	Acenaphthylene	model/secondary	2.74e-10	1.60e-07
Fuel Oil #2 Prod.	Phenol	secondary	2.56e-10	1.49e-07
Japanese Electric Grid	Acenaphthylene	model/secondary	2.51e-10	1.47e-07
Japanese Electric Grid	2,4-Dinitrotoluene	model/secondary	2.43e-10	1.42e-07
Fuel Oil #2 Prod.	Acetophenone	secondary	2.40e-10	1.40e-07
US electric grid	Anthracene	model/secondary	2.37e-10	1.38e-07
Fuel Oil #4 Prod.	n-Propane	secondary	2.34e-10	1.37e-07
Fuel Oil #2 Prod.	Methyl chloride	secondary	2.34e-10	1.37e-07

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Fuel Oil #4 Prod.	o-xylene	secondary	2.30e-10	1.35e-07
Natural Gas Prod.	Styrene	secondary	2.21e-10	1.29e-07
Fuel Oil #6 Prod.	Cumene	secondary	2.18e-10	1.27e-07
US electric grid	2-Chloroacetophenone	model/secondary	2.10e-10	1.23e-07
Japanese Electric Grid	2-Methylnaphthalene	model/secondary	1.81e-10	1.06e-07
Natural Gas Prod.	Benzyl chloride	secondary	1.71e-10	9.97e-08
Japanese Electric Grid	2-Chloroacetophenone	model/secondary	1.68e-10	9.83e-08
Natural Gas Prod.	Methyl tert-butyl ether	secondary	1.62e-10	9.45e-08
Fuel Oil #4 Prod.	Ethylbenzene	secondary	1.61e-10	9.43e-08
Fuel Oil #4 Prod.	Bromomethane	secondary	1.43e-10	8.33e-08
Natural Gas Prod.	Phenol	secondary	1.41e-10	8.26e-08
Fuel Oil #6 Prod.	Aromatic hydrocarbons	secondary	1.35e-10	7.90e-08
Natural Gas Prod.	Acetophenone	secondary	1.32e-10	7.75e-08
Fuel Oil #6 Prod.	Phenanthrene	secondary	1.30e-10	7.62e-08
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	1.29e-10	7.56e-08
Natural Gas Prod.	Methyl chloride	secondary	1.29e-10	7.55e-08
Fuel Oil #2 Prod.	Dichloromethane	secondary	1.28e-10	7.47e-08
US electric grid	Chrysene	model/secondary	1.24e-10	7.25e-08
US electric grid	Benzo[a]anthracene	model/secondary	1.13e-10	6.59e-08
Fuel Oil #2 Prod.	Aromatic hydrocarbons	secondary	1.12e-10	6.56e-08
LPG Production	5-Methyl chrysene	secondary	1.12e-10	6.55e-08
Fuel Oil #6 Prod.	Vinyl acetate	secondary	9.15e-11	5.35e-08
Fuel Oil #2 Prod.	Cumene	secondary	8.47e-11	4.95e-08
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	8.01e-11	4.68e-08
Fuel Oil #4 Prod.	Naphthalene	secondary	7.67e-11	4.49e-08
Natural Gas Prod.	Dichloromethane	secondary	7.07e-11	4.13e-08
Fuel Oil #6 Prod.	Biphenyl	secondary	6.98e-11	4.08e-08
Fuel Oil #6 Prod.	Chloroform	secondary	6.69e-11	3.91e-08
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	5.68e-11	3.32e-08
Natural Gas Prod.	Phenanthrene	secondary	5.36e-11	3.14e-08
Fuel Oil #2 Prod.	Phenanthrene	secondary	5.35e-11	3.13e-08
Fuel Oil #6 Prod.	Tetrachloroethylene	secondary	4.87e-11	2.85e-08
Fuel Oil #6 Prod.	Ethyl Chloride	secondary	4.76e-11	2.78e-08
Natural Gas Prod.	Cumene	secondary	4.68e-11	2.74e-08
Fuel Oil #6 Prod.	1,2-Dichloroethane	secondary	4.53e-11	2.65e-08
LPG Production	Polycyclic aromatic hydrocarbons	secondary	4.44e-11	2.60e-08
US electric grid	Benzo[g,h,i]perylene	model/secondary	4.38e-11	2.56e-08
Fuel Oil #4 Prod.	Styrene	secondary	4.26e-11	2.49e-08
US electric grid	Benzo[a]pyrene	model/secondary	4.14e-11	2.42e-08
Natural Gas Prod.	2-Methylnaphthalene	secondary	4.12e-11	2.41e-08
Fuel Oil #6 Prod.	Fluorene	secondary	4.08e-11	2.39e-08
Fuel Oil #6 Prod.	1,4-Dichlorobenzene	secondary	3.60e-11	2.11e-08
Fuel Oil #2 Prod.	Vinyl acetate	secondary	3.56e-11	2.08e-08
Japanese Electric Grid	Benzo[a]pyrene	model/secondary	3.31e-11	1.93e-08
Fuel Oil #4 Prod.	Benzyl chloride	secondary	3.29e-11	1.92e-08
Fuel Oil #6 Prod.	Fluoranthene	secondary	3.28e-11	1.92e-08
US electric grid	2-Methylnaphthalene	model/secondary	3.24e-11	1.89e-08
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	3.12e-11	1.82e-08
Fuel Oil #4 Prod.	Phenol	secondary	2.73e-11	1.59e-08

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Fuel Oil #2 Prod.	Biphenyl	secondary	2.72e-11	1.59e-08
Fuel Oil #6 Prod.	Acenaphthene	secondary	2.65e-11	1.55e-08
Fuel Oil #6 Prod.	2-Methylnaphthalene	secondary	2.61e-11	1.53e-08
Fuel Oil #2 Prod.	Chloroform	secondary	2.60e-11	1.52e-08
Fuel Oil #6 Prod.	Ethylene dibromide	secondary	2.58e-11	1.51e-08
Fuel Oil #4 Prod.	Acetophenone	secondary	2.56e-11	1.49e-08
Fuel Oil #6 Prod.	Chlorobenzene	secondary	2.49e-11	1.46e-08
Fuel Oil #4 Prod.	Methyl chloride	secondary	2.49e-11	1.46e-08
US electric grid	5-Methyl chrysene	model/secondary	2.40e-11	1.40e-08
Fuel Oil #6 Prod.	1,1,1-Trichloroethane	secondary	2.27e-11	1.33e-08
Natural Gas Prod.	Vinyl acetate	secondary	1.97e-11	1.15e-08
Fuel Oil #6 Prod.	Pyrene	secondary	1.94e-11	1.13e-08
Japanese Electric Grid	5-Methyl chrysene	model/secondary	1.91e-11	1.12e-08
Fuel Oil #2 Prod.	Tetrachloroethylene	secondary	1.90e-11	1.11e-08
Fuel Oil #2 Prod.	1,4-Dichlorobenzene	secondary	1.87e-11	1.10e-08
Fuel Oil #2 Prod.	Ethyl Chloride	secondary	1.85e-11	1.08e-08
Fuel Oil #2 Prod.	1,2-Dichloroethane	secondary	1.76e-11	1.03e-08
Fuel Oil #2 Prod.	Fluorene	secondary	1.64e-11	9.61e-09
Natural Gas Prod.	Biphenyl	secondary	1.50e-11	8.78e-09
Natural Gas Prod.	Chloroform	secondary	1.44e-11	8.41e-09
Fuel Oil #4 Prod.	Dichloromethane	secondary	1.36e-11	7.97e-09
Fuel Oil #2 Prod.	2-Methylnaphthalene	secondary	1.36e-11	7.94e-09
Fuel Oil #2 Prod.	Fluoranthene	secondary	1.34e-11	7.82e-09
Natural Gas Prod.	Fluorene	secondary	1.31e-11	7.66e-09
Fuel Oil #6 Prod.	Acenaphthylene	secondary	1.23e-11	7.18e-09
Fuel Oil #2 Prod.	Acenaphthene	secondary	1.21e-11	7.09e-09
Natural Gas Prod.	Pyrene	secondary	1.17e-11	6.86e-09
Natural Gas Prod.	Fluoranthene	secondary	1.17e-11	6.84e-09
Fuel Oil #6 Prod.	2,4-Dinitrotoluene	secondary	1.15e-11	6.73e-09
Fuel Oil #6 Prod.	Anthracene	secondary	1.14e-11	6.69e-09
Natural Gas Prod.	Tetrachloroethylene	secondary	1.05e-11	6.13e-09
Natural Gas Prod.	Ethyl Chloride	secondary	1.02e-11	5.98e-09
Natural Gas Prod.	Acenaphthene	secondary	1.01e-11	5.89e-09
Fuel Oil #2 Prod.	Ethylene dibromide	secondary	1.00e-11	5.86e-09
Natural Gas Prod.	1,2-Dichloroethane	secondary	9.75e-12	5.70e-09
Fuel Oil #2 Prod.	Chlorobenzene	secondary	9.70e-12	5.67e-09
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	9.11e-12	5.33e-09
Fuel Oil #4 Prod.	Cumene	secondary	9.03e-12	5.28e-09
Fuel Oil #2 Prod.	1,1,1-Trichloroethane	secondary	8.82e-12	5.15e-09
Fuel Oil #2 Prod.	Pyrene	secondary	8.40e-12	4.91e-09
Fuel Oil #6 Prod.	2-Chloroacetophenone	secondary	7.94e-12	4.64e-09
Fuel Oil #6 Prod.	Chrysene	secondary	6.27e-12	3.67e-09
Natural Gas Prod.	Anthracene	secondary	6.11e-12	3.57e-09
Fuel Oil #6 Prod.	Benzo[a]anthracene	secondary	5.93e-12	3.47e-09
Fuel Oil #4 Prod.	Phenanthrene	secondary	5.57e-12	3.26e-09
Natural Gas Prod.	Ethylene dibromide	secondary	5.54e-12	3.24e-09
Natural Gas Prod.	Chlorobenzene	secondary	5.36e-12	3.13e-09
Natural Gas Prod.	Acenaphthylene	secondary	5.32e-12	3.11e-09
Fuel Oil #2 Prod.	Acenaphthylene	secondary	5.05e-12	2.95e-09

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Fuel Oil #2 Prod.	Anthracene	secondary	4.88e-12	2.86e-09
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	4.87e-12	2.85e-09
Fuel Oil #6 Prod.	Indeno(1,2,3-cd)pyrene	secondary	4.65e-12	2.72e-09
Fuel Oil #6 Prod.	Benzo[b,j,k]fluoranthene	secondary	4.52e-12	2.64e-09
Fuel Oil #2 Prod.	2,4-Dinitrotoluene	secondary	4.47e-12	2.62e-09
Natural Gas Prod.	Benzo[a]anthracene	secondary	4.27e-12	2.49e-09
Natural Gas Prod.	Chrysene	secondary	4.11e-12	2.40e-09
Fuel Oil #6 Prod.	Benzo[a]pyrene	secondary	3.88e-12	2.27e-09
Fuel Oil #4 Prod.	Vinyl acetate	secondary	3.79e-12	2.22e-09
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	3.75e-12	2.19e-09
Fuel Oil #2 Prod.	2-Chloroacetophenone	secondary	3.09e-12	1.80e-09
Fuel Oil #4 Prod.	Biphenyl	secondary	2.90e-12	1.69e-09
Fuel Oil #2 Prod.	Benzo[a]anthracene	secondary	2.86e-12	1.67e-09
Fuel Oil #2 Prod.	Chrysene	secondary	2.78e-12	1.63e-09
Fuel Oil #4 Prod.	Chloroform	secondary	2.77e-12	1.62e-09
Fuel Oil #6 Prod.	Benzo[g,h,i]perylene	secondary	2.61e-12	1.53e-09
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	2.47e-12	1.45e-09
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	2.43e-12	1.42e-09
Natural Gas Prod.	Benzo[a]pyrene	secondary	2.40e-12	1.40e-09
Fuel Oil #2 Prod.	Indeno(1,2,3-cd)pyrene	secondary	2.14e-12	1.25e-09
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	2.02e-12	1.18e-09
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	1.97e-12	1.15e-09
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	1.88e-12	1.10e-09
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	1.77e-12	1.04e-09
Fuel Oil #2 Prod.	Benzo[b,j,k]fluoranthene	secondary	1.76e-12	1.03e-09
Fuel Oil #4 Prod.	Fluorene	secondary	1.73e-12	1.01e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	1.71e-12	9.97e-10
Fuel Oil #2 Prod.	Benzo[a]pyrene	secondary	1.61e-12	9.41e-10
Fuel Oil #4 Prod.	Fluoranthene	secondary	1.40e-12	8.17e-10
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	1.28e-12	7.51e-10
Fuel Oil #2 Prod.	Benzo[g,h,i]perylene	secondary	1.27e-12	7.42e-10
Fuel Oil #4 Prod.	Acenaphthene	secondary	1.21e-12	7.05e-10
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	1.07e-12	6.25e-10
Fuel Oil #4 Prod.	Chlorobenzene	secondary	1.03e-12	6.05e-10
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	9.72e-13	5.68e-10
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	9.40e-13	5.50e-10
Fuel Oil #6 Prod.	5-Methyl chrysene	secondary	9.04e-13	5.28e-10
Fuel Oil #4 Prod.	Pyrene	secondary	8.54e-13	4.99e-10
Natural Gas Prod.	Aromatic hydrocarbons	secondary	8.08e-13	4.72e-10
Fuel Oil #4 Prod.	Acenaphthylene	secondary	5.25e-13	3.07e-10
Fuel Oil #4 Prod.	Anthracene	secondary	5.00e-13	2.92e-10
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	4.77e-13	2.79e-10
Fuel Oil #2 Prod.	5-Methyl chrysene	secondary	3.51e-13	2.05e-10
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	3.29e-13	1.92e-10
Fuel Oil #4 Prod.	Chrysene	secondary	2.80e-13	1.64e-10
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	2.78e-13	1.63e-10
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	2.12e-13	1.24e-10
Natural Gas Prod.	5-Methyl chrysene	secondary	1.94e-13	1.14e-10
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	1.87e-13	1.10e-10

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	1.67e-13	9.75e-11
Fuel Oil #6 Prod.	Polycyclic aromatic hydrocarbons	secondary	1.50e-13	8.78e-11
Fuel Oil #2 Prod.	Polycyclic aromatic hydrocarbons	secondary	1.25e-13	7.29e-11
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	1.23e-13	7.20e-11
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	3.75e-14	2.19e-11
Fuel Oil #4 Prod.	Polycyclic aromatic hydrocarbons	secondary	1.01e-14	5.92e-12
Natural Gas Prod.	Polycyclic aromatic hydrocarbons	secondary	8.98e-16	5.25e-13
Total Manufacturing			**1.21e-01**	**7.07e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Methane	model/secondary	4.51e-03	2.64e+00
US electric grid	Isophorone	model/secondary	3.96e-05	2.31e-02
US electric grid	Formaldehyde	model/secondary	3.56e-05	2.08e-02
US electric grid	Acetaldehyde	model/secondary	2.26e-05	1.32e-02
US electric grid	Benzene	model/secondary	2.21e-05	1.29e-02
US electric grid	Propionaldehyde	model/secondary	2.05e-05	1.20e-02
US electric grid	Methyl ethyl ketone	model/secondary	1.65e-05	9.67e-03
US electric grid	Toluene	model/secondary	1.43e-05	8.37e-03
US electric grid	Acrolein	model/secondary	1.15e-05	6.74e-03
US electric grid	Ethylbenzene	model/secondary	6.44e-06	3.77e-03
US electric grid	Bromomethane	model/secondary	5.71e-06	3.34e-03
US electric grid	Xylene (mixed isomers)	model/secondary	2.53e-06	1.48e-03
US electric grid	Hexane	model/secondary	2.50e-06	1.46e-03
US electric grid	Styrene	model/secondary	1.71e-06	9.98e-04
US electric grid	Naphthalene	model/secondary	1.39e-06	8.14e-04
US electric grid	Benzyl chloride	model/secondary	1.32e-06	7.71e-04
US electric grid	Methyl tert-butyl ether	model/secondary	1.25e-06	7.30e-04
US electric grid	Phenol	model/secondary	1.09e-06	6.38e-04
US electric grid	Acetophenone	model/secondary	1.02e-06	5.99e-04
US electric grid	Methyl chloride	model/secondary	9.98e-07	5.84e-04
US electric grid	Dichloromethane	model/secondary	5.46e-07	3.19e-04
US electric grid	Cumene	model/secondary	3.62e-07	2.11e-04
US electric grid	Phenanthrene	model/secondary	1.91e-07	1.11e-04
US electric grid	Vinyl acetate	model/secondary	1.52e-07	8.89e-05
US electric grid	Biphenyl	model/secondary	1.16e-07	6.78e-05
US electric grid	Chloroform	model/secondary	1.11e-07	6.50e-05
US electric grid	Tetrachloroethylene	model/secondary	8.10e-08	4.73e-05
US electric grid	Ethyl Chloride	model/secondary	7.91e-08	4.62e-05
US electric grid	1,2-Dichloroethane	model/secondary	7.53e-08	4.40e-05
US electric grid	Fluorene	model/secondary	6.39e-08	3.74e-05
US electric grid	Fluoranthene	model/secondary	5.11e-08	2.99e-05
US electric grid	o-xylene	model/secondary	4.34e-08	2.54e-05
US electric grid	Acenaphthene	model/secondary	4.32e-08	2.53e-05
US electric grid	Ethylene dibromide	model/secondary	4.28e-08	2.50e-05
US electric grid	Chlorobenzene	model/secondary	4.14e-08	2.42e-05
US electric grid	1,1,1-Trichloroethane	model/secondary	4.03e-08	2.35e-05
US electric grid	Pyrene	model/secondary	2.53e-08	1.48e-05
US electric grid	2,4-Dinitrotoluene	model/secondary	1.91e-08	1.12e-05
US electric grid	Acenaphthylene	model/secondary	1.72e-08	1.00e-05
US electric grid	Anthracene	model/secondary	1.48e-08	8.66e-06

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
US electric grid	2-Chloroacetophenone	model/secondary	1.32e-08	7.71e-06
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	8.10e-09	4.73e-06
US electric grid	Chrysene	model/secondary	7.77e-09	4.54e-06
US electric grid	Benzo[a]anthracene	model/secondary	7.06e-09	4.13e-06
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	5.02e-09	2.93e-06
US electric grid	Benzo[g,h,i]perylene	model/secondary	2.74e-09	1.60e-06
US electric grid	Benzo[a]pyrene	model/secondary	2.59e-09	1.52e-06
US electric grid	2-Methylnaphthalene	model/secondary	2.03e-09	1.19e-06
US electric grid	5-Methyl chrysene	model/secondary	1.50e-09	8.78e-07
Total Use, Maintenance and Repair			**4.72e-03**	**2.76e+00**
End-of-life Life-cycle Stage				
CRT landfilling	Hydrocarbons, remaining unspeciated	primary	1.07e-04	6.28e-02
LPG Production	Hydrocarbons, remaining unspeciated	secondary	5.37e-07	3.14e-04
US electric grid	Methane	model/secondary	4.52e-07	2.64e-04
CRT landfilling	Methane	primary	3.81e-07	2.23e-04
LPG Production	Nonmethane hydrocarbons, remaining unspeciated	secondary	3.66e-07	2.14e-04
CRT landfilling	Benzene	primary	1.28e-07	7.48e-05
LPG Production	Methane	secondary	5.07e-08	2.96e-05
CRT landfilling	Toluene	primary	2.69e-08	1.57e-05
LPG Production	Benzene	secondary	2.34e-08	1.37e-05
CRT landfilling	Xylene (mixed isomers)	primary	1.88e-08	1.10e-05
LPG Production	Aldehydes	secondary	5.71e-09	3.34e-06
LPG Production	Formaldehyde	secondary	4.25e-09	2.49e-06
US electric grid	Isophorone	model/secondary	3.96e-09	2.32e-06
CRT landfilling	Ethylbenzene	primary	3.75e-09	2.19e-06
US electric grid	Formaldehyde	model/secondary	3.56e-09	2.08e-06
LPG Production	Ethane	secondary	2.66e-09	1.56e-06
LPG Production	Pentane	secondary	2.29e-09	1.34e-06
US electric grid	Acetaldehyde	model/secondary	2.27e-09	1.32e-06
US electric grid	Benzene	model/secondary	2.21e-09	1.29e-06
US electric grid	Propionaldehyde	model/secondary	2.06e-09	1.20e-06
LPG Production	Butane	secondary	1.81e-09	1.06e-06
US electric grid	Methyl ethyl ketone	model/secondary	1.66e-09	9.68e-07
LPG Production	Hexane	secondary	1.62e-09	9.47e-07
US electric grid	Toluene	model/secondary	1.43e-09	8.37e-07
US electric grid	Acrolein	model/secondary	1.15e-09	6.74e-07
US electric grid	Ethylbenzene	model/secondary	6.44e-10	3.77e-07
US electric grid	Bromomethane	model/secondary	5.71e-10	3.34e-07
US electric grid	Xylene (mixed isomers)	model/secondary	2.53e-10	1.48e-07
US electric grid	Hexane	model/secondary	2.50e-10	1.46e-07
US electric grid	Styrene	model/secondary	1.71e-10	9.98e-08
US electric grid	Naphthalene	model/secondary	1.39e-10	8.14e-08
US electric grid	Benzyl chloride	model/secondary	1.32e-10	7.71e-08
US electric grid	Methyl tert-butyl ether	model/secondary	1.25e-10	7.31e-08
US electric grid	Phenol	model/secondary	1.09e-10	6.39e-08
US electric grid	Acetophenone	model/secondary	1.02e-10	5.99e-08
US electric grid	Methyl chloride	model/secondary	9.99e-11	5.84e-08
CRT Incineration	Trichloroethylene	secondary	9.69e-11	5.67e-08
CRT landfilling	Trichloroethylene	primary	9.04e-11	5.28e-08

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
CRT Incineration	Vinyl chloride	secondary	6.16e-11	3.60e-08
CRT landfilling	Vinyl chloride	primary	5.74e-11	3.36e-08
US electric grid	Dichloromethane	model/secondary	5.46e-11	3.19e-08
CRT landfilling	Dichloromethane	primary	4.60e-11	2.69e-08
US electric grid	Cumene	model/secondary	3.62e-11	2.12e-08
CRT Incineration	Carbon tetrachloride	secondary	3.08e-11	1.80e-08
CRT landfilling	1,2-Dichloroethane	primary	2.87e-11	1.68e-08
CRT landfilling	Carbon tetrachloride	primary	2.87e-11	1.68e-08
CRT landfilling	Chloroform	primary	2.87e-11	1.68e-08
CRT landfilling	Tetrachloroethylene	primary	2.87e-11	1.68e-08
LPG Production	Isophorone	secondary	2.55e-11	1.49e-08
US electric grid	Phenanthrene	model/secondary	1.91e-11	1.12e-08
LPG Production	Toluene	secondary	1.81e-11	1.06e-08
US electric grid	Vinyl acetate	model/secondary	1.52e-11	8.89e-09
LPG Production	Acetaldehyde	secondary	1.46e-11	8.53e-09
LPG Production	Propionaldehyde	secondary	1.32e-11	7.74e-09
US electric grid	Biphenyl	model/secondary	1.16e-11	6.79e-09
US electric grid	Chloroform	model/secondary	1.11e-11	6.50e-09
LPG Production	Methyl ethyl ketone	secondary	1.07e-11	6.23e-09
US electric grid	Tetrachloroethylene	model/secondary	8.10e-12	4.74e-09
US electric grid	Ethyl Chloride	model/secondary	7.91e-12	4.63e-09
US electric grid	1,2-Dichloroethane	model/secondary	7.54e-12	4.41e-09
LPG Production	Acrolein	secondary	7.42e-12	4.34e-09
LPG Production	o-xylene	secondary	6.78e-12	3.96e-09
US electric grid	Fluorene	model/secondary	6.39e-12	3.74e-09
LPG Production	n-Propane	secondary	6.05e-12	3.54e-09
US electric grid	Fluoranthene	model/secondary	5.11e-12	2.99e-09
US electric grid	o-xylene	model/secondary	4.35e-12	2.54e-09
US electric grid	Acenaphthene	model/secondary	4.32e-12	2.53e-09
US electric grid	Ethylene dibromide	model/secondary	4.29e-12	2.51e-09
LPG Production	Ethylbenzene	secondary	4.17e-12	2.44e-09
US electric grid	Chlorobenzene	model/secondary	4.15e-12	2.42e-09
US electric grid	1,1,1-Trichloroethane	model/secondary	4.03e-12	2.36e-09
LPG Production	Bromomethane	secondary	3.68e-12	2.15e-09
US electric grid	Pyrene	model/secondary	2.54e-12	1.48e-09
LPG Production	Naphthalene	secondary	2.29e-12	1.34e-09
US electric grid	2,4-Dinitrotoluene	model/secondary	1.91e-12	1.12e-09
US electric grid	Acenaphthylene	model/secondary	1.72e-12	1.00e-09
US electric grid	Anthracene	model/secondary	1.48e-12	8.67e-10
US electric grid	2-Chloroacetophenone	model/secondary	1.32e-12	7.71e-10
LPG Production	Styrene	secondary	1.10e-12	6.42e-10
LPG Production	Benzyl chloride	secondary	8.49e-13	4.96e-10
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	8.10e-13	4.74e-10
LPG Production	Methyl tert-butyl ether	secondary	8.05e-13	4.70e-10
US electric grid	Chrysene	model/secondary	7.78e-13	4.55e-10
US electric grid	Benzo[a]anthracene	model/secondary	7.06e-13	4.13e-10
LPG Production	Phenol	secondary	7.03e-13	4.11e-10
LPG Production	Acetophenone	secondary	6.59e-13	3.85e-10
LPG Production	Methyl chloride	secondary	6.43e-13	3.76e-10

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	5.02e-13	2.93e-10
LPG Production	Dichloromethane	secondary	3.52e-13	2.06e-10
LPG Production	Aromatic hydrocarbons	secondary	3.45e-13	2.02e-10
US electric grid	Benzo[g,h,i]perylene	model/secondary	2.74e-13	1.60e-10
US electric grid	Benzo[a]pyrene	model/secondary	2.59e-13	1.52e-10
LPG Production	Cumene	secondary	2.33e-13	1.36e-10
US electric grid	2-Methylnaphthalene	model/secondary	2.03e-13	1.19e-10
US electric grid	5-Methyl chrysene	model/secondary	1.50e-13	8.78e-11
LPG Production	Phenanthrene	secondary	1.49e-13	8.70e-11
LPG Production	Vinyl acetate	secondary	9.79e-14	5.72e-11
LPG Production	Biphenyl	secondary	7.47e-14	4.37e-11
LPG Production	Chloroform	secondary	7.16e-14	4.18e-11
LPG Production	1,4-Dichlorobenzene	secondary	5.44e-14	3.18e-11
LPG Production	Tetrachloroethylene	secondary	5.22e-14	3.05e-11
LPG Production	Ethyl Chloride	secondary	5.09e-14	2.98e-11
LPG Production	1,2-Dichloroethane	secondary	4.85e-14	2.84e-11
LPG Production	Fluorene	secondary	4.56e-14	2.66e-11
LPG Production	2-Methylnaphthalene	secondary	3.94e-14	2.31e-11
LPG Production	Fluoranthene	secondary	3.72e-14	2.17e-11
LPG Production	Acenaphthene	secondary	3.44e-14	2.01e-11
LPG Production	Ethylene dibromide	secondary	2.76e-14	1.61e-11
LPG Production	Chlorobenzene	secondary	2.67e-14	1.56e-11
LPG Production	1,1,1-Trichloroethane	secondary	2.43e-14	1.42e-11
LPG Production	Pyrene	secondary	2.36e-14	1.38e-11
LPG Production	Acenaphthylene	secondary	1.41e-14	8.22e-12
LPG Production	Anthracene	secondary	1.37e-14	8.01e-12
LPG Production	2,4-Dinitrotoluene	secondary	1.23e-14	7.20e-12
LPG Production	2-Chloroacetophenone	secondary	8.49e-15	4.96e-12
LPG Production	Benzo[a]anthracene	secondary	8.20e-15	4.79e-12
LPG Production	Chrysene	secondary	7.87e-15	4.60e-12
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	6.10e-15	3.57e-12
LPG Production	Benzo[b,j,k]fluoranthene	secondary	4.83e-15	2.83e-12
LPG Production	Benzo[a]pyrene	secondary	4.49e-15	2.62e-12
LPG Production	Benzo[g,h,i]perylene	secondary	3.65e-15	2.13e-12
LPG Production	5-Methyl chrysene	secondary	9.67e-16	5.65e-13
LPG Production	Polycyclic aromatic hydrocarbons	secondary	3.83e-16	2.24e-13
Natural Gas Prod.	Polycyclic aromatic hydrocarbons	secondary	-4.51e-16	-2.63e-13
CRT Incineration	Polycyclic aromatic hydrocarbons	secondary	-6.98e-15	-4.08e-12
Natural Gas Prod.	5-Methyl chrysene	secondary	-9.74e-14	-5.70e-11
Fuel Oil #4 Prod.	Polycyclic aromatic hydrocarbons	secondary	-1.09e-13	-6.36e-11
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	-4.03e-13	-2.36e-10
Natural Gas Prod.	Aromatic hydrocarbons	secondary	-4.05e-13	-2.37e-10
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	-4.87e-13	-2.85e-10
Natural Gas Prod.	2-Chloroacetophenone	secondary	-8.56e-13	-5.00e-10
Natural Gas Prod.	Benzo[a]pyrene	secondary	-1.20e-12	-7.02e-10
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	-1.22e-12	-7.12e-10
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	-1.24e-12	-7.25e-10
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	-1.32e-12	-7.74e-10
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	-1.79e-12	-1.05e-09

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	-1.88e-12	-1.10e-09
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	-2.01e-12	-1.18e-09
Natural Gas Prod.	Chrysene	secondary	-2.06e-12	-1.21e-09
Natural Gas Prod.	Benzo[a]anthracene	secondary	-2.14e-12	-1.25e-09
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	-2.28e-12	-1.34e-09
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	-2.44e-12	-1.43e-09
Natural Gas Prod.	Acenaphthylene	secondary	-2.67e-12	-1.56e-09
Natural Gas Prod.	Chlorobenzene	secondary	-2.69e-12	-1.57e-09
Natural Gas Prod.	Ethylene dibromide	secondary	-2.78e-12	-1.63e-09
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	-2.99e-12	-1.75e-09
Fuel Oil #4 Prod.	Chrysene	secondary	-3.01e-12	-1.76e-09
Natural Gas Prod.	Anthracene	secondary	-3.07e-12	-1.79e-09
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	-3.54e-12	-2.07e-09
Natural Gas Prod.	1,2-Dichloroethane	secondary	-4.89e-12	-2.86e-09
Natural Gas Prod.	Acenaphthene	secondary	-5.05e-12	-2.95e-09
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	-5.13e-12	-3.00e-09
Natural Gas Prod.	Ethyl Chloride	secondary	-5.13e-12	-3.00e-09
Natural Gas Prod.	Tetrachloroethylene	secondary	-5.26e-12	-3.07e-09
Fuel Oil #4 Prod.	Anthracene	secondary	-5.38e-12	-3.14e-09
Fuel Oil #4 Prod.	Acenaphthylene	secondary	-5.64e-12	-3.30e-09
Natural Gas Prod.	Fluoranthene	secondary	-5.87e-12	-3.43e-09
Natural Gas Prod.	Pyrene	secondary	-5.89e-12	-3.44e-09
CRT Incineration	Aromatic hydrocarbons	secondary	-6.29e-12	-3.68e-09
Natural Gas Prod.	Fluorene	secondary	-6.57e-12	-3.84e-09
CRT Incineration	2-Methylnaphthalene	secondary	-6.63e-12	-3.88e-09
Natural Gas Prod.	Chloroform	secondary	-7.21e-12	-4.22e-09
Natural Gas Prod.	Biphenyl	secondary	-7.53e-12	-4.40e-09
CRT Incineration	Dichlorobenzene (mixed isomers)	secondary	-9.15e-12	-5.35e-09
Fuel Oil #4 Prod.	Pyrene	secondary	-9.18e-12	-5.37e-09
Natural Gas Prod.	Vinyl acetate	secondary	-9.86e-12	-5.77e-09
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	-1.01e-11	-5.91e-09
Fuel Oil #4 Prod.	Chlorobenzene	secondary	-1.11e-11	-6.50e-09
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	-1.15e-11	-6.72e-09
Fuel Oil #4 Prod.	Acenaphthene	secondary	-1.30e-11	-7.58e-09
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	-1.38e-11	-8.07e-09
Fuel Oil #4 Prod.	Fluoranthene	secondary	-1.50e-11	-8.78e-09
Fuel Oil #4 Prod.	Fluorene	secondary	-1.85e-11	-1.08e-08
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	-1.91e-11	-1.11e-08
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	-2.02e-11	-1.18e-08
Natural Gas Prod.	2-Methylnaphthalene	secondary	-2.06e-11	-1.21e-08
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	-2.12e-11	-1.24e-08
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	-2.17e-11	-1.27e-08
Natural Gas Prod.	Cumene	secondary	-2.35e-11	-1.37e-08
CRT Incineration	5-Methyl chrysene	secondary	-2.49e-11	-1.46e-08
Natural Gas Prod.	Phenanthrene	secondary	-2.69e-11	-1.57e-08
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	-2.85e-11	-1.67e-08
Fuel Oil #4 Prod.	Chloroform	secondary	-2.98e-11	-1.74e-08
CRT Incineration	Benzo[g,h,i]perylene	secondary	-3.09e-11	-1.81e-08
Fuel Oil #4 Prod.	Biphenyl	secondary	-3.11e-11	-1.82e-08

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Natural Gas Prod.	Dichloromethane	secondary	-3.54e-11	-2.07e-08
Fuel Oil #4 Prod.	Vinyl acetate	secondary	-4.08e-11	-2.38e-08
CRT Incineration	Benzo[a]pyrene	secondary	-4.34e-11	-2.53e-08
Fuel Oil #4 Prod.	Phenanthrene	secondary	-5.99e-11	-3.50e-08
Natural Gas Prod.	Methyl chloride	secondary	-6.48e-11	-3.79e-08
Natural Gas Prod.	Acetophenone	secondary	-6.64e-11	-3.88e-08
CRT Incineration	Indeno(1,2,3-cd)pyrene	secondary	-6.95e-11	-4.07e-08
Natural Gas Prod.	Phenol	secondary	-7.09e-11	-4.14e-08
Natural Gas Prod.	Methyl tert-butyl ether	secondary	-8.11e-11	-4.74e-08
Natural Gas Prod.	Benzyl chloride	secondary	-8.56e-11	-5.00e-08
CRT Incineration	Benzo[a]anthracene	secondary	-9.11e-11	-5.32e-08
Fuel Oil #4 Prod.	Cumene	secondary	-9.70e-11	-5.67e-08
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	-9.80e-11	-5.73e-08
Natural Gas Prod.	Styrene	secondary	-1.11e-10	-6.47e-08
CRT Incineration	Chrysene	secondary	-1.14e-10	-6.65e-08
CRT Incineration	Benzo[b,j,k]fluoranthene	secondary	-1.24e-10	-7.28e-08
Fuel Oil #4 Prod.	Dichloromethane	secondary	-1.47e-10	-8.57e-08
CRT Incineration	Anthracene	secondary	-2.38e-10	-1.39e-07
Fuel Oil #4 Prod.	Methyl chloride	secondary	-2.68e-10	-1.57e-07
Fuel Oil #4 Prod.	Acetophenone	secondary	-2.75e-10	-1.61e-07
CRT Incineration	Acenaphthylene	secondary	-2.83e-10	-1.66e-07
Fuel Oil #4 Prod.	Phenol	secondary	-2.93e-10	-1.71e-07
CRT Incineration	2,4-Dinitrotoluene	secondary	-3.17e-10	-1.85e-07
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	-3.35e-10	-1.96e-07
Fuel Oil #4 Prod.	Benzyl chloride	secondary	-3.54e-10	-2.07e-07
Natural Gas Prod.	Bromomethane	secondary	-3.71e-10	-2.17e-07
CRT Incineration	Pyrene	secondary	-3.75e-10	-2.19e-07
Natural Gas Prod.	Ethylbenzene	secondary	-4.21e-10	-2.46e-07
Fuel Oil #4 Prod.	Styrene	secondary	-4.58e-10	-2.68e-07
CRT Incineration	Acenaphthene	secondary	-5.78e-10	-3.38e-07
CRT Incineration	1,1,1-Trichloroethane	secondary	-6.24e-10	-3.65e-07
Natural Gas Prod.	n-Propane	secondary	-6.72e-10	-3.93e-07
Natural Gas Prod.	Naphthalene	secondary	-6.72e-10	-3.93e-07
CRT Incineration	Chlorobenzene	secondary	-6.87e-10	-4.02e-07
CRT Incineration	Ethylene dibromide	secondary	-7.10e-10	-4.15e-07
Natural Gas Prod.	Acrolein	secondary	-7.48e-10	-4.37e-07
CRT Incineration	Fluoranthene	secondary	-8.04e-10	-4.70e-07
Fuel Oil #4 Prod.	Naphthalene	secondary	-8.25e-10	-4.82e-07
CRT Incineration	Fluorene	secondary	-1.03e-09	-6.02e-07
Natural Gas Prod.	Methyl ethyl ketone	secondary	-1.07e-09	-6.28e-07
CRT Incineration	1,2-Dichloroethane	secondary	-1.22e-09	-7.12e-07
CRT Incineration	Ethyl Chloride	secondary	-1.31e-09	-7.67e-07
CRT Incineration	Tetrachloroethylene	secondary	-1.31e-09	-7.67e-07
Natural Gas Prod.	Propionaldehyde	secondary	-1.33e-09	-7.80e-07
Natural Gas Prod.	Acetaldehyde	secondary	-1.47e-09	-8.59e-07
Fuel Oil #4 Prod.	Bromomethane	secondary	-1.53e-09	-8.96e-07
Fuel Oil #4 Prod.	Ethylbenzene	secondary	-1.73e-09	-1.01e-06
CRT Incineration	Chloroform	secondary	-1.81e-09	-1.06e-06
CRT Incineration	Biphenyl	secondary	-1.92e-09	-1.12e-06

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Fuel Oil #4 Prod.	o-xylene	secondary	-2.47e-09	-1.45e-06
Fuel Oil #4 Prod.	n-Propane	secondary	-2.51e-09	-1.47e-06
CRT Incineration	Vinyl acetate	secondary	-2.52e-09	-1.47e-06
Natural Gas Prod.	Isophorone	secondary	-2.57e-09	-1.50e-06
CRT Incineration	Phenanthrene	secondary	-3.06e-09	-1.79e-06
Fuel Oil #4 Prod.	Acrolein	secondary	-3.09e-09	-1.81e-06
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	-4.44e-09	-2.60e-06
Fuel Oil #4 Prod.	Propionaldehyde	secondary	-5.51e-09	-3.22e-06
CRT Incineration	Cumene	secondary	-6.00e-09	-3.51e-06
Fuel Oil #4 Prod.	Acetaldehyde	secondary	-6.08e-09	-3.55e-06
Fuel Oil #4 Prod.	Toluene	secondary	-6.85e-09	-4.00e-06
CRT Incineration	Dichloromethane	secondary	-9.01e-09	-5.27e-06
Fuel Oil #4 Prod.	Isophorone	secondary	-1.06e-08	-6.21e-06
Natural Gas Prod.	Toluene	secondary	-1.46e-08	-8.52e-06
CRT Incineration	Methyl chloride	secondary	-1.65e-08	-9.67e-06
CRT Incineration	Acetophenone	secondary	-1.70e-08	-9.92e-06
CRT Incineration	Phenol	secondary	-1.81e-08	-1.06e-05
CRT Incineration	Methyl tert-butyl ether	secondary	-2.07e-08	-1.21e-05
CRT Incineration	Naphthalene	secondary	-2.09e-08	-1.22e-05
CRT Incineration	Benzyl chloride	secondary	-2.19e-08	-1.28e-05
CRT Incineration	Xylene (mixed isomers)	secondary	-2.44e-08	-1.43e-05
Natural Gas Prod.	o-xylene	secondary	-2.64e-08	-1.54e-05
CRT Incineration	Styrene	secondary	-2.83e-08	-1.65e-05
Natural Gas Prod.	Formaldehyde	secondary	-5.11e-08	-2.99e-05
CRT Incineration	Bromomethane	secondary	-9.47e-08	-5.54e-05
CRT Incineration	Ethylbenzene	secondary	-1.03e-07	-6.00e-05
CRT Incineration	n-Propane	secondary	-1.52e-07	-8.90e-05
CRT Incineration	Acrolein	secondary	-1.91e-07	-1.12e-04
CRT Incineration	Toluene	secondary	-2.25e-07	-1.31e-04
CRT Incineration	Methyl ethyl ketone	secondary	-2.74e-07	-1.60e-04
CRT Incineration	Butane	secondary	-3.03e-07	-1.77e-04
CRT Incineration	Hexane	secondary	-3.13e-07	-1.83e-04
CRT Incineration	Propionaldehyde	secondary	-3.41e-07	-1.99e-04
CRT Incineration	Acetaldehyde	secondary	-3.75e-07	-2.20e-04
CRT Incineration	Pentane	secondary	-3.85e-07	-2.25e-04
CRT Incineration	Ethane	secondary	-4.48e-07	-2.62e-04
Fuel Oil #4 Prod.	Hexane	secondary	-5.67e-07	-3.31e-04
Fuel Oil #4 Prod.	Butane	secondary	-6.32e-07	-3.69e-04
CRT Incineration	Isophorone	secondary	-6.56e-07	-3.84e-04
Fuel Oil #4 Prod.	Pentane	secondary	-8.02e-07	-4.69e-04
Natural Gas Prod.	Hexane	secondary	-8.46e-07	-4.95e-04
Fuel Oil #4 Prod.	Ethane	secondary	-9.33e-07	-5.45e-04
Natural Gas Prod.	Butane	secondary	-9.45e-07	-5.52e-04
Natural Gas Prod.	Pentane	secondary	-1.20e-06	-7.01e-04
Natural Gas Prod.	Ethane	secondary	-1.39e-06	-8.15e-04
CRT Incineration	Formaldehyde	secondary	-1.64e-06	-9.60e-04
Fuel Oil #4 Prod.	Aldehydes	secondary	-2.00e-06	-1.17e-03
Fuel Oil #4 Prod.	Formaldehyde	secondary	-2.03e-06	-1.19e-03
Natural Gas Prod.	Aldehydes	secondary	-2.39e-06	-1.40e-03

Table M-17. CRT LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Fuel Oil #4 Prod.	Benzene	secondary	-8.19e-06	-4.79e-03
CRT Incineration	Benzene	secondary	-1.00e-05	-5.87e-03
Natural Gas Prod.	Hydrocarbons, remaining unspeciated	secondary	-1.24e-05	-7.26e-03
Fuel Oil #4 Prod.	Methane	secondary	-1.96e-05	-1.15e-02
CRT Incineration	Aldehydes	secondary	-6.76e-05	-3.95e-02
CRT Incineration	Methane	secondary	-1.06e-04	-6.20e-02
CRT Incineration	Hydrocarbons, remaining unspeciated	secondary	-1.07e-04	-6.27e-02
Natural Gas Prod.	Benzene	secondary	-1.20e-04	-7.02e-02
CRT Incineration	Nonmethane hydrocarbons, remaining unspeciated	secondary	-1.54e-04	-9.02e-02
Fuel Oil #4 Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	-1.56e-04	-9.11e-02
Natural Gas Prod.	Methane	secondary	-1.76e-04	-1.03e-01
Fuel Oil #4 Prod.	Hydrocarbons, remaining unspeciated	secondary	-2.32e-04	-1.36e-01
Natural Gas Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	-4.52e-04	-2.64e-01
Total End-of-life			**-1.53e-03**	**-8.95e-01**
Total All Life-cycle Stages			**1.71e-01**	**1.00e+02**

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Materials Processing Life-cycle Stage				
Natural Gas Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	6.30e-02	4.45e+01
Natural Gas Prod.	Methane	secondary	2.45e-02	1.73e+01
Natural Gas Prod.	Benzene	secondary	1.67e-02	1.18e+01
Steel Prod., cold-rolled, semi-finished	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.62e-02	1.15e+01
Natural Gas Prod.	Hydrocarbons, remaining unspeciated	secondary	1.73e-03	1.22e+00
Steel Prod., cold-rolled, semi-finished	Hydrocarbons, remaining unspeciated	secondary	1.68e-03	1.19e+00
PMMA Sheet Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.24e-03	8.74e-01
Polycarbonate Production	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.03e-03	7.26e-01
Aluminum Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	5.48e-04	3.87e-01
PET Resin Production	Nonmethane hydrocarbons, remaining unspeciated	secondary	5.06e-04	3.58e-01
Natural Gas Prod.	Aldehydes	secondary	3.33e-04	2.36e-01
Styrene-butadiene Copolymer Prod.	Hydrocarbons, remaining unspeciated	secondary	2.88e-04	2.04e-01
Natural Gas Prod.	Ethane	secondary	1.94e-04	1.37e-01
Natural Gas Prod.	Pentane	secondary	1.67e-04	1.18e-01
Natural Gas Prod.	Butane	secondary	1.32e-04	9.30e-02
Natural Gas Prod.	Hexane	secondary	1.18e-04	8.34e-02
Steel Prod., cold-rolled, semi-finished	Ethylene	secondary	1.02e-04	7.18e-02
PMMA Sheet Prod.	Methane	secondary	8.05e-05	5.69e-02
Polycarbonate Production	Methane	secondary	7.94e-05	5.62e-02
Steel Prod., cold-rolled, semi-finished	Ethane	secondary	4.80e-05	3.39e-02
Steel Prod., cold-rolled, semi-finished	Methane	secondary	3.74e-05	2.64e-02
Polycarbonate Production	Aromatic hydrocarbons	secondary	3.49e-05	2.47e-02
Styrene-butadiene Copolymer Prod.	Aromatic hydrocarbons	secondary	2.26e-05	1.60e-02
Styrene-butadiene Copolymer Prod.	Methane	secondary	2.10e-05	1.49e-02
Aluminum Prod.	Methane	secondary	2.10e-05	1.48e-02
Steel Prod., cold-rolled, semi-finished	n-Propane	secondary	1.88e-05	1.33e-02
PMMA Sheet Prod.	Aldehydes	secondary	1.87e-05	1.32e-02
Polycarbonate Production	Aldehydes	secondary	1.46e-05	1.03e-02
Steel Prod., cold-rolled, semi-finished	Propylene	secondary	1.22e-05	8.62e-03
Steel Prod., cold-rolled, semi-finished	Aldehydes	secondary	9.25e-06	6.54e-03
Natural Gas Prod.	Formaldehyde	secondary	7.11e-06	5.03e-03
PET Resin Production	Methane	secondary	6.99e-06	4.94e-03
Aluminum Prod.	Xylene (mixed isomers)	secondary	5.24e-06	3.71e-03
Aluminum Prod.	Polycyclic aromatic hydrocarbons	secondary	5.13e-06	3.63e-03
Steel Prod., cold-rolled, semi-finished	Butane	secondary	4.43e-06	3.13e-03
Natural Gas Prod.	o-xylene	secondary	3.68e-06	2.60e-03
Steel Prod., cold-rolled, semi-finished	Pentane	secondary	3.39e-06	2.40e-03
Steel Prod., cold-rolled, semi-finished	Benzene	secondary	2.58e-06	1.82e-03
Steel Prod., cold-rolled, semi-finished	Toluene	secondary	2.14e-06	1.51e-03
Steel Prod., cold-rolled, semi-finished	Xylene (mixed isomers)	secondary	2.04e-06	1.44e-03
Natural Gas Prod.	Toluene	secondary	2.03e-06	1.44e-03
Steel Prod., cold-rolled, semi-finished	Acetylene	secondary	1.92e-06	1.36e-03
Aluminum Prod.	Toluene	secondary	1.74e-06	1.23e-03
Aluminum Prod.	Aldehydes	secondary	1.71e-06	1.21e-03
Steel Prod., cold-rolled, semi-finished	Hexane	secondary	9.03e-07	6.39e-04
Steel Prod., cold-rolled, semi-finished	Formaldehyde	secondary	7.47e-07	5.28e-04
Steel Prod., cold-rolled, semi-finished	Phenol	secondary	7.00e-07	4.95e-04
PMMA Sheet Prod.	Aromatic hydrocarbons	secondary	5.84e-07	4.13e-04
Aluminum Prod.	Alcohols	secondary	5.58e-07	3.94e-04

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Aluminum Prod.	Benzene	secondary	4.55e-07	3.21e-04
Steel Prod., cold-rolled, semi-finished	Heptane	secondary	4.32e-07	3.05e-04
Natural Gas Prod.	Isophorone	secondary	3.58e-07	2.53e-04
Steel Prod., cold-rolled, semi-finished	Aromatic hydrocarbons	secondary	2.47e-07	1.75e-04
Steel Prod., cold-rolled, semi-finished	Methanol	secondary	2.17e-07	1.53e-04
Natural Gas Prod.	Acetaldehyde	secondary	2.05e-07	1.45e-04
Natural Gas Prod.	Propionaldehyde	secondary	1.86e-07	1.31e-04
Steel Prod., cold-rolled, semi-finished	Ethanol	secondary	1.74e-07	1.23e-04
Natural Gas Prod.	Methyl ethyl ketone	secondary	1.50e-07	1.06e-04
Steel Prod., cold-rolled, semi-finished	Acetaldehyde	secondary	1.45e-07	1.03e-04
Steel Prod., cold-rolled, semi-finished	Ethylbenzene	secondary	1.15e-07	8.14e-05
Natural Gas Prod.	Acrolein	secondary	1.04e-07	7.36e-05
Polycarbonate Production	Ethanethiol	secondary	1.03e-07	7.26e-05
Natural Gas Prod.	Naphthalene	secondary	9.37e-08	6.62e-05
Natural Gas Prod.	n-Propane	secondary	9.36e-08	6.61e-05
PMMA Sheet Prod.	Ethanethiol	secondary	7.63e-08	5.40e-05
Natural Gas Prod.	Ethylbenzene	secondary	5.87e-08	4.15e-05
Steel Prod., cold-rolled, semi-finished	Acetone	secondary	5.80e-08	4.10e-05
Natural Gas Prod.	Bromomethane	secondary	5.16e-08	3.65e-05
PET Resin Production	Aldehydes	secondary	4.02e-08	2.84e-05
Styrene-butadiene Copolymer Prod.	Aldehydes	secondary	4.01e-08	2.83e-05
Steel Prod., cold-rolled, semi-finished	Benzo[a]pyrene	secondary	3.33e-08	2.35e-05
Steel Prod., cold-rolled, semi-finished	Polycyclic aromatic hydrocarbons	secondary	1.82e-08	1.29e-05
Natural Gas Prod.	Styrene	secondary	1.54e-08	1.09e-05
Natural Gas Prod.	Benzyl chloride	secondary	1.19e-08	8.43e-06
Natural Gas Prod.	Methyl tert-butyl ether	secondary	1.13e-08	7.98e-06
Natural Gas Prod.	Phenol	secondary	9.87e-09	6.98e-06
Natural Gas Prod.	Acetophenone	secondary	9.25e-09	6.54e-06
Natural Gas Prod.	Methyl chloride	secondary	9.02e-09	6.38e-06
Steel Prod., cold-rolled, semi-finished	Naphthalene	secondary	5.55e-09	3.92e-06
Natural Gas Prod.	Dichloromethane	secondary	4.94e-09	3.49e-06
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	3.97e-09	2.80e-06
Natural Gas Prod.	Phenanthrene	secondary	3.75e-09	2.65e-06
Natural Gas Prod.	Cumene	secondary	3.27e-09	2.31e-06
Natural Gas Prod.	2-Methylnaphthalene	secondary	2.88e-09	2.03e-06
Aluminum Prod.	1,2-Dichlorotetrafluoroethane	secondary	1.87e-09	1.32e-06
Natural Gas Prod.	Vinyl acetate	secondary	1.37e-09	9.71e-07
Aluminum Prod.	Phenol	secondary	1.13e-09	8.00e-07
Natural Gas Prod.	Biphenyl	secondary	1.05e-09	7.41e-07
Natural Gas Prod.	Chloroform	secondary	1.00e-09	7.10e-07
Natural Gas Prod.	Fluorene	secondary	9.15e-10	6.47e-07
Natural Gas Prod.	Pyrene	secondary	8.20e-10	5.80e-07
Natural Gas Prod.	Fluoranthene	secondary	8.17e-10	5.78e-07
Natural Gas Prod.	Tetrachloroethylene	secondary	7.32e-10	5.18e-07
Natural Gas Prod.	Ethyl Chloride	secondary	7.15e-10	5.06e-07
Natural Gas Prod.	Acenaphthene	secondary	7.04e-10	4.98e-07
Natural Gas Prod.	1,2-Dichloroethane	secondary	6.81e-10	4.81e-07
Natural Gas Prod.	Anthracene	secondary	4.27e-10	3.02e-07

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Natural Gas Prod.	Ethylene dibromide	secondary	3.87e-10	2.74e-07
Natural Gas Prod.	Chlorobenzene	secondary	3.75e-10	2.65e-07
Natural Gas Prod.	Acenaphthylene	secondary	3.72e-10	2.63e-07
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	3.40e-10	2.41e-07
Natural Gas Prod.	Benzo[a]anthracene	secondary	2.98e-10	2.11e-07
Natural Gas Prod.	Chrysene	secondary	2.87e-10	2.03e-07
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	2.62e-10	1.85e-07
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	1.73e-10	1.22e-07
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	1.70e-10	1.20e-07
Natural Gas Prod.	Benzo[a]pyrene	secondary	1.67e-10	1.18e-07
Natural Gas Prod.	2-Chloroacetophenone	secondary	1.19e-10	8.43e-08
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	6.79e-11	4.80e-08
Natural Gas Prod.	Aromatic hydrocarbons	secondary	5.64e-11	3.99e-08
Natural Gas Prod.	5-Methyl chrysene	secondary	1.36e-11	9.60e-09
Natural Gas Prod.	Polycyclic aromatic hydrocarbons	secondary	6.28e-14	4.44e-11
Steel Prod., cold-rolled, semi-finished	Propionaldehyde	secondary	4.58e-14	3.23e-11
Steel Prod., cold-rolled, semi-finished	Benzaldehyde	secondary	1.23e-14	8.71e-12
Total Materials Processing			**1.29e-01**	**9.12e+01**
Manufacturing Life-cycle Stage				
Monitor/module	Isopropyl alcohol	primary	3.48e-03	2.46e+00
LPG Production	Hydrocarbons, remaining unspeciated	secondary	2.99e-03	2.11e+00
LPG Production	Nonmethane hydrocarbons, remaining unspeciated	secondary	2.04e-03	1.44e+00
Natural Gas Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.42e-03	1.00e+00
Natural Gas Prod.	Methane	secondary	5.54e-04	3.91e-01
Natural Gas Prod.	Benzene	secondary	3.77e-04	2.67e-01
LPG Production	Methane	secondary	2.82e-04	1.99e-01
LPG Production	Benzene	secondary	1.30e-04	9.20e-02
Natural Gas Prod.	Hydrocarbons, remaining unspeciated	secondary	3.91e-05	2.76e-02
Backlight	Diethyl ether	primary	3.69e-05	2.61e-02
Fuel Oil #4 Prod.	Hydrocarbons, remaining unspeciated	secondary	3.32e-05	2.35e-02
Monitor/module	Acetone	primary	3.31e-05	2.34e-02
LPG Production	Aldehydes	secondary	3.17e-05	2.24e-02
Panel components	Heptane	primary	3.09e-05	2.19e-02
Panel components	Nonmethane hydrocarbons, remaining unspeciated	primary	3.09e-05	2.19e-02
Panel components	Toluene	primary	3.06e-05	2.17e-02
LPG Production	Formaldehyde	secondary	2.36e-05	1.67e-02
Fuel Oil #4 Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	2.23e-05	1.58e-02
Monitor/module	Cyclohexane	primary	1.93e-05	1.36e-02
Fuel Oil #6 Prod.	Hydrocarbons, remaining unspeciated	secondary	1.83e-05	1.29e-02
LPG Production	Ethane	secondary	1.48e-05	1.05e-02
Japanese Electric Grid	Formaldehyde	model/secondary	1.44e-05	1.02e-02
LPG Production	Pentane	secondary	1.27e-05	9.00e-03
Backlight	Ethanol	primary	1.24e-05	8.76e-03
Fuel Oil #6 Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.21e-05	8.55e-03
LPG Production	Butane	secondary	1.00e-05	7.09e-03
Fuel Oil #2 Prod.	Hydrocarbons, remaining unspeciated	secondary	9.21e-06	6.51e-03
LPG Production	Hexane	secondary	9.00e-06	6.36e-03
US electric grid	Methane	model/secondary	8.74e-06	6.18e-03
Natural Gas Prod.	Aldehydes	secondary	7.53e-06	5.32e-03

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
PWB Mfg.	Formaldehyde	model/secondary	7.21e-06	5.09e-03
Fuel Oil #2 Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	6.26e-06	4.42e-03
Natural Gas Prod.	Ethane	secondary	4.38e-06	3.10e-03
Natural Gas Prod.	Pentane	secondary	3.77e-06	2.66e-03
Natural Gas Prod.	Butane	secondary	2.97e-06	2.10e-03
Panel components	HCFC-225ca	primary	2.94e-06	2.08e-03
Panel components	HCFC-225cb	primary	2.94e-06	2.08e-03
Fuel Oil #4 Prod.	Methane	secondary	2.81e-06	1.99e-03
Japanese Electric Grid	Toluene	model/secondary	2.71e-06	1.91e-03
Natural Gas Prod.	Hexane	secondary	2.66e-06	1.88e-03
Japanese Electric Grid	Methane	model/secondary	1.91e-06	1.35e-03
Japanese Electric Grid	Isophorone	model/secondary	1.70e-06	1.20e-03
Fuel Oil #6 Prod.	Methane	secondary	1.40e-06	9.92e-04
Fuel Oil #4 Prod.	Benzene	secondary	1.17e-06	8.30e-04
Japanese Electric Grid	Acetaldehyde	model/secondary	9.71e-07	6.86e-04
Japanese Electric Grid	Benzene	model/secondary	9.69e-07	6.85e-04
Japanese Electric Grid	Propionaldehyde	model/secondary	8.81e-07	6.23e-04
Fuel Oil #2 Prod.	Methane	secondary	8.39e-07	5.93e-04
Japanese Electric Grid	Methyl ethyl ketone	model/secondary	7.09e-07	5.01e-04
Japanese Electric Grid	Naphthalene	model/secondary	5.66e-07	4.00e-04
Fuel Oil #6 Prod.	Benzene	secondary	5.27e-07	3.73e-04
Japanese Electric Grid	Acrolein	model/secondary	4.94e-07	3.49e-04
Fuel Oil #2 Prod.	Benzene	secondary	3.76e-07	2.66e-04
Panel components	Methyl ethyl ketone	primary	3.46e-07	2.45e-04
Japanese Electric Grid	Ethylbenzene	model/secondary	3.04e-07	2.15e-04
Fuel Oil #4 Prod.	Formaldehyde	secondary	2.91e-07	2.06e-04
Fuel Oil #4 Prod.	Aldehydes	secondary	2.86e-07	2.02e-04
Japanese Electric Grid	Bromomethane	model/secondary	2.45e-07	1.73e-04
Fuel Oil #6 Prod.	Formaldehyde	secondary	1.71e-07	1.21e-04
Natural Gas Prod.	Formaldehyde	secondary	1.61e-07	1.13e-04
LPG Production	Isophorone	secondary	1.42e-07	1.00e-04
Fuel Oil #4 Prod.	Ethane	secondary	1.34e-07	9.45e-05
Fuel Oil #6 Prod.	Aldehydes	secondary	1.28e-07	9.07e-05
Fuel Oil #4 Prod.	Pentane	secondary	1.15e-07	8.13e-05
Japanese Electric Grid	Xylene (mixed isomers)	model/secondary	1.08e-07	7.65e-05
Japanese Electric Grid	Hexane	model/secondary	1.07e-07	7.57e-05
LPG Production	Toluene	secondary	1.00e-07	7.10e-05
Fuel Oil #2 Prod.	Aldehydes	secondary	9.17e-08	6.48e-05
Fuel Oil #4 Prod.	Butane	secondary	9.06e-08	6.40e-05
Natural Gas Prod.	o-xylene	secondary	8.30e-08	5.87e-05
Fuel Oil #4 Prod.	Hexane	secondary	8.12e-08	5.74e-05
LPG Production	Acetaldehyde	secondary	8.11e-08	5.73e-05
US electric grid	Isophorone	model/secondary	7.66e-08	5.42e-05
Fuel Oil #2 Prod.	Formaldehyde	secondary	7.56e-08	5.35e-05
LPG Production	Propionaldehyde	secondary	7.36e-08	5.20e-05
Japanese Electric Grid	Styrene	model/secondary	7.31e-08	5.17e-05
US electric grid	Formaldehyde	model/secondary	6.90e-08	4.88e-05
Fuel Oil #6 Prod.	Ethane	secondary	6.01e-08	4.25e-05
LPG Production	Methyl ethyl ketone	secondary	5.92e-08	4.19e-05

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Japanese Electric Grid	Benzyl chloride	model/secondary	5.65e-08	4.00e-05
Japanese Electric Grid	Methyl tert-butyl ether	model/secondary	5.34e-08	3.77e-05
Fuel Oil #6 Prod.	Pentane	secondary	5.17e-08	3.65e-05
Japanese Electric Grid	o-xylene	model/secondary	4.94e-08	3.49e-05
Japanese Electric Grid	Phenol	model/secondary	4.68e-08	3.31e-05
Natural Gas Prod.	Toluene	secondary	4.58e-08	3.24e-05
Japanese Electric Grid	Acetophenone	model/secondary	4.39e-08	3.10e-05
US electric grid	Acetaldehyde	model/secondary	4.38e-08	3.10e-05
Fuel Oil #2 Prod.	Ethane	secondary	4.28e-08	3.03e-05
Japanese Electric Grid	Methyl chloride	model/secondary	4.28e-08	3.03e-05
US electric grid	Benzene	model/secondary	4.27e-08	3.02e-05
LPG Production	Acrolein	secondary	4.12e-08	2.92e-05
Fuel Oil #6 Prod.	Butane	secondary	4.07e-08	2.88e-05
US electric grid	Propionaldehyde	model/secondary	3.98e-08	2.81e-05
LPG Production	o-xylene	secondary	3.77e-08	2.66e-05
Fuel Oil #2 Prod.	Pentane	secondary	3.68e-08	2.60e-05
Fuel Oil #6 Prod.	Hexane	secondary	3.65e-08	2.58e-05
LPG Production	n-Propane	secondary	3.36e-08	2.38e-05
US electric grid	Methyl ethyl ketone	model/secondary	3.20e-08	2.26e-05
Fuel Oil #2 Prod.	Butane	secondary	2.90e-08	2.05e-05
US electric grid	Toluene	model/secondary	2.77e-08	1.96e-05
Fuel Oil #2 Prod.	Hexane	secondary	2.60e-08	1.84e-05
Japanese Electric Grid	Dichloromethane	model/secondary	2.34e-08	1.66e-05
LPG Production	Ethylbenzene	secondary	2.32e-08	1.64e-05
US electric grid	Acrolein	model/secondary	2.23e-08	1.58e-05
LPG Production	Bromomethane	secondary	2.04e-08	1.45e-05
Japanese Electric Grid	Cumene hydroperoxide	model/secondary	1.55e-08	1.10e-05
Japanese Electric Grid	Phenanthrene	model/secondary	1.33e-08	9.42e-06
LPG Production	Naphthalene	secondary	1.27e-08	9.01e-06
US electric grid	Ethylbenzene	model/secondary	1.25e-08	8.82e-06
US electric grid	Bromomethane	model/secondary	1.11e-08	7.82e-06
Japanese Electric Grid	Acenaphthene	model/secondary	1.11e-08	7.81e-06
Natural Gas Prod.	Isophorone	secondary	8.08e-09	5.71e-06
Japanese Electric Grid	Vinyl acetate	model/secondary	6.50e-09	4.60e-06
LPG Production	Styrene	secondary	6.11e-09	4.32e-06
Japanese Electric Grid	Biphenyl	model/secondary	4.97e-09	3.52e-06
US electric grid	Xylene (mixed isomers)	model/secondary	4.89e-09	3.46e-06
US electric grid	Hexane	model/secondary	4.84e-09	3.42e-06
Japanese Electric Grid	Chloroform	model/secondary	4.76e-09	3.37e-06
LPG Production	Benzyl chloride	secondary	4.72e-09	3.34e-06
Japanese Electric Grid	Fluorene	model/secondary	4.68e-09	3.31e-06
Natural Gas Prod.	Acetaldehyde	secondary	4.62e-09	3.27e-06
Japanese Electric Grid	1,1,1-Trichloroethane	model/secondary	4.57e-09	3.23e-06
LPG Production	Methyl tert-butyl ether	secondary	4.47e-09	3.16e-06
Japanese Electric Grid	Fluoranthene	model/secondary	4.47e-09	3.16e-06
Natural Gas Prod.	Propionaldehyde	secondary	4.19e-09	2.96e-06
LPG Production	Phenol	secondary	3.91e-09	2.76e-06
LPG Production	Acetophenone	secondary	3.66e-09	2.59e-06
LPG Production	Methyl chloride	secondary	3.57e-09	2.53e-06
Japanese Electric Grid	Tetrachloroethylene	model/secondary	3.47e-09	2.45e-06

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Japanese Electric Grid	Ethyl Chloride	model/secondary	3.39e-09	2.40e-06
Natural Gas Prod.	Methyl ethyl ketone	secondary	3.38e-09	2.39e-06
US electric grid	Styrene	model/secondary	3.30e-09	2.34e-06
Japanese Electric Grid	1,2-Dichloroethane	model/secondary	3.23e-09	2.28e-06
Japanese Electric Grid	Pyrene	model/secondary	3.23e-09	2.28e-06
US electric grid	Naphthalene	model/secondary	2.69e-09	1.90e-06
US electric grid	Benzyl chloride	model/secondary	2.55e-09	1.80e-06
US electric grid	Methyl tert-butyl ether	model/secondary	2.42e-09	1.71e-06
Natural Gas Prod.	Acrolein	secondary	2.35e-09	1.66e-06
US electric grid	Phenol	model/secondary	2.11e-09	1.49e-06
Natural Gas Prod.	Naphthalene	secondary	2.11e-09	1.49e-06
Natural Gas Prod.	n-Propane	secondary	2.11e-09	1.49e-06
Japanese Electric Grid	Benzo[a]anthracene	model/secondary	2.05e-09	1.45e-06
US electric grid	Acetophenone	model/secondary	1.98e-09	1.40e-06
LPG Production	Dichloromethane	secondary	1.96e-09	1.38e-06
US electric grid	Methyl chloride	model/secondary	1.93e-09	1.37e-06
LPG Production	Aromatic hydrocarbons	secondary	1.92e-09	1.36e-06
Japanese Electric Grid	Ethylene dibromide	model/secondary	1.84e-09	1.30e-06
Japanese Electric Grid	Chlorobenzene	model/secondary	1.78e-09	1.26e-06
Fuel Oil #4 Prod.	Isophorone	secondary	1.52e-09	1.08e-06
Japanese Electric Grid	Chrysene	model/secondary	1.37e-09	9.68e-07
Natural Gas Prod.	Ethylbenzene	secondary	1.32e-09	9.37e-07
LPG Production	Cumene	secondary	1.29e-09	9.15e-07
Japanese Electric Grid	Anthracene	model/secondary	1.17e-09	8.24e-07
Natural Gas Prod.	Bromomethane	secondary	1.17e-09	8.24e-07
Japanese Electric Grid	Indeno(1,2,3-cd)pyrene	model/secondary	1.15e-09	8.10e-07
Japanese Electric Grid	Benzo[g,h,i]perylene	model/secondary	1.10e-09	7.78e-07
US electric grid	Dichloromethane	model/secondary	1.06e-09	7.48e-07
Japanese Electric Grid	Benzo[b,j,k]fluoranthene	model/secondary	9.94e-10	7.03e-07
Fuel Oil #4 Prod.	Toluene	secondary	9.81e-10	6.94e-07
Fuel Oil #4 Prod.	Acetaldehyde	secondary	8.71e-10	6.16e-07
Japanese Electric Grid	Acenaphthylene	model/secondary	8.43e-10	5.96e-07
LPG Production	Phenanthrene	secondary	8.28e-10	5.85e-07
Japanese Electric Grid	2,4-Dinitrotoluene	model/secondary	8.17e-10	5.77e-07
Fuel Oil #6 Prod.	Isophorone	secondary	8.11e-10	5.74e-07
Fuel Oil #4 Prod.	Propionaldehyde	secondary	7.90e-10	5.59e-07
US electric grid	Cumene	model/secondary	7.00e-10	4.95e-07
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	6.36e-10	4.50e-07
Japanese Electric Grid	2-Methylnaphthalene	model/secondary	6.09e-10	4.30e-07
Japanese Electric Grid	2-Chloroacetophenone	model/secondary	5.65e-10	4.00e-07
LPG Production	Vinyl acetate	secondary	5.44e-10	3.85e-07
Fuel Oil #6 Prod.	Toluene	secondary	4.80e-10	3.39e-07
Fuel Oil #6 Prod.	Acetaldehyde	secondary	4.64e-10	3.28e-07
Fuel Oil #4 Prod.	Acrolein	secondary	4.43e-10	3.13e-07
Fuel Oil #2 Prod.	Isophorone	secondary	4.32e-10	3.06e-07
Fuel Oil #6 Prod.	Propionaldehyde	secondary	4.21e-10	2.98e-07
LPG Production	Biphenyl	secondary	4.15e-10	2.94e-07
LPG Production	Chloroform	secondary	3.98e-10	2.81e-07

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
US electric grid	Phenanthrene	model/secondary	3.69e-10	2.61e-07
Fuel Oil #4 Prod.	n-Propane	secondary	3.60e-10	2.55e-07
Fuel Oil #4 Prod.	o-xylene	secondary	3.55e-10	2.51e-07
Natural Gas Prod.	Styrene	secondary	3.48e-10	2.46e-07
Fuel Oil #6 Prod.	Methyl ethyl ketone	secondary	3.39e-10	2.40e-07
LPG Production	1,4-Dichlorobenzene	secondary	3.03e-10	2.14e-07
Fuel Oil #2 Prod.	Toluene	secondary	2.97e-10	2.10e-07
US electric grid	Vinyl acetate	model/secondary	2.94e-10	2.08e-07
LPG Production	Tetrachloroethylene	secondary	2.90e-10	2.05e-07
LPG Production	Ethyl Chloride	secondary	2.83e-10	2.00e-07
LPG Production	1,2-Dichloroethane	secondary	2.70e-10	1.91e-07
Natural Gas Prod.	Benzyl chloride	secondary	2.69e-10	1.90e-07
Natural Gas Prod.	Methyl tert-butyl ether	secondary	2.55e-10	1.80e-07
LPG Production	Fluorene	secondary	2.53e-10	1.79e-07
Fuel Oil #4 Prod.	Ethylbenzene	secondary	2.49e-10	1.76e-07
Fuel Oil #2 Prod.	Acetaldehyde	secondary	2.47e-10	1.75e-07
Fuel Oil #6 Prod.	Acrolein	secondary	2.36e-10	1.67e-07
US electric grid	Biphenyl	model/secondary	2.25e-10	1.59e-07
Fuel Oil #2 Prod.	Propionaldehyde	secondary	2.24e-10	1.59e-07
Natural Gas Prod.	Phenol	secondary	2.23e-10	1.58e-07
Fuel Oil #4 Prod.	Bromomethane	secondary	2.20e-10	1.55e-07
LPG Production	2-Methylnaphthalene	secondary	2.19e-10	1.55e-07
US electric grid	Chloroform	model/secondary	2.15e-10	1.52e-07
Natural Gas Prod.	Acetophenone	secondary	2.09e-10	1.48e-07
LPG Production	Fluoranthene	secondary	2.07e-10	1.46e-07
Natural Gas Prod.	Methyl chloride	secondary	2.04e-10	1.44e-07
LPG Production	Acenaphthene	secondary	1.92e-10	1.35e-07
Fuel Oil #6 Prod.	n-Propane	secondary	1.91e-10	1.35e-07
Fuel Oil #2 Prod.	Methyl ethyl ketone	secondary	1.81e-10	1.28e-07
Fuel Oil #6 Prod.	o-xylene	secondary	1.67e-10	1.18e-07
US electric grid	Tetrachloroethylene	model/secondary	1.57e-10	1.11e-07
LPG Production	Ethylene dibromide	secondary	1.53e-10	1.08e-07
US electric grid	Ethyl Chloride	model/secondary	1.53e-10	1.08e-07
LPG Production	Chlorobenzene	secondary	1.48e-10	1.05e-07
US electric grid	1,2-Dichloroethane	model/secondary	1.46e-10	1.03e-07
LPG Production	1,1,1-Trichloroethane	secondary	1.35e-10	9.53e-08
Fuel Oil #6 Prod.	Ethylbenzene	secondary	1.32e-10	9.35e-08
LPG Production	Pyrene	secondary	1.31e-10	9.29e-08
Fuel Oil #2 Prod.	Acrolein	secondary	1.26e-10	8.90e-08
US electric grid	Fluorene	model/secondary	1.24e-10	8.75e-08
Fuel Oil #4 Prod.	Naphthalene	secondary	1.18e-10	8.36e-08
Fuel Oil #6 Prod.	Bromomethane	secondary	1.17e-10	8.28e-08
Natural Gas Prod.	Dichloromethane	secondary	1.11e-10	7.88e-08
Japanese Electric Grid	Benzo[a]pyrene	model/secondary	1.11e-10	7.87e-08
Fuel Oil #2 Prod.	o-xylene	secondary	1.10e-10	7.80e-08
Fuel Oil #2 Prod.	n-Propane	secondary	1.03e-10	7.25e-08
US electric grid	Fluoranthene	model/secondary	9.89e-11	6.99e-08
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	8.95e-11	6.33e-08
Natural Gas Prod.	Phenanthrene	secondary	8.45e-11	5.98e-08
US electric grid	o-xylene	model/secondary	8.41e-11	5.94e-08

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
US electric grid	Acenaphthene	model/secondary	8.37e-11	5.92e-08
US electric grid	Ethylene dibromide	model/secondary	8.29e-11	5.86e-08
US electric grid	Chlorobenzene	model/secondary	8.02e-11	5.67e-08
LPG Production	Acenaphthylene	secondary	7.81e-11	5.52e-08
US electric grid	1,1,1-Trichloroethane	model/secondary	7.80e-11	5.51e-08
LPG Production	Anthracene	secondary	7.62e-11	5.38e-08
Natural Gas Prod.	Cumene	secondary	7.38e-11	5.22e-08
Fuel Oil #2 Prod.	Ethylbenzene	secondary	7.07e-11	5.00e-08
LPG Production	2,4-Dinitrotoluene	secondary	6.84e-11	4.84e-08
Fuel Oil #4 Prod.	Styrene	secondary	6.56e-11	4.64e-08
Natural Gas Prod.	2-Methylnaphthalene	secondary	6.49e-11	4.59e-08
Japanese Electric Grid	5-Methyl chrysene	model/secondary	6.43e-11	4.55e-08
Fuel Oil #2 Prod.	Bromomethane	secondary	6.24e-11	4.41e-08
Fuel Oil #6 Prod.	Naphthalene	secondary	5.48e-11	3.87e-08
Fuel Oil #4 Prod.	Benzyl chloride	secondary	5.07e-11	3.58e-08
US electric grid	Pyrene	model/secondary	4.91e-11	3.47e-08
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	4.80e-11	3.40e-08
LPG Production	2-Chloroacetophenone	secondary	4.72e-11	3.34e-08
LPG Production	Benzo[a]anthracene	secondary	4.56e-11	3.22e-08
LPG Production	Chrysene	secondary	4.37e-11	3.09e-08
Fuel Oil #4 Prod.	Phenol	secondary	4.20e-11	2.97e-08
Fuel Oil #4 Prod.	Acetophenone	secondary	3.94e-11	2.78e-08
Fuel Oil #4 Prod.	Methyl chloride	secondary	3.84e-11	2.71e-08
Fuel Oil #2 Prod.	Naphthalene	secondary	3.71e-11	2.62e-08
US electric grid	2,4-Dinitrotoluene	model/secondary	3.70e-11	2.62e-08
Fuel Oil #6 Prod.	Styrene	secondary	3.50e-11	2.47e-08
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	3.39e-11	2.40e-08
US electric grid	Acenaphthylene	model/secondary	3.32e-11	2.35e-08
Natural Gas Prod.	Vinyl acetate	secondary	3.10e-11	2.19e-08
US electric grid	Anthracene	model/secondary	2.87e-11	2.03e-08
Fuel Oil #6 Prod.	Benzyl chloride	secondary	2.70e-11	1.91e-08
LPG Production	Benzo[b,j,k]fluoranthene	secondary	2.69e-11	1.90e-08
Fuel Oil #6 Prod.	Methyl tert-butyl ether	secondary	2.56e-11	1.81e-08
US electric grid	2-Chloroacetophenone	model/secondary	2.55e-11	1.80e-08
LPG Production	Benzo[a]pyrene	secondary	2.50e-11	1.76e-08
Natural Gas Prod.	Biphenyl	secondary	2.37e-11	1.67e-08
Natural Gas Prod.	Chloroform	secondary	2.27e-11	1.60e-08
Fuel Oil #6 Prod.	Phenol	secondary	2.24e-11	1.58e-08
Fuel Oil #4 Prod.	Dichloromethane	secondary	2.10e-11	1.48e-08
Fuel Oil #6 Prod.	Acetophenone	secondary	2.10e-11	1.48e-08
Natural Gas Prod.	Fluorene	secondary	2.07e-11	1.46e-08
Fuel Oil #6 Prod.	Methyl chloride	secondary	2.05e-11	1.45e-08
LPG Production	Benzo[g,h,i]perylene	secondary	2.03e-11	1.43e-08
Fuel Oil #2 Prod.	Styrene	secondary	1.86e-11	1.32e-08
Natural Gas Prod.	Pyrene	secondary	1.85e-11	1.31e-08
Natural Gas Prod.	Fluoranthene	secondary	1.84e-11	1.30e-08
Natural Gas Prod.	Tetrachloroethylene	secondary	1.65e-11	1.17e-08
Natural Gas Prod.	Ethyl Chloride	secondary	1.61e-11	1.14e-08

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Natural Gas Prod.	Acenaphthene	secondary	1.59e-11	1.12e-08
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	1.57e-11	1.11e-08
Natural Gas Prod.	1,2-Dichloroethane	secondary	1.54e-11	1.09e-08
US electric grid	Chrysene	model/secondary	1.51e-11	1.06e-08
Fuel Oil #2 Prod.	Benzyl chloride	secondary	1.44e-11	1.02e-08
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	1.40e-11	9.93e-09
Fuel Oil #4 Prod.	Cumene	secondary	1.39e-11	9.83e-09
US electric grid	Benzo[a]anthracene	model/secondary	1.37e-11	9.66e-09
Fuel Oil #2 Prod.	Methyl tert-butyl ether	secondary	1.36e-11	9.65e-09
Fuel Oil #2 Prod.	Phenol	secondary	1.19e-11	8.43e-09
Fuel Oil #6 Prod.	Dichloromethane	secondary	1.12e-11	7.91e-09
Fuel Oil #2 Prod.	Acetophenone	secondary	1.12e-11	7.91e-09
Fuel Oil #2 Prod.	Methyl chloride	secondary	1.09e-11	7.71e-09
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	9.71e-12	6.87e-09
Natural Gas Prod.	Anthracene	secondary	9.64e-12	6.81e-09
Natural Gas Prod.	Ethylene dibromide	secondary	8.74e-12	6.18e-09
Fuel Oil #4 Prod.	Phenanthrene	secondary	8.58e-12	6.07e-09
Natural Gas Prod.	Chlorobenzene	secondary	8.45e-12	5.98e-09
Natural Gas Prod.	Acenaphthylene	secondary	8.39e-12	5.93e-09
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	7.68e-12	5.43e-09
Fuel Oil #6 Prod.	Cumene	secondary	7.41e-12	5.24e-09
Natural Gas Prod.	Benzo[a]anthracene	secondary	6.72e-12	4.75e-09
Natural Gas Prod.	Chrysene	secondary	6.48e-12	4.58e-09
Fuel Oil #2 Prod.	Dichloromethane	secondary	5.97e-12	4.22e-09
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	5.91e-12	4.18e-09
Fuel Oil #4 Prod.	Vinyl acetate	secondary	5.85e-12	4.13e-09
LPG Production	5-Methyl chrysene	secondary	5.38e-12	3.80e-09
US electric grid	Benzo[g,h,i]perylene	model/secondary	5.31e-12	3.75e-09
Fuel Oil #2 Prod.	Aromatic hydrocarbons	secondary	5.23e-12	3.70e-09
US electric grid	Benzo[a]pyrene	model/secondary	5.02e-12	3.55e-09
Fuel Oil #6 Prod.	Aromatic hydrocarbons	secondary	4.60e-12	3.25e-09
Fuel Oil #4 Prod.	Biphenyl	secondary	4.46e-12	3.15e-09
Fuel Oil #6 Prod.	Phenanthrene	secondary	4.44e-12	3.14e-09
Fuel Oil #4 Prod.	Chloroform	secondary	4.27e-12	3.02e-09
Fuel Oil #2 Prod.	Cumene	secondary	3.95e-12	2.79e-09
US electric grid	2-Methylnaphthalene	model/secondary	3.93e-12	2.78e-09
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	3.90e-12	2.76e-09
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	3.83e-12	2.71e-09
Natural Gas Prod.	Benzo[a]pyrene	secondary	3.78e-12	2.67e-09
Fuel Oil #6 Prod.	Vinyl acetate	secondary	3.12e-12	2.20e-09
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	3.11e-12	2.20e-09
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	3.04e-12	2.15e-09
US electric grid	5-Methyl chrysene	model/secondary	2.91e-12	2.06e-09
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	2.90e-12	2.05e-09
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	2.73e-12	1.93e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	2.69e-12	1.90e-09
Fuel Oil #4 Prod.	Fluorene	secondary	2.66e-12	1.88e-09
Fuel Oil #2 Prod.	Phenanthrene	secondary	2.50e-12	1.76e-09
Fuel Oil #6 Prod.	Biphenyl	secondary	2.38e-12	1.68e-09
Fuel Oil #6 Prod.	Chloroform	secondary	2.28e-12	1.61e-09

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Fuel Oil #4 Prod.	Fluoranthene	secondary	2.15e-12	1.52e-09
LPG Production	Polycyclic aromatic hydrocarbons	secondary	2.13e-12	1.51e-09
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	1.98e-12	1.40e-09
Fuel Oil #4 Prod.	Acenaphthene	secondary	1.86e-12	1.31e-09
Fuel Oil #2 Prod.	Vinyl acetate	secondary	1.66e-12	1.17e-09
Fuel Oil #6 Prod.	Tetrachloroethylene	secondary	1.66e-12	1.17e-09
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	1.65e-12	1.16e-09
Fuel Oil #6 Prod.	Ethyl Chloride	secondary	1.62e-12	1.15e-09
Fuel Oil #4 Prod.	Chlorobenzene	secondary	1.59e-12	1.13e-09
Fuel Oil #6 Prod.	1,2-Dichloroethane	secondary	1.54e-12	1.09e-09
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	1.53e-12	1.08e-09
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	1.45e-12	1.02e-09
Fuel Oil #6 Prod.	Fluorene	secondary	1.39e-12	9.83e-10
Fuel Oil #4 Prod.	Pyrene	secondary	1.32e-12	9.30e-10
Natural Gas Prod.	Aromatic hydrocarbons	secondary	1.27e-12	9.00e-10
Fuel Oil #2 Prod.	Biphenyl	secondary	1.27e-12	8.96e-10
Fuel Oil #6 Prod.	1,4-Dichlorobenzene	secondary	1.23e-12	8.68e-10
Fuel Oil #2 Prod.	Chloroform	secondary	1.21e-12	8.58e-10
Fuel Oil #6 Prod.	Fluoranthene	secondary	1.12e-12	7.91e-10
Fuel Oil #6 Prod.	Acenaphthene	secondary	9.03e-13	6.39e-10
Fuel Oil #6 Prod.	2-Methylnaphthalene	secondary	8.89e-13	6.29e-10
Fuel Oil #2 Prod.	Tetrachloroethylene	secondary	8.85e-13	6.25e-10
Fuel Oil #6 Prod.	Ethylene dibromide	secondary	8.78e-13	6.21e-10
Fuel Oil #2 Prod.	1,4-Dichlorobenzene	secondary	8.74e-13	6.18e-10
Fuel Oil #2 Prod.	Ethyl Chloride	secondary	8.64e-13	6.11e-10
Fuel Oil #6 Prod.	Chlorobenzene	secondary	8.49e-13	6.00e-10
Fuel Oil #2 Prod.	1,2-Dichloroethane	secondary	8.23e-13	5.82e-10
Fuel Oil #4 Prod.	Acenaphthylene	secondary	8.09e-13	5.72e-10
Fuel Oil #6 Prod.	1,1,1-Trichloroethane	secondary	7.72e-13	5.46e-10
Fuel Oil #4 Prod.	Anthracene	secondary	7.71e-13	5.45e-10
Fuel Oil #2 Prod.	Fluorene	secondary	7.67e-13	5.42e-10
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	7.35e-13	5.20e-10
Fuel Oil #6 Prod.	Pyrene	secondary	6.59e-13	4.66e-10
Fuel Oil #2 Prod.	2-Methylnaphthalene	secondary	6.34e-13	4.48e-10
Fuel Oil #2 Prod.	Fluoranthene	secondary	6.24e-13	4.41e-10
Fuel Oil #2 Prod.	Acenaphthene	secondary	5.66e-13	4.00e-10
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	5.07e-13	3.58e-10
Fuel Oil #2 Prod.	Ethylene dibromide	secondary	4.68e-13	3.31e-10
Fuel Oil #2 Prod.	Chlorobenzene	secondary	4.53e-13	3.20e-10
Fuel Oil #4 Prod.	Chrysene	secondary	4.32e-13	3.05e-10
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	4.29e-13	3.03e-10
Fuel Oil #6 Prod.	Acenaphthylene	secondary	4.18e-13	2.95e-10
Fuel Oil #2 Prod.	1,1,1-Trichloroethane	secondary	4.11e-13	2.91e-10
Fuel Oil #2 Prod.	Pyrene	secondary	3.92e-13	2.77e-10
Fuel Oil #6 Prod.	2,4-Dinitrotoluene	secondary	3.92e-13	2.77e-10
Fuel Oil #6 Prod.	Anthracene	secondary	3.90e-13	2.76e-10
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	3.27e-13	2.31e-10
Natural Gas Prod.	5-Methyl chrysene	secondary	3.06e-13	2.17e-10

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	2.89e-13	2.04e-10
Fuel Oil #6 Prod.	2-Chloroacetophenone	secondary	2.70e-13	1.91e-10
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	2.57e-13	1.82e-10
Fuel Oil #2 Prod.	Acenaphthylene	secondary	2.36e-13	1.67e-10
Fuel Oil #2 Prod.	Anthracene	secondary	2.28e-13	1.61e-10
Fuel Oil #6 Prod.	Chrysene	secondary	2.14e-13	1.51e-10
Fuel Oil #2 Prod.	2,4-Dinitrotoluene	secondary	2.09e-13	1.48e-10
Fuel Oil #6 Prod.	Benzo[a]anthracene	secondary	2.02e-13	1.43e-10
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	1.90e-13	1.34e-10
Fuel Oil #6 Prod.	Indeno(1,2,3-cd)pyrene	secondary	1.58e-13	1.12e-10
Fuel Oil #6 Prod.	Benzo[b,j,k]fluoranthene	secondary	1.54e-13	1.09e-10
Fuel Oil #2 Prod.	2-Chloroacetophenone	secondary	1.44e-13	1.02e-10
Fuel Oil #2 Prod.	Benzo[a]anthracene	secondary	1.33e-13	9.43e-11
Fuel Oil #6 Prod.	Benzo[a]pyrene	secondary	1.32e-13	9.35e-11
Fuel Oil #2 Prod.	Chrysene	secondary	1.30e-13	9.18e-11
Fuel Oil #2 Prod.	Indeno(1,2,3-cd)pyrene	secondary	1.00e-13	7.07e-11
Fuel Oil #6 Prod.	Benzo[g,h,i]perylene	secondary	8.88e-14	6.28e-11
Fuel Oil #2 Prod.	Benzo[b,j,k]fluoranthene	secondary	8.20e-14	5.80e-11
Fuel Oil #2 Prod.	Benzo[a]pyrene	secondary	7.51e-14	5.31e-11
Fuel Oil #2 Prod.	Benzo[g,h,i]perylene	secondary	5.92e-14	4.19e-11
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	5.77e-14	4.08e-11
Fuel Oil #6 Prod.	5-Methyl chrysene	secondary	3.08e-14	2.18e-11
Fuel Oil #2 Prod.	5-Methyl chrysene	secondary	1.64e-14	1.16e-11
Fuel Oil #4 Prod.	Polycyclic aromatic hydrocarbons	secondary	1.56e-14	1.10e-11
Fuel Oil #2 Prod.	Polycyclic aromatic hydrocarbons	secondary	5.82e-15	4.11e-12
Fuel Oil #6 Prod.	Polycyclic aromatic hydrocarbons	secondary	5.11e-15	3.62e-12
Natural Gas Prod.	Polycyclic aromatic hydrocarbons	secondary	1.42e-15	1.00e-12
Total Manufacturing			**1.18e-02**	**8.33e+00**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Methane	model/secondary	1.68e-03	1.19e+00
US electric grid	Isophorone	model/secondary	1.48e-05	1.04e-02
US electric grid	Formaldehyde	model/secondary	1.33e-05	9.40e-03
US electric grid	Acetaldehyde	model/secondary	8.45e-06	5.98e-03
US electric grid	Benzene	model/secondary	8.23e-06	5.82e-03
US electric grid	Propionaldehyde	model/secondary	7.67e-06	5.42e-03
US electric grid	Methyl ethyl ketone	model/secondary	6.17e-06	4.37e-03
US electric grid	Toluene	model/secondary	5.34e-06	3.78e-03
US electric grid	Acrolein	model/secondary	4.30e-06	3.04e-03
US electric grid	Ethylbenzene	model/secondary	2.40e-06	1.70e-03
US electric grid	Bromomethane	model/secondary	2.13e-06	1.51e-03
US electric grid	Xylene (mixed isomers)	model/secondary	9.42e-07	6.66e-04
US electric grid	Hexane	model/secondary	9.33e-07	6.60e-04
US electric grid	Styrene	model/secondary	6.37e-07	4.50e-04
US electric grid	Naphthalene	model/secondary	5.19e-07	3.67e-04
US electric grid	Benzyl chloride	model/secondary	4.92e-07	3.48e-04
US electric grid	Methyl tert-butyl ether	model/secondary	4.66e-07	3.30e-04
US electric grid	Phenol	model/secondary	4.08e-07	2.88e-04
US electric grid	Acetophenone	model/secondary	3.82e-07	2.70e-04
US electric grid	Methyl chloride	model/secondary	3.73e-07	2.63e-04

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
US electric grid	Dichloromethane	model/secondary	2.04e-07	1.44e-04
US electric grid	Cumene	model/secondary	1.35e-07	9.54e-05
US electric grid	Phenanthrene	model/secondary	7.12e-08	5.03e-05
US electric grid	Vinyl acetate	model/secondary	5.67e-08	4.01e-05
US electric grid	Biphenyl	model/secondary	4.33e-08	3.06e-05
US electric grid	Chloroform	model/secondary	4.15e-08	2.93e-05
US electric grid	Tetrachloroethylene	model/secondary	3.02e-08	2.14e-05
US electric grid	Ethyl Chloride	model/secondary	2.95e-08	2.09e-05
US electric grid	1,2-Dichloroethane	model/secondary	2.81e-08	1.99e-05
US electric grid	Fluorene	model/secondary	2.38e-08	1.69e-05
US electric grid	Fluoranthene	model/secondary	1.91e-08	1.35e-05
US electric grid	o-xylene	model/secondary	1.62e-08	1.15e-05
US electric grid	Acenaphthene	model/secondary	1.61e-08	1.14e-05
US electric grid	Ethylene dibromide	model/secondary	1.60e-08	1.13e-05
US electric grid	Chlorobenzene	model/secondary	1.55e-08	1.09e-05
US electric grid	1,1,1-Trichloroethane	model/secondary	1.50e-08	1.06e-05
US electric grid	Pyrene	model/secondary	9.46e-09	6.69e-06
US electric grid	2,4-Dinitrotoluene	model/secondary	7.13e-09	5.04e-06
US electric grid	Acenaphthylene	model/secondary	6.41e-09	4.53e-06
US electric grid	Anthracene	model/secondary	5.53e-09	3.91e-06
US electric grid	2-Chloroacetophenone	model/secondary	4.92e-09	3.48e-06
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	3.02e-09	2.14e-06
US electric grid	Chrysene	model/secondary	2.90e-09	2.05e-06
US electric grid	Benzo[a]anthracene	model/secondary	2.63e-09	1.86e-06
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	1.87e-09	1.32e-06
US electric grid	Benzo[g,h,i]perylene	model/secondary	1.02e-09	7.24e-07
US electric grid	Benzo[a]pyrene	model/secondary	9.68e-10	6.84e-07
US electric grid	2-Methylnaphthalene	model/secondary	7.57e-10	5.36e-07
US electric grid	5-Methyl chrysene	model/secondary	5.60e-10	3.96e-07
Total Use, Maintenance and Repair			**1.76e-03**	**1.25e+00**
End-of-life Life-cycle Stage				
LCD landfilling	Hydrocarbons, remaining unspeciated	primary	2.58e-05	1.83e-02
US electric grid	Methane	model/secondary	3.20e-07	2.26e-04
LPG Production	Hydrocarbons, remaining unspeciated	secondary	2.45e-07	1.73e-04
LPG Production	Nonmethane hydrocarbons, remaining unspeciated	secondary	1.67e-07	1.18e-04
LCD landfilling	Methane	primary	9.18e-08	6.49e-05
LCD landfilling	Benzene	primary	3.08e-08	2.18e-05
LPG Production	Methane	secondary	2.31e-08	1.64e-05
LPG Production	Benzene	secondary	1.07e-08	7.55e-06
LCD landfilling	Toluene	primary	6.48e-09	4.58e-06
LCD landfilling	Xylene (mixed isomers)	primary	4.54e-09	3.21e-06
US electric grid	Isophorone	model/secondary	2.80e-09	1.98e-06
LPG Production	Aldehydes	secondary	2.61e-09	1.84e-06
US electric grid	Formaldehyde	model/secondary	2.52e-09	1.78e-06
LPG Production	Formaldehyde	secondary	1.94e-09	1.37e-06
US electric grid	Acetaldehyde	model/secondary	1.60e-09	1.13e-06
US electric grid	Benzene	model/secondary	1.56e-09	1.10e-06
US electric grid	Propionaldehyde	model/secondary	1.46e-09	1.03e-06
LPG Production	Ethane	secondary	1.22e-09	8.60e-07

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
US electric grid	Methyl ethyl ketone	model/secondary	1.17e-09	8.28e-07
LPG Production	Pentane	secondary	1.05e-09	7.39e-07
US electric grid	Toluene	model/secondary	1.01e-09	7.17e-07
LCD landfilling	Ethylbenzene	primary	9.02e-10	6.38e-07
LPG Production	Butane	secondary	8.24e-10	5.82e-07
US electric grid	Acrolein	model/secondary	8.16e-10	5.77e-07
LPG Production	Hexane	secondary	7.39e-10	5.22e-07
US electric grid	Ethylbenzene	model/secondary	4.56e-10	3.22e-07
US electric grid	Bromomethane	model/secondary	4.04e-10	2.86e-07
US electric grid	Xylene (mixed isomers)	model/secondary	1.79e-10	1.26e-07
US electric grid	Hexane	model/secondary	1.77e-10	1.25e-07
US electric grid	Styrene	model/secondary	1.21e-10	8.54e-08
US electric grid	Naphthalene	model/secondary	9.85e-11	6.97e-08
US electric grid	Benzyl chloride	model/secondary	9.34e-11	6.60e-08
US electric grid	Methyl tert-butyl ether	model/secondary	8.85e-11	6.25e-08
US electric grid	Phenol	model/secondary	7.73e-11	5.47e-08
US electric grid	Acetophenone	model/secondary	7.25e-11	5.13e-08
US electric grid	Methyl chloride	model/secondary	7.07e-11	5.00e-08
US electric grid	Dichloromethane	model/secondary	3.87e-11	2.73e-08
US electric grid	Cumene	model/secondary	2.56e-11	1.81e-08
LCD landfilling	Trichloroethylene	primary	2.18e-11	1.54e-08
LCD incineration	Trichloroethylene	secondary	1.69e-11	1.19e-08
LCD landfilling	Vinyl chloride	primary	1.38e-11	9.78e-09
US electric grid	Phenanthrene	model/secondary	1.35e-11	9.55e-09
LPG Production	Isophorone	secondary	1.16e-11	8.22e-09
LCD landfilling	Dichloromethane	primary	1.11e-11	7.82e-09
US electric grid	Vinyl acetate	model/secondary	1.08e-11	7.61e-09
LCD incineration	Vinyl chloride	secondary	1.07e-11	7.59e-09
LPG Production	Toluene	secondary	8.24e-12	5.83e-09
US electric grid	Biphenyl	model/secondary	8.22e-12	5.81e-09
US electric grid	Chloroform	model/secondary	7.87e-12	5.56e-09
LCD landfilling	1,2-Dichloroethane	primary	6.92e-12	4.90e-09
LCD landfilling	Carbon tetrachloride	primary	6.92e-12	4.90e-09
LCD landfilling	Chloroform	primary	6.92e-12	4.90e-09
LCD landfilling	Tetrachloroethylene	primary	6.92e-12	4.90e-09
LPG Production	Acetaldehyde	secondary	6.66e-12	4.71e-09
LPG Production	Propionaldehyde	secondary	6.04e-12	4.27e-09
US electric grid	Tetrachloroethylene	model/secondary	5.73e-12	4.05e-09
US electric grid	Ethyl Chloride	model/secondary	5.60e-12	3.96e-09
LCD incineration	Carbon tetrachloride	secondary	5.37e-12	3.80e-09
US electric grid	1,2-Dichloroethane	model/secondary	5.33e-12	3.77e-09
LPG Production	Methyl ethyl ketone	secondary	4.86e-12	3.44e-09
US electric grid	Fluorene	model/secondary	4.52e-12	3.20e-09
US electric grid	Fluoranthene	model/secondary	3.62e-12	2.56e-09
LPG Production	Acrolein	secondary	3.39e-12	2.39e-09
LPG Production	o-xylene	secondary	3.09e-12	2.19e-09
US electric grid	o-xylene	model/secondary	3.08e-12	2.17e-09
US electric grid	Acenaphthene	model/secondary	3.06e-12	2.16e-09
US electric grid	Ethylene dibromide	model/secondary	3.03e-12	2.14e-09
US electric grid	Chlorobenzene	model/secondary	2.93e-12	2.07e-09

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
US electric grid	1,1,1-Trichloroethane	model/secondary	2.85e-12	2.02e-09
LPG Production	n-Propane	secondary	2.76e-12	1.95e-09
LPG Production	Ethylbenzene	secondary	1.90e-12	1.35e-09
US electric grid	Pyrene	model/secondary	1.79e-12	1.27e-09
LPG Production	Bromomethane	secondary	1.68e-12	1.19e-09
US electric grid	2,4-Dinitrotoluene	model/secondary	1.35e-12	9.57e-10
US electric grid	Acenaphthylene	model/secondary	1.22e-12	8.59e-10
US electric grid	Anthracene	model/secondary	1.05e-12	7.42e-10
LPG Production	Naphthalene	secondary	1.05e-12	7.40e-10
US electric grid	2-Chloroacetophenone	model/secondary	9.34e-13	6.60e-10
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	5.73e-13	4.05e-10
US electric grid	Chrysene	model/secondary	5.50e-13	3.89e-10
LPG Production	Styrene	secondary	5.01e-13	3.54e-10
US electric grid	Benzo[a]anthracene	model/secondary	5.00e-13	3.53e-10
LPG Production	Benzyl chloride	secondary	3.87e-13	2.74e-10
LPG Production	Methyl tert-butyl ether	secondary	3.67e-13	2.60e-10
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	3.55e-13	2.51e-10
LPG Production	Phenol	secondary	3.21e-13	2.27e-10
LPG Production	Acetophenone	secondary	3.01e-13	2.13e-10
LPG Production	Methyl chloride	secondary	2.93e-13	2.07e-10
US electric grid	Benzo[g,h,i]perylene	model/secondary	1.94e-13	1.37e-10
US electric grid	Benzo[a]pyrene	model/secondary	1.84e-13	1.30e-10
LPG Production	Dichloromethane	secondary	1.61e-13	1.13e-10
LPG Production	Aromatic hydrocarbons	secondary	1.57e-13	1.11e-10
US electric grid	2-Methylnaphthalene	model/secondary	1.44e-13	1.02e-10
US electric grid	5-Methyl chrysene	model/secondary	1.06e-13	7.52e-11
LPG Production	Cumene	secondary	1.06e-13	7.52e-11
LPG Production	Phenanthrene	secondary	6.79e-14	4.80e-11
LPG Production	Vinyl acetate	secondary	4.47e-14	3.16e-11
LPG Production	Biphenyl	secondary	3.41e-14	2.41e-11
LPG Production	Chloroform	secondary	3.27e-14	2.31e-11
LPG Production	1,4-Dichlorobenzene	secondary	2.48e-14	1.76e-11
LPG Production	Tetrachloroethylene	secondary	2.38e-14	1.68e-11
LPG Production	Ethyl Chloride	secondary	2.32e-14	1.64e-11
LPG Production	1,2-Dichloroethane	secondary	2.21e-14	1.57e-11
LPG Production	Fluorene	secondary	2.08e-14	1.47e-11
LPG Production	2-Methylnaphthalene	secondary	1.80e-14	1.27e-11
LPG Production	Fluoranthene	secondary	1.70e-14	1.20e-11
LPG Production	Acenaphthene	secondary	1.57e-14	1.11e-11
LPG Production	Ethylene dibromide	secondary	1.26e-14	8.90e-12
LPG Production	Chlorobenzene	secondary	1.22e-14	8.61e-12
LPG Production	1,1,1-Trichloroethane	secondary	1.11e-14	7.83e-12
LPG Production	Pyrene	secondary	1.08e-14	7.63e-12
LPG Production	Acenaphthylene	secondary	6.41e-15	4.53e-12
LPG Production	Anthracene	secondary	6.25e-15	4.42e-12
LPG Production	2,4-Dinitrotoluene	secondary	5.62e-15	3.97e-12
LPG Production	2-Chloroacetophenone	secondary	3.87e-15	2.74e-12
LPG Production	Benzo[a]anthracene	secondary	3.74e-15	2.65e-12

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
LPG Production	Chrysene	secondary	3.59e-15	2.54e-12
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	2.78e-15	1.97e-12
LPG Production	Benzo[b,j,k]fluoranthene	secondary	2.21e-15	1.56e-12
LPG Production	Benzo[a]pyrene	secondary	2.05e-15	1.45e-12
LPG Production	Benzo[g,h,i]perylene	secondary	1.66e-15	1.18e-12
LPG Production	5-Methyl chrysene	secondary	4.41e-16	3.12e-13
LPG Production	Polycyclic aromatic hydrocarbons	secondary	1.75e-16	1.24e-13
Natural Gas Prod.	Polycyclic aromatic hydrocarbons	secondary	-2.97e-16	-2.10e-13
LCD incineration	Polycyclic aromatic hydrocarbons	secondary	-4.52e-15	-3.20e-12
Natural Gas Prod.	5-Methyl chrysene	secondary	-6.43e-14	-4.55e-11
Fuel Oil #4 Prod.	Polycyclic aromatic hydrocarbons	secondary	-7.19e-14	-5.08e-11
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	-2.66e-13	-1.88e-10
Natural Gas Prod.	Aromatic hydrocarbons	secondary	-2.67e-13	-1.89e-10
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	-3.22e-13	-2.27e-10
Natural Gas Prod.	2-Chloroacetophenone	secondary	-5.65e-13	-3.99e-10
Natural Gas Prod.	Benzo[a]pyrene	secondary	-7.93e-13	-5.61e-10
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	-8.04e-13	-5.69e-10
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	-8.19e-13	-5.79e-10
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	-8.74e-13	-6.18e-10
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	-1.18e-12	-8.37e-10
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	-1.24e-12	-8.78e-10
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	-1.33e-12	-9.40e-10
Natural Gas Prod.	Chrysene	secondary	-1.36e-12	-9.62e-10
Natural Gas Prod.	Benzo[a]anthracene	secondary	-1.41e-12	-9.98e-10
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	-1.51e-12	-1.07e-09
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	-1.61e-12	-1.14e-09
Natural Gas Prod.	Acenaphthylene	secondary	-1.76e-12	-1.25e-09
Natural Gas Prod.	Chlorobenzene	secondary	-1.78e-12	-1.25e-09
Natural Gas Prod.	Ethylene dibromide	secondary	-1.83e-12	-1.30e-09
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	-1.98e-12	-1.40e-09
Fuel Oil #4 Prod.	Chrysene	secondary	-1.99e-12	-1.41e-09
Natural Gas Prod.	Anthracene	secondary	-2.02e-12	-1.43e-09
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	-2.34e-12	-1.65e-09
Natural Gas Prod.	1,2-Dichloroethane	secondary	-3.23e-12	-2.28e-09
Natural Gas Prod.	Acenaphthene	secondary	-3.34e-12	-2.36e-09
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	-3.39e-12	-2.39e-09
Natural Gas Prod.	Ethyl Chloride	secondary	-3.39e-12	-2.40e-09
Natural Gas Prod.	Tetrachloroethylene	secondary	-3.47e-12	-2.45e-09
Fuel Oil #4 Prod.	Anthracene	secondary	-3.55e-12	-2.51e-09
Fuel Oil #4 Prod.	Acenaphthylene	secondary	-3.73e-12	-2.64e-09
Natural Gas Prod.	Fluoranthene	secondary	-3.87e-12	-2.74e-09
Natural Gas Prod.	Pyrene	secondary	-3.89e-12	-2.75e-09
LCD incineration	Aromatic hydrocarbons	secondary	-4.07e-12	-2.88e-09
LCD incineration	2-Methylnaphthalene	secondary	-4.30e-12	-3.04e-09
Natural Gas Prod.	Fluorene	secondary	-4.34e-12	-3.07e-09
Natural Gas Prod.	Chloroform	secondary	-4.76e-12	-3.37e-09
Natural Gas Prod.	Biphenyl	secondary	-4.97e-12	-3.51e-09
LCD incineration	Dichlorobenzene (mixed isomers)	secondary	-5.93e-12	-4.19e-09
Fuel Oil #4 Prod.	Pyrene	secondary	-6.06e-12	-4.29e-09
Natural Gas Prod.	Vinyl acetate	secondary	-6.51e-12	-4.60e-09

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	-6.67e-12	-4.72e-09
Fuel Oil #4 Prod.	Chlorobenzene	secondary	-7.34e-12	-5.19e-09
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	-7.59e-12	-5.37e-09
Fuel Oil #4 Prod.	Acenaphthene	secondary	-8.56e-12	-6.05e-09
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	-9.12e-12	-6.45e-09
Fuel Oil #4 Prod.	Fluoranthene	secondary	-9.92e-12	-7.01e-09
Fuel Oil #4 Prod.	Fluorene	secondary	-1.23e-11	-8.66e-09
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	-1.26e-11	-8.90e-09
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	-1.33e-11	-9.44e-09
Natural Gas Prod.	2-Methylnaphthalene	secondary	-1.36e-11	-9.63e-09
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	-1.40e-11	-9.91e-09
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	-1.43e-11	-1.01e-08
Natural Gas Prod.	Cumene	secondary	-1.55e-11	-1.10e-08
LCD incineration	5-Methyl chrysene	secondary	-1.61e-11	-1.14e-08
Natural Gas Prod.	Phenanthrene	secondary	-1.78e-11	-1.25e-08
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	-1.88e-11	-1.33e-08
Fuel Oil #4 Prod.	Chloroform	secondary	-1.97e-11	-1.39e-08
LCD incineration	Benzo[g,h,i]perylene	secondary	-2.00e-11	-1.42e-08
Fuel Oil #4 Prod.	Biphenyl	secondary	-2.06e-11	-1.45e-08
Natural Gas Prod.	Dichloromethane	secondary	-2.34e-11	-1.65e-08
Fuel Oil #4 Prod.	Vinyl acetate	secondary	-2.69e-11	-1.90e-08
LCD incineration	Benzo[a]pyrene	secondary	-2.81e-11	-1.99e-08
Fuel Oil #4 Prod.	Phenanthrene	secondary	-3.95e-11	-2.80e-08
Natural Gas Prod.	Methyl chloride	secondary	-4.28e-11	-3.02e-08
Natural Gas Prod.	Acetophenone	secondary	-4.39e-11	-3.10e-08
LCD incineration	Indeno(1,2,3-cd)pyrene	secondary	-4.51e-11	-3.19e-08
Natural Gas Prod.	Phenol	secondary	-4.68e-11	-3.31e-08
Natural Gas Prod.	Methyl tert-butyl ether	secondary	-5.35e-11	-3.78e-08
Natural Gas Prod.	Benzyl chloride	secondary	-5.65e-11	-3.99e-08
LCD incineration	Benzo[a]anthracene	secondary	-5.90e-11	-4.17e-08
Fuel Oil #4 Prod.	Cumene	secondary	-6.41e-11	-4.53e-08
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	-6.47e-11	-4.57e-08
Natural Gas Prod.	Styrene	secondary	-7.31e-11	-5.17e-08
LCD incineration	Chrysene	secondary	-7.36e-11	-5.21e-08
LCD incineration	Benzo[b,j,k]fluoranthene	secondary	-8.06e-11	-5.70e-08
Fuel Oil #4 Prod.	Dichloromethane	secondary	-9.68e-11	-6.84e-08
LCD incineration	Anthracene	secondary	-1.54e-10	-1.09e-07
Fuel Oil #4 Prod.	Methyl chloride	secondary	-1.77e-10	-1.25e-07
Fuel Oil #4 Prod.	Acetophenone	secondary	-1.81e-10	-1.28e-07
LCD incineration	Acenaphthylene	secondary	-1.84e-10	-1.30e-07
Fuel Oil #4 Prod.	Phenol	secondary	-1.93e-10	-1.37e-07
LCD incineration	2,4-Dinitrotoluene	secondary	-2.05e-10	-1.45e-07
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	-2.21e-10	-1.56e-07
Fuel Oil #4 Prod.	Benzyl chloride	secondary	-2.34e-10	-1.65e-07
LCD incineration	Pyrene	secondary	-2.43e-10	-1.72e-07
Natural Gas Prod.	Bromomethane	secondary	-2.45e-10	-1.73e-07
Natural Gas Prod.	Ethylbenzene	secondary	-2.78e-10	-1.97e-07
Fuel Oil #4 Prod.	Styrene	secondary	-3.02e-10	-2.14e-07

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
LCD incineration	Acenaphthene	secondary	-3.74e-10	-2.65e-07
LCD incineration	1,1,1-Trichloroethane	secondary	-4.05e-10	-2.86e-07
Natural Gas Prod.	n-Propane	secondary	-4.43e-10	-3.14e-07
Natural Gas Prod.	Naphthalene	secondary	-4.44e-10	-3.14e-07
LCD incineration	Chlorobenzene	secondary	-4.45e-10	-3.15e-07
LCD incineration	Ethylene dibromide	secondary	-4.60e-10	-3.25e-07
Natural Gas Prod.	Acrolein	secondary	-4.94e-10	-3.49e-07
LCD incineration	Fluoranthene	secondary	-5.21e-10	-3.68e-07
Fuel Oil #4 Prod.	Naphthalene	secondary	-5.45e-10	-3.85e-07
LCD incineration	Fluorene	secondary	-6.68e-10	-4.72e-07
Natural Gas Prod.	Methyl ethyl ketone	secondary	-7.09e-10	-5.01e-07
LCD incineration	1,2-Dichloroethane	secondary	-8.04e-10	-5.68e-07
LCD incineration	Ethyl Chloride	secondary	-8.50e-10	-6.01e-07
LCD incineration	Tetrachloroethylene	secondary	-8.65e-10	-6.11e-07
Natural Gas Prod.	Propionaldehyde	secondary	-8.80e-10	-6.22e-07
Natural Gas Prod.	Acetaldehyde	secondary	-9.70e-10	-6.86e-07
Fuel Oil #4 Prod.	Bromomethane	secondary	-1.01e-09	-7.15e-07
Fuel Oil #4 Prod.	Ethylbenzene	secondary	-1.15e-09	-8.10e-07
LCD incineration	Chloroform	secondary	-1.19e-09	-8.40e-07
LCD incineration	Biphenyl	secondary	-1.25e-09	-8.81e-07
LCD incineration	Vinyl acetate	secondary	-1.63e-09	-1.15e-06
Fuel Oil #4 Prod.	o-xylene	secondary	-1.63e-09	-1.16e-06
Fuel Oil #4 Prod.	n-Propane	secondary	-1.66e-09	-1.17e-06
Natural Gas Prod.	Isophorone	secondary	-1.70e-09	-1.20e-06
LCD incineration	Phenanthrene	secondary	-1.98e-09	-1.40e-06
Fuel Oil #4 Prod.	Acrolein	secondary	-2.04e-09	-1.44e-06
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	-2.93e-09	-2.07e-06
Fuel Oil #4 Prod.	Propionaldehyde	secondary	-3.64e-09	-2.57e-06
LCD incineration	Cumene	secondary	-3.89e-09	-2.75e-06
Fuel Oil #4 Prod.	Acetaldehyde	secondary	-4.01e-09	-2.84e-06
Fuel Oil #4 Prod.	Toluene	secondary	-4.52e-09	-3.20e-06
LCD incineration	Dichloromethane	secondary	-5.86e-09	-4.14e-06
Fuel Oil #4 Prod.	Isophorone	secondary	-7.01e-09	-4.96e-06
Natural Gas Prod.	Toluene	secondary	-9.63e-09	-6.80e-06
LCD incineration	Methyl chloride	secondary	-1.07e-08	-7.58e-06
LCD incineration	Acetophenone	secondary	-1.10e-08	-7.77e-06
LCD incineration	Phenol	secondary	-1.17e-08	-8.29e-06
LCD incineration	Methyl tert-butyl ether	secondary	-1.34e-08	-9.49e-06
LCD incineration	Naphthalene	secondary	-1.35e-08	-9.57e-06
LCD incineration	Benzyl chloride	secondary	-1.42e-08	-1.00e-05
Natural Gas Prod.	o-xylene	secondary	-1.74e-08	-1.23e-05
LCD incineration	Styrene	secondary	-1.83e-08	-1.30e-05
LCD incineration	Xylene (mixed isomers)	secondary	-2.54e-08	-1.79e-05
Natural Gas Prod.	Formaldehyde	secondary	-3.37e-08	-2.38e-05
LCD incineration	Bromomethane	secondary	-6.14e-08	-4.34e-05
LCD incineration	Ethylbenzene	secondary	-6.84e-08	-4.84e-05
LCD incineration	n-Propane	secondary	-9.86e-08	-6.97e-05
LCD incineration	Acrolein	secondary	-1.24e-07	-8.75e-05
LCD incineration	Toluene	secondary	-1.59e-07	-1.13e-04
LCD incineration	Methyl ethyl ketone	secondary	-1.78e-07	-1.26e-04

Table M-18. LCD LCIA Results for the Photochemical Smog Impact Category

Process Group	Material	LCI Data Type	Photo. Smog (kg ethene-equivalents)	% of Total
LCD incineration	Butane	secondary	-1.97e-07	-1.39e-04
LCD incineration	Hexane	secondary	-2.03e-07	-1.44e-04
LCD incineration	Propionaldehyde	secondary	-2.21e-07	-1.56e-04
LCD incineration	Acetaldehyde	secondary	-2.43e-07	-1.72e-04
LCD incineration	Pentane	secondary	-2.50e-07	-1.76e-04
LCD incineration	Ethane	secondary	-2.90e-07	-2.05e-04
Fuel Oil #4 Prod.	Hexane	secondary	-3.74e-07	-2.65e-04
Fuel Oil #4 Prod.	Butane	secondary	-4.17e-07	-2.95e-04
LCD incineration	Isophorone	secondary	-4.25e-07	-3.01e-04
Fuel Oil #4 Prod.	Pentane	secondary	-5.30e-07	-3.74e-04
Natural Gas Prod.	Hexane	secondary	-5.59e-07	-3.95e-04
Fuel Oil #4 Prod.	Ethane	secondary	-6.16e-07	-4.36e-04
Natural Gas Prod.	Butane	secondary	-6.24e-07	-4.41e-04
Natural Gas Prod.	Pentane	secondary	-7.91e-07	-5.60e-04
Natural Gas Prod.	Ethane	secondary	-9.20e-07	-6.51e-04
LCD incineration	Formaldehyde	secondary	-1.06e-06	-7.52e-04
Fuel Oil #4 Prod.	Aldehydes	secondary	-1.32e-06	-9.32e-04
Fuel Oil #4 Prod.	Formaldehyde	secondary	-1.34e-06	-9.48e-04
Natural Gas Prod.	Aldehydes	secondary	-1.58e-06	-1.12e-03
Fuel Oil #4 Prod.	Benzene	secondary	-5.41e-06	-3.82e-03
LCD incineration	Benzene	secondary	-6.58e-06	-4.65e-03
Natural Gas Prod.	Hydrocarbons, remaining unspeciated	secondary	-8.20e-06	-5.80e-03
Fuel Oil #4 Prod.	Methane	secondary	-1.30e-05	-9.16e-03
LCD incineration	Aldehydes	secondary	-4.38e-05	-3.10e-02
LCD incineration	Methane	secondary	-6.89e-05	-4.87e-02
Natural Gas Prod.	Benzene	secondary	-7.92e-05	-5.60e-02
LCD incineration	Nonmethane hydrocarbons, remaining unspeciated	secondary	-9.99e-05	-7.07e-02
Fuel Oil #4 Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	-1.03e-04	-7.27e-02
Natural Gas Prod.	Methane	secondary	-1.16e-04	-8.22e-02
LCD incineration	Hydrocarbons, remaining unspeciated	secondary	-1.24e-04	-8.77e-02
Fuel Oil #4 Prod.	Hydrocarbons, remaining unspeciated	secondary	-1.53e-04	-1.08e-01
Natural Gas Prod.	Nonmethane hydrocarbons, remaining unspeciated	secondary	-2.98e-04	-2.11e-01
Total End-of-life			**-1.11e-03**	**-7.82e-01**
Total All Life-cycle Stages			**1.41e-01**	**1.00e+02**

Table M-19. CRT LCIA Results for the Acidification Impact Category

Process Group	Material	LCI Data Type	Acidification (kg SO2 Equivalents)	% of Total
Materials Processing Life-cycle Stage				
Invar	Sulfur dioxide	secondary	2.50e-01	4.75e+00
Steel Prod., cold-rolled, semi-finished	Sulfur dioxide	secondary	3.84e-02	7.31e-01
Aluminum Prod.	Sulfur dioxide	secondary	2.09e-02	3.98e-01
Polycarbonate Production	Nitrogen dioxide	secondary	1.36e-02	2.59e-01
Polycarbonate Production	Sulfur dioxide	secondary	1.20e-02	2.29e-01
Steel Prod., cold-rolled, semi-finished	Nitrogen dioxide	secondary	9.36e-03	1.78e-01
Lead	Sulfur dioxide	secondary	6.92e-03	1.32e-01
Styrene-butadiene Copolymer Prod.	Sulfur oxides	secondary	5.71e-03	1.09e-01
Aluminum Prod.	Nitrogen dioxide	secondary	4.99e-03	9.51e-02
Styrene-butadiene Copolymer Prod.	Nitrogen oxides	secondary	4.89e-03	9.32e-02
ABS Production	Sulfur dioxide	secondary	4.24e-03	8.07e-02
Ferrite mfg.	Sulfur dioxide	secondary	3.56e-03	6.78e-02
Invar	Nitrogen dioxide	secondary	3.55e-03	6.75e-02
ABS Production	Nitrogen dioxide	secondary	3.26e-03	6.21e-02
Lead	Nitrogen dioxide	secondary	2.93e-03	5.58e-02
Polystyrene Prod., high-impact	Sulfur dioxide	secondary	1.81e-03	3.45e-02
Ferrite mfg.	Nitrogen dioxide	secondary	1.42e-03	2.70e-02
Polystyrene Prod., high-impact	Nitrogen dioxide	secondary	1.27e-03	2.42e-02
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	7.79e-04	1.48e-02
ABS Production	Hydrochloric acid	secondary	5.63e-04	1.07e-02
Steel Prod., cold-rolled, semi-finished	Nitrous oxide	secondary	5.44e-04	1.04e-02
Steel Prod., cold-rolled, semi-finished	Hydrochloric acid	secondary	3.93e-04	7.48e-03
ABS Production	Hydrofluoric acid	secondary	3.90e-04	7.42e-03
Aluminum Prod.	Hydrofluoric acid	secondary	3.85e-04	7.33e-03
Invar	Hydrochloric acid	secondary	3.56e-04	6.77e-03
Aluminum Prod.	Hydrochloric acid	secondary	3.43e-04	6.53e-03
Lead	Hydrochloric acid	secondary	2.06e-04	3.92e-03
Ferrite mfg.	Hydrochloric acid	secondary	1.33e-04	2.54e-03
Aluminum Prod.	Nitrous oxide	secondary	9.67e-05	1.84e-03
Polycarbonate Production	Hydrochloric acid	secondary	8.94e-05	1.70e-03
Invar	Hydrofluoric acid	secondary	4.30e-05	8.19e-04
Steel Prod., cold-rolled, semi-finished	Hydrofluoric acid	secondary	3.03e-05	5.77e-04
Steel Prod., cold-rolled, semi-finished	Hydrogen sulfide	secondary	2.55e-05	4.87e-04
Lead	Hydrofluoric acid	secondary	2.18e-05	4.16e-04
ABS Production	Hydrogen sulfide	secondary	1.90e-05	3.62e-04
Aluminum Prod.	Ammonia	secondary	1.69e-05	3.22e-04
Lead	Nitrous oxide	secondary	1.42e-05	2.71e-04
Invar	Hydrogen sulfide	secondary	1.37e-05	2.60e-04
Styrene-butadiene Copolymer Prod.	Hydrochloric acid	secondary	1.31e-05	2.50e-04
Lead	Ammonia	secondary	1.30e-05	2.47e-04
Ferrite mfg.	Hydrofluoric acid	secondary	1.02e-05	1.94e-04
Ferrite mfg.	Hydrogen sulfide	secondary	9.72e-06	1.85e-04
Ferrite mfg.	Nitrous oxide	secondary	7.44e-06	1.42e-04
Aluminum Prod.	Hydrogen sulfide	secondary	7.08e-06	1.35e-04
Invar	Ammonia	secondary	6.66e-06	1.27e-04
Polycarbonate Production	Hydrofluoric acid	secondary	5.91e-06	1.13e-04
Lead	Hydrogen sulfide	secondary	5.57e-06	1.06e-04
Polystyrene Prod., high-impact	Hydrochloric acid	secondary	4.66e-06	8.87e-05
Polycarbonate Production	Hydrogen sulfide	secondary	3.47e-06	6.61e-05
Ferrite mfg.	Ammonia	secondary	2.20e-06	4.19e-05

Table M-19. CRT LCIA Results for the Acidification Impact Category

Process Group	Material	LCI Data Type	Acidification (kg SO2 Equivalents)	% of Total
ABS Production	Ammonia	secondary	1.59e-06	3.03e-05
Styrene-butadiene Copolymer Prod.	Hydrofluoric acid	secondary	6.62e-07	1.26e-05
Styrene-butadiene Copolymer Prod.	Ammonia	secondary	3.89e-07	7.41e-06
Styrene-butadiene Copolymer Prod.	Hydrogen sulfide	secondary	3.89e-07	7.41e-06
Polycarbonate Production	Nitrous oxide	secondary	3.23e-07	6.15e-06
Polycarbonate Production	Sulfuric acid	secondary	3.00e-07	5.72e-06
ABS Production	Nitrous oxide	secondary	1.48e-07	2.82e-06
Styrene-butadiene Copolymer Prod.	Nitrous oxide	secondary	1.45e-07	2.76e-06
ABS Production	Sulfuric acid	secondary	1.38e-07	2.62e-06
Styrene-butadiene Copolymer Prod.	Sulfuric acid	secondary	1.34e-07	2.56e-06
Invar	Nitrous oxide	secondary	3.39e-08	6.46e-07
Invar	Sulfuric acid	secondary	5.66e-11	1.08e-09
Ferrite mfg.	Sulfuric acid	secondary	5.53e-11	1.05e-09
Total Materials Processing			**3.93e-01**	**7.48e+00**
Manufacturing Life-cycle Stage				
LPG Production	Sulfur oxides	secondary	8.01e-01	1.53e+01
LPG Production	Nitrogen oxides	secondary	4.01e-01	7.64e+00
Japanese Electric Grid	Sulfur dioxide	model/secondary	8.62e-02	1.64e+00
US electric grid	Sulfur dioxide	model/secondary	3.98e-02	7.58e-01
Glass/frit	Nitrogen oxides	primary	3.09e-02	5.88e-01
Japanese Electric Grid	Nitrogen oxides	model/secondary	2.85e-02	5.42e-01
US electric grid	Nitrogen oxides	model/secondary	1.32e-02	2.50e-01
LPG Production	Nitrous oxide	secondary	1.14e-02	2.16e-01
CRT tube mfg.	Sulfur oxides	primary	9.96e-03	1.90e-01
LPG Production	Hydrochloric acid	secondary	7.07e-03	1.35e-01
Natural Gas Prod.	Nitrogen oxides	secondary	6.53e-03	1.24e-01
LPG Production	Hydrogen sulfide	secondary	5.76e-03	1.10e-01
Fuel Oil #6 Prod.	Sulfur oxides	secondary	5.47e-03	1.04e-01
LPG Production	Ammonia	secondary	4.09e-03	7.79e-02
Fuel Oil #6 Prod.	Nitrogen oxides	secondary	2.87e-03	5.46e-02
Fuel Oil #2 Prod.	Sulfur oxides	secondary	2.44e-03	4.64e-02
LPG Production	Hydrofluoric acid	secondary	1.61e-03	3.06e-02
CRT tube mfg.	Nitrogen oxides	primary	1.52e-03	2.89e-02
US electric grid	Hydrochloric acid	model/secondary	1.51e-03	2.88e-02
Fuel Oil #2 Prod.	Nitrogen oxides	secondary	1.23e-03	2.34e-02
Japanese Electric Grid	Hydrochloric acid	model/secondary	1.21e-03	2.30e-02
Glass/frit	Nitrogen oxides	primary	3.73e-04	7.11e-03
US electric grid	Hydrofluoric acid	model/secondary	3.44e-04	6.54e-03
Natural Gas Prod.	Ammonia	secondary	2.94e-04	5.61e-03
Natural Gas Prod.	Sulfur oxides	secondary	2.76e-04	5.25e-03
Japanese Electric Grid	Hydrofluoric acid	model/secondary	2.74e-04	5.22e-03
Fuel Oil #4 Prod.	Sulfur oxides	secondary	2.45e-04	4.66e-03
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	1.26e-04	2.39e-03
Fuel Oil #6 Prod.	Nitrous oxide	secondary	1.02e-04	1.93e-03
Japanese Electric Grid	Nitrous oxide	model/secondary	7.82e-05	1.49e-03
Fuel Oil #6 Prod.	Hydrogen sulfide	secondary	5.97e-05	1.14e-03
Fuel Oil #6 Prod.	Hydrochloric acid	secondary	5.70e-05	1.09e-03
Glass/frit	Sulfur oxides	primary	5.08e-05	9.68e-04
US electric grid	Nitrous oxide	model/secondary	3.80e-05	7.23e-04

Table M-19. CRT LCIA Results for the Acidification Impact Category

Process Group	Material	LCI Data Type	Acidification (kg SO2 Equivalents)	% of Total
Fuel Oil #2 Prod.	Nitrous oxide	secondary	3.63e-05	6.91e-04
Fuel Oil #2 Prod.	Hydrochloric acid	secondary	2.22e-05	4.22e-04
Fuel Oil #6 Prod.	Ammonia	secondary	2.20e-05	4.20e-04
Fuel Oil #2 Prod.	Hydrogen sulfide	secondary	1.90e-05	3.62e-04
Fuel Oil #6 Prod.	Hydrofluoric acid	secondary	1.30e-05	2.47e-04
Natural Gas Prod.	Hydrochloric acid	secondary	1.23e-05	2.34e-04
Fuel Oil #2 Prod.	Ammonia	secondary	1.21e-05	2.30e-04
Natural Gas Prod.	Nitrous oxide	secondary	8.08e-06	1.54e-04
Fuel Oil #2 Prod.	Hydrofluoric acid	secondary	5.04e-06	9.60e-05
Fuel Oil #4 Prod.	Nitrous oxide	secondary	4.02e-06	7.66e-05
Natural Gas Prod.	Hydrofluoric acid	secondary	2.79e-06	5.31e-05
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	2.36e-06	4.50e-05
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	2.23e-06	4.24e-05
Fuel Oil #4 Prod.	Ammonia	secondary	1.12e-06	2.13e-05
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	5.37e-07	1.02e-05
Natural Gas Prod.	Hydrogen sulfide	secondary	1.27e-07	2.41e-06
Total Manufacturing			**1.47e+00**	**2.79e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Sulfur dioxide	model/secondary	2.49e+00	4.75e+01
US electric grid	Nitrogen oxides	model/secondary	8.24e-01	1.57e+01
US electric grid	Hydrochloric acid	model/secondary	9.47e-02	1.80e+00
US electric grid	Hydrofluoric acid	model/secondary	2.15e-02	4.10e-01
US electric grid	Nitrous oxide	model/secondary	2.38e-03	4.53e-02
Total Use, Maintenance and Repair			**3.44e+00**	**6.54e+01**
End-of-life Life-cycle Stage				
CRT landfilling	Nitrogen dioxide	primary	1.30e-03	2.47e-02
CRT Incineration	Sulfur dioxide	secondary	3.00e-04	5.72e-03
CRT landfilling	Sulfur dioxide	primary	2.80e-04	5.33e-03
US electric grid	Sulfur dioxide	model/secondary	2.49e-04	4.75e-03
US electric grid	Nitrogen oxides	model/secondary	8.24e-05	1.57e-03
US electric grid	Hydrochloric acid	model/secondary	9.48e-06	1.80e-04
LPG Production	Sulfur oxides	secondary	6.92e-06	1.32e-04
LPG Production	Nitrogen oxides	secondary	3.46e-06	6.59e-05
US electric grid	Hydrofluoric acid	model/secondary	2.15e-06	4.10e-05
CRT landfilling	Hydrochloric acid	primary	9.00e-07	1.71e-05
CRT landfilling	Hydrogen sulfide	primary	4.33e-07	8.25e-06
US electric grid	Nitrous oxide	model/secondary	2.38e-07	4.53e-06
LPG Production	Nitrous oxide	secondary	9.80e-08	1.87e-06
LPG Production	Hydrochloric acid	secondary	6.10e-08	1.16e-06
LPG Production	Hydrogen sulfide	secondary	4.97e-08	9.47e-07
LPG Production	Ammonia	secondary	3.53e-08	6.73e-07
LPG Production	Hydrofluoric acid	secondary	1.39e-08	2.64e-07
Natural Gas Prod.	Hydrogen sulfide	secondary	-6.34e-08	-1.21e-06
CRT Incineration	Hydrogen sulfide	secondary	-1.15e-06	-2.19e-05
Natural Gas Prod.	Hydrofluoric acid	secondary	-1.40e-06	-2.66e-05
Natural Gas Prod.	Nitrous oxide	secondary	-4.05e-06	-7.72e-05
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	-5.78e-06	-1.10e-04
Natural Gas Prod.	Hydrochloric acid	secondary	-6.16e-06	-1.17e-04
Fuel Oil #4 Prod.	Ammonia	secondary	-1.20e-05	-2.29e-04
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	-2.40e-05	-4.56e-04

Table M-19. CRT LCIA Results for the Acidification Impact Category

Process Group	Material	LCI Data Type	Acidification (kg SO2 Equivalents)	% of Total
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	-2.54e-05	-4.84e-04
CRT Incineration	Ammonia	secondary	-3.91e-05	-7.44e-04
Fuel Oil #4 Prod.	Nitrous oxide	secondary	-4.33e-05	-8.24e-04
Natural Gas Prod.	Sulfur oxides	secondary	-1.38e-04	-2.63e-03
Natural Gas Prod.	Ammonia	secondary	-1.48e-04	-2.81e-03
CRT Incineration	Hydrofluoric acid	secondary	-3.57e-04	-6.80e-03
CRT Incineration	Nitrous oxide	secondary	-7.29e-04	-1.39e-02
CRT Incineration	Hydrochloric acid	secondary	-8.95e-04	-1.70e-02
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	-1.35e-03	-2.57e-02
Fuel Oil #4 Prod.	Sulfur oxides	secondary	-2.63e-03	-5.01e-02
Natural Gas Prod.	Nitrogen oxides	secondary	-3.27e-03	-6.23e-02
CRT Incineration	Nitrogen oxides	secondary	-8.78e-03	-1.67e-01
CRT Incineration	Sulfur oxides	secondary	-2.70e-02	-5.14e-01
Total End-of-life			**-4.32e-02**	**-8.23e-01**
Total All Life-cycle Stages			**5.25e+00**	**1.00e+02**

Table M-20. LCD LCIA Results for the Acidification Impact Category

Process Group	Material	LCI Data Type	Acidification (kg SO2 Equivalents)	% of Total
Materials Processing Life-cycle Stage				
Natural Gas Prod.	Nitrogen oxides	secondary	4.56e-01	1.54e+01
Natural Gas Prod.	Ammonia	secondary	2.06e-02	6.95e-01
Natural Gas Prod.	Sulfur oxides	secondary	1.93e-02	6.51e-01
Steel Prod., cold-rolled, semi-finished	Sulfur dioxide	secondary	1.88e-02	6.36e-01
PMMA Sheet Prod.	Sulfur dioxide	secondary	1.30e-02	4.41e-01
Aluminum Prod.	Sulfur dioxide	secondary	7.77e-03	2.63e-01
Polycarbonate Production	Nitrogen dioxide	secondary	7.58e-03	2.56e-01
PMMA Sheet Prod.	Nitrogen dioxide	secondary	7.52e-03	2.54e-01
Polycarbonate Production	Sulfur dioxide	secondary	6.70e-03	2.27e-01
Steel Prod., cold-rolled, semi-finished	Nitrogen dioxide	secondary	4.59e-03	1.55e-01
PET Resin Production	Sulfur oxides	secondary	3.99e-03	1.35e-01
Styrene-butadiene Copolymer Prod.	Sulfur oxides	secondary	2.50e-03	8.43e-02
Styrene-butadiene Copolymer Prod.	Nitrogen oxides	secondary	2.14e-03	7.23e-02
Aluminum Prod.	Nitrogen dioxide	secondary	1.86e-03	6.28e-02
PET Resin Production	Nitrogen oxides	secondary	1.21e-03	4.08e-02
Natural Gas Prod.	Hydrochloric acid	secondary	8.57e-04	2.90e-02
Natural Gas Prod.	Nitrous oxide	secondary	5.65e-04	1.91e-02
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	3.82e-04	1.29e-02
Steel Prod., cold-rolled, semi-finished	Nitrous oxide	secondary	2.67e-04	9.01e-03
Natural Gas Prod.	Hydrofluoric acid	secondary	1.95e-04	6.58e-03
Steel Prod., cold-rolled, semi-finished	Hydrochloric acid	secondary	1.93e-04	6.51e-03
Aluminum Prod.	Hydrofluoric acid	secondary	1.43e-04	4.84e-03
Aluminum Prod.	Hydrochloric acid	secondary	1.28e-04	4.31e-03
PMMA Sheet Prod.	Hydrochloric acid	secondary	5.74e-05	1.94e-03
Polycarbonate Production	Hydrochloric acid	secondary	4.99e-05	1.69e-03
Aluminum Prod.	Nitrous oxide	secondary	3.60e-05	1.22e-03
PET Resin Production	Hydrochloric acid	secondary	2.80e-05	9.45e-04
PMMA Sheet Prod.	Ammonia	secondary	1.51e-05	5.12e-04
Steel Prod., cold-rolled, semi-finished	Hydrofluoric acid	secondary	1.48e-05	5.02e-04
Steel Prod., cold-rolled, semi-finished	Hydrogen sulfide	secondary	1.25e-05	4.23e-04
Natural Gas Prod.	Hydrogen sulfide	secondary	8.84e-06	2.99e-04
Aluminum Prod.	Ammonia	secondary	6.30e-06	2.13e-04
Styrene-butadiene Copolymer Prod.	Hydrochloric acid	secondary	5.73e-06	1.94e-04
PMMA Sheet Prod.	Hydrofluoric acid	secondary	5.52e-06	1.87e-04
Polycarbonate Production	Hydrofluoric acid	secondary	3.30e-06	1.12e-04
PMMA Sheet Prod.	Hydrogen sulfide	secondary	2.88e-06	9.75e-05
Aluminum Prod.	Hydrogen sulfide	secondary	2.64e-06	8.91e-05
Polycarbonate Production	Hydrogen sulfide	secondary	1.94e-06	6.55e-05
PET Resin Production	Hydrofluoric acid	secondary	1.45e-06	4.91e-05
Styrene-butadiene Copolymer Prod.	Hydrofluoric acid	secondary	2.89e-07	9.78e-06
Polycarbonate Production	Nitrous oxide	secondary	1.81e-07	6.10e-06
PET Resin Production	Ammonia	secondary	1.71e-07	5.77e-06
PET Resin Production	Hydrogen sulfide	secondary	1.71e-07	5.77e-06
Styrene-butadiene Copolymer Prod.	Ammonia	secondary	1.70e-07	5.75e-06
Styrene-butadiene Copolymer Prod.	Hydrogen sulfide	secondary	1.70e-07	5.75e-06
Polycarbonate Production	Sulfuric acid	secondary	1.68e-07	5.66e-06
PMMA Sheet Prod.	Nitrous oxide	secondary	1.34e-07	4.54e-06
PMMA Sheet Prod.	Sulfuric acid	secondary	1.25e-07	4.21e-06
PET Resin Production	Nitrous oxide	secondary	6.35e-08	2.15e-06
Styrene-butadiene Copolymer Prod.	Nitrous oxide	secondary	6.33e-08	2.14e-06

Table M-20. LCD LCIA Results for the Acidification Impact Category

Process Group	Material	LCI Data Type	Acidification (kg SO2 Equivalents)	% of Total
PET Resin Production	Sulfuric acid	secondary	5.90e-08	1.99e-06
Styrene-butadiene Copolymer Prod.	Sulfuric acid	secondary	5.88e-08	1.99e-06
Total Materials Processing			**5.76e-01**	**1.95e+01**
Manufacturing Life-cycle Stage				
Monitor/module	Nitrogen oxides	primary	3.84e-01	1.30e+01
Japanese Electric Grid	Sulfur dioxide	model/secondary	2.90e-01	9.80e+00
Monitor/module	Ammonia	primary	1.17e-01	3.96e+00
Japanese Electric Grid	Nitrogen oxides	model/secondary	9.57e-02	3.23e+00
Monitor/module	Hydrofluoric acid	primary	8.33e-02	2.82e+00
Monitor/module	Hydrochloric acid	primary	5.33e-02	1.80e+00
LPG Production	Sulfur oxides	secondary	3.85e-02	1.30e+00
Backlight	Nitrogen oxides	primary	2.06e-02	6.97e-01
LPG Production	Nitrogen oxides	secondary	1.92e-02	6.50e-01
Natural Gas Prod.	Nitrogen oxides	secondary	1.03e-02	3.48e-01
US electric grid	Sulfur dioxide	model/secondary	4.83e-03	1.63e-01
Japanese Electric Grid	Hydrochloric acid	model/secondary	4.06e-03	1.37e-01
US electric grid	Nitrogen oxides	model/secondary	1.60e-03	5.39e-02
LCD glass mfg.	Nitrogen oxides	primary	1.43e-03	4.84e-02
Monitor/module	Sulfur oxides	primary	1.12e-03	3.77e-02
Japanese Electric Grid	Hydrofluoric acid	model/secondary	9.23e-04	3.12e-02
LPG Production	Nitrous oxide	secondary	5.45e-04	1.84e-02
Natural Gas Prod.	Ammonia	secondary	4.64e-04	1.57e-02
Natural Gas Prod.	Sulfur oxides	secondary	4.35e-04	1.47e-02
Fuel Oil #4 Prod.	Sulfur oxides	secondary	3.77e-04	1.28e-02
LPG Production	Hydrochloric acid	secondary	3.39e-04	1.15e-02
Panel components	Nitrogen oxides	primary	2.88e-04	9.73e-03
LPG Production	Hydrogen sulfide	secondary	2.77e-04	9.35e-03
Japanese Electric Grid	Nitrous oxide	model/secondary	2.63e-04	8.89e-03
LPG Production	Ammonia	secondary	1.96e-04	6.64e-03
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	1.94e-04	6.54e-03
Fuel Oil #6 Prod.	Sulfur oxides	secondary	1.86e-04	6.29e-03
US electric grid	Hydrochloric acid	model/secondary	1.83e-04	6.20e-03
Monitor/module	Nitric acid	primary	1.37e-04	4.63e-03
Fuel Oil #2 Prod.	Sulfur oxides	secondary	1.14e-04	3.84e-03
Fuel Oil #6 Prod.	Nitrogen oxides	secondary	9.76e-05	3.30e-03
LPG Production	Hydrofluoric acid	secondary	7.71e-05	2.60e-03
Fuel Oil #2 Prod.	Nitrogen oxides	secondary	5.74e-05	1.94e-03
Monitor/module	Phosphoric acid	primary	4.75e-05	1.61e-03
US electric grid	Hydrofluoric acid	model/secondary	4.17e-05	1.41e-03
Natural Gas Prod.	Hydrochloric acid	secondary	1.94e-05	6.54e-04
Natural Gas Prod.	Nitrous oxide	secondary	1.27e-05	4.31e-04
Panel components	Hydrochloric acid	primary	6.44e-06	2.18e-04
Fuel Oil #4 Prod.	Nitrous oxide	secondary	6.20e-06	2.10e-04
US electric grid	Nitrous oxide	model/secondary	4.61e-06	1.56e-04
Natural Gas Prod.	Hydrofluoric acid	secondary	4.40e-06	1.49e-04
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	3.64e-06	1.23e-04
Fuel Oil #6 Prod.	Nitrous oxide	secondary	3.46e-06	1.17e-04
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	3.43e-06	1.16e-04
LCD glass mfg.	Sulfur oxides	primary	2.35e-06	7.96e-05

Table M-20. LCD LCIA Results for the Acidification Impact Category

Process Group	Material	LCI Data Type	Acidification (kg SO2 Equivalents)	% of Total
Fuel Oil #6 Prod.	Hydrogen sulfide	secondary	2.03e-06	6.87e-05
Fuel Oil #6 Prod.	Hydrochloric acid	secondary	1.94e-06	6.56e-05
Fuel Oil #4 Prod.	Ammonia	secondary	1.72e-06	5.83e-05
Fuel Oil #2 Prod.	Nitrous oxide	secondary	1.69e-06	5.73e-05
Fuel Oil #2 Prod.	Hydrochloric acid	secondary	1.04e-06	3.50e-05
Fuel Oil #2 Prod.	Hydrogen sulfide	secondary	8.88e-07	3.00e-05
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	8.28e-07	2.80e-05
Fuel Oil #6 Prod.	Ammonia	secondary	7.50e-07	2.53e-05
Fuel Oil #2 Prod.	Ammonia	secondary	5.63e-07	1.90e-05
Fuel Oil #6 Prod.	Hydrofluoric acid	secondary	4.41e-07	1.49e-05
Fuel Oil #2 Prod.	Hydrofluoric acid	secondary	2.35e-07	7.95e-06
Natural Gas Prod.	Hydrogen sulfide	secondary	1.99e-07	6.74e-06
Total Manufacturing			**1.13e+00**	**3.82e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Sulfur dioxide	model/secondary	9.30e-01	3.14e+01
US electric grid	Nitrogen oxides	model/secondary	3.08e-01	1.04e+01
US electric grid	Hydrochloric acid	model/secondary	3.53e-02	1.19e+00
US electric grid	Hydrofluoric acid	model/secondary	8.03e-03	2.71e-01
US electric grid	Nitrous oxide	model/secondary	8.88e-04	3.00e-02
Total Use, Maintenance, and Repair			**1.28e+00**	**4.33e+01**
End-of-life Life-cycle Stage				
LCD landfilling	Nitrogen dioxide	primary	3.12e-04	1.06e-02
US electric grid	Sulfur dioxide	model/secondary	1.77e-04	5.97e-03
LCD landfilling	Sulfur dioxide	primary	6.74e-05	2.28e-03
US electric grid	Nitrogen oxides	model/secondary	5.83e-05	1.97e-03
LCD incineration	Sulfur dioxide	secondary	5.23e-05	1.77e-03
US electric grid	Hydrochloric acid	model/secondary	6.71e-06	2.27e-04
LPG Production	Sulfur oxides	secondary	3.16e-06	1.07e-04
LPG Production	Nitrogen oxides	secondary	1.58e-06	5.34e-05
US electric grid	Hydrofluoric acid	model/secondary	1.52e-06	5.15e-05
LCD landfilling	Hydrochloric acid	primary	2.17e-07	7.33e-06
US electric grid	Nitrous oxide	model/secondary	1.68e-07	5.69e-06
LCD landfilling	Hydrogen sulfide	primary	1.04e-07	3.52e-06
LPG Production	Nitrous oxide	secondary	4.47e-08	1.51e-06
LPG Production	Hydrochloric acid	secondary	2.78e-08	9.41e-07
LPG Production	Hydrogen sulfide	secondary	2.27e-08	7.67e-07
LPG Production	Ammonia	secondary	1.61e-08	5.45e-07
LPG Production	Hydrofluoric acid	secondary	6.33e-09	2.14e-07
Natural Gas Prod.	Hydrogen sulfide	secondary	-4.19e-08	-1.42e-06
Natural Gas Prod.	Hydrofluoric acid	secondary	-9.23e-07	-3.12e-05
LCD incineration	Hydrogen sulfide	secondary	-9.64e-07	-3.26e-05
Natural Gas Prod.	Nitrous oxide	secondary	-2.68e-06	-9.04e-05
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	-3.81e-06	-1.29e-04
Natural Gas Prod.	Hydrochloric acid	secondary	-4.06e-06	-1.37e-04
Fuel Oil #4 Prod.	Ammonia	secondary	-7.95e-06	-2.69e-04
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	-1.58e-05	-5.35e-04
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	-1.68e-05	-5.67e-04
LCD incineration	Ammonia	secondary	-2.53e-05	-8.56e-04
Fuel Oil #4 Prod.	Nitrous oxide	secondary	-2.86e-05	-9.66e-04
Natural Gas Prod.	Sulfur oxides	secondary	-9.13e-05	-3.08e-03

Table M-20. LCD LCIA Results for the Acidification Impact Category

Process Group	Material	LCI Data Type	Acidification (kg SO2 Equivalents)	% of Total
Natural Gas Prod.	Ammonia	secondary	-9.75e-05	-3.29e-03
LCD incineration	Hydrofluoric acid	secondary	-2.31e-04	-7.81e-03
LCD incineration	Nitrous oxide	secondary	-4.72e-04	-1.60e-02
LCD incineration	Hydrochloric acid	secondary	-5.91e-04	-2.00e-02
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	-8.92e-04	-3.01e-02
Fuel Oil #4 Prod.	Sulfur oxides	secondary	-1.74e-03	-5.88e-02
Natural Gas Prod.	Nitrogen oxides	secondary	-2.16e-03	-7.30e-02
LCD incineration	Nitrogen oxides	secondary	-6.52e-03	-2.20e-01
LCD incineration	Sulfur oxides	secondary	-1.75e-02	-5.91e-01
Total End-of-life			**-2.97e-02**	**-1.00e+00**
Total All Life-cycle Stages			**2.96e+00**	**1.00e+02**

Table M-21. CRT LCIA Results for the Air Particulates Impact Category

Process Group	Materials	LCI Data Type	Air Particulates (kg)	% of total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	PM	secondary	1.05e-01	3.48e+01
Aluminum Prod.	PM	secondary	8.90e-03	2.96e+00
Polycarbonate Production	PM	secondary	6.46e-03	2.15e+00
Invar	PM	secondary	2.76e-03	9.15e-01
Ferrite mfg.	PM	secondary	1.72e-03	5.72e-01
ABS Production	PM	secondary	1.27e-03	4.22e-01
Styrene-butadiene Copolymer Prod.	PM	secondary	9.93e-04	3.30e-01
Lead	PM	secondary	8.41e-04	2.79e-01
Polystyrene Prod., high-impact	PM	secondary	3.02e-04	1.00e-01
Total Materials Processing			**1.28e-01**	**4.25e+01**
Manufacturing Life-cycle Stage				
LPG Production	PM	secondary	1.29e-01	4.28e+01
Japanese Electric Grid	PM-10	model/secondary	2.00e-03	6.64e-01
Fuel Oil #6 Prod.	PM	secondary	9.24e-04	3.07e-01
US electric grid	PM-10	model/secondary	9.22e-04	3.06e-01
Natural Gas Prod.	PM	secondary	4.14e-04	1.38e-01
Fuel Oil #2 Prod.	PM	secondary	3.96e-04	1.31e-01
LPG Production	PM-10	secondary	2.25e-04	7.47e-02
Glass/frit	PM	primary	1.09e-04	3.63e-02
Fuel Oil #4 Prod.	PM	secondary	4.05e-05	1.34e-02
Fuel Oil #6 Prod.	PM-10	secondary	2.33e-06	7.74e-04
Fuel Oil #2 Prod.	PM-10	secondary	7.42e-07	2.47e-04
Glass/frit	PM	primary	6.67e-07	2.21e-04
Fuel Oil #4 Prod.	PM-10	secondary	8.70e-08	2.89e-05
Natural Gas Prod.	PM-10	secondary	4.94e-09	1.64e-06
Total Manufacturing			**1.34e-01**	**4.45e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	PM-10	model/secondary	5.78e-02	1.92e+01
Total Use, Maintenance and Repair			**5.78e-02**	**1.92e+01**
End-of-life Life-cycle Stage				
CRT landfilling	PM	primary	2.08e-04	6.92e-02
US electric grid	PM-10	model/secondary	5.78e-06	1.92e-03
LPG Production	PM	secondary	1.11e-06	3.70e-04
LPG Production	PM-10	secondary	1.94e-09	6.45e-07
Natural Gas Prod.	PM-10	secondary	-2.48e-09	-8.23e-07
CRT Incineration	PM-10	secondary	-6.30e-08	-2.09e-05
Fuel Oil #4 Prod.	PM-10	secondary	-9.35e-07	-3.11e-04
Natural Gas Prod.	PM	secondary	-2.08e-04	-6.90e-02
Fuel Oil #4 Prod.	PM	secondary	-4.35e-04	-1.44e-01
CRT Incineration	PM	secondary	-1.83e-02	-6.09e+00
Total End-of-life			**-1.88e-02**	**-6.23e+00**
Total All Life-cycle Stages			**3.01e-01**	**1.00e+02**

Table M-22. LCD LCIA Results for the Air Particulates Impact Category

Process Group	Materials	LCI Data Type	Air Particulates (kg)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	PM	secondary	5.14e-02	4.48e+01
Natural Gas Prod.	PM	secondary	2.89e-02	2.52e+01
Polycarbonate Production	PM	secondary	3.61e-03	3.15e+00
Aluminum Prod.	PM	secondary	3.31e-03	2.89e+00
PMMA Sheet Prod.	PM	secondary	3.22e-03	2.81e+00
PET Resin Production	PM	secondary	6.99e-04	6.10e-01
Styrene-butadiene Copolymer Prod.	PM	secondary	4.34e-04	3.79e-01
Natural Gas Prod.	PM-10	secondary	3.45e-07	3.01e-04
Total Materials Processing			**9.16e-02**	**7.99e+01**
Manufacturing Life-cycle Stage				
Japanese Electric Grid	PM-10	model/secondary	6.72e-03	5.87e+00
LPG Production	PM	secondary	6.19e-03	5.40e+00
Natural Gas Prod.	PM	secondary	6.53e-04	5.69e-01
US electric grid	PM-10	model/secondary	1.12e-04	9.76e-02
Fuel Oil #4 Prod.	PM	secondary	6.24e-05	5.44e-02
Fuel Oil #6 Prod.	PM	secondary	3.15e-05	2.75e-02
Panel components	PM	primary	2.74e-05	2.39e-02
Fuel Oil #2 Prod.	PM	secondary	1.85e-05	1.61e-02
Monitor/module	PM	primary	1.10e-05	9.58e-03
LPG Production	PM-10	secondary	1.08e-05	9.42e-03
LCD glass mfg.	PM	primary	5.06e-06	4.41e-03
Fuel Oil #4 Prod.	PM-10	secondary	1.34e-07	1.17e-04
Fuel Oil #6 Prod.	PM-10	secondary	7.94e-08	6.92e-05
Fuel Oil #2 Prod.	PM-10	secondary	3.47e-08	3.02e-05
Natural Gas Prod.	PM-10	secondary	7.79e-09	6.79e-06
Total Manufacturing			**1.38e-02**	**1.21e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	PM-10	model/secondary	2.16e-02	1.88e+01
Total Use, Maintenance and Repair			**2.16e-02**	**1.88e+01**
End-of-life Life-cycle Stage				
LCD landfilling	PM	primary	5.02e-05	4.38e-02
US electric grid	PM-10	model/secondary	4.09e-06	3.57e-03
LPG Production	PM	secondary	5.08e-07	4.43e-04
Natural Gas Prod.	PM-10	secondary	-1.63e-09	-1.43e-06
LCD incineration	PM-10	secondary	-4.08e-08	-3.56e-05
Fuel Oil #4 Prod.	PM-10	secondary	-6.18e-07	-5.39e-04
Natural Gas Prod.	PM	secondary	-1.37e-04	-1.20e-01
Fuel Oil #4 Prod.	PM	secondary	-2.87e-04	-2.51e-01
LCD incineration	PM	secondary	-1.20e-02	-1.05e+01
Total End-of-life			**-1.24e-02**	**-1.08e+01**
Total All Life-cycle Stages			**1.15e-01**	**1.00e+02**

Table M-23. CRT LCIA Results for the Water Eutrophication Impact Category

Process Group	Material	LCI Data Type	Water Eutrophication (kg Phosphate Equivalents)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Other nitrogen	secondary	1.80e-04	3.73e-01
Steel Prod., cold-rolled, semi-finished	COD	secondary	1.61e-04	3.34e-01
Aluminum Prod.	Phosphate (PO43-)	secondary	9.44e-05	1.96e-01
Polycarbonate Production	Phosphate (PO43-)	secondary	4.84e-05	1.00e-01
ABS Production	Ammonia	secondary	3.70e-05	7.67e-02
Lead	Phosphate (PO43-)	secondary	2.79e-05	5.79e-02
ABS Production	COD	secondary	2.05e-05	4.25e-02
Polycarbonate Production	COD	secondary	2.03e-05	4.22e-02
ABS Production	Other nitrogen	secondary	1.78e-05	3.69e-02
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	1.68e-05	3.48e-02
Aluminum Prod.	Other nitrogen	secondary	1.23e-05	2.56e-02
Steel Prod., cold-rolled, semi-finished	Phosphorus (yellow or white)	secondary	1.20e-05	2.48e-02
Aluminum Prod.	Nitrogen	secondary	1.10e-05	2.28e-02
Invar	Other nitrogen	secondary	5.96e-06	1.24e-02
Invar	COD	secondary	5.80e-06	1.20e-02
Ferrite mfg.	COD	secondary	5.66e-06	1.18e-02
Invar	Ammonia	secondary	4.91e-06	1.02e-02
Aluminum Prod.	Nitrate	secondary	4.56e-06	9.47e-03
Styrene-butadiene Copolymer Prod.	COD	secondary	4.10e-06	8.50e-03
Lead	Nitrogen	secondary	3.77e-06	7.83e-03
Polycarbonate Production	Nitrogen	secondary	3.49e-06	7.24e-03
Lead	Other nitrogen	secondary	3.06e-06	6.36e-03
Ferrite mfg.	Phosphate (PO43-)	secondary	3.04e-06	6.31e-03
ABS Production	Nitrate	secondary	3.01e-06	6.24e-03
Styrene-butadiene Copolymer Prod.	Other nitrogen	secondary	1.74e-06	3.61e-03
Invar	Nitrates/nitrites	secondary	1.62e-06	3.37e-03
Ferrite mfg.	Ammonia	secondary	1.58e-06	3.29e-03
Steel Prod., cold-rolled, semi-finished	Phosphate (PO43-)	secondary	1.44e-06	2.98e-03
Ferrite mfg.	Other nitrogen	secondary	1.27e-06	2.65e-03
Polystyrene Prod., high-impact	COD	secondary	1.20e-06	2.48e-03
Aluminum Prod.	COD	secondary	1.18e-06	2.44e-03
Styrene-butadiene Copolymer Prod.	Ammonia ions	secondary	1.17e-06	2.42e-03
Lead	Nitrate	secondary	9.00e-07	1.87e-03
Polycarbonate Production	Ammonia	secondary	7.11e-07	1.48e-03
Steel Prod., cold-rolled, semi-finished	Nitrates/nitrites	secondary	6.71e-07	1.39e-03
Polystyrene Prod., high-impact	Nitrogen	secondary	5.08e-07	1.05e-03
Ferrite mfg.	Nitrate	secondary	4.04e-07	8.38e-04
Polystyrene Prod., high-impact	Ammonia	secondary	3.10e-07	6.44e-04
Lead	COD	secondary	2.92e-07	6.07e-04
Styrene-butadiene Copolymer Prod.	Nitrate	secondary	2.90e-07	6.01e-04
Ferrite mfg.	Phosphorus (yellow or white)	secondary	5.76e-08	1.20e-04
Invar	Phosphorus (yellow or white)	secondary	4.85e-08	1.01e-04
ABS Production	Phosphate (PO43-)	secondary	4.62e-08	9.59e-05
Polycarbonate Production	Nitrate	secondary	4.62e-08	9.58e-05
Polystyrene Prod., high-impact	Nitrate	secondary	3.02e-08	6.27e-05
Total Materials Processing			**7.22e-04**	**1.50e+00**
Manufacturing Life-cycle Stage				

Table M-23. CRT LCIA Results for the Water Eutrophication Impact Category

Process Group	Material	LCI Data Type	Water Eutrophication (kg Phosphate Equivalents)	% of Total
LPG Production	COD	secondary	3.49e-02	7.24e+01
LPG Production	Ammonia ions	secondary	9.04e-03	1.88e+01
CRT tube mfg.	Nitrogen	primary	3.02e-03	6.26e+00
CRT tube mfg.	COD	primary	1.59e-04	3.30e-01
CRT tube mfg.	Phosphorus (yellow or white)	primary	1.54e-04	3.21e-01
Fuel Oil #6 Prod.	COD	secondary	1.18e-04	2.45e-01
Fuel Oil #2 Prod.	COD	secondary	9.79e-05	2.03e-01
Fuel Oil #6 Prod.	Ammonia ions	secondary	3.01e-05	6.24e-02
Fuel Oil #2 Prod.	Ammonia ions	secondary	2.51e-05	5.21e-02
Fuel Oil #4 Prod.	COD	secondary	7.96e-06	1.65e-02
LPG Production	Nitrate	secondary	6.06e-06	1.26e-02
Fuel Oil #4 Prod.	Ammonia ions	secondary	2.04e-06	4.23e-03
CRT tube mfg.	Phosphate as P2O5	primary	1.62e-06	3.36e-03
Natural Gas Prod.	COD	secondary	7.15e-07	1.49e-03
Glass/frit	Nitrates/nitrites	primary	3.95e-07	8.21e-04
Glass/frit	COD	primary	1.81e-07	3.75e-04
Natural Gas Prod.	Ammonia ions	secondary	1.11e-07	2.30e-04
Fuel Oil #6 Prod.	Nitrate	secondary	2.43e-08	5.04e-05
Fuel Oil #2 Prod.	Nitrate	secondary	1.73e-08	3.58e-05
LPG Production	Other nitrogen	secondary	6.62e-09	1.37e-05
Natural Gas Prod.	Nitrate	secondary	1.50e-09	3.12e-06
Fuel Oil #4 Prod.	Nitrate	secondary	1.47e-09	3.05e-06
Fuel Oil #6 Prod.	Other nitrogen	secondary	2.24e-11	4.65e-08
Fuel Oil #2 Prod.	Other nitrogen	secondary	1.86e-11	3.85e-08
Fuel Oil #4 Prod.	Other nitrogen	secondary	1.51e-12	3.13e-09
Natural Gas Prod.	Other nitrogen	secondary	1.34e-13	2.78e-10
Total Manufacturing			**4.76e-02**	**9.87e+01**
Use, Maintenance and Repair Life-cycle Stage				
Total Use, Maintenance and Repair			**0.00e+00**	**0.00e+00**
End-of-life Life-cycle Stage				
CRT landfilling	COD	primary	2.13e-06	4.43e-03
CRT landfilling	Ammonia	primary	4.62e-07	9.59e-04
LPG Production	COD	secondary	3.01e-07	6.25e-04
LPG Production	Ammonia ions	secondary	7.80e-08	1.62e-04
LPG Production	Nitrate	secondary	5.23e-11	1.09e-07
LPG Production	Other nitrogen	secondary	5.71e-14	1.19e-10
Natural Gas Prod.	Other nitrogen	secondary	-6.71e-14	-1.39e-10
CRT Incineration	Other nitrogen	secondary	-1.04e-12	-2.16e-09
Fuel Oil #4 Prod.	Other nitrogen	secondary	-1.62e-11	-3.37e-08
Natural Gas Prod.	Nitrate	secondary	-7.54e-10	-1.57e-06
Fuel Oil #4 Prod.	Nitrate	secondary	-1.58e-08	-3.27e-05
Natural Gas Prod.	Ammonia ions	secondary	-5.56e-08	-1.15e-04
CRT Incineration	Nitrate	secondary	-1.80e-07	-3.73e-04
Natural Gas Prod.	COD	secondary	-3.59e-07	-7.45e-04
CRT Incineration	Ammonia	secondary	-1.80e-06	-3.74e-03
CRT Incineration	COD	secondary	-3.21e-06	-6.65e-03
Fuel Oil #4 Prod.	Ammonia ions	secondary	-2.19e-05	-4.55e-02

Table M-23. CRT LCIA Results for the Water Eutrophication Impact Category

Process Group	Material	LCI Data Type	Water Eutrophication (kg Phosphate Equivalents)	% of Total
Fuel Oil #4 Prod.	COD	secondary	-8.56e-05	-1.78e-01
Total End-of-life			**-1.10e-04**	**-2.29e-01**
Total All Manufacturing Stages			**4.82e-02**	**1.00e+02**

Table M-24. LCD LCIA Results for the Water Eutrophication Impact Category

Process Group	Material	LCI Data Type	Water Eutrophication (kg Phosphate Equivalents)	% of Total
Materials Processing Life-cycle Stage				
PMMA Sheet Prod.	Ammonia	secondary	1.97e-04	3.97e-01
Steel Prod., cold-rolled, semi-finished	Other nitrogen	secondary	8.81e-05	1.78e-01
Steel Prod., cold-rolled, semi-finished	COD	secondary	7.89e-05	1.59e-01
Natural Gas Prod.	COD	secondary	5.00e-05	1.01e-01
PMMA Sheet Prod.	Phosphate (PO43-)	secondary	4.86e-05	9.80e-02
Aluminum Prod.	Phosphate (PO43-)	secondary	3.51e-05	7.09e-02
Polycarbonate Production	Phosphate (PO43-)	secondary	2.70e-05	5.45e-02
PMMA Sheet Prod.	COD	secondary	2.19e-05	4.43e-02
Polycarbonate Production	COD	secondary	1.13e-05	2.29e-02
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	8.21e-06	1.66e-02
Natural Gas Prod.	Ammonia ions	secondary	7.75e-06	1.56e-02
PMMA Sheet Prod.	Nitrates/nitrites	secondary	7.67e-06	1.55e-02
Steel Prod., cold-rolled, semi-finished	Phosphorus (yellow or white)	secondary	5.86e-06	1.18e-02
Aluminum Prod.	Other nitrogen	secondary	4.60e-06	9.27e-03
PET Resin Production	COD	secondary	4.39e-06	8.86e-03
Aluminum Prod.	Nitrogen	secondary	4.09e-06	8.25e-03
Polycarbonate Production	Nitrogen	secondary	1.95e-06	3.93e-03
Styrene-butadiene Copolymer Prod.	COD	secondary	1.79e-06	3.61e-03
Aluminum Prod.	Nitrate	secondary	1.70e-06	3.43e-03
PMMA Sheet Prod.	Other nitrogen	secondary	9.66e-07	1.95e-03
Styrene-butadiene Copolymer Prod.	Other nitrogen	secondary	7.60e-07	1.53e-03
Steel Prod., cold-rolled, semi-finished	Phosphate (PO43-)	secondary	7.03e-07	1.42e-03
Styrene-butadiene Copolymer Prod.	Ammonia ions	secondary	5.11e-07	1.03e-03
Aluminum Prod.	COD	secondary	4.38e-07	8.83e-04
Polycarbonate Production	Ammonia	secondary	3.97e-07	8.01e-04
Steel Prod., cold-rolled, semi-finished	Nitrates/nitrites	secondary	3.29e-07	6.63e-04
Styrene-butadiene Copolymer Prod.	Nitrate	secondary	1.27e-07	2.55e-04
Natural Gas Prod.	Nitrate	secondary	1.05e-07	2.12e-04
PET Resin Production	Other nitrogen	secondary	3.81e-08	7.69e-05
Polycarbonate Production	Nitrate	secondary	2.58e-08	5.20e-05
PET Resin Production	Ammonia ions	secondary	2.33e-08	4.70e-05
PET Resin Production	Nitrate	secondary	9.08e-09	1.83e-05
Natural Gas Prod.	Other nitrogen	secondary	9.34e-12	1.88e-08
Total Materials Processing			**6.10e-04**	**1.23e+00**
Manufacturing Life-cycle Stage				
Monitor/module	Nitrogen	primary	3.33e-02	6.72e+01
Monitor/module	Phosphorus (yellow or white)	primary	1.32e-02	2.66e+01
LPG Production	COD	secondary	1.67e-03	3.38e+00
LPG Production	Ammonia ions	secondary	4.34e-04	8.75e-01
Panel components	Nitrogen	primary	2.40e-04	4.84e-01
Panel components	Phosphorus (yellow or white)	primary	7.60e-05	1.53e-01
Monitor/module	COD	primary	5.91e-05	1.19e-01
Panel components	COD	primary	4.86e-05	9.81e-02
Fuel Oil #4 Prod.	COD	secondary	1.23e-05	2.47e-02
Fuel Oil #2 Prod.	COD	secondary	4.57e-06	9.22e-03
Fuel Oil #6 Prod.	COD	secondary	4.02e-06	8.11e-03
Fuel Oil #4 Prod.	Ammonia ions	secondary	3.14e-06	6.33e-03
Fuel Oil #2 Prod.	Ammonia ions	secondary	1.17e-06	2.36e-03

Table M-24. LCD LCIA Results for the Water Eutrophication Impact Category

Process Group	Material	LCI Data Type	Water Eutrophication (kg Phosphate Equivalents)	% of Total
Natural Gas Prod.	COD	secondary	1.13e-06	2.28e-03
Fuel Oil #6 Prod.	Ammonia ions	secondary	1.02e-06	2.07e-03
LPG Production	Nitrate	secondary	2.91e-07	5.86e-04
Natural Gas Prod.	Ammonia ions	secondary	1.75e-07	3.53e-04
LCD glass mfg.	Nitrate	primary	1.83e-08	3.70e-05
LCD glass mfg.	COD	primary	8.36e-09	1.69e-05
Natural Gas Prod.	Nitrate	secondary	2.37e-09	4.78e-06
Fuel Oil #4 Prod.	Nitrate	secondary	2.26e-09	4.56e-06
Fuel Oil #6 Prod.	Nitrate	secondary	8.26e-10	1.67e-06
Fuel Oil #2 Prod.	Nitrate	secondary	8.06e-10	1.63e-06
LPG Production	Other nitrogen	secondary	3.17e-10	6.41e-07
Fuel Oil #4 Prod.	Other nitrogen	secondary	2.33e-12	4.69e-09
Fuel Oil #2 Prod.	Other nitrogen	secondary	8.67e-13	1.75e-09
Fuel Oil #6 Prod.	Other nitrogen	secondary	7.62e-13	1.54e-09
Natural Gas Prod.	Other nitrogen	secondary	2.11e-13	4.25e-10
Total Manufacturing			**4.90e-02**	**9.89e+01**
Use, Maintenance and Repair Life-cycle Stage				
Total Use, Maintenance and Repair			**0.00e+00**	**0.00e+00**
End-of-life Life-cycle Stage				
LCD landfilling	COD	primary	5.14e-07	1.04e-03
LPG Production	COD	secondary	1.37e-07	2.77e-04
LCD landfilling	Ammonia	primary	1.11e-07	2.25e-04
LPG Production	Ammonia ions	secondary	3.56e-08	7.19e-05
LPG Production	Nitrate	secondary	2.39e-11	4.81e-08
LPG Production	Other nitrogen	secondary	2.61e-14	5.26e-11
Natural Gas Prod.	Other nitrogen	secondary	-4.43e-14	-8.93e-11
LCD incineration	Other nitrogen	secondary	-6.75e-13	-1.36e-09
Fuel Oil #4 Prod.	Other nitrogen	secondary	-1.07e-11	-2.16e-08
Natural Gas Prod.	Nitrate	secondary	-4.98e-10	-1.00e-06
Fuel Oil #4 Prod.	Nitrate	secondary	-1.04e-08	-2.10e-05
Natural Gas Prod.	Ammonia ions	secondary	-3.67e-08	-7.41e-05
LCD incineration	Nitrate	secondary	-1.17e-07	-2.35e-04
Natural Gas Prod.	COD	secondary	-2.37e-07	-4.78e-04
LCD incineration	Ammonia	secondary	-1.40e-06	-2.83e-03
LCD incineration	COD	secondary	-3.16e-06	-6.38e-03
Fuel Oil #4 Prod.	Ammonia ions	secondary	-1.45e-05	-2.92e-02
Fuel Oil #4 Prod.	COD	secondary	-5.65e-05	-1.14e-01
Total End-of-life			**-7.51e-05**	**-1.52e-01**
Total All Life-cycle Stages			**4.96e-02**	**1.00e+02**

Table M-25. CRT LCIA Results for the Water Quality, BOD Impact Category

Process Group	Material	LCI Data Type	BOD (kg)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	BOD	secondary	2.51e-04	1.29e-01
Polycarbonate Production	BOD	secondary	8.68e-05	4.45e-02
Styrene-butadiene Copolymer Prod.	BOD	secondary	1.65e-05	8.48e-03
ABS Production	BOD	secondary	1.40e-05	7.17e-03
Polystyrene Prod., high-impact	BOD	secondary	6.80e-06	3.49e-03
Invar	BOD	secondary	6.65e-06	3.41e-03
Ferrite mfg.	BOD	secondary	4.74e-06	2.43e-03
Aluminum Prod.	BOD	secondary	4.03e-06	2.06e-03
Lead	BOD	secondary	2.48e-06	1.27e-03
Total Materials Processing			**3.93e-04**	**2.02e-01**
Manufacturing Life-cycle Stage				
LPG Production	BOD	secondary	1.88e-01	9.61e+01
CRT tube mfg.	BOD	primary	6.39e-03	3.28e+00
Fuel Oil #6 Prod.	BOD	secondary	6.34e-04	3.25e-01
Fuel Oil #2 Prod.	BOD	secondary	5.26e-04	2.70e-01
Fuel Oil #4 Prod.	BOD	secondary	4.28e-05	2.19e-02
Glass/frit	BOD	primary	8.20e-06	4.21e-03
Natural Gas Prod.	BOD	secondary	4.00e-06	2.05e-03
Total Manufacturing			**1.95e-01**	**1.00e+02**
Use, Maintenance and Repair Life-cycle Stage				
Total Use, Maintenance and Repair			**0.00e+00**	**0.00e+00**
End-of-life Life-cycle Stage				
CRT landfilling	BOD	primary	1.17e-05	5.98e-03
LPG Production	BOD	secondary	1.62e-06	8.30e-04
Natural Gas Prod.	BOD	secondary	-2.01e-06	-1.03e-03
CRT Incineration	BOD	secondary	-1.70e-05	-8.74e-03
Fuel Oil #4 Prod.	BOD	secondary	-4.60e-04	-2.36e-01
Total End-of-life			**-4.65e-04**	**-2.39e-01**
Total All Life-cycle Stages			**1.95e-01**	**1.00e+02**

Table M-26. LCD LCIA Results for the Water Quality, BOD Impact Category

Process Group	Material	LCI Data Type	BOD (kg)	% of Total
Materials Processing Life-cycle Stage				
Natural Gas Prod.	BOD	secondary	2.80e-04	9.88e-01
PMMA Sheet Prod.	BOD	secondary	2.30e-04	8.12e-01
Steel Prod., cold-rolled, semi-finished	BOD	secondary	1.23e-04	4.34e-01
PET Resin Production	BOD	secondary	8.17e-05	2.88e-01
Polycarbonate Production	BOD	secondary	4.85e-05	1.71e-01
Styrene-butadiene Copolymer Prod.	BOD	secondary	7.23e-06	2.55e-02
Aluminum Prod.	BOD	secondary	1.50e-06	5.29e-03
Total Materials Processing			**7.72e-04**	**2.72e+00**
Manufacturing Life-cycle Stage				
Monitor/module	BOD	primary	1.74e-02	6.15e+01
LPG Production	BOD	secondary	9.00e-03	3.18e+01
Panel components	BOD	primary	1.34e-03	4.74e+00
Fuel Oil #4 Prod.	BOD	secondary	6.59e-05	2.33e-01
Fuel Oil #2 Prod.	BOD	secondary	2.46e-05	8.67e-02
Fuel Oil #6 Prod.	BOD	secondary	2.16e-05	7.62e-02
Natural Gas Prod.	BOD	secondary	6.31e-06	2.23e-02
LCD glass mfg.	BOD	primary	3.80e-07	1.34e-03
Total Manufacturing			**2.79e-02**	**9.84e+01**
Use, Maintenance and Repair Life-cycle Stage				
Total Use, Maintenance and Repair			**0.00e+00**	**0.00e+00**
End-of-life Life-cycle Stage				
LCD landfilling	BOD	primary	2.81e-06	9.91e-03
LPG Production	BOD	secondary	7.39e-07	2.61e-03
Natural Gas Prod.	BOD	secondary	-1.33e-06	-4.68e-03
LCD incineration	BOD	secondary	-1.70e-05	-5.99e-02
Fuel Oil #4 Prod.	BOD	secondary	-3.04e-04	-1.07e+00
Total End-of-life			**-3.18e-04**	**-1.12e+00**
Total All Life-cycle Stages			**2.83e-02**	**1.00e+02**

Table M-27. CRT LCIA Results for the Water Quality, TSS Impact Category

Process Group	Material	LCI Data Type	Total Suspended Solids (kg)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Suspended solids	secondary	2.04e-03	2.34e-01
Aluminum Prod.	Suspended solids	secondary	1.74e-03	1.99e-01
Polycarbonate Production	Suspended solids	secondary	1.11e-03	1.27e-01
ABS Production	Suspended solids	secondary	1.02e-03	1.16e-01
Invar	Suspended solids	secondary	8.30e-04	9.49e-02
Lead	Suspended solids	secondary	3.80e-04	4.34e-02
Styrene-butadiene Copolymer Prod.	Suspended solids	secondary	3.06e-04	3.50e-02
Ferrite mfg.	Suspended solids	secondary	2.45e-04	2.81e-02
Polystyrene Prod., high-impact	Suspended solids	secondary	5.14e-05	5.88e-03
Total Materials Processing			**7.72e-03**	**8.83e-01**
Manufacturing Life-cycle Stage				
LPG Production	Suspended solids	secondary	8.51e-01	9.74e+01
Glass/frit	Suspended solids	primary	7.23e-03	8.26e-01
CRT tube mfg.	Suspended solids	primary	4.63e-03	5.30e-01
Fuel Oil #6 Prod.	Suspended solids	secondary	2.88e-03	3.29e-01
Fuel Oil #2 Prod.	Suspended solids	secondary	2.39e-03	2.73e-01
Fuel Oil #4 Prod.	Suspended solids	secondary	1.94e-04	2.22e-02
Japanese Electric Grid	Suspended solids	model/secondary	2.27e-05	2.60e-03
Natural Gas Prod.	Suspended solids	secondary	1.72e-05	1.97e-03
Total Manufacturing			**8.69e-01**	**9.94e+01**
Use, Maintenance and Repair Life-cycle Stage				
Total Use, Maintenance and Repair			**0.00e+00**	**0.00e+00**
End-of-life Life-cycle Stage				
CRT landfilling	Suspended solids	primary	5.52e-05	6.31e-03
LPG Production	Suspended solids	secondary	7.35e-06	8.40e-04
Natural Gas Prod.	Suspended solids	secondary	-8.64e-06	-9.88e-04
CRT Incineration	Suspended solids	secondary	-7.55e-05	-8.63e-03
Fuel Oil #4 Prod.	Suspended solids	secondary	-2.09e-03	-2.39e-01
Total End-of-life			**-2.11e-03**	**-2.41e-01**
Total All Life-cycle Stages			**8.74e-01**	**1.00e+02**

Table M-28. LCD LCIA Results for the Water Quality, TSS Impact Category

Process Group	Material	LCI Data Type	Total Suspended Solids (kg)	% of Total
Materials Processing Life-cycle Stage				
PMMA Sheet Prod.	Suspended solids	secondary	1.34e-03	2.18e+00
Natural Gas Prod.	Suspended solids	secondary	1.20e-03	1.96e+00
Steel Prod., cold-rolled, semi-finished	Suspended solids	secondary	1.00e-03	1.63e+00
Aluminum Prod.	Suspended solids	secondary	6.48e-04	1.05e+00
Polycarbonate Production	Suspended solids	secondary	6.19e-04	1.01e+00
Styrene-butadiene Copolymer Prod.	Suspended solids	secondary	1.34e-04	2.18e-01
PET Resin Production	Suspended solids	secondary	3.45e-05	5.61e-02
Total Materials Processing			**4.98e-03**	**8.10e+00**
Manufacturing Life-cycle Stage				
LPG Production	Suspended solids	secondary	4.09e-02	6.64e+01
Monitor/module	Suspended solids	primary	1.55e-02	2.52e+01
Panel components	Suspended solids	primary	6.46e-04	1.05e+00
LCD glass mfg.	Suspended solids	primary	3.35e-04	5.44e-01
Fuel Oil #4 Prod.	Suspended solids	secondary	2.99e-04	4.86e-01
Fuel Oil #2 Prod.	Suspended solids	secondary	1.12e-04	1.81e-01
Fuel Oil #6 Prod.	Suspended solids	secondary	9.81e-05	1.59e-01
Japanese Electric Grid	Suspended solids	model/secondary	7.63e-05	1.24e-01
Natural Gas Prod.	Suspended solids	secondary	2.72e-05	4.42e-02
Total Manufacturing			**5.80e-02**	**9.42e+01**
Use, Maintenance and Repair Life-cycle Stage				
Total Use, Maintenance and Repair			**0.00e+00**	**0.00e+00**
End-of-life Life-cycle Stage				
LCD landfilling	Suspended solids	primary	1.33e-05	2.16e-02
LPG Production	Suspended solids	secondary	3.35e-06	5.45e-03
Natural Gas Prod.	Suspended solids	secondary	-5.71e-06	-9.28e-03
LCD incineration	Suspended solids	secondary	-7.69e-05	-1.25e-01
Fuel Oil #4 Prod.	Suspended solids	secondary	-1.38e-03	-2.24e+00
Total End-of-life			**-1.44e-03**	**-2.35e+00**
Total All Life-cycle Stages			**6.15e-02**	**1.00e+02**

Table M-29. CRT LCIA Results for the Radioactivity Impact Category

Process Group	Material	LCI Data Type	Radioactivity (Bq)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Plutonium-241 (isotope)	secondary	2.40e+07	6.23e+01
Invar	Plutonium-241 (isotope)	secondary	6.80e+06	1.77e+01
Ferrite mfg.	Plutonium-241 (isotope)	secondary	6.64e+06	1.72e+01
Steel Prod., cold-rolled, semi-finished	Plutonium-240 (isotope)	secondary	1.04e+05	2.69e-01
Steel Prod., cold-rolled, semi-finished	Cesium-135 (isotope)	secondary	9.38e+04	2.43e-01
Steel Prod., cold-rolled, semi-finished	Radon-222 (isotope)	secondary	8.77e+04	2.28e-01
Steel Prod., cold-rolled, semi-finished	Plutonium-239 (isotope)	secondary	7.29e+04	1.89e-01
Invar	Plutonium-240 (isotope)	secondary	2.94e+04	7.62e-02
Ferrite mfg.	Plutonium-240 (isotope)	secondary	2.87e+04	7.44e-02
Invar	Cesium-135 (isotope)	secondary	2.65e+04	6.89e-02
Ferrite mfg.	Cesium-135 (isotope)	secondary	2.59e+04	6.73e-02
Invar	Radon-222 (isotope)	secondary	2.48e+04	6.45e-02
Ferrite mfg.	Radon-222 (isotope)	secondary	2.42e+04	6.30e-02
Invar	Plutonium-239 (isotope)	secondary	2.06e+04	5.36e-02
Ferrite mfg.	Plutonium-239 (isotope)	secondary	2.01e+04	5.23e-02
Steel Prod., cold-rolled, semi-finished	Strontium-90 (isotope)	secondary	1.40e+04	3.64e-02
Invar	Strontium-90 (isotope)	secondary	3.97e+03	1.03e-02
Ferrite mfg.	Strontium-90 (isotope)	secondary	3.87e+03	1.01e-02
Steel Prod., cold-rolled, semi-finished	Tritium-3 (isotope)	secondary	2.50e+03	6.50e-03
Steel Prod., cold-rolled, semi-finished	radioactive gas (unspecified)	secondary	1.83e+03	4.76e-03
Steel Prod., cold-rolled, semi-finished	Xenon-133 (isotope)	secondary	1.56e+03	4.04e-03
Ferrite mfg.	Radioactive substance (unspecified)	secondary	8.77e+02	2.28e-03
Steel Prod., cold-rolled, semi-finished	Radium-226 (isotope)	secondary	8.66e+02	2.25e-03
Invar	Tritium-3 (isotope)	secondary	7.09e+02	1.84e-03
Ferrite mfg.	Tritium-3 (isotope)	secondary	6.92e+02	1.80e-03
Invar	radioactive gas (unspecified)	secondary	5.19e+02	1.35e-03
Steel Prod., cold-rolled, semi-finished	Thorium-230 (isotope)	secondary	5.15e+02	1.34e-03
Ferrite mfg.	radioactive gas (unspecified)	secondary	5.07e+02	1.32e-03
Invar	Xenon-133 (isotope)	secondary	4.41e+02	1.15e-03
Ferrite mfg.	Xenon-133 (isotope)	secondary	4.30e+02	1.12e-03
Steel Prod., cold-rolled, semi-finished	Plutonium-242 (isotope)	secondary	3.91e+02	1.02e-03
Steel Prod., cold-rolled, semi-finished	Curium-244 (isotope)	secondary	3.90e+02	1.01e-03
Steel Prod., cold-rolled, semi-finished	Uranium-234 (isotope)	secondary	3.15e+02	8.19e-04
Ferrite mfg.	Radium-226 (isotope)	secondary	2.39e+02	6.21e-04
Steel Prod., cold-rolled, semi-finished	Americium-241 (isotope)	secondary	1.92e+02	4.99e-04
Ferrite mfg.	Thorium-230 (isotope)	secondary	1.42e+02	3.70e-04
Steel Prod., cold-rolled, semi-finished	Krypton-85 (isotope)	secondary	1.11e+02	2.89e-04
Invar	Plutonium-242 (isotope)	secondary	1.11e+02	2.88e-04
Invar	Curium-244 (isotope)	secondary	1.10e+02	2.87e-04
Ferrite mfg.	Plutonium-242 (isotope)	secondary	1.08e+02	2.81e-04
Ferrite mfg.	Curium-244 (isotope)	secondary	1.08e+02	2.80e-04
Invar	Radium-226 (isotope)	secondary	1.04e+02	2.71e-04
Steel Prod., cold-rolled, semi-finished	Uranium-238 (isotope)	secondary	9.28e+01	2.41e-04
Invar	Uranium-234 (isotope)	secondary	8.74e+01	2.27e-04
Ferrite mfg.	Uranium-234 (isotope)	secondary	8.72e+01	2.26e-04
Steel Prod., cold-rolled, semi-finished	Samarium-151 (isotope)	secondary	8.67e+01	2.25e-04
Steel Prod., cold-rolled, semi-finished	Neptunium-237 (isotope)	secondary	6.02e+01	1.56e-04
Invar	Americium-241 (isotope)	secondary	5.44e+01	1.41e-04
Ferrite mfg.	Americium-241 (isotope)	secondary	5.31e+01	1.38e-04
Invar	Krypton-85 (isotope)	secondary	3.15e+01	8.18e-05

Table M-29. CRT LCIA Results for the Radioactivity Impact Category

Process Group	Material	LCI Data Type	Radioactivity (Bq)	% of Total
Ferrite mfg.	Krypton-85 (isotope)	secondary	3.07e+01	7.99e-05
Ferrite mfg.	Uranium-238 (isotope)	secondary	2.56e+01	6.66e-05
Invar	Samarium-151 (isotope)	secondary	2.45e+01	6.37e-05
Invar	Uranium-238 (isotope)	secondary	2.45e+01	6.35e-05
Ferrite mfg.	Samarium-151 (isotope)	secondary	2.40e+01	6.22e-05
Steel Prod., cold-rolled, semi-finished	Carbon-14 (isotope)	secondary	1.91e+01	4.95e-05
Invar	Neptunium-237 (isotope)	secondary	1.71e+01	4.43e-05
Ferrite mfg.	Neptunium-237 (isotope)	secondary	1.66e+01	4.32e-05
Invar	Radioactive substance (unspecified)	secondary	8.13e+00	2.11e-05
Steel Prod., cold-rolled, semi-finished	Radium-222 (isotope)	secondary	6.66e+00	1.73e-05
Steel Prod., cold-rolled, semi-finished	Uranium-235 (isotope)	secondary	5.85e+00	1.52e-05
Invar	Carbon-14 (isotope)	secondary	5.40e+00	1.40e-05
Ferrite mfg.	Carbon-14 (isotope)	secondary	5.27e+00	1.37e-05
Invar	Thorium-230 (isotope)	secondary	5.10e+00	1.33e-05
Steel Prod., cold-rolled, semi-finished	Americium-243 (isotope)	secondary	4.19e+00	1.09e-05
Steel Prod., cold-rolled, semi-finished	Technetium-99M (isotope)	secondary	2.86e+00	7.43e-06
Steel Prod., cold-rolled, semi-finished	Thorium-228 (isotope)	secondary	2.49e+00	6.48e-06
Steel Prod., cold-rolled, semi-finished	Radon-220 (isotope)	secondary	2.03e+00	5.26e-06
Invar	Radium-222 (isotope)	secondary	1.91e+00	4.95e-06
Ferrite mfg.	Radium-222 (isotope)	secondary	1.86e+00	4.83e-06
Invar	Uranium-234 (isotope)	secondary	1.86e+00	4.83e-06
Invar	Uranium-238 (isotope)	secondary	1.80e+00	4.67e-06
Ferrite mfg.	Uranium-235 (isotope)	secondary	1.62e+00	4.20e-06
Invar	Uranium-235 (isotope)	secondary	1.58e+00	4.10e-06
Steel Prod., cold-rolled, semi-finished	Radium-228 (isotope)	secondary	1.30e+00	3.37e-06
Invar	Americium-243 (isotope)	secondary	1.19e+00	3.08e-06
Ferrite mfg.	Americium-243 (isotope)	secondary	1.16e+00	3.00e-06
Steel Prod., cold-rolled, semi-finished	Polonium-210 (isotope)	secondary	1.13e+00	2.92e-06
Invar	Technetium-99M (isotope)	secondary	8.10e-01	2.10e-06
Ferrite mfg.	Technetium-99M (isotope)	secondary	7.91e-01	2.05e-06
Invar	Thorium-228 (isotope)	secondary	7.52e-01	1.95e-06
Ferrite mfg.	Thorium-228 (isotope)	secondary	7.34e-01	1.91e-06
Steel Prod., cold-rolled, semi-finished	Lead-210 (isotope)	secondary	6.54e-01	1.70e-06
Steel Prod., cold-rolled, semi-finished	Radium-224 (isotope)	secondary	6.05e-01	1.57e-06
Invar	Radon-220 (isotope)	secondary	5.80e-01	1.51e-06
Ferrite mfg.	Radon-220 (isotope)	secondary	5.66e-01	1.47e-06
Invar	Radium-228 (isotope)	secondary	3.90e-01	1.01e-06
Ferrite mfg.	Radium-228 (isotope)	secondary	3.81e-01	9.89e-07
Steel Prod., cold-rolled, semi-finished	Zirconium-93 (isotope)	secondary	3.76e-01	9.77e-07
Invar	Polonium-210 (isotope)	secondary	3.21e-01	8.35e-07
Steel Prod., cold-rolled, semi-finished	Cesium-137 (isotope)	secondary	3.19e-01	8.27e-07
Ferrite mfg.	Polonium-210 (isotope)	secondary	3.14e-01	8.15e-07
Steel Prod., cold-rolled, semi-finished	Protactinium-234 (isotope)	secondary	2.01e-01	5.23e-07
Steel Prod., cold-rolled, semi-finished	Thorium-234 (isotope)	secondary	2.01e-01	5.23e-07
Steel Prod., cold-rolled, semi-finished	Silver-110M (isotope)	secondary	1.88e-01	4.88e-07
Invar	Lead-210 (isotope)	secondary	1.87e-01	4.85e-07
Invar	Radium-224 (isotope)	secondary	1.83e-01	4.75e-07
Ferrite mfg.	Lead-210 (isotope)	secondary	1.82e-01	4.73e-07
Ferrite mfg.	Radium-224 (isotope)	secondary	1.78e-01	4.63e-07
Steel Prod., cold-rolled, semi-finished	Potassium-40 (isotope)	secondary	1.75e-01	4.54e-07
Invar	Radium-226 (isotope)	secondary	1.41e-01	3.66e-07

Table M-29. CRT LCIA Results for the Radioactivity Impact Category

Process Group	Material	LCI Data Type	Radioactivity (Bq)	% of Total
Invar	Thorium-230 (isotope)	secondary	1.41e-01	3.66e-07
Steel Prod., cold-rolled, semi-finished	Cobalt-58 (isotope)	secondary	1.26e-01	3.27e-07
Steel Prod., cold-rolled, semi-finished	Tin-126 (isotope)	secondary	1.18e-01	3.07e-07
Invar	Zirconium-93 (isotope)	secondary	1.07e-01	2.77e-07
Ferrite mfg.	Zirconium-93 (isotope)	secondary	1.04e-01	2.70e-07
Ferrite mfg.	Cesium-137 (isotope)	secondary	8.80e-02	2.29e-07
Steel Prod., cold-rolled, semi-finished	Cobalt-60 (isotope)	secondary	7.90e-02	2.05e-07
Invar	Uranium-235 (isotope)	secondary	7.81e-02	2.03e-07
Invar	Cesium-137 (isotope)	secondary	7.42e-02	1.93e-07
Steel Prod., cold-rolled, semi-finished	Selenium-79 (isotope)	secondary	6.76e-02	1.75e-07
Steel Prod., cold-rolled, semi-finished	Radioactive aerosols and halogenes (unspecified)	secondary	5.74e-02	1.49e-07
Invar	Protactinium-234 (isotope)	secondary	5.70e-02	1.48e-07
Invar	Thorium-234 (isotope)	secondary	5.70e-02	1.48e-07
Ferrite mfg.	Protactinium-234 (isotope)	secondary	5.57e-02	1.45e-07
Ferrite mfg.	Thorium-234 (isotope)	secondary	5.57e-02	1.45e-07
Invar	Silver-110M (isotope)	secondary	5.32e-02	1.38e-07
Ferrite mfg.	Silver-110M (isotope)	secondary	5.19e-02	1.35e-07
Invar	Potassium-40 (isotope)	secondary	4.99e-02	1.30e-07
Ferrite mfg.	Potassium-40 (isotope)	secondary	4.87e-02	1.27e-07
Steel Prod., cold-rolled, semi-finished	Thorium-232 (isotope)	secondary	4.65e-02	1.21e-07
Steel Prod., cold-rolled, semi-finished	Curium-245 (isotope)	secondary	4.35e-02	1.13e-07
Steel Prod., cold-rolled, semi-finished	Antimony-124 (isotope)	secondary	4.33e-02	1.12e-07
Steel Prod., cold-rolled, semi-finished	Cesium-134 (isotope)	secondary	3.88e-02	1.01e-07
Invar	Cobalt-58 (isotope)	secondary	3.57e-02	9.26e-08
Ferrite mfg.	Cobalt-58 (isotope)	secondary	3.48e-02	9.04e-08
Invar	Tin-126 (isotope)	secondary	3.35e-02	8.69e-08
Ferrite mfg.	Tin-126 (isotope)	secondary	3.27e-02	8.48e-08
Invar	Cobalt-60 (isotope)	secondary	2.24e-02	5.81e-08
Ferrite mfg.	Cobalt-60 (isotope)	secondary	2.18e-02	5.67e-08
Steel Prod., cold-rolled, semi-finished	Palladium-107 (isotope)	secondary	2.11e-02	5.49e-08
Invar	Selenium-79 (isotope)	secondary	1.91e-02	4.97e-08
Ferrite mfg.	Selenium-79 (isotope)	secondary	1.87e-02	4.85e-08
Invar	Radioactive aerosols and halogenes (unspecified)	secondary	1.63e-02	4.22e-08
Invar	Cesium-137 (isotope)	secondary	1.60e-02	4.16e-08
Ferrite mfg.	Radioactive aerosols and halogenes (unspecified)	secondary	1.59e-02	4.12e-08
Invar	Thorium-232 (isotope)	secondary	1.33e-02	3.45e-08
Ferrite mfg.	Thorium-232 (isotope)	secondary	1.30e-02	3.37e-08
Invar	Curium-245 (isotope)	secondary	1.23e-02	3.20e-08
Invar	Antimony-124 (isotope)	secondary	1.23e-02	3.18e-08
Ferrite mfg.	Curium-245 (isotope)	secondary	1.20e-02	3.12e-08
Ferrite mfg.	Antimony-124 (isotope)	secondary	1.20e-02	3.11e-08
Invar	Cesium-134 (isotope)	secondary	1.10e-02	2.85e-08
Ferrite mfg.	Cesium-134 (isotope)	secondary	1.07e-02	2.79e-08
Steel Prod., cold-rolled, semi-finished	Iodine-131 (isotope)	secondary	9.03e-03	2.34e-08
Steel Prod., cold-rolled, semi-finished	Iodine-133 (isotope)	secondary	8.35e-03	2.17e-08
Steel Prod., cold-rolled, semi-finished	Manganese-54 (isotope)	secondary	6.26e-03	1.63e-08
Steel Prod., cold-rolled, semi-finished	Iodine-129 (isotope)	secondary	6.14e-03	1.59e-08
Invar	Palladium-107 (isotope)	secondary	5.98e-03	1.55e-08

Table M-29. CRT LCIA Results for the Radioactivity Impact Category

Process Group	Material	LCI Data Type	Radioactivity (Bq)	% of Total
Ferrite mfg.	Palladium-107 (isotope)	secondary	5.84e-03	1.52e-08
Steel Prod., cold-rolled, semi-finished	Radioactive substance (unspecified)	secondary	3.20e-03	8.31e-09
Invar	Iodine-131 (isotope)	secondary	2.56e-03	6.64e-09
Ferrite mfg.	Iodine-131 (isotope)	secondary	2.49e-03	6.48e-09
Invar	Iodine-133 (isotope)	secondary	2.36e-03	6.14e-09
Ferrite mfg.	Iodine-133 (isotope)	secondary	2.31e-03	5.99e-09
Invar	Manganese-54 (isotope)	secondary	1.77e-03	4.60e-09
Invar	Iodine-129 (isotope)	secondary	1.74e-03	4.52e-09
Ferrite mfg.	Manganese-54 (isotope)	secondary	1.73e-03	4.49e-09
Ferrite mfg.	Iodine-129 (isotope)	secondary	1.70e-03	4.41e-09
Total Materials Processing			**3.80e+07**	**9.88e+01**
Manufacturing Life-cycle Stage				0.00e+00
Japanese Electric Grid	Xenon-133M (isotope)	model/secondary	1.96e+04	5.08e-02
US electric grid	Xenon-133 (isotope)	model/secondary	4.98e+03	1.29e-02
Japanese Electric Grid	Tritium-3 (isotope)	model/secondary	2.35e+03	6.10e-03
Japanese Electric Grid	Krypton-85 (isotope)	model/secondary	1.66e+03	4.32e-03
Japanese Electric Grid	Xenon-133 (isotope)	model/secondary	1.30e+03	3.38e-03
Japanese Electric Grid	Argon-41 (isotope)	model/secondary	1.00e+03	2.60e-03
LPG Production	Radioactive substance (unspecified)	secondary	9.21e+02	2.39e-03
Japanese Electric Grid	Xenon-135 (isotope)	model/secondary	7.39e+02	1.92e-03
US electric grid	Tritium-3 (isotope)	model/secondary	5.98e+02	1.55e-03
US electric grid	Krypton-85 (isotope)	model/secondary	4.23e+02	1.10e-03
US electric grid	Xenon-133M (isotope)	model/secondary	3.31e+02	8.59e-04
US electric grid	Argon-41 (isotope)	model/secondary	2.55e+02	6.62e-04
US electric grid	Xenon-135 (isotope)	model/secondary	1.88e+02	4.88e-04
Japanese Electric Grid	Krypton-88 (isotope)	model/secondary	1.41e+02	3.65e-04
Japanese Electric Grid	Xenon-131M (isotope)	model/secondary	1.36e+02	3.52e-04
Japanese Electric Grid	Krypton-85M (isotope)	model/secondary	8.06e+01	2.09e-04
Japanese Electric Grid	Iodine-133 (isotope)	model/secondary	7.03e+01	1.83e-04
US electric grid	Cobalt-58 (isotope)	model/secondary	5.49e+01	1.42e-04
Japanese Electric Grid	Xenon-138 (isotope)	model/secondary	4.68e+01	1.21e-04
US electric grid	Krypton-88 (isotope)	model/secondary	3.58e+01	9.29e-05
US electric grid	Xenon-131M (isotope)	model/secondary	3.45e+01	8.95e-05
Japanese Electric Grid	Krypton-87 (isotope)	model/secondary	3.00e+01	7.79e-05
US electric grid	Krypton-85M (isotope)	model/secondary	2.05e+01	5.32e-05
US electric grid	Iodine-133 (isotope)	model/secondary	1.79e+01	4.65e-05
Japanese Electric Grid	Xenon-135M (isotope)	model/secondary	1.41e+01	3.66e-05
US electric grid	Xenon-138 (isotope)	model/secondary	1.19e+01	3.09e-05
US electric grid	Krypton-87 (isotope)	model/secondary	7.62e+00	1.98e-05
US electric grid	Xenon-135M (isotope)	model/secondary	3.59e+00	9.32e-06
Fuel Oil #6 Prod.	Radioactive substance (unspecified)	secondary	3.12e+00	8.09e-06
Fuel Oil #2 Prod.	Radioactive substance (unspecified)	secondary	2.59e+00	6.71e-06
Japanese Electric Grid	Rubidium-88 (isotope)	model/secondary	3.29e-01	8.55e-07
Fuel Oil #4 Prod.	Radioactive substance (unspecified)	secondary	2.10e-01	5.46e-07
US electric grid	Rubidium-88 (isotope)	model/secondary	8.37e-02	2.17e-07
Japanese Electric Grid	Iodine-134 (isotope)	model/secondary	7.98e-02	2.07e-07
Japanese Electric Grid	Iodine-131 (isotope)	model/secondary	7.58e-02	1.97e-07
Japanese Electric Grid	Chromium-51 (isotope)	model/secondary	6.29e-02	1.63e-07
Japanese Electric Grid	Cesium-137 (isotope)	model/secondary	2.40e-02	6.24e-08
US electric grid	Iodine-134 (isotope)	model/secondary	2.03e-02	5.27e-08
US electric grid	Iodine-131 (isotope)	model/secondary	1.93e-02	5.01e-08

Table M-29. CRT LCIA Results for the Radioactivity Impact Category

Process Group	Material	LCI Data Type	Radioactivity (Bq)	% of Total
Natural Gas Prod.	Radioactive substance (unspecified)	secondary	1.86e-02	4.84e-08
Japanese Electric Grid	Cobalt-60 (isotope)	model/secondary	1.62e-02	4.21e-08
US electric grid	Chromium-51 (isotope)	model/secondary	1.60e-02	4.15e-08
Japanese Electric Grid	Iodine-132 (isotope)	model/secondary	1.54e-02	4.00e-08
US electric grid	Cesium-137 (isotope)	model/secondary	6.11e-03	1.59e-08
US electric grid	Cobalt-60 (isotope)	model/secondary	4.13e-03	1.07e-08
Japanese Electric Grid	Iodine-135 (isotope)	model/secondary	4.01e-03	1.04e-08
US electric grid	Iodine-132 (isotope)	model/secondary	3.92e-03	1.02e-08
Japanese Electric Grid	Cesium-134 (isotope)	model/secondary	3.18e-03	8.27e-09
Japanese Electric Grid	Cobalt-58 (isotope)	model/secondary	2.16e-03	5.60e-09
US electric grid	Iodine-135 (isotope)	model/secondary	1.02e-03	2.65e-09
Japanese Electric Grid	Manganese-54 (isotope)	model/secondary	8.92e-04	2.32e-09
US electric grid	Cesium-134 (isotope)	model/secondary	8.09e-04	2.10e-09
US electric grid	Manganese-54 (isotope)	model/secondary	2.27e-04	5.89e-10
Japanese Electric Grid	Cobalt-57 (isotope)	model/secondary	1.69e-04	4.39e-10
Japanese Electric Grid	Bromine-89 (isotope)	model/secondary	1.16e-04	3.01e-10
Japanese Electric Grid	Zirconium-95 (isotope)	model/secondary	9.16e-05	2.38e-10
Japanese Electric Grid	Bromine-90 (isotope)	model/secondary	4.72e-05	1.22e-10
US electric grid	Cobalt-57 (isotope)	model/secondary	4.30e-05	1.12e-10
Japanese Electric Grid	Niobium-95 (isotope)	model/secondary	3.54e-05	9.20e-11
US electric grid	Bromine-89 (isotope)	model/secondary	2.95e-05	7.66e-11
US electric grid	Zirconium-95 (isotope)	model/secondary	2.33e-05	6.05e-11
US electric grid	Bromine-90 (isotope)	model/secondary	1.20e-05	3.11e-11
US electric grid	Niobium-95 (isotope)	model/secondary	9.01e-06	2.34e-11
Japanese Electric Grid	Technetium-99M (isotope)	model/secondary	4.75e-06	1.23e-11
US electric grid	Technetium-99M (isotope)	model/secondary	1.21e-06	3.14e-12
Japanese Electric Grid	Silver-110M (isotope)	model/secondary	1.06e-06	2.75e-12
US electric grid	Silver-110M (isotope)	model/secondary	2.69e-07	6.98e-13
Total Manufacturing			**3.50e+04**	**9.10e-02**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Xenon-133 (isotope)	model/secondary	3.12e+05	8.10e-01
US electric grid	Tritium-3 (isotope)	model/secondary	3.74e+04	9.72e-02
US electric grid	Krypton-85 (isotope)	model/secondary	2.65e+04	6.88e-02
US electric grid	Xenon-133M (isotope)	model/secondary	2.07e+04	5.38e-02
US electric grid	Argon-41 (isotope)	model/secondary	1.60e+04	4.15e-02
US electric grid	Xenon-135 (isotope)	model/secondary	1.18e+04	3.06e-02
US electric grid	Cobalt-58 (isotope)	model/secondary	3.44e+03	8.93e-03
US electric grid	Krypton-88 (isotope)	model/secondary	2.24e+03	5.82e-03
US electric grid	Xenon-131M (isotope)	model/secondary	2.16e+03	5.61e-03
US electric grid	Krypton-85M (isotope)	model/secondary	1.28e+03	3.33e-03
US electric grid	Iodine-133 (isotope)	model/secondary	1.12e+03	2.91e-03
US electric grid	Xenon-138 (isotope)	model/secondary	7.45e+02	1.93e-03
US electric grid	Krypton-87 (isotope)	model/secondary	4.78e+02	1.24e-03
US electric grid	Xenon-135M (isotope)	model/secondary	2.25e+02	5.84e-04
US electric grid	Rubidium-88 (isotope)	model/secondary	5.25e+00	1.36e-05
US electric grid	Iodine-134 (isotope)	model/secondary	1.27e+00	3.30e-06
US electric grid	Iodine-131 (isotope)	model/secondary	1.21e+00	3.14e-06
US electric grid	Chromium-51 (isotope)	model/secondary	1.00e+00	2.60e-06
US electric grid	Cesium-137 (isotope)	model/secondary	3.83e-01	9.93e-07
US electric grid	Cobalt-60 (isotope)	model/secondary	2.59e-01	6.72e-07

Table M-29. CRT LCIA Results for the Radioactivity Impact Category

Process Group	Material	LCI Data Type	Radioactivity (Bq)	% of Total
US electric grid	Iodine-132 (isotope)	model/secondary	2.45e-01	6.37e-07
US electric grid	Iodine-135 (isotope)	model/secondary	6.39e-02	1.66e-07
US electric grid	Cesium-134 (isotope)	model/secondary	5.07e-02	1.32e-07
US electric grid	Manganese-54 (isotope)	model/secondary	1.42e-02	3.69e-08
US electric grid	Cobalt-57 (isotope)	model/secondary	2.69e-03	6.99e-09
US electric grid	Bromine-89 (isotope)	model/secondary	1.85e-03	4.80e-09
US electric grid	Zirconium-95 (isotope)	model/secondary	1.46e-03	3.79e-09
US electric grid	Bromine-90 (isotope)	model/secondary	7.51e-04	1.95e-09
US electric grid	Niobium-95 (isotope)	model/secondary	5.65e-04	1.47e-09
US electric grid	Technetium-99M (isotope)	model/secondary	7.57e-05	1.97e-10
US electric grid	Silver-110M (isotope)	model/secondary	1.68e-05	4.37e-11
Total Use, Maintenance and Repair			**4.36e+05**	**1.13e+00**
End-of-life Manufacturing Stage				
US electric grid	Xenon-133 (isotope)	model/secondary	3.12e+01	8.10e-05
US electric grid	Tritium-3 (isotope)	model/secondary	3.75e+00	9.73e-06
US electric grid	Krypton-85 (isotope)	model/secondary	2.65e+00	6.88e-06
US electric grid	Xenon-133M (isotope)	model/secondary	2.07e+00	5.38e-06
US electric grid	Argon-41 (isotope)	model/secondary	1.60e+00	4.15e-06
US electric grid	Xenon-135 (isotope)	model/secondary	1.18e+00	3.06e-06
US electric grid	Cobalt-58 (isotope)	model/secondary	3.44e-01	8.93e-07
US electric grid	Krypton-88 (isotope)	model/secondary	2.24e-01	5.82e-07
US electric grid	Xenon-131M (isotope)	model/secondary	2.16e-01	5.61e-07
US electric grid	Krypton-85M (isotope)	model/secondary	1.28e-01	3.33e-07
US electric grid	Iodine-133 (isotope)	model/secondary	1.12e-01	2.91e-07
US electric grid	Xenon-138 (isotope)	model/secondary	7.45e-02	1.94e-07
US electric grid	Krypton-87 (isotope)	model/secondary	4.78e-02	1.24e-07
US electric grid	Xenon-135M (isotope)	model/secondary	2.25e-02	5.84e-08
LPG Production	Radioactive substance (unspecified)	secondary	7.95e-03	2.07e-08
US electric grid	Rubidium-88 (isotope)	model/secondary	5.25e-04	1.36e-09
US electric grid	Iodine-134 (isotope)	model/secondary	1.27e-04	3.30e-10
US electric grid	Iodine-131 (isotope)	model/secondary	1.21e-04	3.14e-10
US electric grid	Chromium-51 (isotope)	model/secondary	1.00e-04	2.60e-10
US electric grid	Cesium-137 (isotope)	model/secondary	3.83e-05	9.94e-11
US electric grid	Cobalt-60 (isotope)	model/secondary	2.59e-05	6.72e-11
US electric grid	Iodine-132 (isotope)	model/secondary	2.46e-05	6.38e-11
US electric grid	Iodine-135 (isotope)	model/secondary	6.39e-06	1.66e-11
US electric grid	Cesium-134 (isotope)	model/secondary	5.07e-06	1.32e-11
US electric grid	Manganese-54 (isotope)	model/secondary	1.42e-06	3.69e-12
US electric grid	Cobalt-57 (isotope)	model/secondary	2.69e-07	7.00e-13
US electric grid	Bromine-89 (isotope)	model/secondary	1.85e-07	4.80e-13
US electric grid	Zirconium-95 (isotope)	model/secondary	1.46e-07	3.79e-13
US electric grid	Bromine-90 (isotope)	model/secondary	7.52e-08	1.95e-13
US electric grid	Niobium-95 (isotope)	model/secondary	5.65e-08	1.47e-13
US electric grid	Technetium-99M (isotope)	model/secondary	7.58e-09	1.97e-14
US electric grid	Silver-110M (isotope)	model/secondary	1.68e-09	4.38e-15
Natural Gas Prod.	Radioactive substance (unspecified)	secondary	-9.34e-03	-2.43e-08
CRT Incineration	Radioactive substance (unspecified)	secondary	-1.45e-01	-3.76e-07
Fuel Oil #4 Prod.	Radioactive substance (unspecified)	secondary	-2.26e+00	-5.87e-06
Total End-of-life			**4.12e+01**	**1.07e-04**
Total All Life-cycle Stages			**3.85e+07**	**1.00e+02**

Table M-30. LCD LCIA Results for the Radioactivity Impact Category

Process Group	Material	LCI Data Type	Radioactivity (Bq)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Plutonium-241 (isotope)	secondary	1.18e+07	9.64e+01
Steel Prod., cold-rolled, semi-finished	Plutonium-240 (isotope)	secondary	5.08e+04	4.16e-01
Steel Prod., cold-rolled, semi-finished	Cesium-135 (isotope)	secondary	4.59e+04	3.76e-01
Steel Prod., cold-rolled, semi-finished	Radon-222 (isotope)	secondary	4.30e+04	3.52e-01
Steel Prod., cold-rolled, semi-finished	Plutonium-239 (isotope)	secondary	3.57e+04	2.93e-01
Steel Prod., cold-rolled, semi-finished	Strontium-90 (isotope)	secondary	6.86e+03	5.62e-02
Steel Prod., cold-rolled, semi-finished	Tritium-3 (isotope)	secondary	1.23e+03	1.00e-02
Steel Prod., cold-rolled, semi-finished	radioactive gas (unspecified)	secondary	8.98e+02	7.36e-03
Steel Prod., cold-rolled, semi-finished	Xenon-133 (isotope)	secondary	7.63e+02	6.25e-03
Steel Prod., cold-rolled, semi-finished	Radium-226 (isotope)	secondary	4.24e+02	3.48e-03
Steel Prod., cold-rolled, semi-finished	Thorium-230 (isotope)	secondary	2.53e+02	2.07e-03
Steel Prod., cold-rolled, semi-finished	Plutonium-242 (isotope)	secondary	1.92e+02	1.57e-03
Steel Prod., cold-rolled, semi-finished	Curium-244 (isotope)	secondary	1.91e+02	1.57e-03
Steel Prod., cold-rolled, semi-finished	Uranium-234 (isotope)	secondary	1.55e+02	1.27e-03
Steel Prod., cold-rolled, semi-finished	Americium-241 (isotope)	secondary	9.42e+01	7.72e-04
Steel Prod., cold-rolled, semi-finished	Krypton-85 (isotope)	secondary	5.45e+01	4.47e-04
Steel Prod., cold-rolled, semi-finished	Uranium-238 (isotope)	secondary	4.55e+01	3.72e-04
Steel Prod., cold-rolled, semi-finished	Samarium-151 (isotope)	secondary	4.25e+01	3.48e-04
Steel Prod., cold-rolled, semi-finished	Neptunium-237 (isotope)	secondary	2.95e+01	2.42e-04
Steel Prod., cold-rolled, semi-finished	Carbon-14 (isotope)	secondary	9.35e+00	7.66e-05
Steel Prod., cold-rolled, semi-finished	Radium-222 (isotope)	secondary	3.26e+00	2.67e-05
Steel Prod., cold-rolled, semi-finished	Uranium-235 (isotope)	secondary	2.87e+00	2.35e-05
Steel Prod., cold-rolled, semi-finished	Americium-243 (isotope)	secondary	2.05e+00	1.68e-05
Steel Prod., cold-rolled, semi-finished	Technetium-99M (isotope)	secondary	1.40e+00	1.15e-05
Natural Gas Prod.	Radioactive substance (unspecified)	secondary	1.30e+00	1.07e-05
Steel Prod., cold-rolled, semi-finished	Thorium-228 (isotope)	secondary	1.22e+00	1.00e-05
Steel Prod., cold-rolled, semi-finished	Radon-220 (isotope)	secondary	9.93e-01	8.13e-06
Steel Prod., cold-rolled, semi-finished	Radium-228 (isotope)	secondary	6.36e-01	5.21e-06
Steel Prod., cold-rolled, semi-finished	Polonium-210 (isotope)	secondary	5.52e-01	4.52e-06
Steel Prod., cold-rolled, semi-finished	Lead-210 (isotope)	secondary	3.21e-01	2.63e-06
Steel Prod., cold-rolled, semi-finished	Radium-224 (isotope)	secondary	2.97e-01	2.43e-06
Steel Prod., cold-rolled, semi-finished	Zirconium-93 (isotope)	secondary	1.84e-01	1.51e-06
Steel Prod., cold-rolled, semi-finished	Cesium-137 (isotope)	secondary	1.56e-01	1.28e-06
Steel Prod., cold-rolled, semi-finished	Protactinium-234 (isotope)	secondary	9.87e-02	8.09e-07
Steel Prod., cold-rolled, semi-finished	Thorium-234 (isotope)	secondary	9.87e-02	8.09e-07
Steel Prod., cold-rolled, semi-finished	Silver-110M (isotope)	secondary	9.21e-02	7.54e-07
Steel Prod., cold-rolled, semi-finished	Potassium-40 (isotope)	secondary	8.57e-02	7.02e-07
Steel Prod., cold-rolled, semi-finished	Cobalt-58 (isotope)	secondary	6.17e-02	5.06e-07
Steel Prod., cold-rolled, semi-finished	Tin-126 (isotope)	secondary	5.79e-02	4.74e-07
Steel Prod., cold-rolled, semi-finished	Cobalt-60 (isotope)	secondary	3.87e-02	3.17e-07
Steel Prod., cold-rolled, semi-finished	Selenium-79 (isotope)	secondary	3.31e-02	2.71e-07
Steel Prod., cold-rolled, semi-finished	Radioactive aerosols and halogenes (unspecified)	secondary	2.81e-02	2.30e-07
Steel Prod., cold-rolled, semi-finished	Thorium-232 (isotope)	secondary	2.28e-02	1.87e-07
Steel Prod., cold-rolled, semi-finished	Curium-245 (isotope)	secondary	2.13e-02	1.75e-07
Steel Prod., cold-rolled, semi-finished	Antimony-124 (isotope)	secondary	2.12e-02	1.74e-07
Steel Prod., cold-rolled, semi-finished	Cesium-134 (isotope)	secondary	1.90e-02	1.56e-07
Steel Prod., cold-rolled, semi-finished	Palladium-107 (isotope)	secondary	1.04e-02	8.48e-08

Table M-30. LCD LCIA Results for the Radioactivity Impact Category

Process Group	Material	LCI Data Type	Radioactivity (Bq)	% of Total
Steel Prod., cold-rolled, semi-finished	Iodine-131 (isotope)	secondary	4.42e-03	3.62e-08
Steel Prod., cold-rolled, semi-finished	Iodine-133 (isotope)	secondary	4.09e-03	3.35e-08
Steel Prod., cold-rolled, semi-finished	Manganese-54 (isotope)	secondary	3.07e-03	2.51e-08
Steel Prod., cold-rolled, semi-finished	Iodine-129 (isotope)	secondary	3.01e-03	2.47e-08
Steel Prod., cold-rolled, semi-finished	Radioactive substance (unspecified)	secondary	1.57e-03	1.28e-08
Total Materials Processing			**1.20e+07**	**9.79e+01**
Manufacturing Life-cycle Stage				
Japanese Electric Grid	Xenon-133M (isotope)	model/secondary	6.58e+04	5.39e-01
Japanese Electric Grid	Tritium-3 (isotope)	model/secondary	7.90e+03	6.48e-02
Japanese Electric Grid	Krypton-85 (isotope)	model/secondary	5.59e+03	4.58e-02
Japanese Electric Grid	Xenon-133 (isotope)	model/secondary	4.37e+03	3.58e-02
Japanese Electric Grid	Argon-41 (isotope)	model/secondary	3.37e+03	2.76e-02
Japanese Electric Grid	Xenon-135 (isotope)	model/secondary	2.48e+03	2.04e-02
US electric grid	Xenon-133 (isotope)	model/secondary	6.04e+02	4.95e-03
Japanese Electric Grid	Krypton-88 (isotope)	model/secondary	4.73e+02	3.88e-03
Japanese Electric Grid	Xenon-131M (isotope)	model/secondary	4.56e+02	3.74e-03
Japanese Electric Grid	Krypton-85M (isotope)	model/secondary	2.71e+02	2.22e-03
Japanese Electric Grid	Iodine-133 (isotope)	model/secondary	2.37e+02	1.94e-03
Japanese Electric Grid	Xenon-138 (isotope)	model/secondary	1.57e+02	1.29e-03
Japanese Electric Grid	Krypton-87 (isotope)	model/secondary	1.01e+02	8.26e-04
US electric grid	Tritium-3 (isotope)	model/secondary	7.25e+01	5.94e-04
US electric grid	Krypton-85 (isotope)	model/secondary	5.13e+01	4.20e-04
Japanese Electric Grid	Xenon-135M (isotope)	model/secondary	4.74e+01	3.89e-04
LPG Production	Radioactive substance (unspecified)	secondary	4.42e+01	3.62e-04
US electric grid	Xenon-133M (isotope)	model/secondary	4.01e+01	3.29e-04
US electric grid	Argon-41 (isotope)	model/secondary	3.09e+01	2.53e-04
US electric grid	Xenon-135 (isotope)	model/secondary	2.28e+01	1.87e-04
US electric grid	Cobalt-58 (isotope)	model/secondary	6.65e+00	5.45e-05
US electric grid	Krypton-88 (isotope)	model/secondary	4.34e+00	3.56e-05
US electric grid	Xenon-131M (isotope)	model/secondary	4.18e+00	3.43e-05
US electric grid	Krypton-85M (isotope)	model/secondary	2.48e+00	2.04e-05
US electric grid	Iodine-133 (isotope)	model/secondary	2.17e+00	1.78e-05
US electric grid	Xenon-138 (isotope)	model/secondary	1.44e+00	1.18e-05
Japanese Electric Grid	Rubidium-88 (isotope)	model/secondary	1.11e+00	9.07e-06
US electric grid	Krypton-87 (isotope)	model/secondary	9.25e-01	7.58e-06
US electric grid	Xenon-135M (isotope)	model/secondary	4.35e-01	3.57e-06
Fuel Oil #4 Prod.	Radioactive substance (unspecified)	secondary	3.24e-01	2.65e-06
Japanese Electric Grid	Iodine-134 (isotope)	model/secondary	2.68e-01	2.20e-06
Japanese Electric Grid	Iodine-131 (isotope)	model/secondary	2.55e-01	2.09e-06
Japanese Electric Grid	Chromium-51 (isotope)	model/secondary	2.11e-01	1.73e-06
Fuel Oil #2 Prod.	Radioactive substance (unspecified)	secondary	1.21e-01	9.88e-07
Fuel Oil #6 Prod.	Radioactive substance (unspecified)	secondary	1.06e-01	8.69e-07
Japanese Electric Grid	Cesium-137 (isotope)	model/secondary	8.08e-02	6.62e-07
Japanese Electric Grid	Cobalt-60 (isotope)	model/secondary	5.46e-02	4.47e-07
Japanese Electric Grid	Iodine-132 (isotope)	model/secondary	5.18e-02	4.24e-07
Natural Gas Prod.	Radioactive substance (unspecified)	secondary	2.94e-02	2.41e-07
Japanese Electric Grid	Iodine-135 (isotope)	model/secondary	1.35e-02	1.10e-07
Japanese Electric Grid	Cesium-134 (isotope)	model/secondary	1.07e-02	8.77e-08
US electric grid	Rubidium-88 (isotope)	model/secondary	1.02e-02	8.32e-08
Japanese Electric Grid	Cobalt-58 (isotope)	model/secondary	7.26e-03	5.94e-08
Japanese Electric Grid	Manganese-54 (isotope)	model/secondary	3.00e-03	2.46e-08

Table M-30. LCD LCIA Results for the Radioactivity Impact Category

Process Group	Material	LCI Data Type	Radioactivity (Bq)	% of Total
US electric grid	Iodine-134 (isotope)	model/secondary	2.46e-03	2.02e-08
US electric grid	Iodine-131 (isotope)	model/secondary	2.34e-03	1.92e-08
US electric grid	Chromium-51 (isotope)	model/secondary	1.94e-03	1.59e-08
US electric grid	Cesium-137 (isotope)	model/secondary	7.41e-04	6.07e-09
Japanese Electric Grid	Cobalt-57 (isotope)	model/secondary	5.68e-04	4.66e-09
US electric grid	Cobalt-60 (isotope)	model/secondary	5.01e-04	4.10e-09
US electric grid	Iodine-132 (isotope)	model/secondary	4.75e-04	3.89e-09
Japanese Electric Grid	Bromine-89 (isotope)	model/secondary	3.90e-04	3.19e-09
Japanese Electric Grid	Zirconium-95 (isotope)	model/secondary	3.08e-04	2.52e-09
Japanese Electric Grid	Bromine-90 (isotope)	model/secondary	1.59e-04	1.30e-09
US electric grid	Iodine-135 (isotope)	model/secondary	1.24e-04	1.01e-09
Japanese Electric Grid	Niobium-95 (isotope)	model/secondary	1.19e-04	9.77e-10
US electric grid	Cesium-134 (isotope)	model/secondary	9.82e-05	8.04e-10
US electric grid	Manganese-54 (isotope)	model/secondary	2.75e-05	2.25e-10
Japanese Electric Grid	Technetium-99M (isotope)	model/secondary	1.60e-05	1.31e-10
US electric grid	Cobalt-57 (isotope)	model/secondary	5.21e-06	4.27e-11
US electric grid	Bromine-89 (isotope)	model/secondary	3.58e-06	2.93e-11
Japanese Electric Grid	Silver-110M (isotope)	model/secondary	3.56e-06	2.91e-11
US electric grid	Zirconium-95 (isotope)	model/secondary	2.82e-06	2.31e-11
US electric grid	Bromine-90 (isotope)	model/secondary	1.45e-06	1.19e-11
US electric grid	Niobium-95 (isotope)	model/secondary	1.09e-06	8.96e-12
US electric grid	Technetium-99M (isotope)	model/secondary	1.47e-07	1.20e-12
US electric grid	Silver-110M (isotope)	model/secondary	3.26e-08	2.67e-13
Total Manufacturing			**9.22e+04**	**7.55e-01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Xenon-133 (isotope)	model/secondary	1.16e+05	9.53e-01
US electric grid	Tritium-3 (isotope)	model/secondary	1.40e+04	1.14e-01
US electric grid	Krypton-85 (isotope)	model/secondary	9.88e+03	8.10e-02
US electric grid	Xenon-133M (isotope)	model/secondary	7.73e+03	6.34e-02
US electric grid	Argon-41 (isotope)	model/secondary	5.96e+03	4.88e-02
US electric grid	Xenon-135 (isotope)	model/secondary	4.39e+03	3.60e-02
US electric grid	Cobalt-58 (isotope)	model/secondary	1.28e+03	1.05e-02
US electric grid	Krypton-88 (isotope)	model/secondary	8.37e+02	6.85e-03
US electric grid	Xenon-131M (isotope)	model/secondary	8.06e+02	6.60e-03
US electric grid	Krypton-85M (isotope)	model/secondary	4.79e+02	3.92e-03
US electric grid	Iodine-133 (isotope)	model/secondary	4.18e+02	3.43e-03
US electric grid	Xenon-138 (isotope)	model/secondary	2.78e+02	2.28e-03
US electric grid	Krypton-87 (isotope)	model/secondary	1.78e+02	1.46e-03
US electric grid	Xenon-135M (isotope)	model/secondary	8.39e+01	6.87e-04
US electric grid	Rubidium-88 (isotope)	model/secondary	1.96e+00	1.60e-05
US electric grid	Iodine-134 (isotope)	model/secondary	4.74e-01	3.89e-06
US electric grid	Iodine-131 (isotope)	model/secondary	4.51e-01	3.69e-06
US electric grid	Chromium-51 (isotope)	model/secondary	3.74e-01	3.06e-06
US electric grid	Cesium-137 (isotope)	model/secondary	1.43e-01	1.17e-06
US electric grid	Cobalt-60 (isotope)	model/secondary	9.65e-02	7.91e-07
US electric grid	Iodine-132 (isotope)	model/secondary	9.16e-02	7.50e-07
US electric grid	Iodine-135 (isotope)	model/secondary	2.38e-02	1.95e-07
US electric grid	Cesium-134 (isotope)	model/secondary	1.89e-02	1.55e-07
US electric grid	Manganese-54 (isotope)	model/secondary	5.30e-03	4.35e-08

Table M-30. LCD LCIA Results for the Radioactivity Impact Category

Process Group	Material	LCI Data Type	Radioactivity (Bq)	% of Total
US electric grid	Cobalt-57 (isotope)	model/secondary	1.00e-03	8.23e-09
US electric grid	Bromine-89 (isotope)	model/secondary	6.89e-04	5.65e-09
US electric grid	Zirconium-95 (isotope)	model/secondary	5.44e-04	4.46e-09
US electric grid	Bromine-90 (isotope)	model/secondary	2.80e-04	2.30e-09
US electric grid	Niobium-95 (isotope)	model/secondary	2.11e-04	1.73e-09
US electric grid	Technetium-99M (isotope)	model/secondary	2.83e-05	2.32e-10
US electric grid	Silver-110M (isotope)	model/secondary	6.29e-06	5.15e-11
Total Use, Maintenance and Repair			**1.63e+05**	**1.33e+00**
End-of-life Life-cycle Stage				
US electric grid	Xenon-133 (isotope)	model/secondary	2.21e+01	1.81e-04
US electric grid	Tritium-3 (isotope)	model/secondary	2.65e+00	2.17e-05
US electric grid	Krypton-85 (isotope)	model/secondary	1.88e+00	1.54e-05
US electric grid	Xenon-133M (isotope)	model/secondary	1.47e+00	1.20e-05
US electric grid	Argon-41 (isotope)	model/secondary	1.13e+00	9.26e-06
US electric grid	Xenon-135 (isotope)	model/secondary	8.33e-01	6.83e-06
US electric grid	Cobalt-58 (isotope)	model/secondary	2.43e-01	1.99e-06
US electric grid	Krypton-88 (isotope)	model/secondary	1.59e-01	1.30e-06
US electric grid	Xenon-131M (isotope)	model/secondary	1.53e-01	1.25e-06
US electric grid	Krypton-85M (isotope)	model/secondary	9.09e-02	7.45e-07
US electric grid	Iodine-133 (isotope)	model/secondary	7.94e-02	6.50e-07
US electric grid	Xenon-138 (isotope)	model/secondary	5.28e-02	4.32e-07
US electric grid	Krypton-87 (isotope)	model/secondary	3.38e-02	2.77e-07
US electric grid	Xenon-135M (isotope)	model/secondary	1.59e-02	1.30e-07
LPG Production	Radioactive substance (unspecified)	secondary	3.63e-03	2.97e-08
US electric grid	Rubidium-88 (isotope)	model/secondary	3.72e-04	3.04e-09
US electric grid	Iodine-134 (isotope)	model/secondary	9.00e-05	7.37e-10
US electric grid	Iodine-131 (isotope)	model/secondary	8.56e-05	7.01e-10
US electric grid	Chromium-51 (isotope)	model/secondary	7.09e-05	5.81e-10
US electric grid	Cesium-137 (isotope)	model/secondary	2.71e-05	2.22e-10
US electric grid	Cobalt-60 (isotope)	model/secondary	1.83e-05	1.50e-10
US electric grid	Iodine-132 (isotope)	model/secondary	1.74e-05	1.42e-10
US electric grid	Iodine-135 (isotope)	model/secondary	4.52e-06	3.70e-11
US electric grid	Cesium-134 (isotope)	model/secondary	3.59e-06	2.94e-11
US electric grid	Manganese-54 (isotope)	model/secondary	1.01e-06	8.25e-12
US electric grid	Cobalt-57 (isotope)	model/secondary	1.91e-07	1.56e-12
US electric grid	Bromine-89 (isotope)	model/secondary	1.31e-07	1.07e-12
US electric grid	Zirconium-95 (isotope)	model/secondary	1.03e-07	8.46e-13
US electric grid	Bromine-90 (isotope)	model/secondary	5.32e-08	4.36e-13
US electric grid	Niobium-95 (isotope)	model/secondary	4.00e-08	3.28e-13
US electric grid	Technetium-99M (isotope)	model/secondary	5.36e-09	4.39e-14
US electric grid	Silver-110M (isotope)	model/secondary	1.19e-09	9.77e-15
Natural Gas Prod.	Radioactive substance (unspecified)	secondary	-6.16e-03	-5.05e-10
LCD incineration	Radioactive substance (unspecified)	secondary	-9.39e-02	-7.69e-09
Fuel Oil #4 Prod.	Radioactive substance (unspecified)	secondary	-1.49e+00	-1.22e-07
Total End-of-life			**2.93e+01**	**2.53e-04**
Total All Life-cycle Stages			**1.22e+07**	**1.00e+02**

Table M-31. CRT LCIA Results for the Chronic Occupational Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Occupational Toxicity (tox-kg)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Sodium Dichromate	secondary	7.23e-01	7.74e-02
Steel Prod., cold-rolled, semi-finished	Phenolsulphonic Acid	secondary	6.24e-03	6.68e-04
Aluminum Prod.	Barium sulfate	secondary	2.28e-03	2.44e-04
Steel Prod., cold-rolled, semi-finished	Dioctyl Sebacate	secondary	2.46e-04	2.64e-05
Ferrite mfg.	Barium sulfate	secondary	2.14e-04	2.29e-05
Steel Prod., cold-rolled, semi-finished	Etoxy Naphtol Sulphonic Acid (ENSA)	secondary	1.99e-04	2.13e-05
Steel Prod., cold-rolled, semi-finished	Barium sulfate	secondary	1.90e-04	2.03e-05
ABS Production	Barium sulfate	secondary	8.47e-07	9.07e-08
Invar	Borax	secondary	5.26e-07	5.64e-08
Ferrite mfg.	Borax	secondary	5.14e-07	5.50e-08
Total Materials Processing			**7.32e-01**	**7.84e-02**
Manufacturing Life-cycle Stage				
Glass/frit	Liquified petroleum gas ("propane")	primary	7.02e+02	7.51e+01
PWB Mfg.	Sulfuric acid	model/secondary	1.26e+02	1.34e+01
CRT tube mfg.	Sulfuric acid	primary	3.84e+01	4.11e+00
Glass/frit	Barium Carbonate	primary	1.68e+01	1.80e+00
CRT tube mfg.	Fuel oil #6	primary	7.37e+00	7.89e-01
Glass/frit	Fuel oil #2	primary	2.32e+00	2.49e-01
CRT monitor assembly	PPE	primary	1.47e+00	1.57e-01
Glass/frit	Lead	primary	8.95e-01	9.58e-02
PWB Mfg.	Hydrochloric acid	model/secondary	8.78e-01	9.40e-02
PWB Mfg.	Formaldehyde	model/secondary	7.56e-01	8.09e-02
CRT tube mfg.	LNG	primary	6.71e-01	7.18e-02
CRT tube mfg.	Ammonium bifluoride	primary	4.85e-01	5.20e-02
Glass/frit.	Cerium Oxide	primary	4.53e-01	4.86e-02
Glass/frit	Strontium Carbonate	primary	3.52e-01	3.77e-02
Glass/frit	Sodium Dichromate	primary	2.88e-01	3.09e-02
CRT monitor assembly	Fuel oil #4	primary	2.74e-01	2.93e-02
PWB Mfg.	Nitric acid	model/secondary	2.72e-01	2.91e-02
CRT tube mfg.	Hydrochloric acid	primary	2.01e-01	2.15e-02
Glass/frit	Hydrofluoric acid	primary	1.58e-01	1.69e-02
PWB Mfg.	Ammonium hydroxide	model/secondary	1.55e-01	1.66e-02
CRT tube mfg.	Sulfuric acid, aluminum salt	primary	1.20e-01	1.28e-02
Glass/frit	Zircon Sand	primary	1.09e-01	1.16e-02
CRT tube mfg.	Hydrogen peroxide	primary	1.07e-01	1.14e-02
CRT monitor assembly	Triphenyl phosphate	primary	1.06e-01	1.13e-02
Glass/frit	Lead	primary	9.33e-02	9.99e-03
CRT tube mfg.	Chlorine	primary	8.07e-02	8.64e-03
CRT glass mfg.	Aluminum Oxide	primary	6.74e-02	7.22e-03
PWB Mfg.	Hydrogen peroxide	model/secondary	6.21e-02	6.65e-03
CRT monitor assembly	Tricresyl phosphate	primary	4.59e-02	4.92e-03
CRT monitor assembly	Isopropyl alcohol	primary	2.44e-02	2.61e-03
CRT tube mfg.	Nitric acid	primary	1.63e-02	1.75e-03
Glass/frit	Borax	primary	1.60e-02	1.71e-03
CRT tube mfg.	Hydrofluoric acid	primary	1.48e-02	1.58e-03
CRT tube mfg.	Boric acid	primary	1.37e-02	1.47e-03
PWB Mfg.	Glycol ethers	model/secondary	1.34e-02	1.43e-03
CRT tube mfg.	Red Phosphor (Y2O2S)	primary	9.31e-03	9.96e-04

Table M-31. CRT LCIA Results for the Chronic Occupational Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Occupational Toxicity (tox-kg)	% of Total
CRT monitor assembly	Phosphate ester	primary	8.41e-03	9.00e-04
CRT tube mfg.	Polyvinyl alcohol	primary	8.11e-03	8.69e-04
CRT tube mfg.	Blue Phosphor (ZnS)	primary	7.67e-03	8.22e-04
CRT tube mfg.	Green Phosphor (ZnS)	primary	6.68e-03	7.15e-04
CRT tube mfg.	Chromium (VI)	primary	5.68e-03	6.09e-04
CRT tube mfg.	Sodium Metabisulfite	primary	4.67e-03	5.00e-04
CRT tube mfg.	Dimethyl Formamide	primary	3.84e-03	4.11e-04
CRT tube mfg.	Isopentylacetate	primary	3.49e-03	3.74e-04
CRT tube mfg.	Blue Phosphor (ZnS.Ag.Al)	primary	3.34e-03	3.57e-04
CRT tube mfg.	Ammonium hydroxide	primary	2.81e-03	3.01e-04
CRT tube mfg.	Green Phosphor (ZnS.Cu.Al)	primary	2.68e-03	2.87e-04
CRT tube mfg.	Red Phosphor (Y2O2S.Eu)	primary	2.67e-03	2.86e-04
CRT tube mfg.	Amyl acetate (mixed isomers)	primary	2.41e-03	2.58e-04
CRT tube mfg.	Ammonium fluoride	primary	1.78e-03	1.91e-04
CRT tube mfg.	Toluene	primary	8.02e-04	8.59e-05
CRT tube mfg.	Sodium Persulfate	primary	7.08e-04	7.58e-05
CRT tube mfg.	Ammonium Oxalate Monohydrate	primary	6.32e-04	6.77e-05
Japanese Electric Grid	Uranium, yellowcake	model/secondary	6.07e-04	6.50e-05
CRT tube mfg.	Sodium Hypochlorite	primary	5.24e-04	5.61e-05
CRT tube mfg.	Polyvinyl Pyrrolidone (PVP)	primary	5.22e-04	5.59e-05
CRT tube mfg.	Periodic Acid	primary	4.53e-04	4.85e-05
CRT tube mfg.	Ammonia	primary	3.24e-04	3.47e-05
CRT monitor assembly	2,2,4-trimethylpentane	primary	3.01e-04	3.22e-05
US electric grid	Uranium, yellowcake	model/secondary	1.55e-04	1.66e-05
CRT tube mfg.	Ammonium Dichromate	primary	6.99e-05	7.49e-06
CRT tube mfg.	Sodium Dichromate Dihydrate (VI)	primary	6.19e-05	6.63e-06
CRT tube mfg.	Acetone	primary	3.77e-05	4.03e-06
CRT monitor assembly	Fluorocarbon resin	primary	3.75e-05	4.02e-06
CRT tube mfg.	Xylene (mixed isomers)	primary	3.19e-05	3.42e-06
CRT monitor assembly	Cyclohexane	primary	8.61e-06	9.22e-07
Total Manufacturing			**9.00e+02**	**9.64e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Natural gas	model/secondary	2.80e+01	3.00e+00
US electric grid	Petroleum (in gournd)	model/secondary	7.60e+00	8.14e-01
US electric grid	Uranium, yellowcake	model/secondary	9.70e-03	1.04e-03
Total Use, Maintenance and Repair			**3.56e+01**	**3.81e+00**
End-of-life Life-cycle Stage				
CRT landfilling	Fuel oil #4	primary	3.86e-02	4.13e-03
CRT Recycling	Liquified petroleum gas ("propane")	primary	6.06e-03	6.48e-04
US electric grid	Uranium, yellowcake	model/secondary	9.71e-07	1.04e-07
CRT Incineration	Fuel oil #4	secondary	-2.88e+00	-3.08e-01
Total End-of-life			**-2.83e+00**	**-3.03e-01**
Total All Life-cycle Stages			**9.34e+02**	**1.00e+02**

Table M-32. LCD LCIA Results for the Chronic Occupational Health Effects Impact Category

Process Group	Materials	LCI Data Type	Chronic Occupational Toxicity (tox-kg)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Sodium Dichromate	secondary	3.54e-01	5.09e-02
Steel Prod., cold-rolled, semi-finished	Phenolsulphonic Acid	secondary	3.06e-03	4.40e-04
Aluminum Prod.	Barium sulfate	secondary	8.47e-04	1.22e-04
Steel Prod., cold-rolled, semi-finished	Dioctyl Sebacate	secondary	1.21e-04	1.73e-05
Steel Prod., cold-rolled, semi-finished	Etoxy Naphtol Sulphonic Acid (ENSA)	secondary	9.76e-05	1.40e-05
Steel Prod., cold-rolled, semi-finished	Barium sulfate	secondary	9.30e-05	1.34e-05
PMMA Sheet Prod.	Barium sulfate	secondary	2.42e-05	3.47e-06
PMMA Sheet Prod.	Ferromanganese (Fe, Mn, C)	secondary	7.67e-07	1.10e-07
Total Materials Processing			**3.59e-01**	**5.15e-02**
Manufacturing Life-cycle Stage				
Monitor/module	LNG	primary	3.95e+02	5.67e+01
Monitor/module	Sulfuric acid	primary	1.58e+02	2.26e+01
PWB Mfg.	Sulfuric acid	model/secondary	5.54e+01	7.96e+00
LCD glass mfg.	Liquified petroleum gas ("propane")	primary	3.25e+01	4.67e+00
Monitor/module	Phosphine	primary	1.23e+01	1.77e+00
Panel components	Sulfuric acid	primary	1.09e+01	1.56e+00
Monitor/module	Dimethylsulfoxide	primary	7.96e+00	1.14e+00
Monitor/module	Ethanol amine	primary	4.32e+00	6.21e-01
Panel components	Tetrahydrofuran	primary	1.32e+00	1.89e-01
Monitor/module	Liquified petroleum gas ("propane")	primary	1.17e+00	1.67e-01
LCD glass mfg.	Barium Carbonate	primary	7.79e-01	1.12e-01
Monitor/module	Kerosene	primary	5.95e-01	8.56e-02
Monitor/module	Ammonium bifluoride	primary	5.62e-01	8.07e-02
Monitor/module	Fuel oil #4	primary	4.22e-01	6.06e-02
Monitor/module	Isopropyl alcohol	primary	4.19e-01	6.02e-02
PWB Mfg.	Hydrochloric acid	model/secondary	3.87e-01	5.57e-02
Panel components	Kerosene	primary	3.35e-01	4.82e-02
PWB Mfg.	Formaldehyde	model/secondary	3.33e-01	4.79e-02
Monitor/module	Tetramethyl ammonium hydroxide	primary	2.57e-01	3.70e-02
Panel components	Fuel oil #6	primary	2.51e-01	3.61e-02
Monitor/module	Nitrogen fluoride	primary	2.16e-01	3.11e-02
Monitor/module	Hydrochloric acid	primary	1.97e-01	2.83e-02
Monitor/module	Phosphoric acid	primary	1.90e-01	2.73e-02
Monitor/module	2-(2-butoxyethoxy)-ethanol	primary	1.81e-01	2.60e-02
Monitor/module	N-Butylacetate	primary	1.64e-01	2.35e-02
Monitor/module	Molybdenum	primary	1.52e-01	2.18e-02
PWB Mfg.	Nitric acid	model/secondary	1.20e-01	1.72e-02
LCD glass mfg.	Fuel oil #2	primary	1.08e-01	1.55e-02
Monitor/module	Hydrofluoric acid	primary	8.42e-02	1.21e-02
PWB Mfg.	Ammonium hydroxide	model/secondary	6.85e-02	9.84e-03
Monitor/module	Ammonia	primary	4.22e-02	6.06e-03
Monitor/module	Sulfur hexafluoride	primary	3.24e-02	4.66e-03
Monitor/module	Propylene glycol monomethyl ether acetate	primary	3.12e-02	4.49e-03
Monitor/module	Chlorine	primary	3.11e-02	4.46e-03
PWB Mfg.	Hydrogen peroxide	model/secondary	2.74e-02	3.94e-03
Monitor/module	Nitric acid	primary	2.49e-02	3.58e-03
Monitor/module	Ammonium fluoride	primary	2.28e-02	3.28e-03

Table M-32. LCD LCIA Results for the Chronic Occupational Health Effects Impact Category

Process Group	Materials	LCI Data Type	Chronic Occupational Toxicity (tox-kg)	% of Total
LCD glass mfg.	Cerium Oxide	primary	2.10e-02	3.02e-03
Monitor/module	Isopropyl alcohol	primary	1.88e-02	2.70e-03
Monitor/module	Acetone	primary	1.74e-02	2.49e-03
LCD glass mfg.	Strontium Carbonate	primary	1.63e-02	2.34e-03
Monitor/module	Glycol ethers	primary	1.23e-02	1.76e-03
Monitor/module	1-Methoxy-2-propanol	primary	1.21e-02	1.74e-03
Monitor/module	Titanium	primary	1.16e-02	1.66e-03
Panel components	Polyvinyl alcohol	primary	8.61e-03	1.24e-03
Panel components	Perchloric acid	primary	7.64e-03	1.10e-03
Monitor/module	1-methyl-2-pyrrolidinone	primary	7.37e-03	1.06e-03
LCD glass mfg.	Hydrofluoric acid	primary	7.33e-03	1.05e-03
Monitor/module	Acetic acid	primary	6.79e-03	9.76e-04
Monitor/module	Propylene glycol	primary	6.26e-03	9.00e-04
Panel components	Hydrochloric acid	primary	5.90e-03	8.47e-04
PWB Mfg.	Glycol ethers	model/secondary	5.89e-03	8.46e-04
LCD glass mfg.	Zircon Sand	primary	5.03e-03	7.23e-04
Panel components	Toluene	primary	4.60e-03	6.61e-04
Panel components	Heptane	primary	4.33e-03	6.22e-04
Monitor/module	2-ethoxyl ethylacetate	primary	3.55e-03	5.10e-04
LCD glass mfg.	Aluminum Oxide	primary	3.12e-03	4.49e-04
Monitor/module	Nitrous oxide	primary	2.71e-03	3.90e-04
Monitor/module	Perfluoromethane	primary	2.57e-03	3.70e-04
Monitor/module	Monosilane	primary	2.25e-03	3.23e-04
Panel components	Orthoboric acid	primary	2.12e-03	3.05e-04
Panel components	Hydrochloric acid	primary	2.07e-03	2.97e-04
Japanese Electric Grid	Uranium, yellowcake	model/secondary	2.04e-03	2.94e-04
Monitor/module	Cresol-formaldehyde resin	primary	1.66e-03	2.38e-04
Panel components	Acetone	primary	1.22e-03	1.75e-04
Monitor/module	Indium tin oxide	primary	1.05e-03	1.51e-04
Monitor/module	Polyethylene mono(nonylphenyl) ether glycol	primary	9.39e-04	1.35e-04
Panel components	Fuel oil #2	primary	8.15e-04	1.17e-04
Panel components	3,4-difluorobromobenzene	primary	7.31e-04	1.05e-04
Panel components	4-pentylphenol	primary	6.84e-04	9.83e-05
Panel components	4-bromophenol	primary	6.53e-04	9.38e-05
Monitor/module	LCD material (confidential)	primary	6.21e-04	8.93e-05
Monitor/module	1,4-butanolide	primary	5.31e-04	7.63e-05
Panel components	3,4,5-trifluorobromobenzene	primary	5.29e-04	7.60e-05
Monitor/module	Hexamethyldisilizane	primary	5.16e-04	7.42e-05
Panel components	4-4(-propylcyclohexyl)cyclohexanone	primary	4.35e-04	6.26e-05
Panel components	4-propionylphenol	primary	3.89e-04	5.59e-05
Monitor/module	Hydrogen peroxide	primary	2.93e-04	4.22e-05
Panel components	HCFC-225ca	primary	2.74e-04	3.93e-05
Panel components	HCFC-225cb	primary	2.74e-04	3.93e-05
Panel components	Borax	primary	1.83e-04	2.62e-05
Panel components	Cyclohexane	primary	1.78e-04	2.56e-05
Panel components	4-ethylphenol	primary	1.40e-04	2.01e-05
Monitor/module	Xylene (mixed isomers)	primary	1.04e-04	1.50e-05
Backlight	Diethyl ether	primary	9.50e-05	1.37e-05
Panel components	Methyl ethyl ketone	primary	4.61e-05	6.62e-06

Table M-32. LCD LCIA Results for the Chronic Occupational Health Effects Impact Category

Process Group	Materials	LCI Data Type	Chronic Occupational Toxicity (tox-kg)	% of Total
Monitor/module	Triallyl isocyanurate	primary	3.09e-05	4.44e-06
Monitor/module	2,2,4-trimethylpentane	primary	3.05e-05	4.38e-06
US electric grid	Uranium, yellowcake	model/secondary	1.88e-05	2.70e-06
Monitor/module	Ammonium hydroxide	primary	1.03e-05	1.48e-06
Backlight	LNG	primary	8.33e-06	1.20e-06
Monitor/module	2-(2-butoxyethoxy)-ethanol acetate	primary	8.18e-06	1.18e-06
Monitor/module	Sodium dihydrogen phosphate dihydrate	primary	8.12e-06	1.17e-06
Backlight	Mercury	primary	3.99e-06	5.73e-07
Monitor/module	Fluorocarbon resin	primary	3.38e-06	4.86e-07
Monitor/module	Cyclohexane	primary	9.30e-07	1.34e-07
Monitor/module	Methyl ethyl ketone	primary	7.00e-07	1.01e-07
Monitor/module	Aluminum (elemental)	primary	1.70e-11	2.45e-12
Total Manufacturing			**6.84e+02**	**9.83e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Natural gas	model/secondary	1.04e+01	1.50e+00
US electric grid	Petroleum (in ground)	model/secondary	2.84e+00	4.08e-01
US electric grid	Uranium, yellowcake	model/secondary	3.62e-03	5.20e-04
Total Use, Maintenance and Repair			**1.33e+01**	**1.91e+00**
End-of-life Life-cycle Stage				
LCD landfilling	Fuel oil #4	primary	9.29e-03	1.34e-03
LCD recycling	Liquified petroleum gas ("propane")	primary	2.76e-03	3.97e-04
US electric grid	Uranium, yellowcake	model/secondary	6.87e-07	9.87e-08
LCD incineration	Fuel oil #4	secondary	-1.95e+00	-2.80e-01
Total End-of-life			**-1.94e+00**	**-2.79e-01**
Total All Life-cycle Stages			**6.96e+02**	**1.00e+02**

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Materials Processing Life-cycle Stage				
Invar	Sulfur dioxide	secondary	1.65e+02	8.33e+00
Steel Prod., cold-rolled, semi-finished	Sulfur dioxide	secondary	2.54e+01	1.28e+00
Aluminum Prod.	Sulfur dioxide	secondary	1.38e+01	6.97e-01
Polycarbonate Production	Sulfur dioxide	secondary	7.93e+00	4.01e-01
Lead	Sulfur dioxide	secondary	4.57e+00	2.31e-01
ABS Production	Sulfur dioxide	secondary	2.80e+00	1.41e-01
Ferrite mfg.	Sulfur dioxide	secondary	2.35e+00	1.19e-01
Lead	Arsenic	secondary	2.21e+00	1.11e-01
Polystyrene Prod., high-impact	Sulfur dioxide	secondary	1.20e+00	6.05e-02
Aluminum Prod.	Titanium tetrachloride	secondary	7.20e-01	3.64e-02
Steel Prod., cold-rolled, semi-finished	Carbon monoxide	secondary	3.00e-01	1.51e-02
Invar	Titanium tetrachloride	secondary	2.56e-01	1.29e-02
Lead	Titanium tetrachloride	secondary	2.10e-01	1.06e-02
Steel Prod., cold-rolled, semi-finished	PM	secondary	2.10e-01	1.06e-02
Aluminum Prod.	Manganese cmpds	secondary	1.62e-01	8.18e-03
Invar	Manganese cmpds	secondary	1.50e-01	7.56e-03
Aluminum Prod.	Vanadium	secondary	1.07e-01	5.43e-03
Ferrite mfg.	Manganese cmpds	secondary	9.39e-02	4.74e-03
Invar	Carbon monoxide	secondary	7.60e-02	3.84e-03
Invar	Vanadium	secondary	7.40e-02	3.74e-03
Ferrite mfg.	Carbon monoxide	secondary	6.32e-02	3.19e-03
Steel Prod., cold-rolled, semi-finished	Vanadium	secondary	5.15e-02	2.60e-03
Aluminum Prod.	Arsenic cmpds	secondary	4.75e-02	2.40e-03
Lead	Manganese cmpds	secondary	4.60e-02	2.33e-03
Polycarbonate Production	Carbon monoxide	secondary	4.48e-02	2.27e-03
Polycarbonate Production	Methane	secondary	4.06e-02	2.05e-03
Polycarbonate Production	Nitrogen dioxide	secondary	3.88e-02	1.96e-03
Invar	Arsenic	secondary	3.21e-02	1.62e-03
Ferrite mfg.	Arsenic	secondary	2.90e-02	1.46e-03
Steel Prod., cold-rolled, semi-finished	Nitrogen dioxide	secondary	2.80e-02	1.41e-03
Lead	Zinc (elemental)	secondary	2.42e-02	1.22e-03
Ferrite mfg.	Titanium tetrachloride	secondary	2.36e-02	1.19e-03
Invar	Zinc (elemental)	secondary	2.28e-02	1.15e-03
Ferrite mfg.	Zinc (elemental)	secondary	2.21e-02	1.12e-03
Steel Prod., cold-rolled, semi-finished	Methane	secondary	2.18e-02	1.10e-03
ABS Production	Carbon monoxide	secondary	2.17e-02	1.10e-03
Lead	Vanadium	secondary	2.09e-02	1.06e-03
Lead	Carbon monoxide	secondary	2.04e-02	1.03e-03
Steel Prod., cold-rolled, semi-finished	Fluorides (F-)	secondary	1.92e-02	9.70e-04
Aluminum Prod.	Carbon monoxide	secondary	1.86e-02	9.41e-04
Aluminum Prod.	PM	secondary	1.78e-02	8.99e-04
Styrene-butadiene Copolymer Prod.	Carbon monoxide	secondary	1.73e-02	8.74e-04
Invar	Arsenic cmpds	secondary	1.69e-02	8.53e-04
Aluminum Prod.	Methane	secondary	1.61e-02	8.13e-04
Steel Prod., cold-rolled, semi-finished	Manganese cmpds	secondary	1.49e-02	7.53e-04
Ferrite mfg.	Vanadium	secondary	1.45e-02	7.33e-04
Aluminum Prod.	Nitrogen dioxide	secondary	1.43e-02	7.21e-04
Styrene-butadiene Copolymer Prod.	Nitrogen oxides	secondary	1.40e-02	7.07e-04
Lead	Arsenic cmpds	secondary	1.38e-02	6.98e-04

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Styrene-butadiene Copolymer Prod.	Methane	secondary	1.37e-02	6.94e-04
Polycarbonate Production	PM	secondary	1.29e-02	6.53e-04
Invar	Methane	secondary	1.15e-02	5.82e-04
Styrene-butadiene Copolymer Prod.	Sulfur oxides	secondary	1.14e-02	5.77e-04
Aluminum Prod.	Barium cmpds	secondary	1.04e-02	5.28e-04
ABS Production	Methane	secondary	1.02e-02	5.14e-04
Invar	Nitrogen dioxide	secondary	1.01e-02	5.12e-04
ABS Production	Nitrogen dioxide	secondary	9.32e-03	4.71e-04
Lead	Nitrogen dioxide	secondary	8.37e-03	4.23e-04
Aluminum Prod.	Selenium	secondary	6.29e-03	3.18e-04
Ferrite mfg.	Methane	secondary	5.71e-03	2.88e-04
Invar	PM	secondary	5.51e-03	2.78e-04
Lead	Methane	secondary	5.04e-03	2.55e-04
Steel Prod., cold-rolled, semi-finished	Arsenic	secondary	4.52e-03	2.28e-04
Invar	Barium cmpds	secondary	4.31e-03	2.18e-04
Steel Prod., cold-rolled, semi-finished	Phosphorus (yellow or white)	secondary	4.07e-03	2.06e-04
Ferrite mfg.	Nitrogen dioxide	secondary	4.05e-03	2.05e-04
Polystyrene Prod., high-impact	Nitrogen dioxide	secondary	3.63e-03	1.83e-04
Ferrite mfg.	PM	secondary	3.44e-03	1.74e-04
Polystyrene Prod., high-impact	Methane	secondary	3.33e-03	1.68e-04
Aluminum Prod.	Aluminum (+3)	secondary	3.18e-03	1.60e-04
Lead	Lead	secondary	3.16e-03	1.60e-04
ABS Production	Hydrochloric acid	secondary	2.93e-03	1.48e-04
Lead	Barium cmpds	secondary	2.71e-03	1.37e-04
ABS Production	PM	secondary	2.54e-03	1.28e-04
Polystyrene Prod., high-impact	Carbon monoxide	secondary	2.45e-03	1.24e-04
Invar	Selenium	secondary	2.32e-03	1.17e-04
Steel Prod., cold-rolled, semi-finished	Hydrochloric acid	secondary	2.05e-03	1.03e-04
Styrene-butadiene Copolymer Prod.	PM	secondary	1.99e-03	1.00e-04
Invar	Hydrochloric acid	secondary	1.85e-03	9.35e-05
Lead	Selenium	secondary	1.84e-03	9.27e-05
Aluminum Prod.	Hydrochloric acid	secondary	1.78e-03	9.02e-05
Steel Prod., cold-rolled, semi-finished	Benzene	secondary	1.76e-03	8.89e-05
Steel Prod., cold-rolled, semi-finished	Barium cmpds	secondary	1.73e-03	8.75e-05
Lead	PM	secondary	1.68e-03	8.50e-05
Ferrite mfg.	Arsenic cmpds	secondary	1.64e-03	8.28e-05
ABS Production	Formaldehyde	secondary	1.60e-03	8.09e-05
Steel Prod., cold-rolled, semi-finished	Nitrous oxide	secondary	1.55e-03	7.85e-05
Steel Prod., cold-rolled, semi-finished	Arsenic cmpds	secondary	1.54e-03	7.76e-05
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	1.26e-03	6.38e-05
Aluminum Prod.	Cadmium cmpds	secondary	1.17e-03	5.92e-05
Invar	Aluminum (+3)	secondary	1.14e-03	5.76e-05
Lead	Hydrochloric acid	secondary	1.07e-03	5.41e-05
Steel Prod., cold-rolled, semi-finished	Silicon	secondary	1.01e-03	5.12e-05
Invar	Copper	secondary	9.89e-04	4.99e-05
Lead	Aluminum (+3)	secondary	9.25e-04	4.67e-05
Invar	Benzene	secondary	9.18e-04	4.64e-05
Steel Prod., cold-rolled, semi-finished	Titanium tetrachloride	secondary	8.33e-04	4.21e-05
Ferrite mfg.	Barium cmpds	secondary	7.81e-04	3.95e-05

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Ferrite mfg.	Hydrochloric acid	secondary	6.93e-04	3.50e-05
Polystyrene Prod., high-impact	PM	secondary	6.05e-04	3.05e-05
Ferrite mfg.	Benzene	secondary	5.86e-04	2.96e-05
Aluminum Prod.	Benzene	secondary	5.70e-04	2.88e-05
Steel Prod., cold-rolled, semi-finished	Ethane	secondary	4.92e-04	2.48e-05
ABS Production	Hydrofluoric acid	secondary	4.87e-04	2.46e-05
Aluminum Prod.	Hydrofluoric acid	secondary	4.81e-04	2.43e-05
Polycarbonate Production	Hydrochloric acid	secondary	4.65e-04	2.35e-05
Aluminum Prod.	Barium sulfate	secondary	4.54e-04	2.29e-05
Invar	Silicon	secondary	4.52e-04	2.28e-05
Steel Prod., cold-rolled, semi-finished	Formaldehyde	secondary	4.15e-04	2.10e-05
ABS Production	Aromatic hydrocarbons	secondary	3.81e-04	1.93e-05
Steel Prod., cold-rolled, semi-finished	Titanium	secondary	3.30e-04	1.67e-05
Polycarbonate Production	Sulfuric acid	secondary	3.18e-04	1.60e-05
ABS Production	Ammonia	secondary	3.07e-04	1.55e-05
Steel Prod., cold-rolled, semi-finished	Selenium	secondary	3.00e-04	1.51e-05
Lead	Benzene	secondary	2.99e-04	1.51e-05
Ferrite mfg.	Silicon	secondary	2.97e-04	1.50e-05
Invar	Phosphorus (yellow or white)	secondary	2.89e-04	1.46e-05
Ferrite mfg.	Selenium	secondary	2.86e-04	1.44e-05
Ferrite mfg.	Phosphorus (yellow or white)	secondary	2.85e-04	1.44e-05
Aluminum Prod.	Nitrous oxide	secondary	2.76e-04	1.40e-05
Aluminum Prod.	Perfluoromethane	secondary	2.59e-04	1.31e-05
Polycarbonate Production	Mercury compounds	secondary	2.44e-04	1.23e-05
ABS Production	Ethane	secondary	2.37e-04	1.20e-05
Aluminum Prod.	Titanium	secondary	2.30e-04	1.16e-05
Aluminum Prod.	Zinc (elemental)	secondary	2.30e-04	1.16e-05
Aluminum Prod.	Silicon	secondary	2.19e-04	1.10e-05
Steel Prod., cold-rolled, semi-finished	Zinc (elemental)	secondary	2.16e-04	1.09e-05
Invar	Titanium	secondary	2.16e-04	1.09e-05
Steel Prod., cold-rolled, semi-finished	Tin (Sn++, Sn4+)	secondary	2.09e-04	1.05e-05
Steel Prod., cold-rolled, semi-finished	Molybdenum	secondary	1.88e-04	9.50e-06
Aluminum Prod.	Copper (+1 & +2)	secondary	1.80e-04	9.10e-06
Aluminum Prod.	Strontium (Sr II)	secondary	1.70e-04	8.57e-06
Invar	Ethane	secondary	1.65e-04	8.35e-06
Polycarbonate Production	Aromatic hydrocarbons	secondary	1.64e-04	8.30e-06
Ferrite mfg.	Ethane	secondary	1.61e-04	8.15e-06
Invar	Formaldehyde	secondary	1.60e-04	8.09e-06
Ferrite mfg.	Formaldehyde	secondary	1.56e-04	7.90e-06
Invar	Molybdenum	secondary	1.52e-04	7.69e-06
ABS Production	Sulfuric acid	secondary	1.46e-04	7.36e-06
Lead	Silicon	secondary	1.43e-04	7.20e-06
Styrene-butadiene Copolymer Prod.	Sulfuric acid	secondary	1.42e-04	7.19e-06
Invar	Nitrates/nitrites	secondary	1.37e-04	6.91e-06
Styrene-butadiene Copolymer Prod.	Aromatic hydrocarbons	secondary	1.36e-04	6.86e-06
Invar	Cadmium cmpds	secondary	1.27e-04	6.42e-06
Steel Prod., cold-rolled, semi-finished	Barium	secondary	1.23e-04	6.22e-06
Lead	Barium sulfate	secondary	1.15e-04	5.79e-06
ABS Production	Mercury compounds	secondary	1.12e-04	5.64e-06
Ferrite mfg.	Aluminum (+3)	secondary	1.12e-04	5.63e-06

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Styrene-butadiene Copolymer Prod.	Mercury compounds	secondary	1.09e-04	5.51e-06
ABS Production	Aluminum (+3)	secondary	1.02e-04	5.14e-06
Steel Prod., cold-rolled, semi-finished	Antimony	secondary	9.54e-05	4.82e-06
Invar	Copper (+1 & +2)	secondary	9.43e-05	4.77e-06
Invar	Nickel	secondary	9.29e-05	4.69e-06
Ferrite mfg.	Titanium	secondary	9.23e-05	4.66e-06
Polycarbonate Production	Fluorides (F-)	secondary	9.20e-05	4.65e-06
Aluminum Prod.	Nitrate	secondary	9.13e-05	4.61e-06
Invar	Strontium (Sr II)	secondary	8.79e-05	4.44e-06
Steel Prod., cold-rolled, semi-finished	Boron	secondary	8.57e-05	4.33e-06
Steel Prod., cold-rolled, semi-finished	Strontium (Sr II)	secondary	7.92e-05	4.00e-06
Invar	Lead	secondary	7.24e-05	3.66e-06
Ferrite mfg.	Lead	secondary	6.92e-05	3.50e-06
Styrene-butadiene Copolymer Prod.	Hydrochloric acid	secondary	6.82e-05	3.45e-06
Invar	Barium	secondary	6.53e-05	3.30e-06
Lead	Ethane	secondary	6.32e-05	3.19e-06
Steel Prod., cold-rolled, semi-finished	Silver compounds	secondary	6.17e-05	3.12e-06
Invar	Tin (Sn++, Sn4+)	secondary	6.07e-05	3.07e-06
Polystyrene Prod., high-impact	Aromatic hydrocarbons	secondary	6.05e-05	3.05e-06
ABS Production	Nitrate	secondary	6.01e-05	3.04e-06
Steel Prod., cold-rolled, semi-finished	Nitrates/nitrites	secondary	5.66e-05	2.86e-06
Invar	Hydrofluoric acid	secondary	5.37e-05	2.72e-06
Ferrite mfg.	Molybdenum	secondary	5.24e-05	2.65e-06
Lead	Copper (+1 & +2)	secondary	5.20e-05	2.63e-06
Steel Prod., cold-rolled, semi-finished	Chromium (VI)	secondary	5.17e-05	2.61e-06
Invar	Ammonia	secondary	5.01e-05	2.53e-06
Invar	Zinc (+2)	secondary	4.87e-05	2.46e-06
Invar	Boron	secondary	4.85e-05	2.45e-06
Steel Prod., cold-rolled, semi-finished	Acetylene	secondary	4.66e-05	2.35e-06
Steel Prod., cold-rolled, semi-finished	Mercury compounds	secondary	4.53e-05	2.29e-06
Lead	Cadmium	secondary	4.52e-05	2.29e-06
Styrene-butadiene Copolymer Prod.	Fluorides (F-)	secondary	4.12e-05	2.08e-06
Lead	Nitrous oxide	secondary	4.06e-05	2.05e-06
Aluminum Prod.	Barium	secondary	3.91e-05	1.98e-06
Steel Prod., cold-rolled, semi-finished	Hydrofluoric acid	secondary	3.79e-05	1.91e-06
Ferrite mfg.	Barium	secondary	3.73e-05	1.89e-06
Ferrite mfg.	Zinc (+2)	secondary	3.69e-05	1.86e-06
Aluminum Prod.	Zinc (+2)	secondary	3.48e-05	1.76e-06
Invar	Barium sulfate	secondary	3.46e-05	1.75e-06
Steel Prod., cold-rolled, semi-finished	Barium sulfate	secondary	3.43e-05	1.73e-06
Lead	Strontium (Sr II)	secondary	3.40e-05	1.72e-06
Ferrite mfg.	Barium sulfate	secondary	3.38e-05	1.71e-06
Steel Prod., cold-rolled, semi-finished	Aluminum (+3)	secondary	3.15e-05	1.59e-06
Lead	Barium	secondary	2.88e-05	1.46e-06
Aluminum Prod.	Aromatic hydrocarbons	secondary	2.83e-05	1.43e-06
Lead	Copper	secondary	2.82e-05	1.42e-06
Lead	Hydrofluoric acid	secondary	2.73e-05	1.38e-06
Steel Prod., cold-rolled, semi-finished	Hydrogen sulfide	secondary	2.72e-05	1.37e-06
Aluminum Prod.	Nickel cmpds	secondary	2.71e-05	1.37e-06
Invar	Antimony	secondary	2.70e-05	1.37e-06

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Steel Prod., cold-rolled, semi-finished	Cadmium cmpds	secondary	2.70e-05	1.36e-06
Ferrite mfg.	Antimony	secondary	2.64e-05	1.33e-06
Ferrite mfg.	Boron	secondary	2.58e-05	1.30e-06
Ferrite mfg.	Strontium (Sr II)	secondary	2.57e-05	1.30e-06
Aluminum Prod.	Nickel	secondary	2.52e-05	1.28e-06
Steel Prod., cold-rolled, semi-finished	Aluminum (elemental)	secondary	2.47e-05	1.25e-06
Aluminum Prod.	Ammonia	secondary	2.45e-05	1.24e-06
Polystyrene Prod., high-impact	Hydrochloric acid	secondary	2.42e-05	1.22e-06
Aluminum Prod.	Copper	secondary	2.38e-05	1.20e-06
Invar	Nickel cmpds	secondary	2.15e-05	1.09e-06
Ferrite mfg.	Nitrous oxide	secondary	2.12e-05	1.07e-06
ABS Production	Hydrogen sulfide	secondary	2.02e-05	1.02e-06
Lead	Ammonia	secondary	1.88e-05	9.49e-07
Invar	Silver compounds	secondary	1.86e-05	9.42e-07
Ferrite mfg.	Silver compounds	secondary	1.82e-05	9.20e-07
Aluminum Prod.	Fluoride	secondary	1.82e-05	9.19e-07
Lead	Nitrate	secondary	1.80e-05	9.10e-07
Aluminum Prod.	Lead cmpds	secondary	1.74e-05	8.81e-07
Steel Prod., cold-rolled, semi-finished	Pentane	secondary	1.70e-05	8.57e-07
Invar	Aromatic hydrocarbons	secondary	1.67e-05	8.44e-07
Lead	Boron	secondary	1.66e-05	8.37e-07
Aluminum Prod.	Vanadium (V3+, V5+)	secondary	1.63e-05	8.23e-07
Ferrite mfg.	Ammonia	secondary	1.62e-05	8.20e-07
Invar	Aluminum (elemental)	secondary	1.52e-05	7.70e-07
Aluminum Prod.	Nitrites	secondary	1.47e-05	7.40e-07
Invar	Hydrogen sulfide	secondary	1.45e-05	7.34e-07
Invar	Chromium (VI)	secondary	1.45e-05	7.31e-07
Aluminum Prod.	Perfluoroethane	secondary	1.44e-05	7.28e-07
Steel Prod., cold-rolled, semi-finished	Aromatic hydrocarbons	secondary	1.43e-05	7.24e-07
Aluminum Prod.	Chromium (VI)	secondary	1.39e-05	7.03e-07
Invar	Cadmium	secondary	1.34e-05	6.77e-07
Invar	Acetylene	secondary	1.32e-05	6.68e-07
Ferrite mfg.	Acetylene	secondary	1.29e-05	6.52e-07
Ferrite mfg.	Hydrofluoric acid	secondary	1.27e-05	6.44e-07
Steel Prod., cold-rolled, semi-finished	Copper	secondary	1.22e-05	6.17e-07
Steel Prod., cold-rolled, semi-finished	Nickel	secondary	1.16e-05	5.84e-07
Ferrite mfg.	Cadmium	secondary	1.11e-05	5.61e-07
Aluminum Prod.	Aluminum (elemental)	secondary	1.05e-05	5.32e-07
Polycarbonate Production	Copper (+1 & +2)	secondary	1.04e-05	5.24e-07
Ferrite mfg.	Hydrogen sulfide	secondary	1.03e-05	5.22e-07
Lead	Zinc (+2)	secondary	9.93e-06	5.02e-07
Aluminum Prod.	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	9.88e-06	4.99e-07
Polycarbonate Production	Phenol	secondary	9.34e-06	4.72e-07
Invar	Pentane	secondary	8.97e-06	4.53e-07
Lead	Fluoride	secondary	8.91e-06	4.50e-07
Steel Prod., cold-rolled, semi-finished	Hexane	secondary	8.86e-06	4.48e-07
Invar	Fluoride	secondary	8.80e-06	4.45e-07
Ferrite mfg.	Pentane	secondary	8.76e-06	4.43e-07
Steel Prod., cold-rolled, semi-finished	Copper (+1 & +2)	secondary	8.59e-06	4.34e-07
Lead	Aluminum (elemental)	secondary	8.16e-06	4.12e-07

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Ferrite mfg.	Nitrate	secondary	8.08e-06	4.08e-07
Lead	Nickel cmpds	secondary	7.95e-06	4.01e-07
Ferrite mfg.	Aluminum (elemental)	secondary	7.77e-06	3.92e-07
Invar	Benzo[a]pyrene	secondary	7.72e-06	3.90e-07
Aluminum Prod.	Hydrogen sulfide	secondary	7.53e-06	3.80e-07
Polycarbonate Production	Hydrofluoric acid	secondary	7.39e-06	3.73e-07
Aluminum Prod.	Acetic acid	secondary	7.33e-06	3.71e-07
Lead	Nickel	secondary	6.71e-06	3.39e-07
Ferrite mfg.	Chromium (VI)	secondary	6.52e-06	3.30e-07
Invar	Nitrites	secondary	6.45e-06	3.26e-07
Invar	Acetic acid	secondary	6.08e-06	3.07e-07
Invar	Vanadium (V3+, V5+)	secondary	6.00e-06	3.03e-07
Invar	Lead cmpds	secondary	5.96e-06	3.01e-07
Ferrite mfg.	Copper (+1 & +2)	secondary	5.96e-06	3.01e-07
Ferrite mfg.	Cadmium cmpds	secondary	5.94e-06	3.00e-07
Lead	Hydrogen sulfide	secondary	5.93e-06	3.00e-07
Polycarbonate Production	Ammonia	secondary	5.86e-06	2.96e-07
Lead	Chromium (VI)	secondary	5.80e-06	2.93e-07
Styrene-butadiene Copolymer Prod.	Nitrate	secondary	5.79e-06	2.93e-07
Lead	Lead cmpds	secondary	5.50e-06	2.78e-07
ABS Production	Heptane	secondary	5.02e-06	2.53e-07
ABS Production	Copper (+1 & +2)	secondary	4.75e-06	2.40e-07
Lead	Vanadium (V3+, V5+)	secondary	4.75e-06	2.40e-07
Styrene-butadiene Copolymer Prod.	Copper (+1 & +2)	secondary	4.64e-06	2.35e-07
Ferrite mfg.	Copper	secondary	4.55e-06	2.30e-07
Ferrite mfg.	Aromatic hydrocarbons	secondary	4.52e-06	2.29e-07
Steel Prod., cold-rolled, semi-finished	Bromine	secondary	4.06e-06	2.05e-07
Polycarbonate Production	Halogenated hydrocarbons (unspecified)	secondary	3.69e-06	1.87e-07
Polycarbonate Production	Hydrogen sulfide	secondary	3.69e-06	1.87e-07
Steel Prod., cold-rolled, semi-finished	Acetic acid	secondary	3.56e-06	1.80e-07
Invar	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	3.45e-06	1.74e-07
Aluminum Prod.	Cadmium	secondary	3.36e-06	1.70e-07
Steel Prod., cold-rolled, semi-finished	Boric acid	secondary	3.30e-06	1.67e-07
Ferrite mfg.	Nickel	secondary	3.26e-06	1.65e-07
Lead	Nitrites	secondary	3.10e-06	1.57e-07
Steel Prod., cold-rolled, semi-finished	Strontium	secondary	3.01e-06	1.52e-07
Lead	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	2.99e-06	1.51e-07
Invar	Cobalt (Co I, Co II, Co III)	secondary	2.88e-06	1.46e-07
Aluminum Prod.	Triethylene glycol	secondary	2.69e-06	1.36e-07
Invar	Hexane	secondary	2.58e-06	1.30e-07
Polystyrene Prod., high-impact	Ammonia	secondary	2.56e-06	1.29e-07
Ferrite mfg.	Hexane	secondary	2.51e-06	1.27e-07
Aluminum Prod.	Lead	secondary	2.40e-06	1.21e-07
Steel Prod., cold-rolled, semi-finished	Lead	secondary	2.20e-06	1.11e-07
Invar	Boron (B III)	secondary	2.18e-06	1.10e-07
Lead	Bromine	secondary	2.16e-06	1.09e-07
Invar	Triethylene glycol	secondary	2.14e-06	1.08e-07
Steel Prod., cold-rolled, semi-finished	Triethylene glycol	secondary	2.12e-06	1.07e-07
Ferrite mfg.	Triethylene glycol	secondary	2.09e-06	1.05e-07
Lead	Triethylene glycol	secondary	2.01e-06	1.01e-07

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Steel Prod., cold-rolled, semi-finished	Cadmium	secondary	1.98e-06	1.00e-07
Invar	Methanol	secondary	1.87e-06	9.43e-08
Polycarbonate Production	Chlorine	secondary	1.85e-06	9.33e-08
Ferrite mfg.	Fluoride	secondary	1.85e-06	9.33e-08
Lead	Cobalt (Co I, Co II, Co III)	secondary	1.84e-06	9.28e-08
Aluminum Prod.	Toluene	secondary	1.81e-06	9.15e-08
Steel Prod., cold-rolled, semi-finished	Lead cmpds	secondary	1.77e-06	8.92e-08
Steel Prod., cold-rolled, semi-finished	Uranium	secondary	1.71e-06	8.65e-08
Styrene-butadiene Copolymer Prod.	Aluminum (+3)	secondary	1.65e-06	8.36e-08
Invar	Strontium	secondary	1.59e-06	8.04e-08
Ferrite mfg.	Acetic acid	secondary	1.52e-06	7.67e-08
Steel Prod., cold-rolled, semi-finished	Toluene	secondary	1.52e-06	7.67e-08
Lead	Mercury	secondary	1.51e-06	7.64e-08
Invar	Bromium (Br)	secondary	1.42e-06	7.16e-08
Ferrite mfg.	Bromine	secondary	1.38e-06	6.99e-08
Aluminum Prod.	Xylene (mixed isomers)	secondary	1.38e-06	6.96e-08
Lead	Boron (B III)	secondary	1.31e-06	6.63e-08
ABS Production	Chlorine	secondary	1.27e-06	6.42e-08
Lead	Acetic acid	secondary	1.27e-06	6.41e-08
Steel Prod., cold-rolled, semi-finished	Ethylene	secondary	1.23e-06	6.20e-08
Steel Prod., cold-rolled, semi-finished	Cyanide (-1)	secondary	1.21e-06	6.10e-08
Steel Prod., cold-rolled, semi-finished	Methanol	secondary	1.19e-06	6.03e-08
Ferrite mfg.	Nickel cmpds	secondary	1.13e-06	5.72e-08
Steel Prod., cold-rolled, semi-finished	Xylene (mixed isomers)	secondary	1.12e-06	5.67e-08
Steel Prod., cold-rolled, semi-finished	Naphthalene	secondary	1.11e-06	5.63e-08
Invar	Toluene	secondary	1.10e-06	5.55e-08
Steel Prod., cold-rolled, semi-finished	Zinc (+2)	secondary	1.06e-06	5.36e-08
Ferrite mfg.	Lead cmpds	secondary	1.04e-06	5.25e-08
Steel Prod., cold-rolled, semi-finished	Phenol	secondary	9.70e-07	4.90e-08
Invar	Boric acid	secondary	9.35e-07	4.72e-08
Steel Prod., cold-rolled, semi-finished	Heptane	secondary	9.33e-07	4.72e-08
Polycarbonate Production	Aluminum (+3)	secondary	9.23e-07	4.67e-08
Polycarbonate Production	Ethanethiol	secondary	9.23e-07	4.67e-08
Polycarbonate Production	Lead	secondary	9.23e-07	4.67e-08
Polycarbonate Production	Nitrate	secondary	9.23e-07	4.67e-08
Polycarbonate Production	Nitrous oxide	secondary	9.23e-07	4.67e-08
Polycarbonate Production	Zinc (+2)	secondary	9.23e-07	4.67e-08
Ferrite mfg.	Boric acid	secondary	9.13e-07	4.61e-08
Lead	Manganese	secondary	8.47e-07	4.28e-08
Steel Prod., cold-rolled, semi-finished	Nickel cmpds	secondary	8.46e-07	4.27e-08
Ferrite mfg.	Strontium	secondary	8.38e-07	4.23e-08
Styrene-butadiene Copolymer Prod.	Chlorine	secondary	8.27e-07	4.18e-08
Styrene-butadiene Copolymer Prod.	Hydrofluoric acid	secondary	8.27e-07	4.18e-08
Aluminum Prod.	Cobalt	secondary	8.23e-07	4.16e-08
Steel Prod., cold-rolled, semi-finished	Cobalt	secondary	8.10e-07	4.09e-08
Lead	Mercury compounds	secondary	7.89e-07	3.99e-08
Invar	Xylene (mixed isomers)	secondary	7.67e-07	3.88e-08
Aluminum Prod.	Strontium	secondary	7.60e-07	3.84e-08
Steel Prod., cold-rolled, semi-finished	Beryllium	secondary	7.21e-07	3.64e-08
ABS Production	Nickel cmpds	secondary	7.16e-07	3.62e-08

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Ferrite mfg.	Vanadium (V3+, V5+)	secondary	6.83e-07	3.45e-08
Aluminum Prod.	Phenol	secondary	6.39e-07	3.23e-08
Invar	Manganese	secondary	6.32e-07	3.19e-08
Polystyrene Prod., high-impact	Nitrate	secondary	6.05e-07	3.05e-08
Invar	Ethylene	secondary	6.01e-07	3.03e-08
Steel Prod., cold-rolled, semi-finished	Vanadium (V3+, V5+)	secondary	5.94e-07	3.00e-08
ABS Production	Phenol	secondary	5.88e-07	2.97e-08
Ferrite mfg.	Ethylene	secondary	5.79e-07	2.92e-08
Styrene-butadiene Copolymer Prod.	Ammonia	secondary	5.62e-07	2.84e-08
Steel Prod., cold-rolled, semi-finished	Benzo[a]pyrene	secondary	5.60e-07	2.83e-08
Ferrite mfg.	Toluene	secondary	5.31e-07	2.68e-08
ABS Production	HALON-1301	secondary	5.12e-07	2.59e-08
Styrene-butadiene Copolymer Prod.	Phenol	secondary	4.92e-07	2.49e-08
Invar	Uranium	secondary	4.89e-07	2.47e-08
Ferrite mfg.	Uranium	secondary	4.77e-07	2.41e-08
Steel Prod., cold-rolled, semi-finished	Boron (B III)	secondary	4.70e-07	2.37e-08
Polycarbonate Production	Mercury	secondary	4.62e-07	2.33e-08
Ferrite mfg.	Nitrites	secondary	4.48e-07	2.26e-08
Invar	Phenol	secondary	4.41e-07	2.23e-08
ABS Production	Ethanethiol	secondary	4.24e-07	2.14e-08
ABS Production	Fluoride	secondary	4.24e-07	2.14e-08
ABS Production	Halogenated hydrocarbons (unspecified)	secondary	4.24e-07	2.14e-08
ABS Production	Lead	secondary	4.24e-07	2.14e-08
ABS Production	Nitrous oxide	secondary	4.24e-07	2.14e-08
ABS Production	Zinc (+2)	secondary	4.24e-07	2.14e-08
Styrene-butadiene Copolymer Prod.	Halogenated hydrocarbons (unspecified)	secondary	4.14e-07	2.09e-08
Styrene-butadiene Copolymer Prod.	Hydrogen sulfide	secondary	4.14e-07	2.09e-08
Styrene-butadiene Copolymer Prod.	Lead	secondary	4.14e-07	2.09e-08
Styrene-butadiene Copolymer Prod.	Nitrous oxide	secondary	4.14e-07	2.09e-08
Styrene-butadiene Copolymer Prod.	Zinc (+2)	secondary	4.14e-07	2.09e-08
Aluminum Prod.	HALON-1301	secondary	3.61e-07	1.82e-08
Steel Prod., cold-rolled, semi-finished	Manganese	secondary	3.60e-07	1.82e-08
Ferrite mfg.	Xylene (mixed isomers)	secondary	3.50e-07	1.77e-08
Ferrite mfg.	Methanol	secondary	3.36e-07	1.70e-08
Invar	Cyanide (-1)	secondary	2.89e-07	1.46e-08
Invar	Heptane	secondary	2.83e-07	1.43e-08
Invar	Acetaldehyde	secondary	2.79e-07	1.41e-08
Ferrite mfg.	Heptane	secondary	2.76e-07	1.40e-08
Lead	Xylene (mixed isomers)	secondary	2.54e-07	1.29e-08
Aluminum Prod.	1,2-Dichlorotetrafluoroethane	secondary	2.49e-07	1.26e-08
Steel Prod., cold-rolled, semi-finished	Rubidium ion (Rb+)	secondary	2.42e-07	1.22e-08
Ferrite mfg.	Cobalt	secondary	2.40e-07	1.21e-08
Invar	Mercury	secondary	2.12e-07	1.07e-08
ABS Production	Mercury	secondary	2.12e-07	1.07e-08
Styrene-butadiene Copolymer Prod.	Mercury	secondary	2.07e-07	1.05e-08
Ferrite mfg.	Cyanide (-1)	secondary	2.05e-07	1.04e-08
Invar	Beryllium	secondary	2.05e-07	1.04e-08
Aluminum Prod.	Mercury	secondary	2.02e-07	1.02e-08
Ferrite mfg.	Beryllium	secondary	2.00e-07	1.01e-08
Ferrite mfg.	Phenol	secondary	1.95e-07	9.87e-09

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Aluminum Prod.	Cyanide (-1)	secondary	1.89e-07	9.57e-09
Steel Prod., cold-rolled, semi-finished	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	1.81e-07	9.17e-09
Polystyrene Prod., high-impact	Phenol	secondary	1.80e-07	9.09e-09
Steel Prod., cold-rolled, semi-finished	Morpholine	secondary	1.79e-07	9.05e-09
Steel Prod., cold-rolled, semi-finished	Propylene	secondary	1.77e-07	8.94e-09
Ferrite mfg.	Cobalt (Co I, Co II, Co III)	secondary	1.76e-07	8.88e-09
Lead	Methanol	secondary	1.62e-07	8.21e-09
Steel Prod., cold-rolled, semi-finished	Acetaldehyde	secondary	1.62e-07	8.18e-09
Ferrite mfg.	Mercury	secondary	1.62e-07	8.16e-09
Ferrite mfg.	Benzo[a]pyrene	secondary	1.55e-07	7.85e-09
Ferrite mfg.	Boron (B III)	secondary	1.55e-07	7.83e-09
ABS Production	Ethylene	secondary	1.52e-07	7.68e-09
Invar	HALON-1301	secondary	1.52e-07	7.68e-09
Lead	Cobalt	secondary	1.46e-07	7.39e-09
Lead	Phenol	secondary	1.37e-07	6.94e-09
Invar	Ethylbenzene	secondary	1.37e-07	6.90e-09
Invar	Acetone	secondary	1.36e-07	6.88e-09
Lead	Aromatic hydrocarbons	secondary	1.36e-07	6.86e-09
Aluminum Prod.	Chromium (III)	secondary	1.31e-07	6.62e-09
Ferrite mfg.	Manganese	secondary	1.19e-07	6.00e-09
Steel Prod., cold-rolled, semi-finished	Fluorine	secondary	1.14e-07	5.78e-09
Steel Prod., cold-rolled, semi-finished	Lanthanum	secondary	1.07e-07	5.43e-09
Invar	1,2-Dichlorotetrafluoroethane	secondary	1.03e-07	5.22e-09
Lead	Cyanide (-1)	secondary	9.76e-08	4.93e-09
Invar	Nitrous oxide	secondary	9.70e-08	4.90e-09
Lead	Ethylene	secondary	9.43e-08	4.77e-09
Lead	Toluene	secondary	8.24e-08	4.16e-09
Steel Prod., cold-rolled, semi-finished	Acetone	secondary	7.91e-08	3.99e-09
Invar	Rubidium ion (Rb+)	secondary	7.31e-08	3.69e-09
Ferrite mfg.	Rubidium ion (Rb+)	secondary	7.14e-08	3.61e-09
Lead	HALON-1301	secondary	6.78e-08	3.42e-09
Invar	Sulfuric acid	secondary	5.99e-08	3.03e-09
Ferrite mfg.	Sulfuric acid	secondary	5.85e-08	2.95e-09
Steel Prod., cold-rolled, semi-finished	Thorium	secondary	5.77e-08	2.91e-09
Invar	Mercury compounds	secondary	5.58e-08	2.82e-09
Ferrite mfg.	Mercury compounds	secondary	5.45e-08	2.75e-09
Steel Prod., cold-rolled, semi-finished	Ethylbenzene	secondary	5.25e-08	2.65e-09
Ferrite mfg.	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	5.09e-08	2.57e-09
Invar	Morpholine	secondary	5.07e-08	2.56e-09
Steel Prod., cold-rolled, semi-finished	HALON-1301	secondary	5.04e-08	2.55e-09
Invar	Propylene	secondary	5.03e-08	2.54e-09
Ferrite mfg.	Morpholine	secondary	4.95e-08	2.50e-09
Ferrite mfg.	Propylene	secondary	4.91e-08	2.48e-09
Invar	Chromium (III)	secondary	4.79e-08	2.42e-09
Lead	Ethylbenzene	secondary	4.72e-08	2.39e-09
Ferrite mfg.	Acetaldehyde	secondary	4.63e-08	2.34e-09
Lead	Chromium (III)	secondary	3.86e-08	1.95e-09
Lead	Acetaldehyde	secondary	3.59e-08	1.81e-09
Steel Prod., cold-rolled, semi-finished	Tin	secondary	3.35e-08	1.69e-09
Steel Prod., cold-rolled, semi-finished	Mercury	secondary	3.26e-08	1.65e-09

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Invar	Fluorine	secondary	3.24e-08	1.64e-09
Steel Prod., cold-rolled, semi-finished	Phosphorus pentoxide	secondary	3.22e-08	1.63e-09
Ferrite mfg.	Fluorine	secondary	3.16e-08	1.60e-09
Invar	Lanthanum	secondary	3.06e-08	1.55e-09
Ferrite mfg.	Lanthanum	secondary	2.99e-08	1.51e-09
Steel Prod., cold-rolled, semi-finished	Hydrazine	secondary	2.65e-08	1.34e-09
Steel Prod., cold-rolled, semi-finished	Scandium	secondary	2.61e-08	1.32e-09
Steel Prod., cold-rolled, semi-finished	Chlorine	secondary	2.28e-08	1.15e-09
Ferrite mfg.	Acetone	secondary	2.23e-08	1.13e-09
Ferrite mfg.	Ethylbenzene	secondary	1.94e-08	9.80e-10
Ferrite mfg.	HALON-1301	secondary	1.90e-08	9.62e-10
Steel Prod., cold-rolled, semi-finished	Thallium	secondary	1.78e-08	8.99e-10
Lead	Acetone	secondary	1.72e-08	8.67e-10
Invar	Thorium	secondary	1.65e-08	8.32e-10
Ferrite mfg.	Thorium	secondary	1.61e-08	8.12e-10
Steel Prod., cold-rolled, semi-finished	Zirconium	secondary	1.37e-08	6.94e-10
Lead	Benzo[a]pyrene	secondary	1.23e-08	6.22e-10
Invar	Tin	secondary	9.53e-09	4.82e-10
Invar	Phosphorus pentoxide	secondary	9.39e-09	4.74e-10
Ferrite mfg.	Tin	secondary	9.31e-09	4.70e-10
Ferrite mfg.	Phosphorus pentoxide	secondary	9.16e-09	4.63e-10
Invar	Trichlorofluoromethane	secondary	8.09e-09	4.09e-10
Invar	Hydrogen cyanide	secondary	7.58e-09	3.83e-10
Invar	Hydrazine	secondary	7.51e-09	3.79e-10
Invar	Scandium	secondary	7.47e-09	3.77e-10
Ferrite mfg.	Hydrogen cyanide	secondary	7.40e-09	3.74e-10
Ferrite mfg.	Hydrazine	secondary	7.33e-09	3.70e-10
Ferrite mfg.	Scandium	secondary	7.29e-09	3.68e-10
Invar	Perfluoromethane	secondary	5.70e-09	2.88e-10
Steel Prod., cold-rolled, semi-finished	Nitrites	secondary	5.63e-09	2.84e-10
Ferrite mfg.	Perfluoromethane	secondary	5.57e-09	2.81e-10
Steel Prod., cold-rolled, semi-finished	Chromium (III)	secondary	5.29e-09	2.67e-10
Invar	Thallium	secondary	5.10e-09	2.58e-10
Ferrite mfg.	Chromium (III)	secondary	5.01e-09	2.53e-10
Ferrite mfg.	Thallium	secondary	4.98e-09	2.52e-10
Invar	Zirconium	secondary	3.94e-09	1.99e-10
Steel Prod., cold-rolled, semi-finished	Edetic acid (EDTA)	secondary	3.86e-09	1.95e-10
Ferrite mfg.	Zirconium	secondary	3.84e-09	1.94e-10
Invar	Hypochlorous acid	secondary	3.54e-09	1.79e-10
Steel Prod., cold-rolled, semi-finished	Hypochlorous acid	secondary	3.52e-09	1.78e-10
Ferrite mfg.	Hypochlorous acid	secondary	3.46e-09	1.75e-10
Steel Prod., cold-rolled, semi-finished	Cobalt (Co I, Co II, Co III)	secondary	3.14e-09	1.59e-10
Ferrite mfg.	Trichlorofluoromethane	secondary	3.01e-09	1.52e-10
ABS Production	HCFC-22	secondary	2.69e-09	1.36e-10
Invar	HFC-125	secondary	2.30e-09	1.16e-10
Ferrite mfg.	HFC-125	secondary	2.24e-09	1.13e-10
Invar	Chlorine	secondary	2.22e-09	1.12e-10
Ferrite mfg.	Chlorine	secondary	2.17e-09	1.10e-10
Invar	Dichloromethane	secondary	1.51e-09	7.61e-11
Steel Prod., cold-rolled, semi-finished	Dichloromethane	secondary	1.50e-09	7.55e-11

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Ferrite mfg.	Dichloromethane	secondary	1.47e-09	7.43e-11
Invar	Dichlorodifluoromethane	secondary	1.44e-09	7.27e-11
Invar	Edetic acid (EDTA)	secondary	1.09e-09	5.52e-11
Ferrite mfg.	Edetic acid (EDTA)	secondary	1.07e-09	5.39e-11
Invar	CFC-13	secondary	1.01e-09	5.09e-11
Steel Prod., cold-rolled, semi-finished	Isopropylpropionate	secondary	4.05e-10	2.04e-11
Ferrite mfg.	Isopropylpropionate	secondary	3.97e-10	2.01e-11
Invar	Halogenated matter (organic)	secondary	2.74e-10	1.39e-11
Ferrite mfg.	Halogenated matter (organic)	secondary	2.68e-10	1.35e-11
Steel Prod., cold-rolled, semi-finished	Lithium salts	secondary	1.98e-10	1.00e-11
Invar	Ethanethiol	secondary	1.74e-10	8.80e-12
Ferrite mfg.	Ethanethiol	secondary	1.70e-10	8.59e-12
Ferrite mfg.	Tin (Sn++, Sn4+)	secondary	1.46e-10	7.36e-12
Steel Prod., cold-rolled, semi-finished	Perfluoromethane	secondary	8.98e-11	4.54e-12
Invar	Lithium salts	secondary	5.61e-11	2.84e-12
Invar	Chloroform	secondary	5.52e-11	2.79e-12
Steel Prod., cold-rolled, semi-finished	Chloroform	secondary	5.48e-11	2.77e-12
Ferrite mfg.	Lithium salts	secondary	5.48e-11	2.77e-12
Ferrite mfg.	Chloroform	secondary	5.39e-11	2.72e-12
Lead	Acrolein	secondary	2.38e-11	1.20e-12
Lead	Benzaldehyde	secondary	1.35e-11	6.81e-13
Invar	Perfluoroethane	secondary	5.35e-12	2.70e-13
Invar	Trichloroethylene	secondary	7.98e-13	4.03e-14
Steel Prod., cold-rolled, semi-finished	Trichloroethylene	secondary	7.91e-13	4.00e-14
Ferrite mfg.	Trichloroethylene	secondary	7.79e-13	3.94e-14
Invar	Propionaldehyde	secondary	2.08e-13	1.05e-14
Steel Prod., cold-rolled, semi-finished	Propionaldehyde	secondary	2.08e-13	1.05e-14
Ferrite mfg.	Propionaldehyde	secondary	2.03e-13	1.03e-14
Steel Prod., cold-rolled, semi-finished	Benzaldehyde	secondary	6.15e-14	3.11e-15
Invar	Benzaldehyde	secondary	6.10e-14	3.08e-15
Ferrite mfg.	Benzaldehyde	secondary	5.95e-14	3.01e-15
Invar	Pentachlorobenzene	secondary	2.77e-14	1.40e-15
Steel Prod., cold-rolled, semi-finished	Tetrachloroethylene	secondary	2.20e-14	1.11e-15
Invar	Tetrachloroethylene	secondary	2.17e-14	1.10e-15
Ferrite mfg.	Tetrachloroethylene	secondary	2.12e-14	1.07e-15
Invar	Acrolein	secondary	9.90e-15	5.00e-16
Ferrite mfg.	1,2-Dichlorotetrafluoroethane	secondary	7.63e-15	3.86e-16
Invar	1,1,1-Trichloroethane	secondary	3.25e-15	1.64e-16
Steel Prod., cold-rolled, semi-finished	1,1,1-Trichloroethane	secondary	3.21e-15	1.62e-16
Ferrite mfg.	1,1,1-Trichloroethane	secondary	3.16e-15	1.60e-16
Invar	Pentachlorophenol	secondary	1.55e-15	7.84e-17
Invar	Hexachloroethane	secondary	1.24e-16	6.27e-18
Steel Prod., cold-rolled, semi-finished	Hexachloroethane	secondary	1.23e-16	6.22e-18
Ferrite mfg.	Hexachloroethane	secondary	1.21e-16	6.12e-18
Ferrite mfg.	Dichlorodifluoromethane	secondary	1.07e-16	5.39e-18
Ferrite mfg.	CFC-13	secondary	7.48e-17	3.78e-18
Invar	HCFC-22	secondary	6.78e-17	3.43e-18
Ferrite mfg.	HCFC-22	secondary	6.62e-17	3.35e-18
Total Materials Processing			**2.28e+02**	**1.15e+01**
Manufacturing Life-cycle Stage				

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Japanese Electric Grid	Sulfur dioxide	model/secondary	5.69e+01	2.88e+00
US electric grid	Sulfur dioxide	model/secondary	2.63e+01	1.33e+00
LPG Production	Carbon monoxide	secondary	5.77e+00	2.92e-01
LPG Production	Methane	secondary	1.68e+00	8.48e-02
LPG Production	Sulfur oxides	secondary	1.60e+00	8.10e-02
LPG Production	Nitrogen oxides	secondary	1.15e+00	5.79e-02
LPG Production	Vanadium	secondary	1.05e+00	5.29e-02
LPG Production	Benzene	secondary	8.58e-01	4.34e-02
Glass/frit	Fluorides (F-)	primary	5.85e-01	2.96e-02
LPG Production	PM	secondary	2.58e-01	1.30e-02
CRT tube mfg.	Carbon monoxide	primary	2.29e-01	1.16e-02
LPG Production	Arsenic	secondary	2.06e-01	1.04e-02
LPG Production	Formaldehyde	secondary	1.34e-01	6.77e-03
Natural Gas Prod.	Methane	secondary	1.00e-01	5.07e-03
Glass/frit	Nitrogen oxides	primary	8.83e-02	4.46e-03
Japanese Electric Grid	Nitrogen oxides	model/secondary	8.13e-02	4.11e-03
Natural Gas Prod.	Benzene	secondary	7.57e-02	3.83e-03
Natural Gas Prod.	Carbon monoxide	secondary	6.87e-02	3.47e-03
CRT monitor assembly	Tricresyl phosphate	primary	4.59e-02	2.32e-03
CRT tube mfg.	Phosphorus (yellow or white)	primary	4.00e-02	2.02e-03
Japanese Electric Grid	Carbon monoxide	model/secondary	3.78e-02	1.91e-03
US electric grid	Nitrogen oxides	model/secondary	3.76e-02	1.90e-03
LPG Production	Hydrochloric acid	secondary	3.68e-02	1.86e-03
LPG Production	Nitrous oxide	secondary	3.24e-02	1.64e-03
Fuel Oil #6 Prod.	Carbon monoxide	secondary	2.83e-02	1.43e-03
Japanese Electric Grid	Vanadium	model/secondary	2.27e-02	1.15e-03
US electric grid	Methane	model/secondary	2.06e-02	1.04e-03
CRT tube mfg.	Sulfur oxides	primary	1.99e-02	1.01e-03
Natural Gas Prod.	Nitrogen oxides	secondary	1.86e-02	9.42e-04
US electric grid	Carbon monoxide	model/secondary	1.74e-02	8.80e-04
Fuel Oil #2 Prod.	Carbon monoxide	secondary	1.68e-02	8.50e-04
Fuel Oil #6 Prod.	Methane	secondary	1.18e-02	5.95e-04
Fuel Oil #6 Prod.	Sulfur oxides	secondary	1.09e-02	5.53e-04
Fuel Oil #6 Prod.	Vanadium	secondary	1.08e-02	5.44e-04
Japanese Electric Grid	Arsenic	model/secondary	1.04e-02	5.27e-04
LPG Production	Phosphorus (yellow or white)	secondary	9.81e-03	4.96e-04
US electric grid	Arsenic	model/secondary	8.91e-03	4.50e-04
Fuel Oil #6 Prod.	Nitrogen oxides	secondary	8.19e-03	4.14e-04
US electric grid	Hydrochloric acid	model/secondary	7.87e-03	3.98e-04
LPG Production	Fluorides (F-)	secondary	7.54e-03	3.81e-04
LPG Production	Selenium	secondary	7.41e-03	3.75e-04
CRT tube mfg.	Fluoride	primary	6.91e-03	3.49e-04
Japanese Electric Grid	Hydrochloric acid	model/secondary	6.28e-03	3.17e-04
LPG Production	Hydrogen sulfide	secondary	6.13e-03	3.10e-04
LPG Production	Ammonia	secondary	5.91e-03	2.99e-04
Glass/frit	Fluorides (F-)	primary	5.85e-03	2.95e-04
Fuel Oil #2 Prod.	Methane	secondary	5.14e-03	2.60e-04
Fuel Oil #6 Prod.	Benzene	secondary	4.90e-03	2.48e-04
Fuel Oil #2 Prod.	Sulfur oxides	secondary	4.87e-03	2.46e-04
PWB Mfg.	Formaldehyde	model/secondary	4.45e-03	2.25e-04

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
CRT tube mfg.	Nitrogen oxides	primary	4.34e-03	2.19e-04
Japanese Electric Grid	PM-10	model/secondary	4.00e-03	2.02e-04
Fuel Oil #2 Prod.	Nitrogen oxides	secondary	3.51e-03	1.78e-04
Fuel Oil #2 Prod.	Vanadium	secondary	3.45e-03	1.74e-04
CRT tube mfg.	Dimethyl Formamide	primary	3.07e-03	1.55e-04
Fuel Oil #2 Prod.	Benzene	secondary	2.55e-03	1.29e-04
Glass/frit	Carbon monoxide	primary	2.16e-03	1.09e-04
LPG Production	Hydrofluoric acid	secondary	2.01e-03	1.01e-04
Fuel Oil #6 Prod.	PM	secondary	1.85e-03	9.34e-05
US electric grid	PM-10	model/secondary	1.84e-03	9.32e-05
Fuel Oil #6 Prod.	Arsenic	secondary	1.72e-03	8.72e-05
CRT tube mfg.	Zinc (elemental)	primary	1.65e-03	8.33e-05
LPG Production	Molybdenum	secondary	1.65e-03	8.33e-05
LPG Production	Chromium (VI)	secondary	1.58e-03	7.97e-05
LPG Production	Ethane	secondary	1.55e-03	7.84e-05
Fuel Oil #4 Prod.	Carbon monoxide	secondary	1.52e-03	7.66e-05
US electric grid	Selenium	model/secondary	1.48e-03	7.48e-05
Fuel Oil #6 Prod.	Formaldehyde	secondary	1.37e-03	6.92e-05
Japanese Electric Grid	Fluorides (F-)	model/secondary	1.32e-03	6.65e-05
Japanese Electric Grid	Selenium	model/secondary	1.27e-03	6.44e-05
LPG Production	Zinc (elemental)	secondary	1.20e-03	6.06e-05
Japanese Electric Grid	Formaldehyde	model/secondary	1.17e-03	5.91e-05
US electric grid	Vanadium	model/secondary	1.11e-03	5.63e-05
Glass/frit	Nitrogen oxides	primary	1.07e-03	5.39e-05
LPG Production	Hexane	secondary	9.02e-04	4.56e-05
Natural Gas Prod.	PM	secondary	8.28e-04	4.18e-05
Fuel Oil #2 Prod.	PM	secondary	7.92e-04	4.00e-05
LPG Production	Phenol	secondary	7.15e-04	3.61e-05
Fuel Oil #2 Prod.	Arsenic	secondary	6.52e-04	3.29e-05
LPG Production	Pentane	secondary	6.51e-04	3.29e-05
CRT tube mfg.	Toluene	primary	6.41e-04	3.24e-05
Japanese Electric Grid	Zinc (elemental)	model/secondary	6.13e-04	3.10e-05
Natural Gas Prod.	Sulfur oxides	secondary	5.51e-04	2.79e-05
Fuel Oil #4 Prod.	Methane	secondary	5.21e-04	2.63e-05
Fuel Oil #4 Prod.	Sulfur oxides	secondary	4.90e-04	2.48e-05
LPG Production	PM-10	secondary	4.50e-04	2.27e-05
Fuel Oil #2 Prod.	Formaldehyde	secondary	4.41e-04	2.23e-05
US electric grid	Hydrofluoric acid	model/secondary	4.29e-04	2.17e-05
Natural Gas Prod.	Ammonia	secondary	4.26e-04	2.15e-05
LPG Production	Nickel	secondary	4.12e-04	2.08e-05
Fuel Oil #4 Prod.	Vanadium	secondary	4.03e-04	2.04e-05
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	3.59e-04	1.81e-05
Japanese Electric Grid	Hydrofluoric acid	model/secondary	3.43e-04	1.73e-05
Japanese Electric Grid	Antimony	model/secondary	3.24e-04	1.64e-05
Natural Gas Prod.	Arsenic	secondary	3.15e-04	1.59e-05
Fuel Oil #6 Prod.	Hydrochloric acid	secondary	2.97e-04	1.50e-05
Fuel Oil #6 Prod.	Nitrous oxide	secondary	2.90e-04	1.47e-05
LPG Production	Aluminum (+3)	secondary	2.83e-04	1.43e-05
CRT tube mfg.	Nickel	primary	2.68e-04	1.35e-05
Fuel Oil #4 Prod.	Benzene	secondary	2.41e-04	1.22e-05

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Japanese Electric Grid	Nitrous oxide	model/secondary	2.24e-04	1.13e-05
Glass/frit	PM	primary	2.18e-04	1.10e-05
LPG Production	Antimony	secondary	2.14e-04	1.08e-05
Japanese Electric Grid	Methane	model/secondary	1.63e-04	8.22e-06
US electric grid	Formaldehyde	model/secondary	1.55e-04	7.82e-06
Japanese Electric Grid	Molybdenum	model/secondary	1.32e-04	6.65e-06
LPG Production	Nitrate	secondary	1.21e-04	6.12e-06
Fuel Oil #2 Prod.	Hydrochloric acid	secondary	1.15e-04	5.83e-06
US electric grid	Benzene	model/secondary	1.11e-04	5.63e-06
US electric grid	Nitrous oxide	model/secondary	1.08e-04	5.48e-06
Fuel Oil #2 Prod.	Nitrous oxide	secondary	1.04e-04	5.24e-06
CRT tube mfg.	Molybdenum	primary	1.02e-04	5.18e-06
Glass/frit	Sulfur oxides	primary	1.02e-04	5.14e-06
Fuel Oil #6 Prod.	Phosphorus (yellow or white)	secondary	9.77e-05	4.94e-06
Japanese Electric Grid	Benzene	model/secondary	9.11e-05	4.60e-06
Glass/frit	Lead	primary	8.74e-05	4.42e-06
Fuel Oil #4 Prod.	PM	secondary	8.09e-05	4.09e-06
Fuel Oil #4 Prod.	Arsenic	secondary	7.04e-05	3.56e-06
Natural Gas Prod.	Vanadium	secondary	6.96e-05	3.52e-06
Natural Gas Prod.	Hydrochloric acid	secondary	6.39e-05	3.23e-06
Fuel Oil #6 Prod.	Hydrogen sulfide	secondary	6.35e-05	3.21e-06
US electric grid	Phosphorus (yellow or white)	model/secondary	6.27e-05	3.17e-06
Fuel Oil #6 Prod.	Selenium	secondary	6.07e-05	3.07e-06
Glass/frit	Carbon monoxide	primary	6.03e-05	3.05e-06
Fuel Oil #6 Prod.	Fluorides (F-)	secondary	5.86e-05	2.96e-06
Fuel Oil #4 Prod.	Formaldehyde	secondary	5.14e-05	2.60e-06
Japanese Electric Grid	Nickel	model/secondary	4.98e-05	2.52e-06
CRT tube mfg.	Copper	primary	4.05e-05	2.04e-06
LPG Production	Copper	secondary	3.49e-05	1.76e-06
LPG Production	Methyl hydrazine	secondary	3.44e-05	1.74e-06
LPG Production	Silicon	secondary	3.38e-05	1.71e-06
Glass/frit	Nitrates/nitrites	primary	3.34e-05	1.69e-06
LPG Production	2-Chloroacetophenone	secondary	3.22e-05	1.63e-06
Fuel Oil #2 Prod.	Phosphorus (yellow or white)	secondary	3.21e-05	1.62e-06
LPG Production	Dimethylbenzanthracene	secondary	3.19e-05	1.61e-06
LPG Production	Bromomethane	secondary	3.18e-05	1.61e-06
Fuel Oil #6 Prod.	Ammonia	secondary	3.18e-05	1.61e-06
Japanese Electric Grid	Barium	model/secondary	2.94e-05	1.48e-06
US electric grid	Zinc (elemental)	model/secondary	2.89e-05	1.46e-06
Natural Gas Prod.	Formaldehyde	secondary	2.77e-05	1.40e-06
LPG Production	Naphthalene	secondary	2.61e-05	1.32e-06
CRT tube mfg.	Xylene (mixed isomers)	primary	2.55e-05	1.29e-06
LPG Production	Lead	secondary	2.47e-05	1.25e-06
US electric grid	Antimony	model/secondary	2.37e-05	1.20e-06
Fuel Oil #2 Prod.	Fluorides (F-)	secondary	2.35e-05	1.19e-06
Fuel Oil #2 Prod.	Selenium	secondary	2.33e-05	1.18e-06
Natural Gas Prod.	Nitrous oxide	secondary	2.31e-05	1.17e-06
LPG Production	Manganese	secondary	2.23e-05	1.13e-06
LPG Production	Beryllium	secondary	2.15e-05	1.08e-06
Fuel Oil #2 Prod.	Hydrogen sulfide	secondary	2.02e-05	1.02e-06

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	Barium	secondary	1.86e-05	9.42e-07
Fuel Oil #2 Prod.	Ammonia	secondary	1.74e-05	8.81e-07
LPG Production	Cyanide (-1)	secondary	1.67e-05	8.45e-07
Japanese Electric Grid	Naphthalene	model/secondary	1.66e-05	8.37e-07
Fuel Oil #6 Prod.	Hydrofluoric acid	secondary	1.62e-05	8.19e-07
LPG Production	Barium cmpds	secondary	1.59e-05	8.02e-07
Fuel Oil #6 Prod.	Molybdenum	secondary	1.56e-05	7.88e-07
Natural Gas Prod.	Ethane	secondary	1.40e-05	7.06e-07
Natural Gas Prod.	Fluorides (F-)	secondary	1.36e-05	6.87e-07
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	1.23e-05	6.22e-07
Natural Gas Prod.	Selenium	secondary	1.21e-05	6.13e-07
Fuel Oil #4 Prod.	Nitrous oxide	secondary	1.15e-05	5.81e-07
Japanese Electric Grid	Chromium (VI)	model/secondary	9.99e-06	5.05e-07
LPG Production	Cadmium	secondary	9.21e-06	4.65e-07
Fuel Oil #6 Prod.	Ethane	secondary	8.87e-06	4.48e-07
US electric grid	Chromium (VI)	model/secondary	8.58e-06	4.33e-07
Natural Gas Prod.	Zinc (elemental)	secondary	8.50e-06	4.30e-07
Natural Gas Prod.	Hexane	secondary	8.11e-06	4.10e-07
US electric grid	Molybdenum	model/secondary	7.93e-06	4.01e-07
US electric grid	Methyl hydrazine	model/secondary	7.36e-06	3.72e-07
Japanese Electric Grid	Copper	model/secondary	7.14e-06	3.61e-07
US electric grid	2-Chloroacetophenone	model/secondary	6.89e-06	3.48e-07
LPG Production	Carbon disulfide	secondary	6.85e-06	3.46e-07
US electric grid	Bromomethane	model/secondary	6.81e-06	3.44e-07
Fuel Oil #6 Prod.	Zinc (elemental)	secondary	6.59e-06	3.33e-07
Fuel Oil #6 Prod.	Chromium (VI)	secondary	6.39e-06	3.23e-07
Fuel Oil #2 Prod.	Hydrofluoric acid	secondary	6.30e-06	3.18e-07
CRT tube mfg.	Lead	primary	6.03e-06	3.05e-07
Japanese Electric Grid	Methyl hydrazine	model/secondary	5.88e-06	2.97e-07
Natural Gas Prod.	Pentane	secondary	5.86e-06	2.96e-07
Japanese Electric Grid	2-Chloroacetophenone	model/secondary	5.51e-06	2.78e-07
Japanese Electric Grid	Bromomethane	model/secondary	5.44e-06	2.75e-07
Fuel Oil #2 Prod.	Molybdenum	secondary	5.33e-06	2.69e-07
LPG Production	Benzyl chloride	secondary	5.24e-06	2.65e-07
Fuel Oil #6 Prod.	Hexane	secondary	5.16e-06	2.61e-07
LPG Production	Cobalt	secondary	5.02e-06	2.54e-07
Fuel Oil #6 Prod.	PM-10	secondary	4.66e-06	2.36e-07
Fuel Oil #2 Prod.	Ethane	secondary	4.61e-06	2.33e-07
Fuel Oil #6 Prod.	Nickel	secondary	3.99e-06	2.02e-07
LPG Production	Aluminum (elemental)	secondary	3.87e-06	1.96e-07
Fuel Oil #6 Prod.	Pentane	secondary	3.72e-06	1.88e-07
Fuel Oil #4 Prod.	Phosphorus (yellow or white)	secondary	3.70e-06	1.87e-07
US electric grid	Nickel	model/secondary	3.70e-06	1.87e-07
LPG Production	Chloroform	secondary	3.70e-06	1.87e-07
CRT tube mfg.	Manganese	primary	3.60e-06	1.82e-07
US electric grid	Cyanide (-1)	model/secondary	3.58e-06	1.81e-07
Fuel Oil #2 Prod.	Zinc (elemental)	secondary	3.54e-06	1.79e-07
Natural Gas Prod.	Hydrofluoric acid	secondary	3.49e-06	1.76e-07
LPG Production	Propionaldehyde	secondary	3.42e-06	1.73e-07
Japanese Electric Grid	Cyanide (-1)	model/secondary	2.86e-06	1.44e-07

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
US electric grid	2,3,7,8-TCDD	model/secondary	2.71e-06	1.37e-07
Fuel Oil #2 Prod.	Hexane	secondary	2.68e-06	1.35e-07
Fuel Oil #4 Prod.	Selenium	secondary	2.50e-06	1.26e-07
Fuel Oil #2 Prod.	Chromium (VI)	secondary	2.48e-06	1.25e-07
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	2.47e-06	1.25e-07
Fuel Oil #6 Prod.	Phenol	secondary	2.42e-06	1.22e-07
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	2.37e-06	1.20e-07
Japanese Electric Grid	Cobalt	model/secondary	2.37e-06	1.20e-07
Natural Gas Prod.	Molybdenum	secondary	2.31e-06	1.17e-07
Japanese Electric Grid	2,3,7,8-TCDD	model/secondary	2.23e-06	1.12e-07
US electric grid	Naphthalene	model/secondary	2.19e-06	1.10e-07
Fuel Oil #2 Prod.	Phenol	secondary	2.01e-06	1.01e-07
LPG Production	Acrolein	secondary	1.94e-06	9.80e-08
Fuel Oil #2 Prod.	Pentane	secondary	1.93e-06	9.77e-08
US electric grid	Barium	model/secondary	1.86e-06	9.39e-08
Natural Gas Prod.	Phosphorus (yellow or white)	secondary	1.77e-06	8.94e-08
Fuel Oil #4 Prod.	Ammonia	secondary	1.62e-06	8.17e-08
LPG Production	Methyl chloride	secondary	1.61e-06	8.13e-08
Japanese Electric Grid	Cadmium	model/secondary	1.60e-06	8.09e-08
Fuel Oil #2 Prod.	PM-10	secondary	1.48e-06	7.50e-08
Natural Gas Prod.	Chromium (VI)	secondary	1.48e-06	7.47e-08
US electric grid	Carbon disulfide	model/secondary	1.46e-06	7.40e-08
Fuel Oil #2 Prod.	Nickel	secondary	1.34e-06	6.77e-08
Glass/frit	PM	primary	1.33e-06	6.74e-08
Fuel Oil #6 Prod.	Antimony	secondary	1.19e-06	6.00e-08
Japanese Electric Grid	Carbon disulfide	model/secondary	1.17e-06	5.91e-08
LPG Production	Di(2-ethylhexyl)phthalate	secondary	1.16e-06	5.86e-08
US electric grid	Benzyl chloride	model/secondary	1.12e-06	5.67e-08
Fuel Oil #6 Prod.	Aluminum (+3)	secondary	9.58e-07	4.84e-08
LPG Production	Acetaldehyde	secondary	9.23e-07	4.67e-08
Japanese Electric Grid	Benzyl chloride	model/secondary	8.95e-07	4.52e-08
US electric grid	Cadmium	model/secondary	8.74e-07	4.42e-08
LPG Production	Mercury	secondary	8.69e-07	4.39e-08
Fuel Oil #2 Prod.	Aluminum (+3)	secondary	7.95e-07	4.02e-08
US electric grid	Chloroform	model/secondary	7.91e-07	4.00e-08
US electric grid	Propionaldehyde	model/secondary	7.31e-07	3.69e-08
US electric grid	Manganese	model/secondary	7.28e-07	3.68e-08
LPG Production	Cadmium cmpds	secondary	6.95e-07	3.51e-08
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	6.72e-07	3.39e-08
LPG Production	Dimethyl sulfate	secondary	6.42e-07	3.25e-08
Fuel Oil #2 Prod.	Antimony	secondary	6.34e-07	3.20e-08
Japanese Electric Grid	Chloroform	model/secondary	6.31e-07	3.19e-08
US electric grid	Fluoride	model/secondary	6.23e-07	3.15e-08
LPG Production	Toluene	secondary	6.23e-07	3.15e-08
CRT tube mfg.	Cyanide (-1)	primary	6.06e-07	3.06e-08
Fuel Oil #4 Prod.	Molybdenum	secondary	6.03e-07	3.05e-08
Japanese Electric Grid	Propionaldehyde	model/secondary	5.84e-07	2.95e-08
Glass/frit	Zinc (elemental)	primary	5.55e-07	2.81e-08
Japanese Electric Grid	Beryllium	model/secondary	4.94e-07	2.50e-08
Fuel Oil #6 Prod.	Nitrate	secondary	4.85e-07	2.45e-08

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
US electric grid	Beryllium	model/secondary	4.65e-07	2.35e-08
Natural Gas Prod.	Antimony	secondary	4.46e-07	2.25e-08
Glass/frit	Chromium	primary	4.41e-07	2.23e-08
Fuel Oil #4 Prod.	Ethane	secondary	4.36e-07	2.20e-08
US electric grid	Acrolein	model/secondary	4.15e-07	2.10e-08
US electric grid	Lead	model/secondary	4.07e-07	2.06e-08
US electric grid	Cobalt	model/secondary	3.88e-07	1.96e-08
LPG Production	1,4-Dichlorobenzene	secondary	3.62e-07	1.83e-08
US electric grid	Copper	model/secondary	3.57e-07	1.80e-08
Fuel Oil #6 Prod.	Silicon	secondary	3.50e-07	1.77e-08
Fuel Oil #2 Prod.	Nitrate	secondary	3.45e-07	1.74e-08
US electric grid	Methyl chloride	model/secondary	3.44e-07	1.74e-08
Japanese Electric Grid	Acrolein	model/secondary	3.31e-07	1.67e-08
Fuel Oil #4 Prod.	Zinc (elemental)	secondary	3.31e-07	1.67e-08
Fuel Oil #6 Prod.	Copper	secondary	3.17e-07	1.60e-08
LPG Production	Isophorone	secondary	3.10e-07	1.57e-08
Natural Gas Prod.	Dimethylbenzanthracene	secondary	2.87e-07	1.45e-08
LPG Production	Aromatic hydrocarbons	secondary	2.80e-07	1.42e-08
Fuel Oil #6 Prod.	Methyl hydrazine	secondary	2.78e-07	1.40e-08
Glass/frit	Nickel	primary	2.77e-07	1.40e-08
Japanese Electric Grid	Methyl chloride	model/secondary	2.75e-07	1.39e-08
Fuel Oil #4 Prod.	Chromium (VI)	secondary	2.64e-07	1.34e-08
Fuel Oil #6 Prod.	2-Chloroacetophenone	secondary	2.60e-07	1.31e-08
Fuel Oil #6 Prod.	Bromomethane	secondary	2.57e-07	1.30e-08
Fuel Oil #4 Prod.	Hexane	secondary	2.53e-07	1.28e-08
LPG Production	Methyl ethyl ketone	secondary	2.48e-07	1.26e-08
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	2.48e-07	1.25e-08
LPG Production	Tetrachloroethylene	secondary	2.46e-07	1.24e-08
Japanese Electric Grid	Toluene	model/secondary	2.39e-07	1.21e-08
LPG Production	1,2-Dichloroethane	secondary	2.18e-07	1.10e-08
LPG Production	Methyl methacrylate	secondary	2.12e-07	1.07e-08
Fuel Oil #6 Prod.	Lead	secondary	2.00e-07	1.01e-08
Japanese Electric Grid	Di(2-ethylhexyl)phthalate	model/secondary	1.98e-07	1.00e-08
US electric grid	Acetaldehyde	model/secondary	1.98e-07	9.98e-09
US electric grid	Hexane	model/secondary	1.92e-07	9.69e-09
LPG Production	Styrene	secondary	1.88e-07	9.48e-09
Fuel Oil #4 Prod.	Pentane	secondary	1.83e-07	9.24e-09
Fuel Oil #6 Prod.	Dimethylbenzanthracene	secondary	1.82e-07	9.22e-09
Fuel Oil #6 Prod.	Manganese	secondary	1.79e-07	9.04e-09
LPG Production	Bromoform	secondary	1.75e-07	8.85e-09
Natural Gas Prod.	Nickel	secondary	1.74e-07	8.81e-09
Fuel Oil #4 Prod.	PM-10	secondary	1.74e-07	8.79e-09
LPG Production	Dichloromethane	secondary	1.73e-07	8.74e-09
LPG Production	Chromium (III)	secondary	1.72e-07	8.67e-09
Fuel Oil #6 Prod.	Beryllium	secondary	1.71e-07	8.64e-09
Fuel Oil #4 Prod.	Phenol	secondary	1.63e-07	8.24e-09
Fuel Oil #6 Prod.	Naphthalene	secondary	1.58e-07	8.00e-09
Japanese Electric Grid	Acetaldehyde	model/secondary	1.58e-07	7.97e-09
Japanese Electric Grid	Hexane	model/secondary	1.53e-07	7.74e-09
Fuel Oil #4 Prod.	Nickel	secondary	1.53e-07	7.73e-09
LPG Production	Chlorobenzene	secondary	1.40e-07	7.08e-09

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
US electric grid	Dimethyl sulfate	model/secondary	1.37e-07	6.94e-09
Fuel Oil #6 Prod.	Cyanide (-1)	secondary	1.35e-07	6.82e-09
Natural Gas Prod.	Hydrogen sulfide	secondary	1.35e-07	6.80e-09
Natural Gas Prod.	Naphthalene	secondary	1.32e-07	6.66e-09
LPG Production	Copper (+1 & +2)	secondary	1.31e-07	6.62e-09
US electric grid	Mercury	model/secondary	1.20e-07	6.06e-09
Japanese Electric Grid	Mercury	model/secondary	1.18e-07	5.97e-09
LPG Production	2,4-Dinitrotoluene	secondary	1.12e-07	5.68e-09
Fuel Oil #2 Prod.	Copper	secondary	1.12e-07	5.65e-09
Fuel Oil #2 Prod.	Silicon	secondary	1.12e-07	5.64e-09
Japanese Electric Grid	Dimethyl sulfate	model/secondary	1.10e-07	5.54e-09
Fuel Oil #2 Prod.	Methyl hydrazine	secondary	1.08e-07	5.45e-09
LPG Production	Acetophenone	secondary	1.03e-07	5.21e-09
Fuel Oil #2 Prod.	2-Chloroacetophenone	secondary	1.01e-07	5.11e-09
Fuel Oil #2 Prod.	Bromomethane	secondary	9.99e-08	5.05e-09
Fuel Oil #6 Prod.	Barium	secondary	9.97e-08	5.04e-09
Fuel Oil #2 Prod.	Dimethylbenzanthracene	secondary	9.48e-08	4.79e-09
Fuel Oil #2 Prod.	Naphthalene	secondary	7.83e-08	3.95e-09
Fuel Oil #2 Prod.	Lead	secondary	7.76e-08	3.92e-09
Fuel Oil #6 Prod.	Cadmium	secondary	7.24e-08	3.66e-09
Fuel Oil #2 Prod.	Manganese	secondary	7.00e-08	3.53e-09
LPG Production	o-xylene	secondary	6.86e-08	3.47e-09
US electric grid	Toluene	model/secondary	6.78e-08	3.43e-09
Fuel Oil #2 Prod.	Beryllium	secondary	6.72e-08	3.39e-09
US electric grid	Isophorone	model/secondary	6.64e-08	3.36e-09
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	6.46e-08	3.26e-09
Natural Gas Prod.	Methyl hydrazine	secondary	5.97e-08	3.01e-09
Fuel Oil #4 Prod.	Antimony	secondary	5.94e-08	3.00e-09
Natural Gas Prod.	Barium	secondary	5.90e-08	2.98e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	5.59e-08	2.82e-09
LPG Production	Ethylbenzene	secondary	5.56e-08	2.81e-09
Natural Gas Prod.	Bromomethane	secondary	5.52e-08	2.79e-09
Fuel Oil #6 Prod.	Carbon disulfide	secondary	5.52e-08	2.79e-09
Fuel Oil #2 Prod.	Barium	secondary	5.49e-08	2.77e-09
Fuel Oil #6 Prod.	Barium cmpds	secondary	5.37e-08	2.71e-09
US electric grid	Methyl ethyl ketone	model/secondary	5.32e-08	2.69e-09
Japanese Electric Grid	Isophorone	model/secondary	5.30e-08	2.68e-09
Glass/frit	Barium	primary	5.29e-08	2.67e-09
Natural Gas Prod.	Copper	secondary	5.28e-08	2.67e-09
US electric grid	Tetrachloroethylene	model/secondary	5.25e-08	2.65e-09
Fuel Oil #2 Prod.	Cyanide (-1)	secondary	5.25e-08	2.65e-09
US electric grid	1,2-Dichloroethane	model/secondary	4.67e-08	2.36e-09
US electric grid	Methyl methacrylate	model/secondary	4.54e-08	2.30e-09
Fuel Oil #2 Prod.	Barium cmpds	secondary	4.45e-08	2.25e-09
Natural Gas Prod.	Lead	secondary	4.33e-08	2.19e-09
Natural Gas Prod.	Beryllium	secondary	4.27e-08	2.16e-09
Fuel Oil #6 Prod.	Cobalt	secondary	4.25e-08	2.14e-09
Japanese Electric Grid	Methyl ethyl ketone	model/secondary	4.24e-08	2.14e-09
Fuel Oil #6 Prod.	Benzyl chloride	secondary	4.23e-08	2.14e-09
Japanese Electric Grid	Tetrachloroethylene	model/secondary	4.19e-08	2.12e-09

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
US electric grid	Styrene	model/secondary	4.01e-08	2.03e-09
Fuel Oil #6 Prod.	Aluminum (elemental)	secondary	4.01e-08	2.03e-09
Natural Gas Prod.	Manganese	secondary	3.95e-08	2.00e-09
US electric grid	Bromoform	model/secondary	3.75e-08	1.89e-09
Japanese Electric Grid	1,2-Dichloroethane	model/secondary	3.73e-08	1.88e-09
US electric grid	Dichloromethane	model/secondary	3.70e-08	1.87e-09
Japanese Electric Grid	Methyl methacrylate	model/secondary	3.63e-08	1.83e-09
Japanese Electric Grid	Styrene	model/secondary	3.20e-08	1.62e-09
Natural Gas Prod.	Nitrate	secondary	3.01e-08	1.52e-09
US electric grid	Chlorobenzene	model/secondary	3.00e-08	1.51e-09
Japanese Electric Grid	Bromoform	model/secondary	2.99e-08	1.51e-09
Fuel Oil #6 Prod.	Chloroform	secondary	2.98e-08	1.51e-09
Japanese Electric Grid	Dichloromethane	model/secondary	2.95e-08	1.49e-09
Fuel Oil #4 Prod.	Nitrate	secondary	2.93e-08	1.48e-09
Natural Gas Prod.	Cyanide (-1)	secondary	2.90e-08	1.47e-09
Fuel Oil #2 Prod.	Cadmium	secondary	2.88e-08	1.45e-09
LPG Production	Methyl tert-butyl ether	secondary	2.79e-08	1.41e-09
Fuel Oil #6 Prod.	Propionaldehyde	secondary	2.76e-08	1.39e-09
US electric grid	2,4-Dinitrotoluene	model/secondary	2.40e-08	1.21e-09
Japanese Electric Grid	Chlorobenzene	model/secondary	2.39e-08	1.21e-09
LPG Production	Zinc (+2)	secondary	2.35e-08	1.19e-09
LPG Production	Phenanthrene	secondary	2.27e-08	1.15e-09
US electric grid	Acetophenone	model/secondary	2.21e-08	1.12e-09
Fuel Oil #2 Prod.	Carbon disulfide	secondary	2.15e-08	1.09e-09
LPG Production	Vinyl acetate	secondary	1.98e-08	1.00e-09
Japanese Electric Grid	Cumene hydroperoxide	model/secondary	1.95e-08	9.84e-10
LPG Production	3-Methylcholanthrene	secondary	1.92e-08	9.70e-10
Japanese Electric Grid	2,4-Dinitrotoluene	model/secondary	1.91e-08	9.67e-10
LPG Production	Ethylene dibromide	secondary	1.84e-08	9.30e-10
Japanese Electric Grid	Acetophenone	model/secondary	1.76e-08	8.91e-10
Fuel Oil #2 Prod.	Benzyl chloride	secondary	1.64e-08	8.31e-10
Natural Gas Prod.	Cadmium	secondary	1.60e-08	8.06e-10
Fuel Oil #2 Prod.	Cobalt	secondary	1.59e-08	8.03e-10
Fuel Oil #6 Prod.	Acrolein	secondary	1.57e-08	7.91e-10
Natural Gas Prod.	Phenol	secondary	1.46e-08	7.37e-10
Glass/frit	Copper	primary	1.42e-08	7.18e-10
Fuel Oil #4 Prod.	Silicon	secondary	1.31e-08	6.61e-10
Fuel Oil #6 Prod.	Methyl chloride	secondary	1.30e-08	6.56e-10
Fuel Oil #2 Prod.	Aluminum (elemental)	secondary	1.28e-08	6.45e-10
Fuel Oil #4 Prod.	Copper	secondary	1.25e-08	6.30e-10
LPG Production	2-Methylnaphthalene	secondary	1.20e-08	6.07e-10
Natural Gas Prod.	Carbon disulfide	secondary	1.19e-08	6.00e-10
US electric grid	Ethylbenzene	model/secondary	1.18e-08	5.97e-10
Fuel Oil #2 Prod.	Chloroform	secondary	1.16e-08	5.86e-10
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	1.15e-08	5.81e-10
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	1.08e-08	5.45e-10
Fuel Oil #2 Prod.	Propionaldehyde	secondary	1.07e-08	5.41e-10
Fuel Oil #4 Prod.	Bromomethane	secondary	1.07e-08	5.38e-10
LPG Production	Chlorine	secondary	1.06e-08	5.38e-10
Japanese Electric Grid	Ethylbenzene	model/secondary	1.04e-08	5.25e-10
Natural Gas Prod.	PM-10	secondary	9.88e-09	4.99e-10

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #6 Prod.	Di(2-ethylhexyl)phthalate	secondary	9.36e-09	4.73e-10
Natural Gas Prod.	Benzyl chloride	secondary	9.09e-09	4.59e-10
Fuel Oil #4 Prod.	Dimethylbenzanthracene	secondary	8.97e-09	4.53e-10
Natural Gas Prod.	Toluene	secondary	8.63e-09	4.36e-10
Fuel Oil #4 Prod.	Lead	secondary	8.28e-09	4.18e-10
LPG Production	1,1,1-Trichloroethane	secondary	7.57e-09	3.82e-10
Fuel Oil #4 Prod.	Naphthalene	secondary	7.55e-09	3.81e-10
Fuel Oil #6 Prod.	Acetaldehyde	secondary	7.45e-09	3.76e-10
Fuel Oil #4 Prod.	Manganese	secondary	7.44e-09	3.76e-10
Fuel Oil #4 Prod.	Beryllium	secondary	7.13e-09	3.60e-10
LPG Production	Acenaphthene	secondary	7.03e-09	3.55e-10
Fuel Oil #6 Prod.	Mercury	secondary	6.94e-09	3.51e-10
Natural Gas Prod.	Chloroform	secondary	6.41e-09	3.24e-10
Fuel Oil #2 Prod.	Acrolein	secondary	6.09e-09	3.08e-10
US electric grid	Methyl tert-butyl ether	model/secondary	5.96e-09	3.01e-10
Natural Gas Prod.	Propionaldehyde	secondary	5.93e-09	2.99e-10
Japanese Electric Grid	Acenaphthene	model/secondary	5.79e-09	2.92e-10
Natural Gas Prod.	Aluminum (+3)	secondary	5.72e-09	2.89e-10
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	5.60e-09	2.83e-10
LPG Production	Ethyl Chloride	secondary	5.36e-09	2.71e-10
Natural Gas Prod.	Cobalt	secondary	5.28e-09	2.67e-10
Japanese Electric Grid	Phenanthrene	model/secondary	5.21e-09	2.63e-10
Fuel Oil #6 Prod.	Dimethyl sulfate	secondary	5.18e-09	2.62e-10
Fuel Oil #4 Prod.	Barium	secondary	5.08e-09	2.57e-10
Fuel Oil #2 Prod.	Methyl chloride	secondary	5.05e-09	2.55e-10
Japanese Electric Grid	Methyl tert-butyl ether	model/secondary	4.75e-09	2.40e-10
Natural Gas Prod.	o-xylene	secondary	4.60e-09	2.32e-10
US electric grid	Phenol	model/secondary	4.54e-09	2.30e-10
LPG Production	Cumene	secondary	4.54e-09	2.29e-10
Japanese Electric Grid	Chromium (III)	model/secondary	4.48e-09	2.26e-10
LPG Production	Benzo[a]pyrene	secondary	4.28e-09	2.16e-10
US electric grid	Vinyl acetate	model/secondary	4.25e-09	2.15e-10
Fuel Oil #6 Prod.	Toluene	secondary	4.19e-09	2.12e-10
US electric grid	Phenanthrene	model/secondary	4.00e-09	2.02e-10
US electric grid	Ethylene dibromide	model/secondary	3.94e-09	1.99e-10
Japanese Electric Grid	1,1,1-Trichloroethane	model/secondary	3.66e-09	1.85e-10
Fuel Oil #2 Prod.	Di(2-ethylhexyl)phthalate	secondary	3.64e-09	1.84e-10
Japanese Electric Grid	Phenol	model/secondary	3.63e-09	1.83e-10
Fuel Oil #4 Prod.	Barium cmpds	secondary	3.62e-09	1.83e-10
US electric grid	Xylene (mixed isomers)	model/secondary	3.52e-09	1.78e-10
Japanese Electric Grid	Vinyl acetate	model/secondary	3.38e-09	1.71e-10
Natural Gas Prod.	Acrolein	secondary	3.37e-09	1.70e-10
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	3.26e-09	1.65e-10
US electric grid	Chromium (III)	model/secondary	3.15e-09	1.59e-10
Japanese Electric Grid	Ethylene dibromide	model/secondary	3.14e-09	1.59e-10
Fuel Oil #4 Prod.	Cadmium	secondary	3.04e-09	1.53e-10
Fuel Oil #2 Prod.	Acetaldehyde	secondary	2.90e-09	1.46e-10
Japanese Electric Grid	Xylene (mixed isomers)	model/secondary	2.81e-09	1.42e-10
Natural Gas Prod.	Methyl chloride	secondary	2.79e-09	1.41e-10
Fuel Oil #2 Prod.	Mercury	secondary	2.72e-09	1.37e-10

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	Biphenyl	secondary	2.71e-09	1.37e-10
Fuel Oil #6 Prod.	Isophorone	secondary	2.50e-09	1.27e-10
Fuel Oil #6 Prod.	Cadmium cmpds	secondary	2.35e-09	1.19e-10
LPG Production	Lead cmpds	secondary	2.33e-09	1.18e-10
Fuel Oil #4 Prod.	Carbon disulfide	secondary	2.29e-09	1.16e-10
LPG Production	Dibenzo[a,h]anthracene	secondary	2.23e-09	1.12e-10
LPG Production	Acenaphthylene	secondary	2.14e-09	1.08e-10
LPG Production	Anthracene	secondary	2.11e-09	1.07e-10
Fuel Oil #6 Prod.	1,4-Dichlorobenzene	secondary	2.07e-09	1.05e-10
Fuel Oil #2 Prod.	Dimethyl sulfate	secondary	2.02e-09	1.02e-10
Natural Gas Prod.	Di(2-ethylhexyl)phthalate	secondary	2.01e-09	1.02e-10
Fuel Oil #6 Prod.	Methyl ethyl ketone	secondary	2.00e-09	1.01e-10
Fuel Oil #6 Prod.	Tetrachloroethylene	secondary	1.98e-09	1.00e-10
LPG Production	Nickel cmpds	secondary	1.97e-09	9.96e-11
Fuel Oil #2 Prod.	Cadmium cmpds	secondary	1.95e-09	9.85e-11
LPG Production	Benzo[a]anthracene	secondary	1.91e-09	9.63e-11
Fuel Oil #2 Prod.	Toluene	secondary	1.90e-09	9.58e-11
Natural Gas Prod.	Mercury	secondary	1.88e-09	9.51e-11
US electric grid	2,3,7,8-TCDF	model/secondary	1.86e-09	9.41e-11
Japanese Electric Grid	Dibenzo[a,h]anthracene	model/secondary	1.86e-09	9.37e-11
Glass/frit	Nickel	primary	1.80e-09	9.11e-11
Fuel Oil #6 Prod.	1,2-Dichloroethane	secondary	1.76e-09	8.90e-11
Fuel Oil #4 Prod.	Benzyl chloride	secondary	1.75e-09	8.86e-11
US electric grid	1,1,1-Trichloroethane	model/secondary	1.73e-09	8.74e-11
Fuel Oil #4 Prod.	Cobalt	secondary	1.72e-09	8.71e-11
Fuel Oil #6 Prod.	Methyl methacrylate	secondary	1.71e-09	8.66e-11
Natural Gas Prod.	Acetaldehyde	secondary	1.60e-09	8.09e-11
Fuel Oil #6 Prod.	Styrene	secondary	1.51e-09	7.65e-11
Fuel Oil #4 Prod.	Aluminum (elemental)	secondary	1.50e-09	7.56e-11
Japanese Electric Grid	2,3,7,8-TCDF	model/secondary	1.49e-09	7.53e-11
LPG Production	Benzo[b,j,k]fluoranthene	secondary	1.47e-09	7.44e-11
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	1.42e-09	7.16e-11
Fuel Oil #6 Prod.	Bromoform	secondary	1.41e-09	7.14e-11
Fuel Oil #6 Prod.	Dichloromethane	secondary	1.40e-09	7.05e-11
Japanese Electric Grid	o-xylene	model/secondary	1.28e-09	6.48e-11
Fuel Oil #4 Prod.	Chloroform	secondary	1.24e-09	6.25e-11
Japanese Electric Grid	Benzo[a]anthracene	model/secondary	1.22e-09	6.17e-11
US electric grid	Acenaphthene	model/secondary	1.21e-09	6.14e-11
LPG Production	Chrysene	secondary	1.20e-09	6.08e-11
US electric grid	Ethyl Chloride	model/secondary	1.15e-09	5.80e-11
Fuel Oil #4 Prod.	Propionaldehyde	secondary	1.14e-09	5.77e-11
Fuel Oil #6 Prod.	Chlorobenzene	secondary	1.13e-09	5.71e-11
Natural Gas Prod.	Dimethyl sulfate	secondary	1.11e-09	5.63e-11
Fuel Oil #2 Prod.	1,4-Dichlorobenzene	secondary	1.08e-09	5.44e-11
Natural Gas Prod.	Zinc (+2)	secondary	1.05e-09	5.30e-11
LPG Production	HALON-1301	secondary	1.02e-09	5.13e-11
Fuel Oil #2 Prod.	Isophorone	secondary	9.74e-10	4.92e-11
US electric grid	Cumene	model/secondary	9.71e-10	4.90e-11
Fuel Oil #6 Prod.	Aromatic hydrocarbons	secondary	9.47e-10	4.79e-11
Natural Gas Prod.	Chlorine	secondary	9.46e-10	4.78e-11

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Glass/frit	Chromium	primary	9.33e-10	4.72e-11
Japanese Electric Grid	Ethyl Chloride	model/secondary	9.16e-10	4.63e-11
Fuel Oil #6 Prod.	2,4-Dinitrotoluene	secondary	9.07e-10	4.58e-11
Fuel Oil #6 Prod.	Acetophenone	secondary	8.33e-10	4.21e-11
Fuel Oil #2 Prod.	Aromatic hydrocarbons	secondary	7.86e-10	3.97e-11
Fuel Oil #2 Prod.	Methyl ethyl ketone	secondary	7.79e-10	3.94e-11
Japanese Electric Grid	Benzo[b,j,k]fluoranthene	model/secondary	7.77e-10	3.93e-11
Fuel Oil #2 Prod.	Tetrachloroethylene	secondary	7.70e-10	3.89e-11
LPG Production	Benzo[b]fluoranthene	secondary	7.62e-10	3.85e-11
Natural Gas Prod.	Silicon	secondary	7.43e-10	3.75e-11
LPG Production	Mercury compounds	secondary	7.08e-10	3.58e-11
Fuel Oil #6 Prod.	Chromium (III)	secondary	6.96e-10	3.52e-11
Fuel Oil #2 Prod.	1,2-Dichloroethane	secondary	6.85e-10	3.46e-11
Japanese Electric Grid	Indeno(1,2,3-cd)pyrene	model/secondary	6.84e-10	3.45e-11
Fuel Oil #2 Prod.	Methyl methacrylate	secondary	6.66e-10	3.37e-11
LPG Production	Fluorene	secondary	6.60e-10	3.34e-11
Fuel Oil #4 Prod.	Acrolein	secondary	6.49e-10	3.28e-11
Glass/frit	Lead	primary	6.40e-10	3.23e-11
Fuel Oil #2 Prod.	Styrene	secondary	5.89e-10	2.97e-11
US electric grid	Biphenyl	model/secondary	5.79e-10	2.93e-11
LPG Production	Pyrene	secondary	5.71e-10	2.88e-11
LPG Production	Benzo[g,h,i]perylene	secondary	5.55e-10	2.80e-11
Fuel Oil #2 Prod.	Bromoform	secondary	5.50e-10	2.78e-11
Fuel Oil #2 Prod.	Dichloromethane	secondary	5.42e-10	2.74e-11
LPG Production	Fluoranthene	secondary	5.39e-10	2.72e-11
Fuel Oil #4 Prod.	Methyl chloride	secondary	5.39e-10	2.72e-11
Natural Gas Prod.	Isophorone	secondary	5.38e-10	2.72e-11
Japanese Electric Grid	Chrysene	model/secondary	5.38e-10	2.72e-11
Japanese Electric Grid	2-Methylnaphthalene	model/secondary	4.75e-10	2.40e-11
Glass/frit	Manganese	primary	4.67e-10	2.36e-11
Japanese Electric Grid	Biphenyl	model/secondary	4.62e-10	2.34e-11
Japanese Electric Grid	Anthracene	model/secondary	4.61e-10	2.33e-11
Fuel Oil #6 Prod.	Ethylbenzene	secondary	4.47e-10	2.26e-11
Fuel Oil #6 Prod.	Copper (+1 & +2)	secondary	4.43e-10	2.24e-11
Fuel Oil #2 Prod.	Chlorobenzene	secondary	4.40e-10	2.22e-11
Natural Gas Prod.	Methyl ethyl ketone	secondary	4.31e-10	2.18e-11
Japanese Electric Grid	Benzo[g,h,i]perylene	model/secondary	4.30e-10	2.17e-11
Fuel Oil #6 Prod.	o-xylene	secondary	4.29e-10	2.17e-11
Natural Gas Prod.	Tetrachloroethylene	secondary	4.26e-10	2.15e-11
Fuel Oil #4 Prod.	Di(2-ethylhexyl)phthalate	secondary	3.88e-10	1.96e-11
Natural Gas Prod.	1,2-Dichloroethane	secondary	3.79e-10	1.91e-11
Natural Gas Prod.	Methyl methacrylate	secondary	3.68e-10	1.86e-11
Fuel Oil #2 Prod.	Copper (+1 & +2)	secondary	3.68e-10	1.86e-11
US electric grid	Acenaphthylene	model/secondary	3.60e-10	1.82e-11
Fuel Oil #2 Prod.	2,4-Dinitrotoluene	secondary	3.52e-10	1.78e-11
US electric grid	Benzo[a]pyrene	model/secondary	3.41e-10	1.72e-11
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	3.40e-10	1.72e-11
Japanese Electric Grid	Acenaphthylene	model/secondary	3.29e-10	1.66e-11
Natural Gas Prod.	Styrene	secondary	3.25e-10	1.64e-11
Fuel Oil #2 Prod.	Acetophenone	secondary	3.24e-10	1.64e-11

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Barium cmpds	secondary	3.21e-10	1.62e-11
US electric grid	Anthracene	model/secondary	3.15e-10	1.59e-11
Fuel Oil #4 Prod.	Acetaldehyde	secondary	3.09e-10	1.56e-11
Natural Gas Prod.	Bromoform	secondary	3.04e-10	1.54e-11
Natural Gas Prod.	Dichloromethane	secondary	3.00e-10	1.52e-11
LPG Production	5-Methyl chrysene	secondary	2.94e-10	1.49e-11
Fuel Oil #4 Prod.	Mercury	secondary	2.89e-10	1.46e-11
Glass/frit	Cobalt	primary	2.87e-10	1.45e-11
Japanese Electric Grid	Benzo[a]pyrene	model/secondary	2.73e-10	1.38e-11
Fuel Oil #2 Prod.	Chromium (III)	secondary	2.70e-10	1.36e-11
Natural Gas Prod.	Chlorobenzene	secondary	2.43e-10	1.23e-11
LPG Production	Halogenated matter (organic)	secondary	2.33e-10	1.18e-11
US electric grid	Benzo[a]anthracene	model/secondary	2.26e-10	1.14e-11
Fuel Oil #6 Prod.	Methyl tert-butyl ether	secondary	2.25e-10	1.14e-11
Fuel Oil #4 Prod.	Dimethyl sulfate	secondary	2.15e-10	1.09e-11
Fuel Oil #2 Prod.	o-xylene	secondary	2.06e-10	1.04e-11
Japanese Electric Grid	Pyrene	model/secondary	2.00e-10	1.01e-11
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	1.95e-10	9.85e-12
Fuel Oil #4 Prod.	Toluene	secondary	1.90e-10	9.57e-12
Natural Gas Prod.	Acetophenone	secondary	1.79e-10	9.04e-12
Fuel Oil #2 Prod.	Ethylbenzene	secondary	1.74e-10	8.80e-12
Japanese Electric Grid	Fluorene	model/secondary	1.74e-10	8.80e-12
Natural Gas Prod.	3-Methylcholanthrene	secondary	1.73e-10	8.73e-12
Fuel Oil #6 Prod.	Phenanthrene	secondary	1.71e-10	8.65e-12
Japanese Electric Grid	Fluoranthene	model/secondary	1.66e-10	8.40e-12
US electric grid	Chrysene	model/secondary	1.64e-10	8.28e-12
Natural Gas Prod.	Chromium (III)	secondary	1.61e-10	8.14e-12
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	1.61e-10	8.12e-12
Fuel Oil #6 Prod.	Vinyl acetate	secondary	1.60e-10	8.09e-12
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	1.58e-10	8.00e-12
Fuel Oil #6 Prod.	Ethylene dibromide	secondary	1.48e-10	7.50e-12
US electric grid	Fluorene	model/secondary	1.28e-10	6.45e-12
Fuel Oil #6 Prod.	3-Methylcholanthrene	secondary	1.10e-10	5.54e-12
Natural Gas Prod.	2-Methylnaphthalene	secondary	1.08e-10	5.47e-12
Fuel Oil #6 Prod.	Zinc (+2)	secondary	1.07e-10	5.38e-12
Fuel Oil #4 Prod.	Isophorone	secondary	1.04e-10	5.25e-12
US electric grid	Fluoranthene	model/secondary	1.02e-10	5.15e-12
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	1.02e-10	5.15e-12
Natural Gas Prod.	Ethylbenzene	secondary	9.66e-11	4.88e-12
US electric grid	Dibenzo[a,h]anthracene	model/secondary	8.75e-11	4.42e-12
Fuel Oil #2 Prod.	Methyl tert-butyl ether	secondary	8.74e-11	4.42e-12
US electric grid	2-Methylnaphthalene	model/secondary	8.51e-11	4.30e-12
Natural Gas Prod.	Aluminum (elemental)	secondary	8.50e-11	4.29e-12
US electric grid	Pyrene	model/secondary	8.43e-11	4.26e-12
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	8.31e-11	4.20e-12
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	8.21e-11	4.15e-12
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	7.30e-11	3.69e-12
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	7.10e-11	3.59e-12
Natural Gas Prod.	Phenanthrene	secondary	7.05e-11	3.56e-12
Fuel Oil #2 Prod.	Phenanthrene	secondary	7.03e-11	3.55e-12
Fuel Oil #6 Prod.	2-Methylnaphthalene	secondary	6.87e-11	3.47e-12

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #2 Prod.	Zinc (+2)	secondary	6.78e-11	3.42e-12
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	6.39e-11	3.23e-12
US electric grid	5-Methyl chrysene	model/secondary	6.30e-11	3.18e-12
Fuel Oil #4 Prod.	Styrene	secondary	6.28e-11	3.17e-12
Fuel Oil #2 Prod.	Vinyl acetate	secondary	6.23e-11	3.15e-12
Fuel Oil #6 Prod.	1,1,1-Trichloroethane	secondary	6.11e-11	3.08e-12
US electric grid	o-xylene	model/secondary	6.06e-11	3.06e-12
Fuel Oil #6 Prod.	Chlorine	secondary	5.92e-11	2.99e-12
Fuel Oil #4 Prod.	Bromoform	secondary	5.86e-11	2.96e-12
Fuel Oil #4 Prod.	Dichloromethane	secondary	5.78e-11	2.92e-12
Fuel Oil #2 Prod.	Ethylene dibromide	secondary	5.77e-11	2.92e-12
US electric grid	Benzo[g,h,i]perylene	model/secondary	5.75e-11	2.91e-12
Fuel Oil #2 Prod.	3-Methylcholanthrene	secondary	5.70e-11	2.88e-12
Japanese Electric Grid	5-Methyl chrysene	model/secondary	5.03e-11	2.54e-12
Natural Gas Prod.	Methyl tert-butyl ether	secondary	4.83e-11	2.44e-12
Fuel Oil #4 Prod.	Chlorobenzene	secondary	4.69e-11	2.37e-12
Fuel Oil #6 Prod.	Acenaphthene	secondary	4.67e-11	2.36e-12
Fuel Oil #6 Prod.	Ethyl Chloride	secondary	4.33e-11	2.19e-12
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	3.76e-11	1.90e-12
Fuel Oil #6 Prod.	Cumene	secondary	3.66e-11	1.85e-12
Fuel Oil #2 Prod.	2-Methylnaphthalene	secondary	3.57e-11	1.80e-12
Fuel Oil #4 Prod.	Acetophenone	secondary	3.45e-11	1.74e-12
Natural Gas Prod.	Vinyl acetate	secondary	3.44e-11	1.74e-12
Fuel Oil #6 Prod.	Benzo[a]pyrene	secondary	3.20e-11	1.62e-12
Natural Gas Prod.	Ethylene dibromide	secondary	3.19e-11	1.61e-12
Fuel Oil #2 Prod.	Chlorine	secondary	3.12e-11	1.58e-12
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	2.99e-11	1.51e-12
Fuel Oil #4 Prod.	Chromium (III)	secondary	2.88e-11	1.45e-12
Fuel Oil #2 Prod.	1,1,1-Trichloroethane	secondary	2.37e-11	1.20e-12
Fuel Oil #6 Prod.	Biphenyl	secondary	2.18e-11	1.10e-12
Fuel Oil #2 Prod.	Acenaphthene	secondary	2.13e-11	1.08e-12
Fuel Oil #4 Prod.	o-xylene	secondary	2.01e-11	1.02e-12
Natural Gas Prod.	Benzo[a]pyrene	secondary	1.97e-11	9.97e-13
Fuel Oil #4 Prod.	Ethylbenzene	secondary	1.86e-11	9.37e-13
Natural Gas Prod.	Dibenzo[a,h]anthracene	secondary	1.78e-11	8.98e-13
Natural Gas Prod.	Acenaphthene	secondary	1.77e-11	8.96e-13
Fuel Oil #2 Prod.	Ethyl Chloride	secondary	1.68e-11	8.50e-13
Fuel Oil #6 Prod.	Acenaphthylene	secondary	1.61e-11	8.15e-13
Fuel Oil #6 Prod.	Anthracene	secondary	1.52e-11	7.69e-13
Fuel Oil #2 Prod.	Cumene	secondary	1.42e-11	7.19e-13
Natural Gas Prod.	Cadmium cmpds	secondary	1.40e-11	7.09e-13
Fuel Oil #2 Prod.	Benzo[a]pyrene	secondary	1.33e-11	6.70e-13
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	1.31e-11	6.63e-13
Fuel Oil #6 Prod.	Dibenzo[a,h]anthracene	secondary	1.19e-11	6.03e-13
Fuel Oil #6 Prod.	Benzo[a]anthracene	secondary	1.19e-11	6.02e-13
Fuel Oil #6 Prod.	Benzo[b,j,k]fluoranthene	secondary	1.19e-11	6.00e-13
Fuel Oil #6 Prod.	Indeno(1,2,3-cd)pyrene	secondary	9.33e-12	4.71e-13
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	9.32e-12	4.71e-13
Natural Gas Prod.	Ethyl Chloride	secondary	9.30e-12	4.70e-13
Natural Gas Prod.	Benzo[a]anthracene	secondary	8.56e-12	4.32e-13

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #2 Prod.	Biphenyl	secondary	8.49e-12	4.29e-13
Fuel Oil #6 Prod.	Chrysene	secondary	8.28e-12	4.19e-13
Natural Gas Prod.	Anthracene	secondary	8.13e-12	4.11e-13
Fuel Oil #6 Prod.	Lead cmpds	secondary	7.89e-12	3.99e-13
Natural Gas Prod.	Cumene	secondary	7.87e-12	3.98e-13
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	7.53e-12	3.80e-13
Fuel Oil #4 Prod.	Phenanthrene	secondary	7.32e-12	3.70e-13
Natural Gas Prod.	Acenaphthylene	secondary	7.00e-12	3.54e-13
Fuel Oil #6 Prod.	Nickel cmpds	secondary	6.67e-12	3.37e-13
Fuel Oil #4 Prod.	Vinyl acetate	secondary	6.64e-12	3.35e-13
Fuel Oil #2 Prod.	Acenaphthylene	secondary	6.63e-12	3.35e-13
Fuel Oil #2 Prod.	Dibenzo[a,h]anthracene	secondary	6.56e-12	3.31e-13
Fuel Oil #2 Prod.	Lead cmpds	secondary	6.55e-12	3.31e-13
Fuel Oil #2 Prod.	Anthracene	secondary	6.49e-12	3.28e-13
Natural Gas Prod.	Benzo[b]fluoranthene	secondary	6.37e-12	3.22e-13
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	6.16e-12	3.11e-13
Fuel Oil #4 Prod.	Zinc (+2)	secondary	5.97e-12	3.02e-13
Fuel Oil #2 Prod.	Benzo[a]anthracene	secondary	5.73e-12	2.90e-13
Natural Gas Prod.	Aromatic hydrocarbons	secondary	5.66e-12	2.86e-13
Fuel Oil #2 Prod.	Nickel cmpds	secondary	5.53e-12	2.80e-13
Natural Gas Prod.	Chrysene	secondary	5.43e-12	2.74e-13
Fuel Oil #4 Prod.	3-Methylcholanthrene	secondary	5.39e-12	2.73e-13
Fuel Oil #6 Prod.	Fluorene	secondary	5.11e-12	2.58e-13
Natural Gas Prod.	Biphenyl	secondary	4.70e-12	2.37e-13
Fuel Oil #2 Prod.	Benzo[b,j,k]fluoranthene	secondary	4.62e-12	2.33e-13
Fuel Oil #2 Prod.	Indeno(1,2,3-cd)pyrene	secondary	4.30e-12	2.17e-13
Fuel Oil #6 Prod.	Benzo[b]fluoranthene	secondary	4.19e-12	2.11e-13
Fuel Oil #6 Prod.	Fluoranthene	secondary	4.11e-12	2.08e-13
Fuel Oil #6 Prod.	Pyrene	secondary	4.04e-12	2.04e-13
Fuel Oil #2 Prod.	Chrysene	secondary	3.68e-12	1.86e-13
Fuel Oil #6 Prod.	HALON-1301	secondary	3.43e-12	1.74e-13
Fuel Oil #6 Prod.	Benzo[g,h,i]perylene	secondary	3.43e-12	1.73e-13
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	3.38e-12	1.71e-13
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	3.19e-12	1.61e-13
Fuel Oil #4 Prod.	Chlorine	secondary	2.94e-12	1.48e-13
Fuel Oil #2 Prod.	HALON-1301	secondary	2.85e-12	1.44e-13
Natural Gas Prod.	Copper (+1 & +2)	secondary	2.65e-12	1.34e-13
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	2.55e-12	1.29e-13
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	2.53e-12	1.28e-13
Natural Gas Prod.	Pyrene	secondary	2.45e-12	1.24e-13
Fuel Oil #6 Prod.	Mercury compounds	secondary	2.39e-12	1.21e-13
Fuel Oil #6 Prod.	5-Methyl chrysene	secondary	2.38e-12	1.20e-13
Fuel Oil #2 Prod.	Benzo[b]fluoranthene	secondary	2.25e-12	1.14e-13
Fuel Oil #4 Prod.	Acenaphthene	secondary	2.12e-12	1.07e-13
Fuel Oil #2 Prod.	Fluorene	secondary	2.06e-12	1.04e-13
Fuel Oil #2 Prod.	Mercury compounds	secondary	1.99e-12	1.00e-13
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	1.79e-12	9.06e-14
Fuel Oil #2 Prod.	Pyrene	secondary	1.75e-12	8.85e-14
Fuel Oil #2 Prod.	Fluoranthene	secondary	1.67e-12	8.46e-14
Fuel Oil #2 Prod.	Benzo[g,h,i]perylene	secondary	1.67e-12	8.42e-14

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Fluorene	secondary	1.64e-12	8.28e-14
Fuel Oil #4 Prod.	Cumene	secondary	1.52e-12	7.67e-14
Natural Gas Prod.	Fluoranthene	secondary	1.46e-12	7.40e-14
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	1.37e-12	6.95e-14
Fuel Oil #2 Prod.	5-Methyl chrysene	secondary	9.24e-13	4.67e-14
Fuel Oil #4 Prod.	Biphenyl	secondary	9.06e-13	4.58e-14
Fuel Oil #6 Prod.	Halogenated matter (organic)	secondary	7.89e-13	3.99e-14
Fuel Oil #4 Prod.	Acenaphthylene	secondary	6.90e-13	3.49e-14
Fuel Oil #4 Prod.	Anthracene	secondary	6.65e-13	3.36e-14
Fuel Oil #2 Prod.	Halogenated matter (organic)	secondary	6.55e-13	3.31e-14
Fuel Oil #4 Prod.	Dibenzo[a,h]anthracene	secondary	6.08e-13	3.07e-14
LPG Production	Halogenated hydrocarbons (unspecified)	secondary	5.84e-13	2.95e-14
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	5.59e-13	2.82e-14
Fuel Oil #4 Prod.	Lead cmpds	secondary	5.32e-13	2.69e-14
Natural Gas Prod.	5-Methyl chrysene	secondary	5.11e-13	2.58e-14
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	4.92e-13	2.49e-14
Fuel Oil #4 Prod.	Nickel cmpds	secondary	4.50e-13	2.27e-14
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	4.26e-13	2.15e-14
Fuel Oil #4 Prod.	Chrysene	secondary	3.70e-13	1.87e-14
Fuel Oil #4 Prod.	HALON-1301	secondary	2.32e-13	1.17e-14
Fuel Oil #4 Prod.	Fluorene	secondary	2.16e-13	1.09e-14
Fuel Oil #4 Prod.	Benzo[b]fluoranthene	secondary	2.10e-13	1.06e-14
Fuel Oil #4 Prod.	Pyrene	secondary	1.78e-13	9.00e-15
Fuel Oil #4 Prod.	Fluoranthene	secondary	1.75e-13	8.83e-15
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	1.62e-13	8.18e-15
Fuel Oil #4 Prod.	Mercury compounds	secondary	1.61e-13	8.16e-15
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	9.85e-14	4.98e-15
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	5.32e-14	2.69e-15
Natural Gas Prod.	Lead cmpds	secondary	4.72e-14	2.38e-15
Natural Gas Prod.	Nickel cmpds	secondary	3.99e-14	2.01e-15
Natural Gas Prod.	HALON-1301	secondary	2.05e-14	1.04e-15
Natural Gas Prod.	Mercury compounds	secondary	1.43e-14	7.23e-16
Natural Gas Prod.	Halogenated matter (organic)	secondary	4.72e-15	2.38e-16
Fuel Oil #6 Prod.	Halogenated hydrocarbons (unspecified)	secondary	1.97e-15	9.98e-17
Fuel Oil #2 Prod.	Halogenated hydrocarbons (unspecified)	secondary	1.64e-15	8.27e-17
Fuel Oil #4 Prod.	Halogenated hydrocarbons (unspecified)	secondary	1.33e-16	6.72e-18
Natural Gas Prod.	Halogenated hydrocarbons (unspecified)	secondary	1.18e-17	5.95e-19
Total Manufacturing			**9.77e+01**	**4.94e+00**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Sulfur dioxide	model/secondary	1.65e+03	8.32e+01
US electric grid	Nitrogen oxides	model/secondary	2.35e+00	1.19e-01
US electric grid	Methane	model/secondary	1.29e+00	6.52e-02
US electric grid	Carbon monoxide	model/secondary	1.09e+00	5.51e-02
US electric grid	Arsenic	model/secondary	5.58e-01	2.82e-02
US electric grid	Hydrochloric acid	model/secondary	4.93e-01	2.49e-02
US electric grid	PM-10	model/secondary	1.16e-01	5.84e-03
US electric grid	Selenium	model/secondary	9.28e-02	4.69e-03
US electric grid	Vanadium	model/secondary	6.98e-02	3.53e-03
US electric grid	Hydrofluoric acid	model/secondary	2.69e-02	1.36e-03
US electric grid	Formaldehyde	model/secondary	9.70e-03	4.90e-04

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
US electric grid	Benzene	model/secondary	6.98e-03	3.53e-04
US electric grid	Nitrous oxide	model/secondary	6.80e-03	3.43e-04
US electric grid	Phosphorus (yellow or white)	model/secondary	3.93e-03	1.99e-04
US electric grid	Zinc (elemental)	model/secondary	1.81e-03	9.16e-05
US electric grid	Antimony	model/secondary	1.49e-03	7.52e-05
US electric grid	Chromium (VI)	model/secondary	5.37e-04	2.71e-05
US electric grid	Molybdenum	model/secondary	4.97e-04	2.51e-05
US electric grid	Methyl hydrazine	model/secondary	4.61e-04	2.33e-05
US electric grid	2-Chloroacetophenone	model/secondary	4.32e-04	2.18e-05
US electric grid	Bromomethane	model/secondary	4.27e-04	2.16e-05
US electric grid	Nickel	model/secondary	2.32e-04	1.17e-05
US electric grid	Cyanide (-1)	model/secondary	2.24e-04	1.13e-05
US electric grid	2,3,7,8-TCDD	model/secondary	1.70e-04	8.58e-06
US electric grid	Naphthalene	model/secondary	1.37e-04	6.92e-06
US electric grid	Barium	model/secondary	1.16e-04	5.88e-06
US electric grid	Carbon disulfide	model/secondary	9.18e-05	4.64e-06
US electric grid	Benzyl chloride	model/secondary	7.02e-05	3.55e-06
US electric grid	Cadmium	model/secondary	5.48e-05	2.77e-06
US electric grid	Chloroform	model/secondary	4.95e-05	2.50e-06
US electric grid	Propionaldehyde	model/secondary	4.58e-05	2.31e-06
US electric grid	Manganese	model/secondary	4.56e-05	2.30e-06
US electric grid	Fluoride	model/secondary	3.91e-05	1.97e-06
US electric grid	Beryllium	model/secondary	2.92e-05	1.47e-06
US electric grid	Acrolein	model/secondary	2.60e-05	1.31e-06
US electric grid	Lead	model/secondary	2.55e-05	1.29e-06
US electric grid	Cobalt	model/secondary	2.43e-05	1.23e-06
US electric grid	Copper	model/secondary	2.24e-05	1.13e-06
US electric grid	Methyl chloride	model/secondary	2.16e-05	1.09e-06
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	1.55e-05	7.85e-07
US electric grid	Acetaldehyde	model/secondary	1.24e-05	6.25e-07
US electric grid	Hexane	model/secondary	1.20e-05	6.07e-07
US electric grid	Dimethyl sulfate	model/secondary	8.61e-06	4.35e-07
US electric grid	Mercury	model/secondary	7.51e-06	3.80e-07
US electric grid	Toluene	model/secondary	4.25e-06	2.15e-07
US electric grid	Isophorone	model/secondary	4.16e-06	2.10e-07
US electric grid	Methyl ethyl ketone	model/secondary	3.33e-06	1.68e-07
US electric grid	Tetrachloroethylene	model/secondary	3.29e-06	1.66e-07
US electric grid	1,2-Dichloroethane	model/secondary	2.93e-06	1.48e-07
US electric grid	Methyl methacrylate	model/secondary	2.85e-06	1.44e-07
US electric grid	Styrene	model/secondary	2.51e-06	1.27e-07
US electric grid	Bromoform	model/secondary	2.35e-06	1.19e-07
US electric grid	Dichloromethane	model/secondary	2.32e-06	1.17e-07
US electric grid	Chlorobenzene	model/secondary	1.88e-06	9.49e-08
US electric grid	2,4-Dinitrotoluene	model/secondary	1.51e-06	7.61e-08
US electric grid	Acetophenone	model/secondary	1.38e-06	6.99e-08
US electric grid	Ethylbenzene	model/secondary	7.41e-07	3.74e-08
US electric grid	Methyl tert-butyl ether	model/secondary	3.74e-07	1.89e-08
US electric grid	Phenol	model/secondary	2.85e-07	1.44e-08
US electric grid	Vinyl acetate	model/secondary	2.66e-07	1.34e-08
US electric grid	Phenanthrene	model/secondary	2.51e-07	1.27e-08

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
US electric grid	Ethylene dibromide	model/secondary	2.47e-07	1.25e-08
US electric grid	Xylene (mixed isomers)	model/secondary	2.21e-07	1.11e-08
US electric grid	Chromium (III)	model/secondary	1.97e-07	9.96e-09
US electric grid	2,3,7,8-TCDF	model/secondary	1.17e-07	5.89e-09
US electric grid	1,1,1-Trichloroethane	model/secondary	1.08e-07	5.48e-09
US electric grid	Acenaphthene	model/secondary	7.61e-08	3.84e-09
US electric grid	Ethyl Chloride	model/secondary	7.19e-08	3.63e-09
US electric grid	Cumene	model/secondary	6.08e-08	3.07e-09
US electric grid	Biphenyl	model/secondary	3.63e-08	1.83e-09
US electric grid	Acenaphthylene	model/secondary	2.26e-08	1.14e-09
US electric grid	Benzo[a]pyrene	model/secondary	2.14e-08	1.08e-09
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	2.13e-08	1.08e-09
US electric grid	Anthracene	model/secondary	1.97e-08	9.96e-10
US electric grid	Benzo[a]anthracene	model/secondary	1.42e-08	7.15e-10
US electric grid	Chrysene	model/secondary	1.03e-08	5.19e-10
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	1.01e-08	5.08e-10
US electric grid	Fluorene	model/secondary	7.99e-09	4.04e-10
US electric grid	Fluoranthene	model/secondary	6.39e-09	3.23e-10
US electric grid	Dibenzo[a,h]anthracene	model/secondary	5.48e-09	2.77e-10
US electric grid	2-Methylnaphthalene	model/secondary	5.33e-09	2.69e-10
US electric grid	Pyrene	model/secondary	5.28e-09	2.67e-10
US electric grid	5-Methyl chrysene	model/secondary	3.95e-09	1.99e-10
US electric grid	o-xylene	model/secondary	3.79e-09	1.92e-10
US electric grid	Benzo[g,h,i]perylene	model/secondary	3.60e-09	1.82e-10
Total Use, Maintenance and Repair			**1.65e+03**	**8.35e+01**
End-of-life Life-cycle Stage				
CRT Incineration	Sulfur dioxide	secondary	1.98e-01	1.00e-02
CRT landfilling	Sulfur dioxide	primary	1.85e-01	9.34e-03
US electric grid	Sulfur dioxide	model/secondary	1.65e-01	8.32e-03
CRT landfilling	Carbon monoxide	primary	9.95e-03	5.03e-04
CRT landfilling	Nitrogen dioxide	primary	3.71e-03	1.87e-04
CRT landfilling	PM	primary	4.17e-04	2.11e-05
US electric grid	Nitrogen oxides	model/secondary	2.36e-04	1.19e-05
US electric grid	Methane	model/secondary	1.29e-04	6.52e-06
US electric grid	Carbon monoxide	model/secondary	1.09e-04	5.52e-06
CRT landfilling	Methane	primary	1.09e-04	5.50e-06
CRT landfilling	Arsenic cmpds	primary	1.02e-04	5.17e-06
CRT Incineration	Arsenic cmpds	secondary	9.83e-05	4.97e-06
US electric grid	Arsenic	model/secondary	5.58e-05	2.82e-06
LPG Production	Carbon monoxide	secondary	4.98e-05	2.52e-06
US electric grid	Hydrochloric acid	model/secondary	4.93e-05	2.49e-06
CRT landfilling	Benzene	primary	4.05e-05	2.04e-06
CRT Incineration	Lead	secondary	2.86e-05	1.44e-06
LPG Production	Methane	secondary	1.45e-05	7.32e-07
LPG Production	Sulfur oxides	secondary	1.38e-05	6.99e-07
CRT Incineration	Barium cmpds	secondary	1.27e-05	6.43e-07
US electric grid	PM-10	model/secondary	1.16e-05	5.84e-07
CRT Incineration	Silver compounds	secondary	1.12e-05	5.67e-07
CRT landfilling	Silver compounds	primary	1.05e-05	5.29e-07
CRT landfilling	Barium cmpds	primary	1.01e-05	5.12e-07

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	Nitrogen oxides	secondary	9.89e-06	5.00e-07
US electric grid	Selenium	model/secondary	9.28e-06	4.69e-07
LPG Production	Vanadium	secondary	9.04e-06	4.57e-07
LPG Production	Benzene	secondary	7.41e-06	3.74e-07
US electric grid	Vanadium	model/secondary	6.99e-06	3.53e-07
CRT landfilling	Hydrochloric acid	primary	4.69e-06	2.37e-07
CRT landfilling	Ammonia	primary	3.81e-06	1.92e-07
US electric grid	Hydrofluoric acid	model/secondary	2.69e-06	1.36e-07
LPG Production	PM	secondary	2.23e-06	1.12e-07
LPG Production	Arsenic	secondary	1.78e-06	9.01e-08
LPG Production	Formaldehyde	secondary	1.16e-06	5.85e-08
CRT landfilling	Cadmium cmpds	primary	9.72e-07	4.91e-08
US electric grid	Formaldehyde	model/secondary	9.70e-07	4.90e-08
CRT Incineration	Cadmium cmpds	secondary	9.41e-07	4.76e-08
US electric grid	Benzene	model/secondary	6.98e-07	3.53e-08
US electric grid	Nitrous oxide	model/secondary	6.80e-07	3.44e-08
CRT landfilling	Hydrogen sulfide	primary	4.61e-07	2.33e-08
CRT landfilling	Chromium (VI)	primary	4.44e-07	2.24e-08
US electric grid	Phosphorus (yellow or white)	model/secondary	3.93e-07	1.99e-08
LPG Production	Hydrochloric acid	secondary	3.18e-07	1.60e-08
LPG Production	Nitrous oxide	secondary	2.80e-07	1.41e-08
US electric grid	Zinc (elemental)	model/secondary	1.81e-07	9.16e-09
US electric grid	Antimony	model/secondary	1.49e-07	7.52e-09
LPG Production	Phosphorus (yellow or white)	secondary	8.47e-08	4.28e-09
LPG Production	Fluorides (F-)	secondary	6.51e-08	3.29e-09
LPG Production	Selenium	secondary	6.40e-08	3.23e-09
US electric grid	Chromium (VI)	model/secondary	5.37e-08	2.72e-09
LPG Production	Hydrogen sulfide	secondary	5.29e-08	2.67e-09
LPG Production	Ammonia	secondary	5.11e-08	2.58e-09
US electric grid	Molybdenum	model/secondary	4.97e-08	2.51e-09
US electric grid	Methyl hydrazine	model/secondary	4.61e-08	2.33e-09
US electric grid	2-Chloroacetophenone	model/secondary	4.32e-08	2.18e-09
US electric grid	Bromomethane	model/secondary	4.27e-08	2.16e-09
CRT landfilling	Selenium	primary	3.21e-08	1.62e-09
US electric grid	Nickel	model/secondary	2.32e-08	1.17e-09
US electric grid	Cyanide (-1)	model/secondary	2.24e-08	1.13e-09
CRT Incineration	Carbon tetrachloride	secondary	1.81e-08	9.16e-10
LPG Production	Hydrofluoric acid	secondary	1.73e-08	8.75e-10
US electric grid	2,3,7,8-TCDD	model/secondary	1.70e-08	8.59e-10
CRT landfilling	Carbon tetrachloride	primary	1.69e-08	8.54e-10
LPG Production	Molybdenum	secondary	1.42e-08	7.19e-10
US electric grid	Naphthalene	model/secondary	1.37e-08	6.92e-10
LPG Production	Chromium (VI)	secondary	1.36e-08	6.88e-10
LPG Production	Ethane	secondary	1.34e-08	6.77e-10
CRT landfilling	Chloroform	primary	1.32e-08	6.67e-10
US electric grid	Barium	model/secondary	1.17e-08	5.89e-10
CRT landfilling	Mercury compounds	primary	1.15e-08	5.84e-10
CRT Incineration	Mercury compounds	secondary	1.13e-08	5.72e-10
LPG Production	Zinc (elemental)	secondary	1.04e-08	5.23e-10
US electric grid	Carbon disulfide	model/secondary	9.18e-09	4.64e-10

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
CRT landfilling	Toluene	primary	8.22e-09	4.15e-10
LPG Production	Hexane	secondary	7.78e-09	3.93e-10
US electric grid	Benzyl chloride	model/secondary	7.03e-09	3.55e-10
LPG Production	Phenol	secondary	6.17e-09	3.12e-10
LPG Production	Pentane	secondary	5.62e-09	2.84e-10
US electric grid	Cadmium	model/secondary	5.48e-09	2.77e-10
US electric grid	Chloroform	model/secondary	4.96e-09	2.50e-10
US electric grid	Propionaldehyde	model/secondary	4.58e-09	2.31e-10
US electric grid	Manganese	model/secondary	4.56e-09	2.30e-10
US electric grid	Fluoride	model/secondary	3.91e-09	1.97e-10
LPG Production	PM-10	secondary	3.88e-09	1.96e-10
LPG Production	Nickel	secondary	3.56e-09	1.80e-10
US electric grid	Beryllium	model/secondary	2.92e-09	1.47e-10
US electric grid	Acrolein	model/secondary	2.60e-09	1.31e-10
US electric grid	Lead	model/secondary	2.55e-09	1.29e-10
LPG Production	Aluminum (+3)	secondary	2.44e-09	1.24e-10
US electric grid	Cobalt	model/secondary	2.43e-09	1.23e-10
US electric grid	Copper	model/secondary	2.24e-09	1.13e-10
US electric grid	Methyl chloride	model/secondary	2.16e-09	1.09e-10
LPG Production	Antimony	secondary	1.85e-09	9.35e-11
CRT landfilling	Xylene (mixed isomers)	primary	1.69e-09	8.56e-11
CRT Incineration	Lead cmpds	secondary	1.62e-09	8.19e-11
CRT landfilling	Lead cmpds	primary	1.58e-09	7.98e-11
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	1.55e-09	7.86e-11
US electric grid	Acetaldehyde	model/secondary	1.24e-09	6.26e-11
CRT landfilling	Tetrachloroethylene	primary	1.20e-09	6.08e-11
US electric grid	Hexane	model/secondary	1.20e-09	6.07e-11
CRT landfilling	1,2-Dichloroethane	primary	1.15e-09	5.81e-11
LPG Production	Nitrate	secondary	1.05e-09	5.28e-11
US electric grid	Dimethyl sulfate	model/secondary	8.61e-10	4.35e-11
CRT Incineration	Trichloroethylene	secondary	7.65e-10	3.86e-11
US electric grid	Mercury	model/secondary	7.52e-10	3.80e-11
CRT landfilling	Trichloroethylene	primary	7.13e-10	3.60e-11
CRT landfilling	Ethylbenzene	primary	4.44e-10	2.24e-11
US electric grid	Toluene	model/secondary	4.25e-10	2.15e-11
US electric grid	Isophorone	model/secondary	4.16e-10	2.10e-11
US electric grid	Methyl ethyl ketone	model/secondary	3.33e-10	1.68e-11
US electric grid	Tetrachloroethylene	model/secondary	3.29e-10	1.66e-11
LPG Production	Copper	secondary	3.01e-10	1.52e-11
LPG Production	Methyl hydrazine	secondary	2.97e-10	1.50e-11
US electric grid	1,2-Dichloroethane	model/secondary	2.93e-10	1.48e-11
LPG Production	Silicon	secondary	2.92e-10	1.48e-11
US electric grid	Methyl methacrylate	model/secondary	2.85e-10	1.44e-11
LPG Production	2-Chloroacetophenone	secondary	2.78e-10	1.41e-11
LPG Production	Dimethylbenzanthracene	secondary	2.75e-10	1.39e-11
LPG Production	Bromomethane	secondary	2.75e-10	1.39e-11
US electric grid	Styrene	model/secondary	2.52e-10	1.27e-11
US electric grid	Bromoform	model/secondary	2.35e-10	1.19e-11
US electric grid	Dichloromethane	model/secondary	2.32e-10	1.17e-11
LPG Production	Naphthalene	secondary	2.26e-10	1.14e-11

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	Lead	secondary	2.13e-10	1.08e-11
CRT landfilling	Dichloromethane	primary	2.01e-10	1.01e-11
LPG Production	Manganese	secondary	1.93e-10	9.73e-12
US electric grid	Chlorobenzene	model/secondary	1.88e-10	9.50e-12
LPG Production	Beryllium	secondary	1.85e-10	9.36e-12
CRT Incineration	Vinyl chloride	secondary	1.61e-10	8.14e-12
LPG Production	Barium	secondary	1.61e-10	8.13e-12
US electric grid	2,4-Dinitrotoluene	model/secondary	1.51e-10	7.61e-12
CRT landfilling	Vinyl chloride	primary	1.50e-10	7.59e-12
LPG Production	Cyanide (-1)	secondary	1.44e-10	7.30e-12
US electric grid	Acetophenone	model/secondary	1.38e-10	6.99e-12
LPG Production	Barium cmpds	secondary	1.37e-10	6.92e-12
LPG Production	Cadmium	secondary	7.95e-11	4.02e-12
US electric grid	Ethylbenzene	model/secondary	7.41e-11	3.74e-12
LPG Production	Carbon disulfide	secondary	5.91e-11	2.99e-12
CRT Incineration	o-xylene	secondary	5.21e-11	2.63e-12
CRT landfilling	Chromium (III)	primary	4.83e-11	2.44e-12
LPG Production	Benzyl chloride	secondary	4.52e-11	2.29e-12
LPG Production	Cobalt	secondary	4.34e-11	2.19e-12
US electric grid	Methyl tert-butyl ether	model/secondary	3.74e-11	1.89e-12
LPG Production	Aluminum (elemental)	secondary	3.34e-11	1.69e-12
LPG Production	Chloroform	secondary	3.19e-11	1.61e-12
LPG Production	Propionaldehyde	secondary	2.95e-11	1.49e-12
US electric grid	Phenol	model/secondary	2.85e-11	1.44e-12
US electric grid	Vinyl acetate	model/secondary	2.66e-11	1.34e-12
US electric grid	Phenanthrene	model/secondary	2.51e-11	1.27e-12
US electric grid	Ethylene dibromide	model/secondary	2.47e-11	1.25e-12
US electric grid	Xylene (mixed isomers)	model/secondary	2.21e-11	1.12e-12
US electric grid	Chromium (III)	model/secondary	1.97e-11	9.96e-13
LPG Production	Acrolein	secondary	1.67e-11	8.46e-13
LPG Production	Methyl chloride	secondary	1.39e-11	7.02e-13
US electric grid	2,3,7,8-TCDF	model/secondary	1.17e-11	5.90e-13
US electric grid	1,1,1-Trichloroethane	model/secondary	1.08e-11	5.48e-13
LPG Production	Di(2-ethylhexyl)phthalate	secondary	1.00e-11	5.06e-13
LPG Production	Acetaldehyde	secondary	7.97e-12	4.03e-13
US electric grid	Acenaphthene	model/secondary	7.61e-12	3.85e-13
LPG Production	Mercury	secondary	7.50e-12	3.79e-13
US electric grid	Ethyl Chloride	model/secondary	7.19e-12	3.63e-13
US electric grid	Cumene	model/secondary	6.08e-12	3.07e-13
LPG Production	Cadmium cmpds	secondary	6.00e-12	3.03e-13
LPG Production	Dimethyl sulfate	secondary	5.54e-12	2.80e-13
LPG Production	Toluene	secondary	5.38e-12	2.72e-13
US electric grid	Biphenyl	model/secondary	3.63e-12	1.83e-13
LPG Production	1,4-Dichlorobenzene	secondary	3.13e-12	1.58e-13
LPG Production	Isophorone	secondary	2.68e-12	1.35e-13
LPG Production	Aromatic hydrocarbons	secondary	2.42e-12	1.22e-13
US electric grid	Acenaphthylene	model/secondary	2.26e-12	1.14e-13
LPG Production	Methyl ethyl ketone	secondary	2.14e-12	1.08e-13
US electric grid	Benzo[a]pyrene	model/secondary	2.14e-12	1.08e-13
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	2.13e-12	1.08e-13

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	Tetrachloroethylene	secondary	2.12e-12	1.07e-13
US electric grid	Anthracene	model/secondary	1.97e-12	9.96e-14
LPG Production	1,2-Dichloroethane	secondary	1.88e-12	9.52e-14
LPG Production	Methyl methacrylate	secondary	1.83e-12	9.26e-14
LPG Production	Styrene	secondary	1.62e-12	8.18e-14
LPG Production	Bromoform	secondary	1.51e-12	7.64e-14
LPG Production	Dichloromethane	secondary	1.49e-12	7.54e-14
LPG Production	Chromium (III)	secondary	1.48e-12	7.49e-14
US electric grid	Benzo[a]anthracene	model/secondary	1.42e-12	7.16e-14
LPG Production	Chlorobenzene	secondary	1.21e-12	6.11e-14
LPG Production	Copper (+1 & +2)	secondary	1.13e-12	5.71e-14
US electric grid	Chrysene	model/secondary	1.03e-12	5.19e-14
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	1.01e-12	5.09e-14
LPG Production	2,4-Dinitrotoluene	secondary	9.70e-13	4.90e-14
LPG Production	Acetophenone	secondary	8.91e-13	4.50e-14
US electric grid	Fluorene	model/secondary	8.00e-13	4.04e-14
US electric grid	Fluoranthene	model/secondary	6.39e-13	3.23e-14
LPG Production	o-xylene	secondary	5.92e-13	2.99e-14
US electric grid	Dibenzo[a,h]anthracene	model/secondary	5.48e-13	2.77e-14
US electric grid	2-Methylnaphthalene	model/secondary	5.34e-13	2.70e-14
US electric grid	Pyrene	model/secondary	5.29e-13	2.67e-14
LPG Production	Ethylbenzene	secondary	4.80e-13	2.42e-14
US electric grid	5-Methyl chrysene	model/secondary	3.95e-13	1.99e-14
US electric grid	o-xylene	model/secondary	3.80e-13	1.92e-14
US electric grid	Benzo[g,h,i]perylene	model/secondary	3.61e-13	1.82e-14
LPG Production	Methyl tert-butyl ether	secondary	2.41e-13	1.22e-14
LPG Production	Zinc (+2)	secondary	2.03e-13	1.02e-14
LPG Production	Phenanthrene	secondary	1.96e-13	9.88e-15
LPG Production	Vinyl acetate	secondary	1.71e-13	8.66e-15
LPG Production	3-Methylcholanthrene	secondary	1.66e-13	8.37e-15
LPG Production	Ethylene dibromide	secondary	1.59e-13	8.03e-15
LPG Production	2-Methylnaphthalene	secondary	1.04e-13	5.24e-15
LPG Production	Chlorine	secondary	9.19e-14	4.64e-15
LPG Production	1,1,1-Trichloroethane	secondary	6.53e-14	3.30e-15
LPG Production	Acenaphthene	secondary	6.07e-14	3.06e-15
LPG Production	Ethyl Chloride	secondary	4.63e-14	2.34e-15
LPG Production	Cumene	secondary	3.92e-14	1.98e-15
LPG Production	Benzo[a]pyrene	secondary	3.70e-14	1.87e-15
LPG Production	Biphenyl	secondary	2.34e-14	1.18e-15
LPG Production	Lead cmpds	secondary	2.01e-14	1.02e-15
LPG Production	Dibenzo[a,h]anthracene	secondary	1.92e-14	9.71e-16
LPG Production	Acenaphthylene	secondary	1.85e-14	9.33e-16
LPG Production	Anthracene	secondary	1.82e-14	9.20e-16
LPG Production	Nickel cmpds	secondary	1.70e-14	8.60e-16
LPG Production	Benzo[a]anthracene	secondary	1.65e-14	8.31e-16
LPG Production	Benzo[b,j,k]fluoranthene	secondary	1.27e-14	6.42e-16
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	1.22e-14	6.18e-16
LPG Production	Chrysene	secondary	1.04e-14	5.25e-16
LPG Production	HALON-1301	secondary	8.76e-15	4.43e-16
LPG Production	Benzo[b]fluoranthene	secondary	6.58e-15	3.32e-16

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	Mercury compounds	secondary	6.11e-15	3.09e-16
LPG Production	Fluorene	secondary	5.70e-15	2.88e-16
LPG Production	Pyrene	secondary	4.93e-15	2.49e-16
LPG Production	Benzo[g,h,i]perylene	secondary	4.79e-15	2.42e-16
LPG Production	Fluoranthene	secondary	4.65e-15	2.35e-16
LPG Production	5-Methyl chrysene	secondary	2.54e-15	1.28e-16
LPG Production	Halogenated matter (organic)	secondary	2.01e-15	1.02e-16
LPG Production	Halogenated hydrocarbons (unspecified)	secondary	5.04e-18	2.55e-19
Natural Gas Prod.	Halogenated hydrocarbons (unspecified)	secondary	-5.91e-18	-2.98e-19
CRT Incineration	Halogenated hydrocarbons (unspecified)	secondary	-8.69e-17	-4.39e-18
Fuel Oil #4 Prod.	Halogenated hydrocarbons (unspecified)	secondary	-1.43e-15	-7.22e-17
Natural Gas Prod.	Halogenated matter (organic)	secondary	-2.37e-15	-1.20e-16
Natural Gas Prod.	Mercury compounds	secondary	-7.18e-15	-3.63e-16
Natural Gas Prod.	HALON-1301	secondary	-1.03e-14	-5.20e-16
Natural Gas Prod.	Nickel cmpds	secondary	-2.00e-14	-1.01e-15
Natural Gas Prod.	Lead cmpds	secondary	-2.37e-14	-1.20e-15
CRT Incineration	Halogenated matter (organic)	secondary	-3.67e-14	-1.85e-15
CRT Incineration	HALON-1301	secondary	-1.60e-13	-8.07e-15
Natural Gas Prod.	5-Methyl chrysene	secondary	-2.56e-13	-1.29e-14
CRT Incineration	Nickel cmpds	secondary	-3.10e-13	-1.57e-14
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	-5.72e-13	-2.89e-14
Natural Gas Prod.	Fluoranthene	secondary	-7.34e-13	-3.71e-14
Natural Gas Prod.	Fluorene	secondary	-8.22e-13	-4.15e-14
CRT Incineration	Benzo[b]fluoranthene	secondary	-1.02e-12	-5.13e-14
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	-1.06e-12	-5.35e-14
Natural Gas Prod.	Pyrene	secondary	-1.23e-12	-6.20e-14
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	-1.28e-12	-6.47e-14
Natural Gas Prod.	Copper (+1 & +2)	secondary	-1.33e-12	-6.71e-14
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	-1.60e-12	-8.09e-14
Fuel Oil #4 Prod.	Mercury compounds	secondary	-1.74e-12	-8.77e-14
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	-1.74e-12	-8.79e-14
Fuel Oil #4 Prod.	Fluoranthene	secondary	-1.88e-12	-9.50e-14
Fuel Oil #4 Prod.	Pyrene	secondary	-1.91e-12	-9.67e-14
Fuel Oil #4 Prod.	Benzo[b]fluoranthene	secondary	-2.26e-12	-1.14e-13
Fuel Oil #4 Prod.	Fluorene	secondary	-2.32e-12	-1.17e-13
Natural Gas Prod.	Biphenyl	secondary	-2.35e-12	-1.19e-13
Fuel Oil #4 Prod.	HALON-1301	secondary	-2.49e-12	-1.26e-13
Natural Gas Prod.	Chrysene	secondary	-2.72e-12	-1.38e-13
CRT Incineration	Dibenzo[a,h]anthracene	secondary	-2.82e-12	-1.42e-13
Natural Gas Prod.	Aromatic hydrocarbons	secondary	-2.84e-12	-1.43e-13
Natural Gas Prod.	Benzo[b]fluoranthene	secondary	-3.19e-12	-1.61e-13
Natural Gas Prod.	Acenaphthylene	secondary	-3.51e-12	-1.77e-13
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	-3.78e-12	-1.91e-13
Natural Gas Prod.	Cumene	secondary	-3.95e-12	-1.99e-13
Fuel Oil #4 Prod.	Chrysene	secondary	-3.98e-12	-2.01e-13
Natural Gas Prod.	Anthracene	secondary	-4.08e-12	-2.06e-13
Natural Gas Prod.	Benzo[a]anthracene	secondary	-4.29e-12	-2.17e-13
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	-4.58e-12	-2.32e-13
Natural Gas Prod.	Ethyl Chloride	secondary	-4.66e-12	-2.36e-13
Fuel Oil #4 Prod.	Nickel cmpds	secondary	-4.83e-12	-2.44e-13

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	-5.29e-12	-2.67e-13
Fuel Oil #4 Prod.	Lead cmpds	secondary	-5.72e-12	-2.89e-13
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	-6.01e-12	-3.03e-13
Fuel Oil #4 Prod.	Dibenzo[a,h]anthracene	secondary	-6.53e-12	-3.30e-13
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	-6.58e-12	-3.33e-13
Natural Gas Prod.	Cadmium cmpds	secondary	-7.04e-12	-3.56e-13
Fuel Oil #4 Prod.	Anthracene	secondary	-7.15e-12	-3.61e-13
Fuel Oil #4 Prod.	Acenaphthylene	secondary	-7.42e-12	-3.75e-13
Natural Gas Prod.	Acenaphthene	secondary	-8.90e-12	-4.50e-13
Natural Gas Prod.	Dibenzo[a,h]anthracene	secondary	-8.91e-12	-4.50e-13
Fuel Oil #4 Prod.	Biphenyl	secondary	-9.73e-12	-4.92e-13
Natural Gas Prod.	Benzo[a]pyrene	secondary	-9.90e-12	-5.00e-13
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	-1.48e-11	-7.47e-13
Natural Gas Prod.	Ethylene dibromide	secondary	-1.60e-11	-8.09e-13
Fuel Oil #4 Prod.	Cumene	secondary	-1.63e-11	-8.24e-13
Natural Gas Prod.	Vinyl acetate	secondary	-1.73e-11	-8.72e-13
CRT Incineration	2-Methylnaphthalene	secondary	-1.74e-11	-8.80e-13
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	-1.93e-11	-9.74e-13
CRT Incineration	Copper (+1 & +2)	secondary	-2.06e-11	-1.04e-12
Fuel Oil #4 Prod.	Acenaphthene	secondary	-2.28e-11	-1.15e-12
Natural Gas Prod.	Methyl tert-butyl ether	secondary	-2.42e-11	-1.22e-12
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	-2.72e-11	-1.37e-12
CRT Incineration	3-Methylcholanthrene	secondary	-2.78e-11	-1.41e-12
Fuel Oil #4 Prod.	Chlorine	secondary	-3.16e-11	-1.59e-12
Natural Gas Prod.	Phenanthrene	secondary	-3.53e-11	-1.79e-12
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	-3.63e-11	-1.83e-12
CRT Incineration	Chlorine	secondary	-3.87e-11	-1.96e-12
CRT Incineration	Benzo[g,h,i]perylene	secondary	-4.06e-11	-2.05e-12
Natural Gas Prod.	Aluminum (elemental)	secondary	-4.26e-11	-2.15e-12
CRT Incineration	Aromatic hydrocarbons	secondary	-4.41e-11	-2.23e-12
CRT Incineration	Zinc (+2)	secondary	-4.48e-11	-2.26e-12
Natural Gas Prod.	Ethylbenzene	secondary	-4.85e-11	-2.45e-12
CRT Incineration	Dichlorobenzene (mixed isomers)	secondary	-4.90e-11	-2.48e-12
Natural Gas Prod.	2-Methylnaphthalene	secondary	-5.42e-11	-2.74e-12
Fuel Oil #4 Prod.	3-Methylcholanthrene	secondary	-5.80e-11	-2.93e-12
Fuel Oil #4 Prod.	Zinc (+2)	secondary	-6.42e-11	-3.24e-12
CRT Incineration	5-Methyl chrysene	secondary	-6.54e-11	-3.31e-12
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	-6.62e-11	-3.34e-12
Fuel Oil #4 Prod.	Vinyl acetate	secondary	-7.14e-11	-3.61e-12
CRT Incineration	Pyrene	secondary	-7.81e-11	-3.95e-12
Fuel Oil #4 Prod.	Phenanthrene	secondary	-7.87e-11	-3.97e-12
Natural Gas Prod.	Chromium (III)	secondary	-8.08e-11	-4.08e-12
Natural Gas Prod.	3-Methylcholanthrene	secondary	-8.67e-11	-4.38e-12
Natural Gas Prod.	Acetophenone	secondary	-8.98e-11	-4.53e-12
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	-9.77e-11	-4.94e-12
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	-1.00e-10	-5.06e-12
CRT Incineration	Fluoranthene	secondary	-1.01e-10	-5.08e-12
Natural Gas Prod.	Chlorobenzene	secondary	-1.22e-10	-6.16e-12
CRT Incineration	Fluorene	secondary	-1.29e-10	-6.51e-12
CRT Incineration	Indeno(1,2,3-cd)pyrene	secondary	-1.40e-10	-7.05e-12

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
CRT Incineration	Chrysene	secondary	-1.50e-10	-7.59e-12
Natural Gas Prod.	Dichloromethane	secondary	-1.50e-10	-7.60e-12
Natural Gas Prod.	Bromoform	secondary	-1.52e-10	-7.70e-12
Natural Gas Prod.	Barium cmpds	secondary	-1.61e-10	-8.13e-12
Natural Gas Prod.	Styrene	secondary	-1.63e-10	-8.24e-12
CRT Incineration	Benzo[a]anthracene	secondary	-1.83e-10	-9.23e-12
Natural Gas Prod.	Methyl methacrylate	secondary	-1.85e-10	-9.33e-12
Natural Gas Prod.	1,2-Dichloroethane	secondary	-1.90e-10	-9.60e-12
Fuel Oil #4 Prod.	Ethylbenzene	secondary	-1.99e-10	-1.01e-11
Natural Gas Prod.	Tetrachloroethylene	secondary	-2.14e-10	-1.08e-11
Natural Gas Prod.	Methyl ethyl ketone	secondary	-2.16e-10	-1.09e-11
Fuel Oil #4 Prod.	o-xylene	secondary	-2.16e-10	-1.09e-11
Natural Gas Prod.	Isophorone	secondary	-2.70e-10	-1.36e-11
Fuel Oil #4 Prod.	Chromium (III)	secondary	-3.09e-10	-1.56e-11
CRT Incineration	Anthracene	secondary	-3.17e-10	-1.60e-11
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	-3.21e-10	-1.62e-11
CRT Incineration	Benzo[b,j,k]fluoranthene	secondary	-3.27e-10	-1.65e-11
CRT Incineration	Benzo[a]pyrene	secondary	-3.57e-10	-1.80e-11
Fuel Oil #4 Prod.	Acetophenone	secondary	-3.71e-10	-1.87e-11
CRT Incineration	Acenaphthylene	secondary	-3.72e-10	-1.88e-11
Natural Gas Prod.	Silicon	secondary	-3.72e-10	-1.88e-11
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	-4.04e-10	-2.04e-11
Natural Gas Prod.	Chlorine	secondary	-4.75e-10	-2.40e-11
Fuel Oil #4 Prod.	Chlorobenzene	secondary	-5.04e-10	-2.55e-11
Natural Gas Prod.	Zinc (+2)	secondary	-5.26e-10	-2.66e-11
Natural Gas Prod.	Dimethyl sulfate	secondary	-5.59e-10	-2.82e-11
CRT Incineration	Biphenyl	secondary	-6.02e-10	-3.04e-11
Fuel Oil #4 Prod.	Dichloromethane	secondary	-6.22e-10	-3.14e-11
Fuel Oil #4 Prod.	Bromoform	secondary	-6.30e-10	-3.18e-11
Fuel Oil #4 Prod.	Styrene	secondary	-6.75e-10	-3.41e-11
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	-6.87e-10	-3.47e-11
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	-7.64e-10	-3.86e-11
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	-7.85e-10	-3.97e-11
Natural Gas Prod.	Acetaldehyde	secondary	-8.03e-10	-4.06e-11
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	-8.83e-10	-4.46e-11
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	-8.93e-10	-4.51e-11
Natural Gas Prod.	Mercury	secondary	-9.44e-10	-4.77e-11
CRT Incineration	Cumene	secondary	-1.01e-09	-5.09e-11
Natural Gas Prod.	Di(2-ethylhexyl)phthalate	secondary	-1.01e-09	-5.10e-11
CRT Incineration	Acenaphthene	secondary	-1.02e-09	-5.14e-11
CRT Incineration	Aluminum (elemental)	secondary	-1.08e-09	-5.47e-11
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	-1.09e-09	-5.53e-11
Fuel Oil #4 Prod.	Isophorone	secondary	-1.12e-09	-5.64e-11
CRT Incineration	Ethyl Chloride	secondary	-1.19e-09	-6.02e-11
Natural Gas Prod.	Methyl chloride	secondary	-1.40e-09	-7.07e-11
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	-1.64e-09	-8.27e-11
CRT Incineration	1,1,1-Trichloroethane	secondary	-1.68e-09	-8.50e-11
Natural Gas Prod.	Acrolein	secondary	-1.69e-09	-8.53e-11
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	-1.70e-09	-8.60e-11
Fuel Oil #4 Prod.	Toluene	secondary	-2.04e-09	-1.03e-10

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
CRT Incineration	Xylene (mixed isomers)	secondary	-2.13e-09	-1.08e-10
Natural Gas Prod.	o-xylene	secondary	-2.31e-09	-1.17e-10
Fuel Oil #4 Prod.	Dimethyl sulfate	secondary	-2.31e-09	-1.17e-10
Natural Gas Prod.	Cobalt	secondary	-2.65e-09	-1.34e-10
Natural Gas Prod.	Aluminum (+3)	secondary	-2.87e-09	-1.45e-10
Natural Gas Prod.	Propionaldehyde	secondary	-2.97e-09	-1.50e-10
Fuel Oil #4 Prod.	Mercury	secondary	-3.11e-09	-1.57e-10
Natural Gas Prod.	Chloroform	secondary	-3.21e-09	-1.62e-10
Fuel Oil #4 Prod.	Acetaldehyde	secondary	-3.32e-09	-1.68e-10
CRT Incineration	Phenanthrene	secondary	-4.02e-09	-2.03e-10
CRT Incineration	Ethylene dibromide	secondary	-4.09e-09	-2.07e-10
Fuel Oil #4 Prod.	Di(2-ethylhexyl)phthalate	secondary	-4.17e-09	-2.11e-10
Natural Gas Prod.	Toluene	secondary	-4.33e-09	-2.19e-10
CRT Incineration	Vinyl acetate	secondary	-4.41e-09	-2.23e-10
Natural Gas Prod.	Benzyl chloride	secondary	-4.56e-09	-2.30e-10
Natural Gas Prod.	PM-10	secondary	-4.95e-09	-2.50e-10
Fuel Oil #4 Prod.	Methyl chloride	secondary	-5.79e-09	-2.92e-10
Natural Gas Prod.	Carbon disulfide	secondary	-5.95e-09	-3.01e-10
CRT Incineration	Methyl tert-butyl ether	secondary	-6.19e-09	-3.13e-10
Fuel Oil #4 Prod.	Acrolein	secondary	-6.98e-09	-3.53e-10
Natural Gas Prod.	Phenol	secondary	-7.32e-09	-3.70e-10
Natural Gas Prod.	Cadmium	secondary	-8.00e-09	-4.04e-10
CRT Incineration	Silicon	secondary	-9.47e-09	-4.78e-10
CRT Incineration	Ethylbenzene	secondary	-1.18e-08	-5.96e-10
Fuel Oil #4 Prod.	Propionaldehyde	secondary	-1.23e-08	-6.21e-10
Fuel Oil #4 Prod.	Chloroform	secondary	-1.33e-08	-6.72e-10
Natural Gas Prod.	Cyanide (-1)	secondary	-1.45e-08	-7.35e-10
Natural Gas Prod.	Nitrate	secondary	-1.51e-08	-7.62e-10
Fuel Oil #4 Prod.	Aluminum (elemental)	secondary	-1.61e-08	-8.13e-10
CRT Incineration	Chromium (III)	secondary	-1.69e-08	-8.55e-10
Fuel Oil #4 Prod.	Cobalt	secondary	-1.85e-08	-9.36e-10
Fuel Oil #4 Prod.	Benzyl chloride	secondary	-1.88e-08	-9.52e-10
Natural Gas Prod.	Manganese	secondary	-1.98e-08	-1.00e-09
CRT Incineration	Chloroacetophenone	secondary	-2.08e-08	-1.05e-09
Natural Gas Prod.	Beryllium	secondary	-2.14e-08	-1.08e-09
Natural Gas Prod.	Lead	secondary	-2.17e-08	-1.10e-09
CRT Incineration	Acetophenone	secondary	-2.29e-08	-1.16e-09
Fuel Oil #4 Prod.	Carbon disulfide	secondary	-2.46e-08	-1.24e-09
CRT Incineration	2,4-Dinitrotoluene	secondary	-2.50e-08	-1.26e-09
Natural Gas Prod.	Copper	secondary	-2.65e-08	-1.34e-09
Natural Gas Prod.	Bromomethane	secondary	-2.77e-08	-1.40e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	-2.80e-08	-1.42e-09
Natural Gas Prod.	Barium	secondary	-2.96e-08	-1.49e-09
Natural Gas Prod.	Methyl hydrazine	secondary	-2.99e-08	-1.51e-09
CRT Incineration	Chlorobenzene	secondary	-3.11e-08	-1.57e-09
Fuel Oil #4 Prod.	Cadmium	secondary	-3.26e-08	-1.65e-09
CRT Incineration	Dichloromethane	secondary	-3.82e-08	-1.93e-09
Fuel Oil #4 Prod.	Barium cmpds	secondary	-3.89e-08	-1.97e-09
CRT Incineration	Bromoform	secondary	-3.89e-08	-1.97e-09
CRT Incineration	Styrene	secondary	-4.17e-08	-2.11e-09

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
CRT Incineration	Aluminum (+3)	secondary	-4.46e-08	-2.25e-09
CRT Incineration	Methyl methacrylate	secondary	-4.72e-08	-2.38e-09
CRT Incineration	1,2-Dichloroethane	secondary	-4.73e-08	-2.39e-09
CRT Incineration	Dimethylbenzanthracene	secondary	-4.82e-08	-2.44e-09
CRT Incineration	Tetrachloroethylene	secondary	-5.33e-08	-2.69e-09
Fuel Oil #4 Prod.	Barium	secondary	-5.46e-08	-2.76e-09
CRT Incineration	Methyl ethyl ketone	secondary	-5.52e-08	-2.79e-09
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	-6.02e-08	-3.04e-09
Natural Gas Prod.	Naphthalene	secondary	-6.61e-08	-3.34e-09
CRT Incineration	Toluene	secondary	-6.65e-08	-3.36e-09
Natural Gas Prod.	Hydrogen sulfide	secondary	-6.75e-08	-3.41e-09
CRT Incineration	Isophorone	secondary	-6.90e-08	-3.49e-09
Fuel Oil #4 Prod.	Beryllium	secondary	-7.66e-08	-3.87e-09
Fuel Oil #4 Prod.	Manganese	secondary	-8.00e-08	-4.04e-09
Fuel Oil #4 Prod.	Naphthalene	secondary	-8.11e-08	-4.10e-09
Natural Gas Prod.	Nickel	secondary	-8.75e-08	-4.42e-09
Fuel Oil #4 Prod.	Lead	secondary	-8.90e-08	-4.50e-09
Fuel Oil #4 Prod.	Dimethylbenzanthracene	secondary	-9.64e-08	-4.87e-09
CRT Incineration	Mercury	secondary	-1.12e-07	-5.64e-09
Fuel Oil #4 Prod.	Bromomethane	secondary	-1.15e-07	-5.79e-09
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	-1.16e-07	-5.85e-09
CRT Incineration	Phenol	secondary	-1.17e-07	-5.92e-09
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	-1.24e-07	-6.25e-09
CRT Incineration	PM-10	secondary	-1.26e-07	-6.36e-09
Fuel Oil #4 Prod.	Copper	secondary	-1.34e-07	-6.77e-09
Fuel Oil #4 Prod.	Silicon	secondary	-1.41e-07	-7.10e-09
CRT Incineration	Dimethyl sulfate	secondary	-1.43e-07	-7.21e-09
Natural Gas Prod.	Dimethylbenzanthracene	secondary	-1.44e-07	-7.28e-09
CRT Incineration	Acetaldehyde	secondary	-2.05e-07	-1.04e-08
Natural Gas Prod.	Antimony	secondary	-2.24e-07	-1.13e-08
CRT Incineration	Di(2-ethylhexyl)phthalate	secondary	-2.58e-07	-1.30e-08
Fuel Oil #4 Prod.	Nitrate	secondary	-3.15e-07	-1.59e-08
CRT Incineration	Methyl chloride	secondary	-3.58e-07	-1.81e-08
CRT Incineration	Cobalt	secondary	-3.83e-07	-1.94e-08
CRT Incineration	Copper	secondary	-4.12e-07	-2.08e-08
CRT Incineration	Acrolein	secondary	-4.31e-07	-2.18e-08
Fuel Oil #4 Prod.	Antimony	secondary	-6.39e-07	-3.23e-08
CRT Incineration	Cadmium	secondary	-6.89e-07	-3.48e-08
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	-6.94e-07	-3.51e-08
Natural Gas Prod.	Chromium (VI)	secondary	-7.42e-07	-3.75e-08
CRT Incineration	Propionaldehyde	secondary	-7.59e-07	-3.84e-08
CRT Incineration	Chloroform	secondary	-8.07e-07	-4.08e-08
Natural Gas Prod.	Phosphorus (yellow or white)	secondary	-8.87e-07	-4.48e-08
CRT Incineration	Pentane	secondary	-9.44e-07	-4.77e-08
Natural Gas Prod.	Molybdenum	secondary	-1.16e-06	-5.86e-08
CRT Incineration	Benzyl chloride	secondary	-1.16e-06	-5.88e-08
CRT Incineration	Hydrogen sulfide	secondary	-1.22e-06	-6.17e-08
CRT Incineration	Barium	secondary	-1.31e-06	-6.64e-08
CRT Incineration	Hexane	secondary	-1.51e-06	-7.61e-08
CRT Incineration	Carbon disulfide	secondary	-1.52e-06	-7.69e-08

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	Nickel	secondary	-1.64e-06	-8.31e-08
Natural Gas Prod.	Hydrofluoric acid	secondary	-1.75e-06	-8.83e-08
Fuel Oil #4 Prod.	Phenol	secondary	-1.75e-06	-8.86e-08
Fuel Oil #4 Prod.	PM-10	secondary	-1.87e-06	-9.45e-08
Fuel Oil #4 Prod.	Pentane	secondary	-1.97e-06	-9.93e-08
CRT Incineration	Naphthalene	secondary	-2.05e-06	-1.04e-07
CRT Incineration	Ethane	secondary	-2.25e-06	-1.14e-07
Fuel Oil #4 Prod.	Hexane	secondary	-2.72e-06	-1.38e-07
Fuel Oil #4 Prod.	Chromium (VI)	secondary	-2.84e-06	-1.44e-07
Natural Gas Prod.	Pentane	secondary	-2.94e-06	-1.48e-07
Fuel Oil #4 Prod.	Zinc (elemental)	secondary	-3.56e-06	-1.80e-07
CRT Incineration	Nitrate	secondary	-3.60e-06	-1.82e-07
CRT Incineration	Cyanide (-1)	secondary	-3.72e-06	-1.88e-07
Natural Gas Prod.	Hexane	secondary	-4.07e-06	-2.06e-07
Natural Gas Prod.	Zinc (elemental)	secondary	-4.26e-06	-2.15e-07
CRT Incineration	Beryllium	secondary	-4.59e-06	-2.32e-07
Fuel Oil #4 Prod.	Ethane	secondary	-4.69e-06	-2.37e-07
CRT Incineration	Manganese	secondary	-4.89e-06	-2.47e-07
Natural Gas Prod.	Selenium	secondary	-6.09e-06	-3.07e-07
Fuel Oil #4 Prod.	Molybdenum	secondary	-6.49e-06	-3.28e-07
Natural Gas Prod.	Fluorides (F-)	secondary	-6.82e-06	-3.44e-07
Natural Gas Prod.	Ethane	secondary	-7.01e-06	-3.54e-07
CRT Incineration	Bromomethane	secondary	-7.08e-06	-3.58e-07
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	-7.22e-06	-3.65e-07
CRT Incineration	Methyl hydrazine	secondary	-7.64e-06	-3.86e-07
CRT Incineration	Molybdenum	secondary	-9.96e-06	-5.03e-07
Natural Gas Prod.	Nitrous oxide	secondary	-1.16e-05	-5.85e-07
CRT Incineration	Nickel	secondary	-1.38e-05	-6.97e-07
Natural Gas Prod.	Formaldehyde	secondary	-1.39e-05	-7.02e-07
Fuel Oil #4 Prod.	Ammonia	secondary	-1.74e-05	-8.79e-07
CRT Incineration	Antimony	secondary	-2.16e-05	-1.09e-06
CRT Incineration	Zinc (elemental)	secondary	-2.54e-05	-1.28e-06
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	-2.55e-05	-1.29e-06
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	-2.66e-05	-1.34e-06
Fuel Oil #4 Prod.	Selenium	secondary	-2.69e-05	-1.36e-06
Natural Gas Prod.	Hydrochloric acid	secondary	-3.20e-05	-1.62e-06
Natural Gas Prod.	Vanadium	secondary	-3.49e-05	-1.76e-06
Fuel Oil #4 Prod.	Phosphorus (yellow or white)	secondary	-3.98e-05	-2.01e-06
CRT Incineration	Phosphorus (yellow or white)	secondary	-5.50e-05	-2.78e-06
CRT Incineration	Ammonia	secondary	-7.13e-05	-3.60e-06
Fuel Oil #4 Prod.	Nitrous oxide	secondary	-1.24e-04	-6.24e-06
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	-1.32e-04	-6.68e-06
CRT Incineration	Chromium (VI)	secondary	-1.56e-04	-7.86e-06
Natural Gas Prod.	Arsenic	secondary	-1.58e-04	-7.97e-06
Natural Gas Prod.	Ammonia	secondary	-2.13e-04	-1.08e-05
Natural Gas Prod.	Sulfur oxides	secondary	-2.76e-04	-1.40e-05
Natural Gas Prod.	PM	secondary	-4.15e-04	-2.10e-05
CRT Incineration	Hydrofluoric acid	secondary	-4.46e-04	-2.25e-05
CRT Incineration	Formaldehyde	secondary	-4.47e-04	-2.26e-05

Table M-33. CRT LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	Formaldehyde	secondary	-5.52e-04	-2.79e-05
Fuel Oil #4 Prod.	Arsenic	secondary	-7.57e-04	-3.82e-05
Fuel Oil #4 Prod.	PM	secondary	-8.70e-04	-4.40e-05
CRT Incineration	Vanadium	secondary	-1.17e-03	-5.92e-05
CRT Incineration	Selenium	secondary	-1.53e-03	-7.74e-05
CRT Incineration	Fluorides (F-)	secondary	-1.57e-03	-7.93e-05
CRT Incineration	Nitrous oxide	secondary	-2.08e-03	-1.05e-04
Fuel Oil #4 Prod.	Benzene	secondary	-2.59e-03	-1.31e-04
CRT Incineration	Benzene	secondary	-3.18e-03	-1.61e-04
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	-3.86e-03	-1.95e-04
Fuel Oil #4 Prod.	Vanadium	secondary	-4.33e-03	-2.19e-04
CRT Incineration	Hydrochloric acid	secondary	-4.66e-03	-2.35e-04
Fuel Oil #4 Prod.	Sulfur oxides	secondary	-5.27e-03	-2.66e-04
Fuel Oil #4 Prod.	Methane	secondary	-5.60e-03	-2.83e-04
Natural Gas Prod.	Nitrogen oxides	secondary	-9.35e-03	-4.72e-04
CRT Incineration	Carbon monoxide	secondary	-1.56e-02	-7.88e-04
Fuel Oil #4 Prod.	Carbon monoxide	secondary	-1.63e-02	-8.23e-04
CRT Incineration	Nitrogen oxides	secondary	-2.51e-02	-1.27e-03
CRT Incineration	Methane	secondary	-3.03e-02	-1.53e-03
Natural Gas Prod.	Carbon monoxide	secondary	-3.45e-02	-1.74e-03
CRT Incineration	PM	secondary	-3.67e-02	-1.85e-03
Natural Gas Prod.	Benzene	secondary	-3.80e-02	-1.92e-03
CRT Incineration	Arsenic	secondary	-3.84e-02	-1.94e-03
Natural Gas Prod.	Methane	secondary	-5.03e-02	-2.54e-03
CRT Incineration	Sulfur oxides	secondary	-5.39e-02	-2.73e-03
Total End-of-life			**1.74e-01**	**8.78e-03**
Total All Life-cycle Stages			**1.98e+03**	**1.00e+02**

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Sulfur dioxide	secondary	1.24e+01	1.38e+00
PMMA Sheet Prod.	Sulfur dioxide	secondary	8.61e+00	9.55e-01
Natural Gas Prod.	Methane	secondary	7.01e+00	7.77e-01
Natural Gas Prod.	Benzene	secondary	5.29e+00	5.87e-01
Aluminum Prod.	Sulfur dioxide	secondary	5.13e+00	5.70e-01
Natural Gas Prod.	Carbon monoxide	secondary	4.80e+00	5.32e-01
Polycarbonate Production	Sulfur dioxide	secondary	4.43e+00	4.91e-01
Natural Gas Prod.	Nitrogen oxides	secondary	1.30e+00	1.44e-01
Aluminum Prod.	Titanium tetrachloride	secondary	2.68e-01	2.97e-02
Steel Prod., cold-rolled, semi-finished	Carbon monoxide	secondary	1.47e-01	1.63e-02
Steel Prod., cold-rolled, semi-finished	PM	secondary	1.03e-01	1.14e-02
Aluminum Prod.	Manganese cmpds	secondary	6.03e-02	6.69e-03
Natural Gas Prod.	PM	secondary	5.78e-02	6.42e-03
Aluminum Prod.	Vanadium	secondary	4.00e-02	4.44e-03
Natural Gas Prod.	Sulfur oxides	secondary	3.85e-02	4.27e-03
Natural Gas Prod.	Ammonia	secondary	2.97e-02	3.30e-03
PET Resin Production	Carbon monoxide	secondary	2.82e-02	3.12e-03
PMMA Sheet Prod.	Carbon monoxide	secondary	2.53e-02	2.81e-03
Steel Prod., cold-rolled, semi-finished	Vanadium	secondary	2.53e-02	2.80e-03
Polycarbonate Production	Carbon monoxide	secondary	2.50e-02	2.78e-03
PMMA Sheet Prod.	Methane	secondary	2.30e-02	2.55e-03
Polycarbonate Production	Methane	secondary	2.27e-02	2.52e-03
Natural Gas Prod.	Arsenic	secondary	2.20e-02	2.44e-03
Polycarbonate Production	Nitrogen dioxide	secondary	2.17e-02	2.40e-03
PMMA Sheet Prod.	Nitrogen dioxide	secondary	2.15e-02	2.38e-03
Aluminum Prod.	Arsenic cmpds	secondary	1.77e-02	1.96e-03
Steel Prod., cold-rolled, semi-finished	Nitrogen dioxide	secondary	1.37e-02	1.52e-03
Steel Prod., cold-rolled, semi-finished	Methane	secondary	1.07e-02	1.19e-03
Steel Prod., cold-rolled, semi-finished	Fluorides (F-)	secondary	9.41e-03	1.04e-03
PET Resin Production	Sulfur oxides	secondary	7.99e-03	8.86e-04
Styrene-butadiene Copolymer Prod.	Carbon monoxide	secondary	7.56e-03	8.39e-04
Steel Prod., cold-rolled, semi-finished	Manganese cmpds	secondary	7.30e-03	8.10e-04
Polycarbonate Production	PM	secondary	7.22e-03	8.01e-04
Aluminum Prod.	Carbon monoxide	secondary	6.93e-03	7.69e-04
Aluminum Prod.	PM	secondary	6.63e-03	7.35e-04
PMMA Sheet Prod.	PM	secondary	6.44e-03	7.15e-04
Styrene-butadiene Copolymer Prod.	Nitrogen oxides	secondary	6.11e-03	6.78e-04
Styrene-butadiene Copolymer Prod.	Methane	secondary	6.00e-03	6.66e-04
Aluminum Prod.	Methane	secondary	5.99e-03	6.65e-04
Aluminum Prod.	Nitrogen dioxide	secondary	5.31e-03	5.89e-04
Styrene-butadiene Copolymer Prod.	Sulfur oxides	secondary	4.99e-03	5.54e-04
Natural Gas Prod.	Vanadium	secondary	4.86e-03	5.39e-04
Natural Gas Prod.	Hydrochloric acid	secondary	4.46e-03	4.95e-04
Aluminum Prod.	Barium cmpds	secondary	3.89e-03	4.31e-04
PET Resin Production	Nitrogen oxides	secondary	3.45e-03	3.83e-04
Aluminum Prod.	Selenium	secondary	2.34e-03	2.60e-04
Steel Prod., cold-rolled, semi-finished	Arsenic	secondary	2.22e-03	2.46e-04
PET Resin Production	Methane	secondary	2.00e-03	2.21e-04

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Steel Prod., cold-rolled, semi-finished	Phosphorus (yellow or white)	secondary	1.99e-03	2.21e-04
Natural Gas Prod.	Formaldehyde	secondary	1.94e-03	2.15e-04
PMMA Sheet Prod.	Ammonia	secondary	1.64e-03	1.82e-04
Natural Gas Prod.	Nitrous oxide	secondary	1.61e-03	1.79e-04
PET Resin Production	PM	secondary	1.40e-03	1.55e-04
Aluminum Prod.	Aluminum (+3)	secondary	1.18e-03	1.31e-04
Steel Prod., cold-rolled, semi-finished	Hydrochloric acid	secondary	1.00e-03	1.11e-04
Natural Gas Prod.	Ethane	secondary	9.76e-04	1.08e-04
Natural Gas Prod.	Fluorides (F-)	secondary	9.49e-04	1.05e-04
Styrene-butadiene Copolymer Prod.	PM	secondary	8.68e-04	9.63e-05
Steel Prod., cold-rolled, semi-finished	Benzene	secondary	8.62e-04	9.56e-05
Steel Prod., cold-rolled, semi-finished	Barium cmpds	secondary	8.49e-04	9.41e-05
Natural Gas Prod.	Selenium	secondary	8.48e-04	9.40e-05
Steel Prod., cold-rolled, semi-finished	Nitrous oxide	secondary	7.62e-04	8.45e-05
Steel Prod., cold-rolled, semi-finished	Arsenic cmpds	secondary	7.53e-04	8.35e-05
Aluminum Prod.	Hydrochloric acid	secondary	6.64e-04	7.37e-05
PMMA Sheet Prod.	Nitrates/nitrites	secondary	6.47e-04	7.18e-05
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	6.19e-04	6.87e-05
Natural Gas Prod.	Zinc (elemental)	secondary	5.94e-04	6.59e-05
Natural Gas Prod.	Hexane	secondary	5.67e-04	6.29e-05
Steel Prod., cold-rolled, semi-finished	Silicon	secondary	4.96e-04	5.50e-05
Aluminum Prod.	Cadmium cmpds	secondary	4.36e-04	4.84e-05
Natural Gas Prod.	Pentane	secondary	4.09e-04	4.54e-05
Steel Prod., cold-rolled, semi-finished	Titanium tetrachloride	secondary	4.08e-04	4.53e-05
PMMA Sheet Prod.	Hydrogen cyanide	secondary	3.73e-04	4.13e-05
PMMA Sheet Prod.	Hydrochloric acid	secondary	2.99e-04	3.31e-05
Polycarbonate Production	Hydrochloric acid	secondary	2.60e-04	2.88e-05
Natural Gas Prod.	Hydrofluoric acid	secondary	2.43e-04	2.70e-05
Steel Prod., cold-rolled, semi-finished	Ethane	secondary	2.41e-04	2.67e-05
Aluminum Prod.	Benzene	secondary	2.12e-04	2.35e-05
Steel Prod., cold-rolled, semi-finished	Formaldehyde	secondary	2.03e-04	2.26e-05
Aluminum Prod.	Hydrofluoric acid	secondary	1.79e-04	1.99e-05
Polycarbonate Production	Sulfuric acid	secondary	1.77e-04	1.97e-05
Aluminum Prod.	Barium sulfate	secondary	1.69e-04	1.87e-05
Steel Prod., cold-rolled, semi-finished	Titanium	secondary	1.62e-04	1.80e-05
Natural Gas Prod.	Molybdenum	secondary	1.62e-04	1.79e-05
Steel Prod., cold-rolled, semi-finished	Selenium	secondary	1.47e-04	1.63e-05
PET Resin Production	Hydrochloric acid	secondary	1.45e-04	1.61e-05
Polycarbonate Production	Mercury compounds	secondary	1.36e-04	1.51e-05
PMMA Sheet Prod.	Sulfuric acid	secondary	1.32e-04	1.46e-05
Natural Gas Prod.	Phosphorus (yellow or white)	secondary	1.24e-04	1.37e-05
Steel Prod., cold-rolled, semi-finished	Zinc (elemental)	secondary	1.06e-04	1.18e-05
Natural Gas Prod.	Chromium (VI)	secondary	1.03e-04	1.15e-05
Aluminum Prod.	Nitrous oxide	secondary	1.03e-04	1.14e-05
Steel Prod., cold-rolled, semi-finished	Tin (Sn++, Sn4+)	secondary	1.02e-04	1.13e-05
PMMA Sheet Prod.	Mercury compounds	secondary	1.01e-04	1.12e-05
Aluminum Prod.	Perfluoromethane	secondary	9.65e-05	1.07e-05
Steel Prod., cold-rolled, semi-finished	Molybdenum	secondary	9.21e-05	1.02e-05
Polycarbonate Production	Aromatic hydrocarbons	secondary	9.18e-05	1.02e-05
Aluminum Prod.	Titanium	secondary	8.57e-05	9.51e-06
Aluminum Prod.	Zinc (elemental)	secondary	8.55e-05	9.48e-06

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Aluminum Prod.	Silicon	secondary	8.14e-05	9.03e-06
Aluminum Prod.	Copper (+1 & +2)	secondary	6.70e-05	7.44e-06
Aluminum Prod.	Strontium (Sr II)	secondary	6.32e-05	7.01e-06
PET Resin Production	Sulfuric acid	secondary	6.24e-05	6.93e-06
Styrene-butadiene Copolymer Prod.	Sulfuric acid	secondary	6.22e-05	6.90e-06
Steel Prod., cold-rolled, semi-finished	Barium	secondary	6.03e-05	6.69e-06
Styrene-butadiene Copolymer Prod.	Aromatic hydrocarbons	secondary	5.93e-05	6.58e-06
Polycarbonate Production	Fluorides (F-)	secondary	5.14e-05	5.70e-06
Styrene-butadiene Copolymer Prod.	Mercury compounds	secondary	4.77e-05	5.29e-06
Steel Prod., cold-rolled, semi-finished	Antimony	secondary	4.67e-05	5.18e-06
Steel Prod., cold-rolled, semi-finished	Boron	secondary	4.20e-05	4.66e-06
Steel Prod., cold-rolled, semi-finished	Strontium (Sr II)	secondary	3.88e-05	4.31e-06
PMMA Sheet Prod.	Fluorine	secondary	3.82e-05	4.24e-06
Aluminum Prod.	Nitrate	secondary	3.40e-05	3.77e-06
Natural Gas Prod.	Antimony	secondary	3.11e-05	3.45e-06
Steel Prod., cold-rolled, semi-finished	Silver compounds	secondary	3.03e-05	3.36e-06
Styrene-butadiene Copolymer Prod.	Hydrochloric acid	secondary	2.98e-05	3.31e-06
Steel Prod., cold-rolled, semi-finished	Nitrates/nitrites	secondary	2.77e-05	3.08e-06
Steel Prod., cold-rolled, semi-finished	Chromium (VI)	secondary	2.53e-05	2.81e-06
Steel Prod., cold-rolled, semi-finished	Acetylene	secondary	2.28e-05	2.53e-06
Steel Prod., cold-rolled, semi-finished	Mercury compounds	secondary	2.22e-05	2.46e-06
Natural Gas Prod.	Dimethylbenzanthracene	secondary	2.01e-05	2.23e-06
Steel Prod., cold-rolled, semi-finished	Hydrofluoric acid	secondary	1.86e-05	2.06e-06
PET Resin Production	Fluorine	secondary	1.81e-05	2.01e-06
Styrene-butadiene Copolymer Prod.	Fluorides (F-)	secondary	1.80e-05	2.00e-06
Steel Prod., cold-rolled, semi-finished	Barium sulfate	secondary	1.68e-05	1.87e-06
Steel Prod., cold-rolled, semi-finished	Aluminum (+3)	secondary	1.54e-05	1.71e-06
Aluminum Prod.	Barium	secondary	1.46e-05	1.62e-06
Steel Prod., cold-rolled, semi-finished	Hydrogen sulfide	secondary	1.33e-05	1.48e-06
Steel Prod., cold-rolled, semi-finished	Cadmium cmpds	secondary	1.32e-05	1.47e-06
Aluminum Prod.	Zinc (+2)	secondary	1.30e-05	1.44e-06
Natural Gas Prod.	Nickel	secondary	1.22e-05	1.35e-06
Steel Prod., cold-rolled, semi-finished	Aluminum (elemental)	secondary	1.21e-05	1.34e-06
Aluminum Prod.	Aromatic hydrocarbons	secondary	1.05e-05	1.17e-06
Aluminum Prod.	Nickel cmpds	secondary	1.01e-05	1.12e-06
Natural Gas Prod.	Hydrogen sulfide	secondary	9.40e-06	1.04e-06
Aluminum Prod.	Nickel	secondary	9.40e-06	1.04e-06
Natural Gas Prod.	Naphthalene	secondary	9.21e-06	1.02e-06
Aluminum Prod.	Ammonia	secondary	9.11e-06	1.01e-06
Aluminum Prod.	Copper	secondary	8.87e-06	9.84e-07
Steel Prod., cold-rolled, semi-finished	Pentane	secondary	8.31e-06	9.22e-07
Steel Prod., cold-rolled, semi-finished	Aromatic hydrocarbons	secondary	7.02e-06	7.79e-07
PMMA Sheet Prod.	Hydrofluoric acid	secondary	6.90e-06	7.66e-07
Aluminum Prod.	Fluoride	secondary	6.78e-06	7.52e-07
Aluminum Prod.	Lead cmpds	secondary	6.49e-06	7.20e-07
Aluminum Prod.	Vanadium (V3+, V5+)	secondary	6.06e-06	6.73e-07
Steel Prod., cold-rolled, semi-finished	Copper	secondary	5.99e-06	6.64e-07
Polycarbonate Production	Copper (+1 & +2)	secondary	5.79e-06	6.42e-07
Steel Prod., cold-rolled, semi-finished	Nickel	secondary	5.67e-06	6.29e-07

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Aluminum Prod.	Nitrites	secondary	5.46e-06	6.05e-07
Aluminum Prod.	Perfluoroethane	secondary	5.36e-06	5.95e-07
Polycarbonate Production	Phenol	secondary	5.22e-06	5.79e-07
Aluminum Prod.	Chromium (VI)	secondary	5.18e-06	5.75e-07
Steel Prod., cold-rolled, semi-finished	Hexane	secondary	4.34e-06	4.82e-07
PMMA Sheet Prod.	Copper (+1 & +2)	secondary	4.31e-06	4.78e-07
Steel Prod., cold-rolled, semi-finished	Copper (+1 & +2)	secondary	4.21e-06	4.67e-07
Natural Gas Prod.	Methyl hydrazine	secondary	4.17e-06	4.62e-07
Polycarbonate Production	Hydrofluoric acid	secondary	4.13e-06	4.58e-07
Natural Gas Prod.	Barium	secondary	4.12e-06	4.57e-07
Aluminum Prod.	Aluminum (elemental)	secondary	3.92e-06	4.35e-07
Natural Gas Prod.	2-Chloroacetophenone	secondary	3.90e-06	4.33e-07
Natural Gas Prod.	Bromomethane	secondary	3.86e-06	4.28e-07
PMMA Sheet Prod.	Cyanide (-1)	secondary	3.83e-06	4.25e-07
Natural Gas Prod.	Copper	secondary	3.69e-06	4.09e-07
Aluminum Prod.	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	3.68e-06	4.08e-07
Polycarbonate Production	Ammonia	secondary	3.27e-06	3.63e-07
PMMA Sheet Prod.	Hydrogen sulfide	secondary	3.07e-06	3.40e-07
Natural Gas Prod.	Lead	secondary	3.03e-06	3.36e-07
Natural Gas Prod.	Beryllium	secondary	2.99e-06	3.31e-07
Aluminum Prod.	Hydrogen sulfide	secondary	2.80e-06	3.11e-07
Natural Gas Prod.	Manganese	secondary	2.76e-06	3.06e-07
Aluminum Prod.	Acetic acid	secondary	2.73e-06	3.03e-07
Styrene-butadiene Copolymer Prod.	Nitrate	secondary	2.53e-06	2.81e-07
Natural Gas Prod.	Nitrate	secondary	2.10e-06	2.33e-07
Polycarbonate Production	Halogenated hydrocarbons (unspecified)	secondary	2.06e-06	2.29e-07
Polycarbonate Production	Hydrogen sulfide	secondary	2.06e-06	2.29e-07
PET Resin Production	Copper (+1 & +2)	secondary	2.04e-06	2.26e-07
Styrene-butadiene Copolymer Prod.	Copper (+1 & +2)	secondary	2.03e-06	2.25e-07
Natural Gas Prod.	Cyanide (-1)	secondary	2.03e-06	2.25e-07
Steel Prod., cold-rolled, semi-finished	Bromine	secondary	1.99e-06	2.21e-07
PET Resin Production	Hydrofluoric acid	secondary	1.82e-06	2.01e-07
PMMA Sheet Prod.	Phenol	secondary	1.75e-06	1.94e-07
Steel Prod., cold-rolled, semi-finished	Acetic acid	secondary	1.74e-06	1.93e-07
Steel Prod., cold-rolled, semi-finished	Boric acid	secondary	1.62e-06	1.80e-07
PMMA Sheet Prod.	Aromatic hydrocarbons	secondary	1.53e-06	1.70e-07
Steel Prod., cold-rolled, semi-finished	Strontium	secondary	1.47e-06	1.63e-07
Aluminum Prod.	Cadmium	secondary	1.25e-06	1.39e-07
Natural Gas Prod.	Cadmium	secondary	1.11e-06	1.24e-07
Steel Prod., cold-rolled, semi-finished	Lead	secondary	1.08e-06	1.20e-07
Steel Prod., cold-rolled, semi-finished	Triethylene glycol	secondary	1.04e-06	1.15e-07
Polycarbonate Production	Chlorine	secondary	1.03e-06	1.14e-07
Natural Gas Prod.	Phenol	secondary	1.02e-06	1.13e-07
Aluminum Prod.	Triethylene glycol	secondary	1.00e-06	1.11e-07
Steel Prod., cold-rolled, semi-finished	Cadmium	secondary	9.71e-07	1.08e-07
Aluminum Prod.	Lead	secondary	8.94e-07	9.92e-08
Steel Prod., cold-rolled, semi-finished	Lead cmpds	secondary	8.65e-07	9.60e-08
Steel Prod., cold-rolled, semi-finished	Uranium	secondary	8.39e-07	9.31e-08
Natural Gas Prod.	Carbon disulfide	secondary	8.29e-07	9.20e-08
PMMA Sheet Prod.	Chlorine	secondary	7.67e-07	8.51e-08

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Steel Prod., cold-rolled, semi-finished	Toluene	secondary	7.44e-07	8.25e-08
Styrene-butadiene Copolymer Prod.	Aluminum (+3)	secondary	7.23e-07	8.02e-08
Natural Gas Prod.	PM-10	secondary	6.90e-07	7.65e-08
Aluminum Prod.	Toluene	secondary	6.75e-07	7.48e-08
PMMA Sheet Prod.	Nickel cmpds	secondary	6.48e-07	7.19e-08
Natural Gas Prod.	Benzyl chloride	secondary	6.35e-07	7.04e-08
Natural Gas Prod.	Toluene	secondary	6.03e-07	6.69e-08
Steel Prod., cold-rolled, semi-finished	Ethylene	secondary	6.02e-07	6.67e-08
Steel Prod., cold-rolled, semi-finished	Cyanide (-1)	secondary	5.92e-07	6.56e-08
Steel Prod., cold-rolled, semi-finished	Methanol	secondary	5.84e-07	6.48e-08
Steel Prod., cold-rolled, semi-finished	Xylene (mixed isomers)	secondary	5.50e-07	6.10e-08
Steel Prod., cold-rolled, semi-finished	Naphthalene	secondary	5.46e-07	6.05e-08
Steel Prod., cold-rolled, semi-finished	Zinc (+2)	secondary	5.20e-07	5.77e-08
Polycarbonate Production	Aluminum (+3)	secondary	5.16e-07	5.72e-08
Polycarbonate Production	Ethanethiol	secondary	5.16e-07	5.72e-08
Polycarbonate Production	Lead	secondary	5.16e-07	5.72e-08
Polycarbonate Production	Nitrate	secondary	5.16e-07	5.72e-08
Polycarbonate Production	Nitrous oxide	secondary	5.16e-07	5.72e-08
Polycarbonate Production	Zinc (+2)	secondary	5.16e-07	5.72e-08
Aluminum Prod.	Xylene (mixed isomers)	secondary	5.13e-07	5.69e-08
Steel Prod., cold-rolled, semi-finished	Phenol	secondary	4.75e-07	5.27e-08
Steel Prod., cold-rolled, semi-finished	Heptane	secondary	4.57e-07	5.07e-08
Natural Gas Prod.	Chloroform	secondary	4.48e-07	4.97e-08
Steel Prod., cold-rolled, semi-finished	Nickel cmpds	secondary	4.15e-07	4.60e-08
Natural Gas Prod.	Propionaldehyde	secondary	4.14e-07	4.59e-08
Natural Gas Prod.	Aluminum (+3)	secondary	4.00e-07	4.44e-08
Steel Prod., cold-rolled, semi-finished	Cobalt	secondary	3.97e-07	4.40e-08
PMMA Sheet Prod.	Aluminum (+3)	secondary	3.83e-07	4.25e-08
PMMA Sheet Prod.	Ethanethiol	secondary	3.83e-07	4.25e-08
PMMA Sheet Prod.	Lead	secondary	3.83e-07	4.25e-08
PMMA Sheet Prod.	Nitrous oxide	secondary	3.83e-07	4.25e-08
PMMA Sheet Prod.	Zinc (+2)	secondary	3.83e-07	4.25e-08
Natural Gas Prod.	Cobalt	secondary	3.69e-07	4.09e-08
PET Resin Production	Chlorine	secondary	3.63e-07	4.03e-08
Styrene-butadiene Copolymer Prod.	Chlorine	secondary	3.62e-07	4.01e-08
Styrene-butadiene Copolymer Prod.	Hydrofluoric acid	secondary	3.62e-07	4.01e-08
Steel Prod., cold-rolled, semi-finished	Beryllium	secondary	3.53e-07	3.92e-08
Natural Gas Prod.	o-xylene	secondary	3.21e-07	3.56e-08
Aluminum Prod.	Cobalt	secondary	3.06e-07	3.40e-08
Steel Prod., cold-rolled, semi-finished	Vanadium (V3+, V5+)	secondary	2.91e-07	3.23e-08
Aluminum Prod.	Strontium	secondary	2.83e-07	3.14e-08
Steel Prod., cold-rolled, semi-finished	Benzo[a]pyrene	secondary	2.74e-07	3.04e-08
Polycarbonate Production	Mercury	secondary	2.58e-07	2.86e-08
PET Resin Production	Ammonia	secondary	2.47e-07	2.74e-08
Styrene-butadiene Copolymer Prod.	Ammonia	secondary	2.46e-07	2.73e-08
Aluminum Prod.	Phenol	secondary	2.38e-07	2.64e-08
Natural Gas Prod.	Acrolein	secondary	2.35e-07	2.61e-08
Steel Prod., cold-rolled, semi-finished	Boron (B III)	secondary	2.30e-07	2.55e-08
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	2.28e-07	2.53e-08

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Styrene-butadiene Copolymer Prod.	Phenol	secondary	2.15e-07	2.39e-08
PET Resin Production	Phenol	secondary	1.98e-07	2.20e-08
Natural Gas Prod.	Methyl chloride	secondary	1.95e-07	2.16e-08
PMMA Sheet Prod.	Mercury	secondary	1.92e-07	2.13e-08
PET Resin Production	Mercury	secondary	1.82e-07	2.01e-08
PET Resin Production	Aluminum (+3)	secondary	1.82e-07	2.01e-08
PET Resin Production	Hydrogen sulfide	secondary	1.82e-07	2.01e-08
PET Resin Production	Lead	secondary	1.82e-07	2.01e-08
PET Resin Production	Nitrate	secondary	1.82e-07	2.01e-08
PET Resin Production	Nitrous oxide	secondary	1.82e-07	2.01e-08
PET Resin Production	Zinc (+2)	secondary	1.82e-07	2.01e-08
Styrene-butadiene Copolymer Prod.	Halogenated hydrocarbons (unspecified)	secondary	1.81e-07	2.01e-08
Styrene-butadiene Copolymer Prod.	Hydrogen sulfide	secondary	1.81e-07	2.01e-08
Styrene-butadiene Copolymer Prod.	Lead	secondary	1.81e-07	2.01e-08
Styrene-butadiene Copolymer Prod.	Nitrous oxide	secondary	1.81e-07	2.01e-08
Styrene-butadiene Copolymer Prod.	Zinc (+2)	secondary	1.81e-07	2.01e-08
Steel Prod., cold-rolled, semi-finished	Manganese	secondary	1.76e-07	1.96e-08
Natural Gas Prod.	Di(2-ethylhexyl)phthalate	secondary	1.40e-07	1.56e-08
Aluminum Prod.	HALON-1301	secondary	1.34e-07	1.49e-08
Natural Gas Prod.	Mercury	secondary	1.32e-07	1.46e-08
Steel Prod., cold-rolled, semi-finished	Rubidium ion (Rb+)	secondary	1.19e-07	1.32e-08
Natural Gas Prod.	Acetaldehyde	secondary	1.12e-07	1.24e-08
Aluminum Prod.	1,2-Dichlorotetrafluoroethane	secondary	9.29e-08	1.03e-08
Styrene-butadiene Copolymer Prod.	Mercury	secondary	9.04e-08	1.00e-08
Steel Prod., cold-rolled, semi-finished	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	8.89e-08	9.86e-09
Steel Prod., cold-rolled, semi-finished	Morpholine	secondary	8.78e-08	9.74e-09
Steel Prod., cold-rolled, semi-finished	Propylene	secondary	8.67e-08	9.62e-09
Steel Prod., cold-rolled, semi-finished	Acetaldehyde	secondary	7.93e-08	8.80e-09
Natural Gas Prod.	Dimethyl sulfate	secondary	7.78e-08	8.63e-09
Aluminum Prod.	Mercury	secondary	7.51e-08	8.33e-09
Natural Gas Prod.	Zinc (+2)	secondary	7.32e-08	8.12e-09
Aluminum Prod.	Cyanide (-1)	secondary	7.05e-08	7.82e-09
Natural Gas Prod.	Chlorine	secondary	6.61e-08	7.33e-09
Steel Prod., cold-rolled, semi-finished	Fluorine	secondary	5.60e-08	6.21e-09
Steel Prod., cold-rolled, semi-finished	Lanthanum	secondary	5.27e-08	5.84e-09
Natural Gas Prod.	Silicon	secondary	5.19e-08	5.75e-09
Aluminum Prod.	Chromium (III)	secondary	4.88e-08	5.42e-09
Steel Prod., cold-rolled, semi-finished	Acetone	secondary	3.87e-08	4.30e-09
Natural Gas Prod.	Isophorone	secondary	3.76e-08	4.17e-09
Natural Gas Prod.	Methyl ethyl ketone	secondary	3.01e-08	3.34e-09
Natural Gas Prod.	Tetrachloroethylene	secondary	2.97e-08	3.30e-09
Steel Prod., cold-rolled, semi-finished	Thorium	secondary	2.83e-08	3.13e-09
Natural Gas Prod.	1,2-Dichloroethane	secondary	2.65e-08	2.93e-09
Natural Gas Prod.	Methyl methacrylate	secondary	2.57e-08	2.85e-09
Steel Prod., cold-rolled, semi-finished	Ethylbenzene	secondary	2.57e-08	2.85e-09
Steel Prod., cold-rolled, semi-finished	HALON-1301	secondary	2.47e-08	2.74e-09
Natural Gas Prod.	Styrene	secondary	2.27e-08	2.52e-09
Natural Gas Prod.	Barium cmpds	secondary	2.24e-08	2.49e-09
Natural Gas Prod.	Bromoform	secondary	2.12e-08	2.35e-09
Natural Gas Prod.	Dichloromethane	secondary	2.10e-08	2.32e-09

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Chlorobenzene	secondary	1.70e-08	1.88e-09
Steel Prod., cold-rolled, semi-finished	Tin	secondary	1.64e-08	1.82e-09
Steel Prod., cold-rolled, semi-finished	Mercury	secondary	1.60e-08	1.77e-09
Steel Prod., cold-rolled, semi-finished	Phosphorus pentoxide	secondary	1.58e-08	1.75e-09
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	1.36e-08	1.51e-09
Steel Prod., cold-rolled, semi-finished	Hydrazine	secondary	1.30e-08	1.44e-09
Steel Prod., cold-rolled, semi-finished	Scandium	secondary	1.28e-08	1.42e-09
Natural Gas Prod.	Acetophenone	secondary	1.25e-08	1.39e-09
Natural Gas Prod.	3-Methylcholanthrene	secondary	1.21e-08	1.34e-09
Natural Gas Prod.	Chromium (III)	secondary	1.13e-08	1.25e-09
Steel Prod., cold-rolled, semi-finished	Chlorine	secondary	1.12e-08	1.24e-09
Steel Prod., cold-rolled, semi-finished	Thallium	secondary	8.72e-09	9.67e-10
Natural Gas Prod.	2-Methylnaphthalene	secondary	7.56e-09	8.38e-10
Natural Gas Prod.	Ethylbenzene	secondary	6.75e-09	7.49e-10
Steel Prod., cold-rolled, semi-finished	Zirconium	secondary	6.73e-09	7.47e-10
Natural Gas Prod.	Aluminum (elemental)	secondary	5.93e-09	6.58e-10
Natural Gas Prod.	Phenanthrene	secondary	4.92e-09	5.46e-10
Natural Gas Prod.	Methyl tert-butyl ether	secondary	3.38e-09	3.75e-10
Steel Prod., cold-rolled, semi-finished	Nitrites	secondary	2.76e-09	3.06e-10
Steel Prod., cold-rolled, semi-finished	Chromium (III)	secondary	2.59e-09	2.88e-10
Natural Gas Prod.	Vinyl acetate	secondary	2.40e-09	2.67e-10
Natural Gas Prod.	Ethylene dibromide	secondary	2.23e-09	2.47e-10
Steel Prod., cold-rolled, semi-finished	Edetic acid (EDTA)	secondary	1.89e-09	2.10e-10
Steel Prod., cold-rolled, semi-finished	Hypochlorous acid	secondary	1.72e-09	1.91e-10
Steel Prod., cold-rolled, semi-finished	Cobalt (Co I, Co II, Co III)	secondary	1.54e-09	1.71e-10
Natural Gas Prod.	Benzo[a]pyrene	secondary	1.38e-09	1.53e-10
Natural Gas Prod.	Dibenzo[a,h]anthracene	secondary	1.24e-09	1.38e-10
Natural Gas Prod.	Acenaphthene	secondary	1.24e-09	1.37e-10
Natural Gas Prod.	Cadmium cmpds	secondary	9.81e-10	1.09e-10
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	9.17e-10	1.02e-10
Steel Prod., cold-rolled, semi-finished	Dichloromethane	secondary	7.33e-10	8.13e-11
Natural Gas Prod.	Ethyl Chloride	secondary	6.50e-10	7.21e-11
Natural Gas Prod.	Benzo[a]anthracene	secondary	5.98e-10	6.63e-11
Natural Gas Prod.	Anthracene	secondary	5.68e-10	6.30e-11
Natural Gas Prod.	Cumene	secondary	5.50e-10	6.10e-11
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	5.26e-10	5.83e-11
Natural Gas Prod.	Acenaphthylene	secondary	4.89e-10	5.42e-11
Natural Gas Prod.	Benzo[b]fluoranthene	secondary	4.45e-10	4.93e-11
Natural Gas Prod.	Aromatic hydrocarbons	secondary	3.95e-10	4.39e-11
Natural Gas Prod.	Chrysene	secondary	3.79e-10	4.21e-11
Natural Gas Prod.	Biphenyl	secondary	3.28e-10	3.64e-11
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	2.23e-10	2.47e-11
Steel Prod., cold-rolled, semi-finished	Isopropylpropionate	secondary	1.98e-10	2.20e-11
Natural Gas Prod.	Copper (+1 & +2)	secondary	1.85e-10	2.05e-11
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	1.78e-10	1.98e-11
Natural Gas Prod.	Pyrene	secondary	1.71e-10	1.90e-11
Natural Gas Prod.	Fluorene	secondary	1.14e-10	1.27e-11
Natural Gas Prod.	Fluoranthene	secondary	1.02e-10	1.13e-11
Steel Prod., cold-rolled, semi-finished	Lithium salts	secondary	9.71e-11	1.08e-11

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Steel Prod., cold-rolled, semi-finished	Perfluoromethane	secondary	4.40e-11	4.88e-12
Natural Gas Prod.	5-Methyl chrysene	secondary	3.57e-11	3.96e-12
Steel Prod., cold-rolled, semi-finished	Chloroform	secondary	2.69e-11	2.98e-12
Natural Gas Prod.	Lead cmpds	secondary	3.30e-12	3.66e-13
Natural Gas Prod.	Nickel cmpds	secondary	2.78e-12	3.09e-13
Natural Gas Prod.	HALON-1301	secondary	1.43e-12	1.59e-13
Natural Gas Prod.	Mercury compounds	secondary	1.00e-12	1.11e-13
Steel Prod., cold-rolled, semi-finished	Trichloroethylene	secondary	3.88e-13	4.30e-14
Natural Gas Prod.	Halogenated matter (organic)	secondary	3.29e-13	3.65e-14
Steel Prod., cold-rolled, semi-finished	Propionaldehyde	secondary	1.02e-13	1.13e-14
Steel Prod., cold-rolled, semi-finished	Benzaldehyde	secondary	3.01e-14	3.34e-15
Steel Prod., cold-rolled, semi-finished	Tetrachloroethylene	secondary	1.08e-14	1.20e-15
Steel Prod., cold-rolled, semi-finished	1,1,1-Trichloroethane	secondary	1.57e-15	1.75e-16
Natural Gas Prod.	Halogenated hydrocarbons (unspecified)	secondary	8.23e-16	9.13e-17
Steel Prod., cold-rolled, semi-finished	Hexachloroethane	secondary	6.03e-17	6.69e-18
Total Materials Processing			**5.01e+01**	**5.56e+00**
Manufacturing Life-cycle Stage				
Japanese Electric Grid	Sulfur dioxide	model/secondary	1.92e+02	2.12e+01
Monitor/module	Phosphine	primary	2.87e+01	3.18e+00
Monitor/module	Phosphorus (yellow or white)	primary	3.42e+00	3.79e-01
US electric grid	Sulfur dioxide	model/secondary	3.19e+00	3.54e-01
Monitor/module	Fluorides (F-)	primary	2.55e+00	2.83e-01
Monitor/module	Tetramethyl ammonium hydroxide	primary	1.29e+00	1.43e-01
Monitor/module	Nitrogen oxides	primary	1.10e+00	1.22e-01
Monitor/module	Nitrogen fluoride	primary	4.91e-01	5.44e-02
Monitor/module	Hydrochloric acid	primary	2.77e-01	3.08e-02
LPG Production	Carbon monoxide	secondary	2.77e-01	3.07e-02
Japanese Electric Grid	Nitrogen oxides	model/secondary	2.73e-01	3.03e-02
Monitor/module	Ammonia	primary	1.69e-01	1.88e-02
Natural Gas Prod.	Methane	secondary	1.58e-01	1.75e-02
Japanese Electric Grid	Carbon monoxide	model/secondary	1.27e-01	1.41e-02
Natural Gas Prod.	Benzene	secondary	1.19e-01	1.32e-02
Natural Gas Prod.	Carbon monoxide	secondary	1.08e-01	1.20e-02
Monitor/module	Hydrofluoric acid	primary	1.04e-01	1.16e-02
LPG Production	Methane	secondary	8.05e-02	8.93e-03
LPG Production	Sulfur oxides	secondary	7.69e-02	8.53e-03
Japanese Electric Grid	Vanadium	model/secondary	7.63e-02	8.46e-03
Backlight	Nitrogen oxides	primary	5.89e-02	6.53e-03
LPG Production	Nitrogen oxides	secondary	5.50e-02	6.10e-03
LPG Production	Vanadium	secondary	5.02e-02	5.57e-03
LPG Production	Benzene	secondary	4.12e-02	4.57e-03
Japanese Electric Grid	Arsenic	model/secondary	3.51e-02	3.89e-03
Natural Gas Prod.	Nitrogen oxides	secondary	2.94e-02	3.26e-03
LCD glass mfg.	Fluorides (F-)	primary	2.71e-02	3.01e-03
Monitor/module	Isopropyl alcohol	primary	2.23e-02	2.47e-03
Japanese Electric Grid	Hydrochloric acid	model/secondary	2.11e-02	2.34e-03
Panel components	Phosphorus (yellow or white)	primary	1.97e-02	2.19e-03
Monitor/module	N-bromoacetamide	primary	1.84e-02	2.04e-03
Monitor/module	Sulfur hexafluoride	primary	1.46e-02	1.62e-03
Japanese Electric Grid	PM-10	model/secondary	1.34e-02	1.49e-03

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	PM	secondary	1.24e-02	1.37e-03
LPG Production	Arsenic	secondary	9.91e-03	1.10e-03
LPG Production	Formaldehyde	secondary	6.43e-03	7.14e-04
US electric grid	Nitrogen oxides	model/secondary	4.56e-03	5.06e-04
Japanese Electric Grid	Fluorides (F-)	model/secondary	4.43e-03	4.91e-04
Japanese Electric Grid	Selenium	model/secondary	4.29e-03	4.76e-04
LCD glass mfg.	Nitrogen oxides	primary	4.09e-03	4.54e-04
Japanese Electric Grid	Formaldehyde	model/secondary	3.93e-03	4.36e-04
Monitor/module	Monosilane	primary	3.07e-03	3.41e-04
US electric grid	Methane	model/secondary	2.50e-03	2.77e-04
Fuel Oil #4 Prod.	Carbon monoxide	secondary	2.34e-03	2.59e-04
Monitor/module	Sulfur oxides	primary	2.23e-03	2.47e-04
US electric grid	Carbon monoxide	model/secondary	2.11e-03	2.34e-04
Japanese Electric Grid	Zinc (elemental)	model/secondary	2.06e-03	2.29e-04
PWB Mfg.	Formaldehyde	model/secondary	1.96e-03	2.18e-04
LPG Production	Hydrochloric acid	secondary	1.77e-03	1.96e-04
Monitor/module	Arsenic	primary	1.70e-03	1.88e-04
LPG Production	Nitrous oxide	secondary	1.56e-03	1.73e-04
Monitor/module	Acetic acid	primary	1.44e-03	1.60e-04
Natural Gas Prod.	PM	secondary	1.31e-03	1.45e-04
Monitor/module	Hexane	primary	1.18e-03	1.31e-04
Japanese Electric Grid	Hydrofluoric acid	model/secondary	1.15e-03	1.28e-04
Japanese Electric Grid	Antimony	model/secondary	1.09e-03	1.21e-04
US electric grid	Arsenic	model/secondary	1.08e-03	1.20e-04
Fuel Oil #6 Prod.	Carbon monoxide	secondary	9.64e-04	1.07e-04
US electric grid	Hydrochloric acid	model/secondary	9.54e-04	1.06e-04
Natural Gas Prod.	Sulfur oxides	secondary	8.69e-04	9.64e-05
Panel components	Nitrogen oxides	primary	8.22e-04	9.12e-05
Fuel Oil #4 Prod.	Methane	secondary	8.03e-04	8.91e-05
Fuel Oil #2 Prod.	Carbon monoxide	secondary	7.85e-04	8.71e-05
Fuel Oil #4 Prod.	Sulfur oxides	secondary	7.55e-04	8.37e-05
Japanese Electric Grid	Nitrous oxide	model/secondary	7.52e-04	8.34e-05
Natural Gas Prod.	Ammonia	secondary	6.71e-04	7.44e-05
Fuel Oil #4 Prod.	Vanadium	secondary	6.21e-04	6.89e-05
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	5.53e-04	6.14e-05
Japanese Electric Grid	Methane	model/secondary	5.47e-04	6.07e-05
Monitor/module	Nitric acid	primary	5.37e-04	5.96e-05
Natural Gas Prod.	Arsenic	secondary	4.96e-04	5.50e-05
LPG Production	Phosphorus (yellow or white)	secondary	4.71e-04	5.22e-05
Japanese Electric Grid	Molybdenum	model/secondary	4.43e-04	4.91e-05
Fuel Oil #6 Prod.	Methane	secondary	4.01e-04	4.45e-05
Fuel Oil #6 Prod.	Sulfur oxides	secondary	3.72e-04	4.13e-05
Fuel Oil #4 Prod.	Benzene	secondary	3.71e-04	4.12e-05
Fuel Oil #6 Prod.	Vanadium	secondary	3.67e-04	4.07e-05
LPG Production	Fluorides (F-)	secondary	3.62e-04	4.01e-05
LPG Production	Selenium	secondary	3.56e-04	3.94e-05
Monitor/module	Zinc (elemental)	primary	3.13e-04	3.48e-05
Japanese Electric Grid	Benzene	model/secondary	3.06e-04	3.40e-05
LPG Production	Hydrogen sulfide	secondary	2.94e-04	3.26e-05

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	Ammonia	secondary	2.84e-04	3.15e-05
Panel components	HCFC-225ca	primary	2.80e-04	3.10e-05
Panel components	HCFC-225cb	primary	2.80e-04	3.10e-05
Fuel Oil #6 Prod.	Nitrogen oxides	secondary	2.79e-04	3.09e-05
Fuel Oil #2 Prod.	Methane	secondary	2.40e-04	2.66e-05
Monitor/module	Phosphoric acid	primary	2.33e-04	2.59e-05
Fuel Oil #2 Prod.	Sulfur oxides	secondary	2.27e-04	2.52e-05
US electric grid	PM-10	model/secondary	2.24e-04	2.48e-05
US electric grid	Selenium	model/secondary	1.80e-04	1.99e-05
Japanese Electric Grid	Nickel	model/secondary	1.67e-04	1.86e-05
Fuel Oil #6 Prod.	Benzene	secondary	1.67e-04	1.85e-05
Fuel Oil #2 Prod.	Nitrogen oxides	secondary	1.64e-04	1.82e-05
Fuel Oil #2 Prod.	Vanadium	secondary	1.61e-04	1.79e-05
US electric grid	Vanadium	model/secondary	1.35e-04	1.50e-05
Fuel Oil #4 Prod.	PM	secondary	1.25e-04	1.38e-05
Fuel Oil #2 Prod.	Benzene	secondary	1.19e-04	1.32e-05
Natural Gas Prod.	Vanadium	secondary	1.10e-04	1.22e-05
Fuel Oil #4 Prod.	Arsenic	secondary	1.09e-04	1.20e-05
Natural Gas Prod.	Hydrochloric acid	secondary	1.01e-04	1.12e-05
Japanese Electric Grid	Barium	model/secondary	9.88e-05	1.10e-05
Monitor/module	Diethylene glycol	primary	9.79e-05	1.09e-05
LPG Production	Hydrofluoric acid	secondary	9.63e-05	1.07e-05
Backlight	Diethyl ether	primary	9.49e-05	1.05e-05
Fuel Oil #4 Prod.	Formaldehyde	secondary	7.92e-05	8.78e-06
LPG Production	Molybdenum	secondary	7.91e-05	8.77e-06
LPG Production	Chromium (VI)	secondary	7.57e-05	8.39e-06
LPG Production	Ethane	secondary	7.44e-05	8.26e-06
Fuel Oil #6 Prod.	PM	secondary	6.29e-05	6.98e-06
Fuel Oil #6 Prod.	Arsenic	secondary	5.87e-05	6.51e-06
LPG Production	Zinc (elemental)	secondary	5.75e-05	6.38e-06
Japanese Electric Grid	Naphthalene	model/secondary	5.57e-05	6.18e-06
Panel components	PM	primary	5.48e-05	6.08e-06
US electric grid	Hydrofluoric acid	model/secondary	5.21e-05	5.78e-06
Fuel Oil #6 Prod.	Formaldehyde	secondary	4.66e-05	5.17e-06
Natural Gas Prod.	Formaldehyde	secondary	4.37e-05	4.85e-06
LPG Production	Hexane	secondary	4.33e-05	4.80e-06
Monitor/module	Antimony	primary	3.89e-05	4.32e-06
Fuel Oil #2 Prod.	PM	secondary	3.69e-05	4.10e-06
Natural Gas Prod.	Nitrous oxide	secondary	3.64e-05	4.04e-06
LPG Production	Phenol	secondary	3.43e-05	3.81e-06
Japanese Electric Grid	Chromium (VI)	model/secondary	3.36e-05	3.73e-06
Panel components	Hydrochloric acid	primary	3.35e-05	3.72e-06
Panel components	Heptane	primary	3.28e-05	3.63e-06
LPG Production	Pentane	secondary	3.12e-05	3.46e-06
Fuel Oil #2 Prod.	Arsenic	secondary	3.04e-05	3.38e-06
Japanese Electric Grid	Copper	model/secondary	2.40e-05	2.67e-06
Monitor/module	Acetone	primary	2.22e-05	2.46e-06
Natural Gas Prod.	Ethane	secondary	2.20e-05	2.44e-06
Monitor/module	PM	primary	2.20e-05	2.44e-06
LPG Production	PM-10	secondary	2.16e-05	2.40e-06
Natural Gas Prod.	Fluorides (F-)	secondary	2.14e-05	2.38e-06

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Monitor/module	Copper	primary	2.06e-05	2.29e-06
Fuel Oil #2 Prod.	Formaldehyde	secondary	2.06e-05	2.28e-06
LPG Production	Nickel	secondary	1.98e-05	2.19e-06
Japanese Electric Grid	Methyl hydrazine	model/secondary	1.98e-05	2.19e-06
Monitor/module	Polychlorinated biphenyls	primary	1.94e-05	2.15e-06
Natural Gas Prod.	Selenium	secondary	1.91e-05	2.12e-06
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	1.90e-05	2.10e-06
US electric grid	Formaldehyde	model/secondary	1.88e-05	2.08e-06
Japanese Electric Grid	2-Chloroacetophenone	model/secondary	1.85e-05	2.05e-06
Japanese Electric Grid	Bromomethane	model/secondary	1.83e-05	2.03e-06
Fuel Oil #4 Prod.	Nitrous oxide	secondary	1.77e-05	1.97e-06
Monitor/module	Chromium	primary	1.77e-05	1.96e-06
Monitor/module	Chromium (VI)	primary	1.71e-05	1.89e-06
LPG Production	Aluminum (+3)	secondary	1.36e-05	1.51e-06
US electric grid	Benzene	model/secondary	1.35e-05	1.50e-06
Natural Gas Prod.	Zinc (elemental)	secondary	1.34e-05	1.49e-06
US electric grid	Nitrous oxide	model/secondary	1.32e-05	1.46e-06
Natural Gas Prod.	Hexane	secondary	1.28e-05	1.42e-06
Monitor/module	Lead	primary	1.23e-05	1.37e-06
Monitor/module	Boron	primary	1.08e-05	1.20e-06
LPG Production	Antimony	secondary	1.03e-05	1.14e-06
LCD glass mfg.	PM	primary	1.01e-05	1.12e-06
Fuel Oil #6 Prod.	Hydrochloric acid	secondary	1.01e-05	1.12e-06
Fuel Oil #6 Prod.	Nitrous oxide	secondary	9.88e-06	1.10e-06
Japanese Electric Grid	Cyanide (-1)	model/secondary	9.61e-06	1.07e-06
Natural Gas Prod.	Pentane	secondary	9.24e-06	1.02e-06
Panel components	Toluene	primary	9.09e-06	1.01e-06
Japanese Electric Grid	Cobalt	model/secondary	7.96e-06	8.83e-07
US electric grid	Phosphorus (yellow or white)	model/secondary	7.61e-06	8.44e-07
Japanese Electric Grid	2,3,7,8-TCDD	model/secondary	7.49e-06	8.30e-07
LPG Production	Nitrate	secondary	5.81e-06	6.45e-07
Fuel Oil #4 Prod.	Phosphorus (yellow or white)	secondary	5.71e-06	6.33e-07
Natural Gas Prod.	Hydrofluoric acid	secondary	5.49e-06	6.09e-07
Japanese Electric Grid	Cadmium	model/secondary	5.39e-06	5.98e-07
Fuel Oil #2 Prod.	Hydrochloric acid	secondary	5.39e-06	5.98e-07
Fuel Oil #2 Prod.	Nitrous oxide	secondary	4.84e-06	5.37e-07
LCD glass mfg.	Sulfur oxides	primary	4.71e-06	5.22e-07
LCD glass mfg.	Lead	primary	4.02e-06	4.46e-07
Japanese Electric Grid	Carbon disulfide	model/secondary	3.93e-06	4.36e-07
Fuel Oil #4 Prod.	Selenium	secondary	3.85e-06	4.27e-07
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	3.81e-06	4.23e-07
Monitor/module	Cyanide (-1)	primary	3.66e-06	4.06e-07
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	3.65e-06	4.05e-07
Natural Gas Prod.	Molybdenum	secondary	3.65e-06	4.05e-07
US electric grid	Zinc (elemental)	model/secondary	3.51e-06	3.89e-07
Fuel Oil #6 Prod.	Phosphorus (yellow or white)	secondary	3.33e-06	3.69e-07
Japanese Electric Grid	Benzyl chloride	model/secondary	3.01e-06	3.34e-07
US electric grid	Antimony	model/secondary	2.88e-06	3.20e-07
LCD glass mfg.	Carbon monoxide	primary	2.79e-06	3.10e-07

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Phosphorus (yellow or white)	secondary	2.79e-06	3.09e-07
Monitor/module	Hexamethyldisilizane	primary	2.75e-06	3.04e-07
Fuel Oil #4 Prod.	Ammonia	secondary	2.49e-06	2.77e-07
Natural Gas Prod.	Chromium (VI)	secondary	2.33e-06	2.59e-07
Monitor/module	Cyclohexane	primary	2.22e-06	2.46e-07
Fuel Oil #6 Prod.	Hydrogen sulfide	secondary	2.16e-06	2.40e-07
Japanese Electric Grid	Chloroform	model/secondary	2.12e-06	2.36e-07
Fuel Oil #6 Prod.	Selenium	secondary	2.07e-06	2.29e-07
Fuel Oil #6 Prod.	Fluorides (F-)	secondary	2.00e-06	2.21e-07
Japanese Electric Grid	Propionaldehyde	model/secondary	1.96e-06	2.18e-07
LPG Production	Copper	secondary	1.67e-06	1.86e-07
Japanese Electric Grid	Beryllium	model/secondary	1.66e-06	1.84e-07
LPG Production	Methyl hydrazine	secondary	1.65e-06	1.83e-07
LPG Production	Silicon	secondary	1.62e-06	1.80e-07
LPG Production	2-Chloroacetophenone	secondary	1.55e-06	1.72e-07
LPG Production	Dimethylbenzanthracene	secondary	1.53e-06	1.70e-07
LPG Production	Bromomethane	secondary	1.53e-06	1.70e-07
Fuel Oil #2 Prod.	Phosphorus (yellow or white)	secondary	1.50e-06	1.66e-07
Monitor/module	Cadmium	primary	1.30e-06	1.44e-07
LPG Production	Naphthalene	secondary	1.25e-06	1.39e-07
LPG Production	Lead	secondary	1.19e-06	1.32e-07
Japanese Electric Grid	Acrolein	model/secondary	1.11e-06	1.24e-07
Fuel Oil #2 Prod.	Fluorides (F-)	secondary	1.10e-06	1.22e-07
Fuel Oil #2 Prod.	Selenium	secondary	1.09e-06	1.21e-07
Fuel Oil #6 Prod.	Ammonia	secondary	1.08e-06	1.20e-07
LPG Production	Manganese	secondary	1.07e-06	1.19e-07
US electric grid	Chromium (VI)	model/secondary	1.04e-06	1.15e-07
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	1.03e-06	1.15e-07
LPG Production	Beryllium	secondary	1.03e-06	1.14e-07
US electric grid	Molybdenum	model/secondary	9.62e-07	1.07e-07
Fuel Oil #2 Prod.	Hydrogen sulfide	secondary	9.44e-07	1.05e-07
Fuel Oil #4 Prod.	Molybdenum	secondary	9.30e-07	1.03e-07
Japanese Electric Grid	Methyl chloride	model/secondary	9.25e-07	1.03e-07
Monitor/module	Tin	primary	9.16e-07	1.02e-07
LPG Production	Barium	secondary	8.94e-07	9.92e-08
US electric grid	Methyl hydrazine	model/secondary	8.93e-07	9.90e-08
US electric grid	2-Chloroacetophenone	model/secondary	8.36e-07	9.28e-08
US electric grid	Bromomethane	model/secondary	8.27e-07	9.17e-08
Fuel Oil #2 Prod.	Ammonia	secondary	8.14e-07	9.03e-08
Japanese Electric Grid	Toluene	model/secondary	8.04e-07	8.92e-08
LPG Production	Cyanide (-1)	secondary	8.03e-07	8.90e-08
Monitor/module	Nickel	primary	7.74e-07	8.59e-08
LPG Production	Barium cmpds	secondary	7.62e-07	8.45e-08
Natural Gas Prod.	Antimony	secondary	7.03e-07	7.79e-08
Fuel Oil #4 Prod.	Ethane	secondary	6.72e-07	7.45e-08
Japanese Electric Grid	Di(2-ethylhexyl)phthalate	model/secondary	6.66e-07	7.39e-08
Fuel Oil #6 Prod.	Hydrofluoric acid	secondary	5.52e-07	6.12e-08
Fuel Oil #6 Prod.	Molybdenum	secondary	5.31e-07	5.89e-08
Japanese Electric Grid	Acetaldehyde	model/secondary	5.31e-07	5.88e-08
Japanese Electric Grid	Hexane	model/secondary	5.15e-07	5.71e-08
Fuel Oil #4 Prod.	Zinc (elemental)	secondary	5.10e-07	5.66e-08

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Dimethylbenzanthracene	secondary	4.53e-07	5.03e-08
US electric grid	Nickel	model/secondary	4.48e-07	4.97e-08
LPG Production	Cadmium	secondary	4.42e-07	4.90e-08
US electric grid	Cyanide (-1)	model/secondary	4.34e-07	4.82e-08
Fuel Oil #4 Prod.	Chromium (VI)	secondary	4.07e-07	4.52e-08
Japanese Electric Grid	Mercury	model/secondary	3.97e-07	4.41e-08
Fuel Oil #4 Prod.	Hexane	secondary	3.91e-07	4.33e-08
Japanese Electric Grid	Dimethyl sulfate	model/secondary	3.69e-07	4.09e-08
LCD glass mfg.	Nitrate	primary	3.66e-07	4.06e-08
US electric grid	2,3,7,8-TCDD	model/secondary	3.29e-07	3.65e-08
LPG Production	Carbon disulfide	secondary	3.28e-07	3.64e-08
Fuel Oil #6 Prod.	Ethane	secondary	3.02e-07	3.35e-08
Fuel Oil #2 Prod.	Hydrofluoric acid	secondary	2.94e-07	3.26e-08
Fuel Oil #4 Prod.	Pentane	secondary	2.82e-07	3.13e-08
Natural Gas Prod.	Nickel	secondary	2.75e-07	3.05e-08
Fuel Oil #4 Prod.	PM-10	secondary	2.68e-07	2.97e-08
US electric grid	Naphthalene	model/secondary	2.65e-07	2.94e-08
LPG Production	Benzyl chloride	secondary	2.51e-07	2.79e-08
Fuel Oil #4 Prod.	Phenol	secondary	2.51e-07	2.79e-08
Fuel Oil #2 Prod.	Molybdenum	secondary	2.49e-07	2.76e-08
LPG Production	Cobalt	secondary	2.41e-07	2.67e-08
Fuel Oil #4 Prod.	Nickel	secondary	2.36e-07	2.61e-08
Monitor/module	Manganese	primary	2.29e-07	2.54e-08
US electric grid	Barium	model/secondary	2.25e-07	2.50e-08
Fuel Oil #6 Prod.	Zinc (elemental)	secondary	2.25e-07	2.49e-08
Fuel Oil #6 Prod.	Chromium (VI)	secondary	2.18e-07	2.41e-08
Fuel Oil #2 Prod.	Ethane	secondary	2.15e-07	2.39e-08
Natural Gas Prod.	Hydrogen sulfide	secondary	2.12e-07	2.35e-08
Natural Gas Prod.	Naphthalene	secondary	2.08e-07	2.31e-08
LPG Production	Aluminum (elemental)	secondary	1.86e-07	2.06e-08
Japanese Electric Grid	Isophorone	model/secondary	1.78e-07	1.98e-08
US electric grid	Carbon disulfide	model/secondary	1.78e-07	1.97e-08
LPG Production	Chloroform	secondary	1.77e-07	1.97e-08
Fuel Oil #6 Prod.	Hexane	secondary	1.76e-07	1.95e-08
Fuel Oil #2 Prod.	Zinc (elemental)	secondary	1.65e-07	1.84e-08
LPG Production	Propionaldehyde	secondary	1.64e-07	1.82e-08
Fuel Oil #6 Prod.	PM-10	secondary	1.59e-07	1.76e-08
Japanese Electric Grid	Methyl ethyl ketone	model/secondary	1.43e-07	1.58e-08
Japanese Electric Grid	Tetrachloroethylene	model/secondary	1.41e-07	1.56e-08
US electric grid	Benzyl chloride	model/secondary	1.36e-07	1.51e-08
Fuel Oil #6 Prod.	Nickel	secondary	1.36e-07	1.51e-08
Fuel Oil #6 Prod.	Pentane	secondary	1.27e-07	1.40e-08
Japanese Electric Grid	1,2-Dichloroethane	model/secondary	1.25e-07	1.39e-08
Fuel Oil #2 Prod.	Hexane	secondary	1.25e-07	1.39e-08
Japanese Electric Grid	Methyl methacrylate	model/secondary	1.22e-07	1.35e-08
Fuel Oil #2 Prod.	Chromium (VI)	secondary	1.16e-07	1.28e-08
Japanese Electric Grid	Styrene	model/secondary	1.08e-07	1.20e-08
US electric grid	Cadmium	model/secondary	1.06e-07	1.18e-08
Japanese Electric Grid	Bromoform	model/secondary	1.01e-07	1.12e-08

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	9.95e-08	1.10e-08
Japanese Electric Grid	Dichloromethane	model/secondary	9.94e-08	1.10e-08
Monitor/module	Mercury	primary	9.69e-08	1.08e-08
US electric grid	Chloroform	model/secondary	9.59e-08	1.06e-08
Natural Gas Prod.	Methyl hydrazine	secondary	9.41e-08	1.04e-08
Fuel Oil #2 Prod.	Phenol	secondary	9.37e-08	1.04e-08
LPG Production	Acrolein	secondary	9.31e-08	1.03e-08
Natural Gas Prod.	Barium	secondary	9.30e-08	1.03e-08
Fuel Oil #4 Prod.	Antimony	secondary	9.15e-08	1.02e-08
Fuel Oil #2 Prod.	Pentane	secondary	9.02e-08	1.00e-08
US electric grid	Propionaldehyde	model/secondary	8.86e-08	9.83e-09
US electric grid	Manganese	model/secondary	8.83e-08	9.79e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	8.81e-08	9.77e-09
Natural Gas Prod.	Bromomethane	secondary	8.71e-08	9.66e-09
Natural Gas Prod.	Copper	secondary	8.32e-08	9.23e-09
Fuel Oil #6 Prod.	Phenol	secondary	8.24e-08	9.14e-09
Japanese Electric Grid	Chlorobenzene	model/secondary	8.05e-08	8.93e-09
LPG Production	Methyl chloride	secondary	7.72e-08	8.57e-09
US electric grid	Fluoride	model/secondary	7.56e-08	8.39e-09
Panel components	Methyl ethyl ketone	primary	6.97e-08	7.73e-09
Fuel Oil #2 Prod.	PM-10	secondary	6.93e-08	7.69e-09
Natural Gas Prod.	Lead	secondary	6.83e-08	7.58e-09
Natural Gas Prod.	Beryllium	secondary	6.74e-08	7.47e-09
Japanese Electric Grid	Cumene hydroperoxide	model/secondary	6.55e-08	7.27e-09
Japanese Electric Grid	2,4-Dinitrotoluene	model/secondary	6.44e-08	7.14e-09
Fuel Oil #2 Prod.	Nickel	secondary	6.25e-08	6.94e-09
Natural Gas Prod.	Manganese	secondary	6.23e-08	6.91e-09
Japanese Electric Grid	Acetophenone	model/secondary	5.93e-08	6.58e-09
US electric grid	Beryllium	model/secondary	5.64e-08	6.26e-09
LPG Production	Di(2-ethylhexyl)phthalate	secondary	5.56e-08	6.17e-09
US electric grid	Acrolein	model/secondary	5.04e-08	5.59e-09
US electric grid	Lead	model/secondary	4.94e-08	5.48e-09
Natural Gas Prod.	Nitrate	secondary	4.74e-08	5.26e-09
US electric grid	Cobalt	model/secondary	4.71e-08	5.22e-09
Natural Gas Prod.	Cyanide (-1)	secondary	4.57e-08	5.07e-09
Monitor/module	Phenol	primary	4.54e-08	5.04e-09
Fuel Oil #4 Prod.	Nitrate	secondary	4.52e-08	5.02e-09
LPG Production	Acetaldehyde	secondary	4.43e-08	4.91e-09
US electric grid	Copper	model/secondary	4.33e-08	4.80e-09
US electric grid	Methyl chloride	model/secondary	4.18e-08	4.63e-09
LPG Production	Mercury	secondary	4.17e-08	4.62e-09
Fuel Oil #6 Prod.	Antimony	secondary	4.05e-08	4.49e-09
Fuel Oil #2 Prod.	Aluminum (+3)	secondary	3.71e-08	4.11e-09
Japanese Electric Grid	Ethylbenzene	model/secondary	3.49e-08	3.88e-09
LPG Production	Cadmium cmpds	secondary	3.33e-08	3.70e-09
Fuel Oil #6 Prod.	Aluminum (+3)	secondary	3.26e-08	3.62e-09
LPG Production	Dimethyl sulfate	secondary	3.08e-08	3.42e-09
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	3.01e-08	3.34e-09
LPG Production	Toluene	secondary	2.99e-08	3.32e-09
Fuel Oil #2 Prod.	Antimony	secondary	2.96e-08	3.28e-09
Natural Gas Prod.	Cadmium	secondary	2.52e-08	2.79e-09

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
US electric grid	Acetaldehyde	model/secondary	2.40e-08	2.66e-09
US electric grid	Hexane	model/secondary	2.33e-08	2.58e-09
Natural Gas Prod.	Phenol	secondary	2.30e-08	2.55e-09
LCD glass mfg.	Chromium	primary	2.04e-08	2.26e-09
Fuel Oil #4 Prod.	Silicon	secondary	2.02e-08	2.24e-09
Monitor/module	Tetrachloroethylene	primary	1.95e-08	2.17e-09
Japanese Electric Grid	Acenaphthene	model/secondary	1.95e-08	2.16e-09
Fuel Oil #4 Prod.	Copper	secondary	1.92e-08	2.13e-09
Natural Gas Prod.	Carbon disulfide	secondary	1.87e-08	2.08e-09
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	1.77e-08	1.97e-09
Japanese Electric Grid	Phenanthrene	model/secondary	1.75e-08	1.94e-09
LPG Production	1,4-Dichlorobenzene	secondary	1.74e-08	1.93e-09
US electric grid	Dimethyl sulfate	model/secondary	1.67e-08	1.85e-09
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	1.66e-08	1.84e-09
Fuel Oil #6 Prod.	Nitrate	secondary	1.65e-08	1.83e-09
Fuel Oil #4 Prod.	Bromomethane	secondary	1.64e-08	1.82e-09
Fuel Oil #2 Prod.	Nitrate	secondary	1.61e-08	1.79e-09
Japanese Electric Grid	Methyl tert-butyl ether	model/secondary	1.60e-08	1.77e-09
Natural Gas Prod.	PM-10	secondary	1.56e-08	1.73e-09
Japanese Electric Grid	Chromium (III)	model/secondary	1.51e-08	1.67e-09
LPG Production	Isophorone	secondary	1.49e-08	1.65e-09
US electric grid	Mercury	model/secondary	1.45e-08	1.61e-09
Natural Gas Prod.	Benzyl chloride	secondary	1.43e-08	1.59e-09
Fuel Oil #4 Prod.	Dimethylbenzanthracene	secondary	1.38e-08	1.53e-09
Natural Gas Prod.	Toluene	secondary	1.36e-08	1.51e-09
LPG Production	Aromatic hydrocarbons	secondary	1.34e-08	1.49e-09
LCD glass mfg.	Nickel	primary	1.28e-08	1.42e-09
Fuel Oil #4 Prod.	Lead	secondary	1.28e-08	1.41e-09
Japanese Electric Grid	1,1,1-Trichloroethane	model/secondary	1.23e-08	1.36e-09
Japanese Electric Grid	Phenol	model/secondary	1.22e-08	1.35e-09
Fuel Oil #6 Prod.	Silicon	secondary	1.19e-08	1.32e-09
LPG Production	Methyl ethyl ketone	secondary	1.19e-08	1.32e-09
LPG Production	Tetrachloroethylene	secondary	1.18e-08	1.31e-09
Fuel Oil #4 Prod.	Naphthalene	secondary	1.16e-08	1.29e-09
Monitor/module	Trichloroethylene	primary	1.16e-08	1.29e-09
Fuel Oil #4 Prod.	Manganese	secondary	1.15e-08	1.27e-09
Japanese Electric Grid	Vinyl acetate	model/secondary	1.14e-08	1.26e-09
Fuel Oil #4 Prod.	Beryllium	secondary	1.10e-08	1.22e-09
Fuel Oil #6 Prod.	Copper	secondary	1.08e-08	1.20e-09
Japanese Electric Grid	Ethylene dibromide	model/secondary	1.06e-08	1.17e-09
LPG Production	1,2-Dichloroethane	secondary	1.05e-08	1.16e-09
LPG Production	Methyl methacrylate	secondary	1.02e-08	1.13e-09
Natural Gas Prod.	Chloroform	secondary	1.01e-08	1.12e-09
Japanese Electric Grid	Xylene (mixed isomers)	model/secondary	9.46e-09	1.05e-09
Fuel Oil #6 Prod.	Methyl hydrazine	secondary	9.45e-09	1.05e-09
Natural Gas Prod.	Propionaldehyde	secondary	9.34e-09	1.04e-09
Natural Gas Prod.	Aluminum (+3)	secondary	9.03e-09	1.00e-09
LPG Production	Styrene	secondary	9.00e-09	9.99e-10
Fuel Oil #6 Prod.	2-Chloroacetophenone	secondary	8.85e-09	9.82e-10

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #6 Prod.	Bromomethane	secondary	8.75e-09	9.71e-10
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	8.62e-09	9.56e-10
LPG Production	Bromoform	secondary	8.41e-09	9.33e-10
Natural Gas Prod.	Cobalt	secondary	8.33e-09	9.24e-10
LPG Production	Dichloromethane	secondary	8.30e-09	9.20e-10
LPG Production	Chromium (III)	secondary	8.24e-09	9.14e-10
US electric grid	Toluene	model/secondary	8.23e-09	9.12e-10
US electric grid	Isophorone	model/secondary	8.06e-09	8.94e-10
Fuel Oil #4 Prod.	Barium	secondary	7.83e-09	8.69e-10
Natural Gas Prod.	o-xylene	secondary	7.25e-09	8.04e-10
Fuel Oil #6 Prod.	Lead	secondary	6.80e-09	7.55e-10
LPG Production	Chlorobenzene	secondary	6.72e-09	7.46e-10
US electric grid	Methyl ethyl ketone	model/secondary	6.45e-09	7.15e-10
US electric grid	Tetrachloroethylene	model/secondary	6.37e-09	7.07e-10
LPG Production	Copper (+1 & +2)	secondary	6.29e-09	6.97e-10
Japanese Electric Grid	Dibenzo[a,h]anthracene	model/secondary	6.24e-09	6.92e-10
Fuel Oil #6 Prod.	Dimethylbenzanthracene	secondary	6.21e-09	6.89e-10
Fuel Oil #6 Prod.	Manganese	secondary	6.09e-09	6.76e-10
Fuel Oil #6 Prod.	Beryllium	secondary	5.82e-09	6.46e-10
US electric grid	1,2-Dichloroethane	model/secondary	5.67e-09	6.29e-10
Fuel Oil #4 Prod.	Barium cmpds	secondary	5.58e-09	6.19e-10
US electric grid	Methyl methacrylate	model/secondary	5.51e-09	6.11e-10
LPG Production	2,4-Dinitrotoluene	secondary	5.39e-09	5.98e-10
Fuel Oil #6 Prod.	Naphthalene	secondary	5.39e-09	5.98e-10
Natural Gas Prod.	Acrolein	secondary	5.31e-09	5.89e-10
Fuel Oil #2 Prod.	Copper	secondary	5.22e-09	5.79e-10
Fuel Oil #2 Prod.	Silicon	secondary	5.21e-09	5.78e-10
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	5.15e-09	5.71e-10
Fuel Oil #2 Prod.	Methyl hydrazine	secondary	5.04e-09	5.59e-10
Japanese Electric Grid	2,3,7,8-TCDF	model/secondary	5.01e-09	5.56e-10
LPG Production	Acetophenone	secondary	4.95e-09	5.49e-10
US electric grid	Styrene	model/secondary	4.87e-09	5.40e-10
Fuel Oil #2 Prod.	2-Chloroacetophenone	secondary	4.72e-09	5.23e-10
Fuel Oil #4 Prod.	Cadmium	secondary	4.68e-09	5.19e-10
Fuel Oil #2 Prod.	Bromomethane	secondary	4.66e-09	5.17e-10
Fuel Oil #6 Prod.	Cyanide (-1)	secondary	4.60e-09	5.10e-10
US electric grid	Bromoform	model/secondary	4.55e-09	5.04e-10
US electric grid	Dichloromethane	model/secondary	4.49e-09	4.98e-10
Fuel Oil #2 Prod.	Dimethylbenzanthracene	secondary	4.43e-09	4.91e-10
Natural Gas Prod.	Methyl chloride	secondary	4.40e-09	4.88e-10
Japanese Electric Grid	o-xylene	model/secondary	4.31e-09	4.79e-10
Japanese Electric Grid	Benzo[a]anthracene	model/secondary	4.11e-09	4.56e-10
Fuel Oil #2 Prod.	Naphthalene	secondary	3.65e-09	4.05e-10
US electric grid	Chlorobenzene	model/secondary	3.64e-09	4.03e-10
Fuel Oil #2 Prod.	Lead	secondary	3.62e-09	4.02e-10
Fuel Oil #4 Prod.	Carbon disulfide	secondary	3.53e-09	3.91e-10
Fuel Oil #6 Prod.	Barium	secondary	3.39e-09	3.76e-10
LPG Production	o-xylene	secondary	3.29e-09	3.65e-10
Fuel Oil #2 Prod.	Manganese	secondary	3.26e-09	3.62e-10
Natural Gas Prod.	Di(2-ethylhexyl)phthalate	secondary	3.17e-09	3.52e-10
Fuel Oil #2 Prod.	Beryllium	secondary	3.13e-09	3.48e-10

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Japanese Electric Grid	Ethyl Chloride	model/secondary	3.08e-09	3.42e-10
Natural Gas Prod.	Mercury	secondary	2.97e-09	3.29e-10
US electric grid	2,4-Dinitrotoluene	model/secondary	2.92e-09	3.23e-10
Fuel Oil #4 Prod.	Benzyl chloride	secondary	2.70e-09	3.00e-10
US electric grid	Acetophenone	model/secondary	2.68e-09	2.97e-10
LPG Production	Ethylbenzene	secondary	2.67e-09	2.96e-10
Fuel Oil #4 Prod.	Cobalt	secondary	2.66e-09	2.95e-10
Japanese Electric Grid	Benzo[b,j,k]fluoranthene	model/secondary	2.61e-09	2.90e-10
Fuel Oil #2 Prod.	Barium	secondary	2.56e-09	2.84e-10
Natural Gas Prod.	Acetaldehyde	secondary	2.52e-09	2.80e-10
Fuel Oil #6 Prod.	Cadmium	secondary	2.46e-09	2.73e-10
Fuel Oil #2 Prod.	Cyanide (-1)	secondary	2.45e-09	2.72e-10
Fuel Oil #4 Prod.	Aluminum (elemental)	secondary	2.31e-09	2.56e-10
Japanese Electric Grid	Indeno(1,2,3-cd)pyrene	model/secondary	2.30e-09	2.55e-10
Fuel Oil #2 Prod.	Barium cmpds	secondary	2.08e-09	2.31e-10
Fuel Oil #4 Prod.	Chloroform	secondary	1.91e-09	2.11e-10
Fuel Oil #6 Prod.	Carbon disulfide	secondary	1.88e-09	2.09e-10
Fuel Oil #6 Prod.	Barium cmpds	secondary	1.83e-09	2.03e-10
Japanese Electric Grid	Chrysene	model/secondary	1.81e-09	2.01e-10
Fuel Oil #4 Prod.	Propionaldehyde	secondary	1.76e-09	1.95e-10
Natural Gas Prod.	Dimethyl sulfate	secondary	1.76e-09	1.95e-10
Natural Gas Prod.	Zinc (+2)	secondary	1.65e-09	1.83e-10
Japanese Electric Grid	2-Methylnaphthalene	model/secondary	1.60e-09	1.77e-10
Japanese Electric Grid	Biphenyl	model/secondary	1.56e-09	1.72e-10
Japanese Electric Grid	Anthracene	model/secondary	1.55e-09	1.72e-10
Natural Gas Prod.	Chlorine	secondary	1.49e-09	1.65e-10
Fuel Oil #6 Prod.	Cobalt	secondary	1.45e-09	1.60e-10
Japanese Electric Grid	Benzo[g,h,i]perylene	model/secondary	1.45e-09	1.60e-10
Fuel Oil #6 Prod.	Benzyl chloride	secondary	1.44e-09	1.60e-10
US electric grid	Ethylbenzene	model/secondary	1.43e-09	1.59e-10
Fuel Oil #6 Prod.	Aluminum (elemental)	secondary	1.37e-09	1.51e-10
Fuel Oil #2 Prod.	Cadmium	secondary	1.34e-09	1.49e-10
LPG Production	Methyl tert-butyl ether	secondary	1.34e-09	1.48e-10
Monitor/module	1,1,1-Trichloroethane	primary	1.30e-09	1.44e-10
Natural Gas Prod.	Silicon	secondary	1.17e-09	1.30e-10
LPG Production	Zinc (+2)	secondary	1.13e-09	1.25e-10
Japanese Electric Grid	Acenaphthylene	model/secondary	1.11e-09	1.23e-10
LPG Production	Phenanthrene	secondary	1.09e-09	1.21e-10
Fuel Oil #6 Prod.	Chloroform	secondary	1.02e-09	1.13e-10
Fuel Oil #2 Prod.	Carbon disulfide	secondary	1.00e-09	1.11e-10
Fuel Oil #4 Prod.	Acrolein	secondary	1.00e-09	1.11e-10
LPG Production	Vinyl acetate	secondary	9.52e-10	1.06e-10
Fuel Oil #6 Prod.	Propionaldehyde	secondary	9.38e-10	1.04e-10
LPG Production	3-Methylcholanthrene	secondary	9.21e-10	1.02e-10
Japanese Electric Grid	Benzo[a]pyrene	model/secondary	9.17e-10	1.02e-10
LPG Production	Ethylene dibromide	secondary	8.83e-10	9.79e-11
Natural Gas Prod.	Isophorone	secondary	8.49e-10	9.42e-11
Fuel Oil #4 Prod.	Methyl chloride	secondary	8.30e-10	9.20e-11
Fuel Oil #2 Prod.	Benzyl chloride	secondary	7.67e-10	8.51e-11

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #2 Prod.	Cobalt	secondary	7.42e-10	8.23e-11
US electric grid	Methyl tert-butyl ether	model/secondary	7.23e-10	8.02e-11
Natural Gas Prod.	Methyl ethyl ketone	secondary	6.79e-10	7.54e-11
Japanese Electric Grid	Pyrene	model/secondary	6.73e-10	7.46e-11
Natural Gas Prod.	Tetrachloroethylene	secondary	6.71e-10	7.45e-11
Fuel Oil #4 Prod.	Di(2-ethylhexyl)phthalate	secondary	5.98e-10	6.63e-11
Natural Gas Prod.	1,2-Dichloroethane	secondary	5.97e-10	6.62e-11
Fuel Oil #2 Prod.	Aluminum (elemental)	secondary	5.96e-10	6.61e-11
Japanese Electric Grid	Fluorene	model/secondary	5.86e-10	6.50e-11
Natural Gas Prod.	Methyl methacrylate	secondary	5.81e-10	6.44e-11
LPG Production	2-Methylnaphthalene	secondary	5.76e-10	6.39e-11
Japanese Electric Grid	Fluoranthene	model/secondary	5.59e-10	6.21e-11
US electric grid	Phenol	model/secondary	5.51e-10	6.11e-11
Fuel Oil #2 Prod.	Chloroform	secondary	5.41e-10	6.00e-11
Fuel Oil #6 Prod.	Acrolein	secondary	5.33e-10	5.91e-11
US electric grid	Vinyl acetate	model/secondary	5.15e-10	5.71e-11
Natural Gas Prod.	Styrene	secondary	5.13e-10	5.69e-11
LPG Production	Chlorine	secondary	5.11e-10	5.66e-11
Natural Gas Prod.	Barium cmpds	secondary	5.06e-10	5.61e-11
Fuel Oil #2 Prod.	Propionaldehyde	secondary	5.00e-10	5.55e-11
US electric grid	Phenanthrene	model/secondary	4.85e-10	5.38e-11
Natural Gas Prod.	Bromoform	secondary	4.79e-10	5.31e-11
US electric grid	Ethylene dibromide	model/secondary	4.78e-10	5.30e-11
Fuel Oil #4 Prod.	Acetaldehyde	secondary	4.76e-10	5.28e-11
Natural Gas Prod.	Dichloromethane	secondary	4.73e-10	5.24e-11
Fuel Oil #4 Prod.	Mercury	secondary	4.46e-10	4.94e-11
Fuel Oil #6 Prod.	Methyl chloride	secondary	4.42e-10	4.91e-11
US electric grid	Xylene (mixed isomers)	model/secondary	4.27e-10	4.74e-11
Natural Gas Prod.	Chlorobenzene	secondary	3.83e-10	4.25e-11
US electric grid	Chromium (III)	model/secondary	3.82e-10	4.23e-11
LPG Production	1,1,1-Trichloroethane	secondary	3.63e-10	4.03e-11
LPG Production	Acenaphthene	secondary	3.37e-10	3.74e-11
Fuel Oil #4 Prod.	Dimethyl sulfate	secondary	3.31e-10	3.67e-11
Fuel Oil #6 Prod.	Di(2-ethylhexyl)phthalate	secondary	3.19e-10	3.53e-11
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	3.07e-10	3.41e-11
Fuel Oil #4 Prod.	Toluene	secondary	2.92e-10	3.24e-11
Fuel Oil #2 Prod.	Acrolein	secondary	2.84e-10	3.15e-11
Natural Gas Prod.	Acetophenone	secondary	2.82e-10	3.13e-11
Natural Gas Prod.	3-Methylcholanthrene	secondary	2.72e-10	3.02e-11
LPG Production	Ethyl Chloride	secondary	2.57e-10	2.85e-11
Natural Gas Prod.	Chromium (III)	secondary	2.54e-10	2.82e-11
Fuel Oil #6 Prod.	Acetaldehyde	secondary	2.54e-10	2.81e-11
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	2.44e-10	2.71e-11
Fuel Oil #6 Prod.	Mercury	secondary	2.36e-10	2.62e-11
Fuel Oil #2 Prod.	Methyl chloride	secondary	2.36e-10	2.61e-11
US electric grid	2,3,7,8-TCDF	model/secondary	2.26e-10	2.50e-11
LPG Production	Cumene	secondary	2.18e-10	2.41e-11
US electric grid	1,1,1-Trichloroethane	model/secondary	2.10e-10	2.33e-11
LPG Production	Benzo[a]pyrene	secondary	2.06e-10	2.28e-11
Fuel Oil #6 Prod.	Dimethyl sulfate	secondary	1.76e-10	1.96e-11
Natural Gas Prod.	2-Methylnaphthalene	secondary	1.71e-10	1.89e-11

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #2 Prod.	Di(2-ethylhexyl)phthalate	secondary	1.70e-10	1.88e-11
Japanese Electric Grid	5-Methyl chrysene	model/secondary	1.69e-10	1.88e-11
Fuel Oil #4 Prod.	Isophorone	secondary	1.60e-10	1.78e-11
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	1.57e-10	1.74e-11
Natural Gas Prod.	Ethylbenzene	secondary	1.52e-10	1.69e-11
US electric grid	Acenaphthene	model/secondary	1.47e-10	1.63e-11
Fuel Oil #6 Prod.	Toluene	secondary	1.43e-10	1.58e-11
US electric grid	Ethyl Chloride	model/secondary	1.39e-10	1.54e-11
Fuel Oil #2 Prod.	Acetaldehyde	secondary	1.35e-10	1.50e-11
Natural Gas Prod.	Aluminum (elemental)	secondary	1.34e-10	1.49e-11
LPG Production	Biphenyl	secondary	1.30e-10	1.44e-11
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	1.28e-10	1.42e-11
Fuel Oil #2 Prod.	Mercury	secondary	1.27e-10	1.41e-11
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	1.27e-10	1.40e-11
US electric grid	Cumene	model/secondary	1.18e-10	1.31e-11
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	1.13e-10	1.25e-11
LPG Production	Lead cmpds	secondary	1.12e-10	1.24e-11
Natural Gas Prod.	Phenanthrene	secondary	1.11e-10	1.23e-11
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	1.09e-10	1.21e-11
LPG Production	Dibenzo[a,h]anthracene	secondary	1.07e-10	1.18e-11
LPG Production	Acenaphthylene	secondary	1.03e-10	1.14e-11
LPG Production	Anthracene	secondary	1.01e-10	1.12e-11
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	9.84e-11	1.09e-11
Fuel Oil #4 Prod.	Styrene	secondary	9.67e-11	1.07e-11
LPG Production	Nickel cmpds	secondary	9.46e-11	1.05e-11
Fuel Oil #2 Prod.	Dimethyl sulfate	secondary	9.40e-11	1.04e-11
LPG Production	Benzo[a]anthracene	secondary	9.15e-11	1.01e-11
Fuel Oil #2 Prod.	Cadmium cmpds	secondary	9.10e-11	1.01e-11
Fuel Oil #4 Prod.	Bromoform	secondary	9.03e-11	1.00e-11
Fuel Oil #4 Prod.	Dichloromethane	secondary	8.91e-11	9.89e-12
Fuel Oil #2 Prod.	Toluene	secondary	8.85e-11	9.82e-12
Fuel Oil #6 Prod.	Isophorone	secondary	8.53e-11	9.46e-12
Fuel Oil #6 Prod.	Cadmium cmpds	secondary	8.00e-11	8.87e-12
Natural Gas Prod.	Methyl tert-butyl ether	secondary	7.62e-11	8.45e-12
Fuel Oil #4 Prod.	Chlorobenzene	secondary	7.22e-11	8.01e-12
LPG Production	Benzo[b,j,k]fluoranthene	secondary	7.06e-11	7.83e-12
Fuel Oil #6 Prod.	1,4-Dichlorobenzene	secondary	7.05e-11	7.82e-12
US electric grid	Biphenyl	model/secondary	7.03e-11	7.79e-12
Fuel Oil #6 Prod.	Methyl ethyl ketone	secondary	6.82e-11	7.57e-12
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	6.80e-11	7.55e-12
Fuel Oil #6 Prod.	Tetrachloroethylene	secondary	6.75e-11	7.48e-12
Fuel Oil #6 Prod.	1,2-Dichloroethane	secondary	6.00e-11	6.65e-12
Fuel Oil #6 Prod.	Methyl methacrylate	secondary	5.83e-11	6.47e-12
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	5.79e-11	6.42e-12
LPG Production	Chrysene	secondary	5.78e-11	6.41e-12
Natural Gas Prod.	Vinyl acetate	secondary	5.43e-11	6.02e-12
Fuel Oil #4 Prod.	Acetophenone	secondary	5.32e-11	5.90e-12
Fuel Oil #6 Prod.	Styrene	secondary	5.15e-11	5.72e-12
Natural Gas Prod.	Ethylene dibromide	secondary	5.03e-11	5.58e-12

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #2 Prod.	1,4-Dichlorobenzene	secondary	5.02e-11	5.57e-12
LPG Production	HALON-1301	secondary	4.87e-11	5.40e-12
Fuel Oil #6 Prod.	Bromoform	secondary	4.81e-11	5.34e-12
Fuel Oil #6 Prod.	Dichloromethane	secondary	4.75e-11	5.27e-12
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	4.60e-11	5.11e-12
Fuel Oil #2 Prod.	Isophorone	secondary	4.55e-11	5.04e-12
Fuel Oil #4 Prod.	Chromium (III)	secondary	4.44e-11	4.92e-12
US electric grid	Acenaphthylene	model/secondary	4.37e-11	4.84e-12
US electric grid	Benzo[a]pyrene	model/secondary	4.14e-11	4.59e-12
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	4.12e-11	4.57e-12
Fuel Oil #6 Prod.	Chlorobenzene	secondary	3.85e-11	4.27e-12
US electric grid	Anthracene	model/secondary	3.82e-11	4.23e-12
Fuel Oil #2 Prod.	Aromatic hydrocarbons	secondary	3.67e-11	4.07e-12
LPG Production	Benzo[b]fluoranthene	secondary	3.66e-11	4.05e-12
Fuel Oil #2 Prod.	Methyl ethyl ketone	secondary	3.64e-11	4.03e-12
Fuel Oil #2 Prod.	Tetrachloroethylene	secondary	3.59e-11	3.99e-12
LPG Production	Mercury compounds	secondary	3.40e-11	3.77e-12
Fuel Oil #6 Prod.	Aromatic hydrocarbons	secondary	3.23e-11	3.58e-12
Fuel Oil #2 Prod.	1,2-Dichloroethane	secondary	3.20e-11	3.55e-12
LPG Production	Fluorene	secondary	3.17e-11	3.51e-12
Natural Gas Prod.	Benzo[a]pyrene	secondary	3.11e-11	3.45e-12
Fuel Oil #2 Prod.	Methyl methacrylate	secondary	3.11e-11	3.45e-12
Fuel Oil #4 Prod.	o-xylene	secondary	3.10e-11	3.44e-12
Fuel Oil #6 Prod.	2,4-Dinitrotoluene	secondary	3.09e-11	3.42e-12
Fuel Oil #4 Prod.	Ethylbenzene	secondary	2.86e-11	3.17e-12
Fuel Oil #6 Prod.	Acetophenone	secondary	2.83e-11	3.14e-12
Natural Gas Prod.	Dibenzo[a,h]anthracene	secondary	2.80e-11	3.11e-12
Natural Gas Prod.	Acenaphthene	secondary	2.80e-11	3.10e-12
Fuel Oil #2 Prod.	Styrene	secondary	2.75e-11	3.05e-12
US electric grid	Benzo[a]anthracene	model/secondary	2.74e-11	3.04e-12
LPG Production	Pyrene	secondary	2.74e-11	3.04e-12
LPG Production	Benzo[g,h,i]perylene	secondary	2.66e-11	2.95e-12
LPG Production	Fluoranthene	secondary	2.59e-11	2.87e-12
Fuel Oil #2 Prod.	Bromoform	secondary	2.57e-11	2.85e-12
Fuel Oil #2 Prod.	Dichloromethane	secondary	2.53e-11	2.81e-12
Fuel Oil #6 Prod.	Chromium (III)	secondary	2.37e-11	2.63e-12
Natural Gas Prod.	Cadmium cmpds	secondary	2.21e-11	2.46e-12
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	2.07e-11	2.30e-12
Fuel Oil #2 Prod.	Chlorobenzene	secondary	2.05e-11	2.28e-12
US electric grid	Chrysene	model/secondary	1.99e-11	2.21e-12
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	1.95e-11	2.16e-12
Fuel Oil #2 Prod.	Copper (+1 & +2)	secondary	1.72e-11	1.90e-12
Fuel Oil #2 Prod.	2,4-Dinitrotoluene	secondary	1.65e-11	1.82e-12
US electric grid	Fluorene	model/secondary	1.55e-11	1.72e-12
Fuel Oil #6 Prod.	Ethylbenzene	secondary	1.52e-11	1.69e-12
Fuel Oil #2 Prod.	Acetophenone	secondary	1.51e-11	1.68e-12
Fuel Oil #6 Prod.	Copper (+1 & +2)	secondary	1.51e-11	1.67e-12
Natural Gas Prod.	Ethyl Chloride	secondary	1.47e-11	1.63e-12
Fuel Oil #6 Prod.	o-xylene	secondary	1.46e-11	1.62e-12
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	1.44e-11	1.59e-12
LPG Production	5-Methyl chrysene	secondary	1.41e-11	1.57e-12

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Benzo[a]anthracene	secondary	1.35e-11	1.50e-12
Natural Gas Prod.	Anthracene	secondary	1.28e-11	1.42e-12
Fuel Oil #2 Prod.	Chromium (III)	secondary	1.26e-11	1.40e-12
Natural Gas Prod.	Cumene	secondary	1.24e-11	1.38e-12
US electric grid	Fluoranthene	model/secondary	1.24e-11	1.37e-12
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	1.19e-11	1.32e-12
Fuel Oil #4 Prod.	Phenanthrene	secondary	1.13e-11	1.25e-12
LPG Production	Halogenated matter (organic)	secondary	1.12e-11	1.24e-12
Natural Gas Prod.	Acenaphthylene	secondary	1.10e-11	1.22e-12
US electric grid	Dibenzo[a,h]anthracene	model/secondary	1.06e-11	1.18e-12
US electric grid	2-Methylnaphthalene	model/secondary	1.03e-11	1.15e-12
Fuel Oil #4 Prod.	Vinyl acetate	secondary	1.02e-11	1.13e-12
US electric grid	Pyrene	model/secondary	1.02e-11	1.13e-12
Natural Gas Prod.	Benzo[b]fluoranthene	secondary	1.00e-11	1.11e-12
Fuel Oil #2 Prod.	o-xylene	secondary	9.63e-12	1.07e-12
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	9.49e-12	1.05e-12
Fuel Oil #4 Prod.	Zinc (+2)	secondary	9.20e-12	1.02e-12
Natural Gas Prod.	Aromatic hydrocarbons	secondary	8.92e-12	9.90e-13
Natural Gas Prod.	Chrysene	secondary	8.56e-12	9.49e-13
Fuel Oil #4 Prod.	3-Methylcholanthrene	secondary	8.31e-12	9.22e-13
Fuel Oil #2 Prod.	Ethylbenzene	secondary	8.13e-12	9.02e-13
Fuel Oil #6 Prod.	Methyl tert-butyl ether	secondary	7.66e-12	8.49e-13
US electric grid	5-Methyl chrysene	model/secondary	7.64e-12	8.47e-13
Natural Gas Prod.	Biphenyl	secondary	7.40e-12	8.21e-13
US electric grid	o-xylene	model/secondary	7.35e-12	8.15e-13
US electric grid	Benzo[g,h,i]perylene	model/secondary	6.98e-12	7.74e-13
Fuel Oil #6 Prod.	Phenanthrene	secondary	5.83e-12	6.47e-13
Fuel Oil #6 Prod.	Vinyl acetate	secondary	5.45e-12	6.05e-13
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	5.20e-12	5.77e-13
Fuel Oil #6 Prod.	Ethylene dibromide	secondary	5.06e-12	5.61e-13
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	5.03e-12	5.58e-13
Fuel Oil #4 Prod.	Chlorine	secondary	4.52e-12	5.02e-13
Natural Gas Prod.	Copper (+1 & +2)	secondary	4.17e-12	4.63e-13
Fuel Oil #2 Prod.	Methyl tert-butyl ether	secondary	4.08e-12	4.53e-13
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	4.03e-12	4.46e-13
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	3.90e-12	4.33e-13
Natural Gas Prod.	Pyrene	secondary	3.86e-12	4.28e-13
Fuel Oil #6 Prod.	3-Methylcholanthrene	secondary	3.73e-12	4.14e-13
Fuel Oil #6 Prod.	Zinc (+2)	secondary	3.63e-12	4.02e-13
Fuel Oil #2 Prod.	Phenanthrene	secondary	3.28e-12	3.64e-13
Fuel Oil #4 Prod.	Acenaphthene	secondary	3.27e-12	3.63e-13
Fuel Oil #2 Prod.	Zinc (+2)	secondary	3.16e-12	3.51e-13
Fuel Oil #2 Prod.	Vinyl acetate	secondary	2.91e-12	3.22e-13
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	2.76e-12	3.07e-13
Fuel Oil #2 Prod.	Ethylene dibromide	secondary	2.69e-12	2.99e-13
Fuel Oil #2 Prod.	3-Methylcholanthrene	secondary	2.66e-12	2.95e-13
Natural Gas Prod.	Fluorene	secondary	2.58e-12	2.87e-13
Fuel Oil #4 Prod.	Cumene	secondary	2.34e-12	2.59e-13
Fuel Oil #6 Prod.	2-Methylnaphthalene	secondary	2.34e-12	2.59e-13

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Fluoranthene	secondary	2.31e-12	2.56e-13
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	2.12e-12	2.35e-13
Fuel Oil #6 Prod.	1,1,1-Trichloroethane	secondary	2.08e-12	2.31e-13
Fuel Oil #6 Prod.	Chlorine	secondary	2.01e-12	2.23e-13
Fuel Oil #2 Prod.	2-Methylnaphthalene	secondary	1.67e-12	1.85e-13
Fuel Oil #6 Prod.	Acenaphthene	secondary	1.59e-12	1.76e-13
Fuel Oil #6 Prod.	Ethyl Chloride	secondary	1.47e-12	1.63e-13
Fuel Oil #2 Prod.	Chlorine	secondary	1.46e-12	1.62e-13
Fuel Oil #4 Prod.	Biphenyl	secondary	1.40e-12	1.55e-13
Fuel Oil #6 Prod.	Cumene	secondary	1.25e-12	1.38e-13
Fuel Oil #2 Prod.	1,1,1-Trichloroethane	secondary	1.11e-12	1.23e-13
Fuel Oil #6 Prod.	Benzo[a]pyrene	secondary	1.09e-12	1.21e-13
Fuel Oil #4 Prod.	Acenaphthylene	secondary	1.06e-12	1.18e-13
Fuel Oil #4 Prod.	Anthracene	secondary	1.02e-12	1.14e-13
Fuel Oil #2 Prod.	Acenaphthene	secondary	9.96e-13	1.10e-13
Fuel Oil #4 Prod.	Dibenzo[a,h]anthracene	secondary	9.37e-13	1.04e-13
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	8.61e-13	9.55e-14
Fuel Oil #4 Prod.	Lead cmpds	secondary	8.20e-13	9.10e-14
Natural Gas Prod.	5-Methyl chrysene	secondary	8.05e-13	8.93e-14
Fuel Oil #2 Prod.	Ethyl Chloride	secondary	7.85e-13	8.71e-14
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	7.59e-13	8.42e-14
Fuel Oil #6 Prod.	Biphenyl	secondary	7.44e-13	8.25e-14
Fuel Oil #4 Prod.	Nickel cmpds	secondary	6.93e-13	7.69e-14
Fuel Oil #2 Prod.	Cumene	secondary	6.64e-13	7.37e-14
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	6.57e-13	7.29e-14
Fuel Oil #2 Prod.	Benzo[a]pyrene	secondary	6.19e-13	6.86e-14
Fuel Oil #4 Prod.	Chrysene	secondary	5.71e-13	6.33e-14
Fuel Oil #6 Prod.	Acenaphthylene	secondary	5.49e-13	6.09e-14
Fuel Oil #6 Prod.	Anthracene	secondary	5.18e-13	5.75e-14
Fuel Oil #6 Prod.	Dibenzo[a,h]anthracene	secondary	4.07e-13	4.51e-14
Fuel Oil #6 Prod.	Benzo[a]anthracene	secondary	4.05e-13	4.50e-14
Fuel Oil #6 Prod.	Benzo[b,j,k]fluoranthene	secondary	4.04e-13	4.49e-14
Fuel Oil #2 Prod.	Biphenyl	secondary	3.96e-13	4.40e-14
Fuel Oil #4 Prod.	HALON-1301	secondary	3.57e-13	3.96e-14
Fuel Oil #4 Prod.	Fluorene	secondary	3.33e-13	3.69e-14
Fuel Oil #4 Prod.	Benzo[b]fluoranthene	secondary	3.24e-13	3.59e-14
Fuel Oil #6 Prod.	Indeno(1,2,3-cd)pyrene	secondary	3.18e-13	3.52e-14
Fuel Oil #2 Prod.	Acenaphthylene	secondary	3.10e-13	3.43e-14
Fuel Oil #2 Prod.	Dibenzo[a,h]anthracene	secondary	3.06e-13	3.39e-14
Fuel Oil #2 Prod.	Lead cmpds	secondary	3.06e-13	3.39e-14
Fuel Oil #2 Prod.	Anthracene	secondary	3.03e-13	3.36e-14
Fuel Oil #6 Prod.	Chrysene	secondary	2.82e-13	3.13e-14
Fuel Oil #4 Prod.	Pyrene	secondary	2.74e-13	3.04e-14
Fuel Oil #4 Prod.	Fluoranthene	secondary	2.69e-13	2.99e-14
Fuel Oil #6 Prod.	Lead cmpds	secondary	2.69e-13	2.98e-14
Fuel Oil #2 Prod.	Benzo[a]anthracene	secondary	2.68e-13	2.97e-14
Fuel Oil #2 Prod.	Nickel cmpds	secondary	2.58e-13	2.86e-14
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	2.49e-13	2.77e-14
Fuel Oil #4 Prod.	Mercury compounds	secondary	2.49e-13	2.76e-14
Fuel Oil #6 Prod.	Nickel cmpds	secondary	2.27e-13	2.52e-14
Fuel Oil #2 Prod.	Benzo[b,j,k]fluoranthene	secondary	2.16e-13	2.39e-14

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #2 Prod.	Indeno(1,2,3-cd)pyrene	secondary	2.01e-13	2.23e-14
Fuel Oil #6 Prod.	Fluorene	secondary	1.74e-13	1.93e-14
Fuel Oil #2 Prod.	Chrysene	secondary	1.72e-13	1.90e-14
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	1.52e-13	1.68e-14
Fuel Oil #6 Prod.	Benzo[b]fluoranthene	secondary	1.43e-13	1.58e-14
Fuel Oil #6 Prod.	Fluoranthene	secondary	1.40e-13	1.55e-14
Fuel Oil #6 Prod.	Pyrene	secondary	1.37e-13	1.52e-14
Fuel Oil #2 Prod.	HALON-1301	secondary	1.33e-13	1.47e-14
Fuel Oil #6 Prod.	HALON-1301	secondary	1.17e-13	1.30e-14
Fuel Oil #6 Prod.	Benzo[g,h,i]perylene	secondary	1.17e-13	1.29e-14
Fuel Oil #2 Prod.	Benzo[b]fluoranthene	secondary	1.05e-13	1.17e-14
Fuel Oil #2 Prod.	Fluorene	secondary	9.59e-14	1.06e-14
Fuel Oil #2 Prod.	Mercury compounds	secondary	9.27e-14	1.03e-14
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	8.20e-14	9.10e-15
Fuel Oil #2 Prod.	Pyrene	secondary	8.17e-14	9.06e-15
Fuel Oil #6 Prod.	Mercury compounds	secondary	8.15e-14	9.04e-15
Fuel Oil #6 Prod.	5-Methyl chrysene	secondary	8.09e-14	8.97e-15
Fuel Oil #2 Prod.	Fluoranthene	secondary	7.81e-14	8.66e-15
Fuel Oil #2 Prod.	Benzo[g,h,i]perylene	secondary	7.78e-14	8.63e-15
Natural Gas Prod.	Lead cmpds	secondary	7.44e-14	8.25e-15
Natural Gas Prod.	Nickel cmpds	secondary	6.29e-14	6.97e-15
Fuel Oil #2 Prod.	5-Methyl chrysene	secondary	4.31e-14	4.78e-15
Natural Gas Prod.	HALON-1301	secondary	3.24e-14	3.59e-15
Fuel Oil #2 Prod.	Halogenated matter (organic)	secondary	3.06e-14	3.39e-15
LPG Production	Halogenated hydrocarbons (unspecified)	secondary	2.80e-14	3.11e-15
Fuel Oil #6 Prod.	Halogenated matter (organic)	secondary	2.69e-14	2.98e-15
Natural Gas Prod.	Mercury compounds	secondary	2.26e-14	2.50e-15
Natural Gas Prod.	Halogenated matter (organic)	secondary	7.44e-15	8.25e-16
Fuel Oil #4 Prod.	Halogenated hydrocarbons (unspecified)	secondary	2.05e-16	2.27e-17
Fuel Oil #2 Prod.	Halogenated hydrocarbons (unspecified)	secondary	7.64e-17	8.48e-18
Fuel Oil #6 Prod.	Halogenated hydrocarbons (unspecified)	secondary	6.72e-17	7.46e-18
Natural Gas Prod.	Halogenated hydrocarbons (unspecified)	secondary	1.86e-17	2.06e-18
Total Manufacturing			**2.35e+02**	**2.60e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Sulfur dioxide	model/secondary	6.15e+02	6.82e+01
US electric grid	Nitrogen oxides	model/secondary	8.79e-01	9.75e-02
US electric grid	Methane	model/secondary	4.81e-01	5.34e-02
US electric grid	Carbon monoxide	model/secondary	4.07e-01	4.52e-02
US electric grid	Arsenic	model/secondary	2.08e-01	2.31e-02
US electric grid	Hydrochloric acid	model/secondary	1.84e-01	2.04e-02
US electric grid	PM-10	model/secondary	4.31e-02	4.78e-03
US electric grid	Selenium	model/secondary	3.46e-02	3.84e-03
US electric grid	Vanadium	model/secondary	2.61e-02	2.89e-03
US electric grid	Hydrofluoric acid	model/secondary	1.00e-02	1.11e-03
US electric grid	Formaldehyde	model/secondary	3.62e-03	4.01e-04
US electric grid	Benzene	model/secondary	2.60e-03	2.89e-04
US electric grid	Nitrous oxide	model/secondary	2.54e-03	2.81e-04
US electric grid	Phosphorus (yellow or white)	model/secondary	1.47e-03	1.63e-04
US electric grid	Zinc (elemental)	model/secondary	6.77e-04	7.51e-05

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
US electric grid	Antimony	model/secondary	5.55e-04	6.16e-05
US electric grid	Chromium (VI)	model/secondary	2.00e-04	2.22e-05
US electric grid	Molybdenum	model/secondary	1.85e-04	2.06e-05
US electric grid	Methyl hydrazine	model/secondary	1.72e-04	1.91e-05
US electric grid	2-Chloroacetophenone	model/secondary	1.61e-04	1.79e-05
US electric grid	Bromomethane	model/secondary	1.59e-04	1.77e-05
US electric grid	Nickel	model/secondary	8.64e-05	9.59e-06
US electric grid	Cyanide (-1)	model/secondary	8.37e-05	9.28e-06
US electric grid	2,3,7,8-TCDD	model/secondary	6.34e-05	7.03e-06
US electric grid	Naphthalene	model/secondary	5.11e-05	5.67e-06
US electric grid	Barium	model/secondary	4.35e-05	4.82e-06
US electric grid	Carbon disulfide	model/secondary	3.42e-05	3.80e-06
US electric grid	Benzyl chloride	model/secondary	2.62e-05	2.91e-06
US electric grid	Cadmium	model/secondary	2.04e-05	2.27e-06
US electric grid	Chloroform	model/secondary	1.85e-05	2.05e-06
US electric grid	Propionaldehyde	model/secondary	1.71e-05	1.90e-06
US electric grid	Manganese	model/secondary	1.70e-05	1.89e-06
US electric grid	Fluoride	model/secondary	1.46e-05	1.62e-06
US electric grid	Beryllium	model/secondary	1.09e-05	1.21e-06
US electric grid	Acrolein	model/secondary	9.71e-06	1.08e-06
US electric grid	Lead	model/secondary	9.52e-06	1.06e-06
US electric grid	Cobalt	model/secondary	9.07e-06	1.01e-06
US electric grid	Copper	model/secondary	8.34e-06	9.25e-07
US electric grid	Methyl chloride	model/secondary	8.05e-06	8.93e-07
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	5.80e-06	6.43e-07
US electric grid	Acetaldehyde	model/secondary	4.62e-06	5.12e-07
US electric grid	Hexane	model/secondary	4.49e-06	4.98e-07
US electric grid	Dimethyl sulfate	model/secondary	3.21e-06	3.56e-07
US electric grid	Mercury	model/secondary	2.80e-06	3.11e-07
US electric grid	Toluene	model/secondary	1.59e-06	1.76e-07
US electric grid	Isophorone	model/secondary	1.55e-06	1.72e-07
US electric grid	Methyl ethyl ketone	model/secondary	1.24e-06	1.38e-07
US electric grid	Tetrachloroethylene	model/secondary	1.23e-06	1.36e-07
US electric grid	1,2-Dichloroethane	model/secondary	1.09e-06	1.21e-07
US electric grid	Methyl methacrylate	model/secondary	1.06e-06	1.18e-07
US electric grid	Styrene	model/secondary	9.39e-07	1.04e-07
US electric grid	Bromoform	model/secondary	8.76e-07	9.72e-08
US electric grid	Dichloromethane	model/secondary	8.65e-07	9.59e-08
US electric grid	Chlorobenzene	model/secondary	7.01e-07	7.78e-08
US electric grid	2,4-Dinitrotoluene	model/secondary	5.62e-07	6.23e-08
US electric grid	Acetophenone	model/secondary	5.16e-07	5.73e-08
US electric grid	Ethylbenzene	model/secondary	2.76e-07	3.07e-08
US electric grid	Methyl tert-butyl ether	model/secondary	1.39e-07	1.55e-08
US electric grid	Phenol	model/secondary	1.06e-07	1.18e-08
US electric grid	Vinyl acetate	model/secondary	9.93e-08	1.10e-08
US electric grid	Phenanthrene	model/secondary	9.35e-08	1.04e-08
US electric grid	Ethylene dibromide	model/secondary	9.21e-08	1.02e-08
US electric grid	Xylene (mixed isomers)	model/secondary	8.23e-08	9.13e-09
US electric grid	Chromium (III)	model/secondary	7.36e-08	8.16e-09
US electric grid	2,3,7,8-TCDF	model/secondary	4.35e-08	4.83e-09
US electric grid	1,1,1-Trichloroethane	model/secondary	4.05e-08	4.49e-09

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
US electric grid	Acenaphthene	model/secondary	2.84e-08	3.15e-09
US electric grid	Ethyl Chloride	model/secondary	2.68e-08	2.98e-09
US electric grid	Cumene	model/secondary	2.27e-08	2.52e-09
US electric grid	Biphenyl	model/secondary	1.35e-08	1.50e-09
US electric grid	Acenaphthylene	model/secondary	8.42e-09	9.34e-10
US electric grid	Benzo[a]pyrene	model/secondary	7.97e-09	8.85e-10
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	7.94e-09	8.81e-10
US electric grid	Anthracene	model/secondary	7.35e-09	8.16e-10
US electric grid	Benzo[a]anthracene	model/secondary	5.29e-09	5.86e-10
US electric grid	Chrysene	model/secondary	3.83e-09	4.25e-10
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	3.76e-09	4.17e-10
US electric grid	Fluorene	model/secondary	2.98e-09	3.31e-10
US electric grid	Fluoranthene	model/secondary	2.38e-09	2.64e-10
US electric grid	Dibenzo[a,h]anthracene	model/secondary	2.05e-09	2.27e-10
US electric grid	2-Methylnaphthalene	model/secondary	1.99e-09	2.21e-10
US electric grid	Pyrene	model/secondary	1.97e-09	2.19e-10
US electric grid	5-Methyl chrysene	model/secondary	1.47e-09	1.63e-10
US electric grid	o-xylene	model/secondary	1.42e-09	1.57e-10
US electric grid	Benzo[g,h,i]perylene	model/secondary	1.35e-09	1.49e-10
Total Use, Maintenance and Repair			**6.17e+02**	**6.84e+01**
End-of-life Life-cycle Stage				
US electric grid	Sulfur dioxide	model/secondary	1.17e-01	1.29e-02
LCD landfilling	Sulfur dioxide	primary	4.45e-02	4.94e-03
LCD incineration	Sulfur dioxide	secondary	3.45e-02	3.83e-03
LCD landfilling	Carbon monoxide	primary	2.40e-03	2.66e-04
LCD landfilling	Nitrogen dioxide	primary	8.92e-04	9.90e-05
US electric grid	Nitrogen oxides	model/secondary	1.67e-04	1.85e-05
LCD landfilling	PM	primary	1.00e-04	1.11e-05
US electric grid	Methane	model/secondary	9.13e-05	1.01e-05
US electric grid	Carbon monoxide	model/secondary	7.73e-05	8.57e-06
LCD incineration	Arsenic cmpds	secondary	4.30e-05	4.77e-06
US electric grid	Arsenic	model/secondary	3.95e-05	4.38e-06
LCD landfilling	Arsenic cmpds	primary	3.65e-05	4.05e-06
US electric grid	Hydrochloric acid	model/secondary	3.49e-05	3.87e-06
LCD landfilling	Methane	primary	2.62e-05	2.91e-06
LPG Production	Carbon monoxide	secondary	2.27e-05	2.52e-06
LCD landfilling	Benzene	primary	9.74e-06	1.08e-06
LCD incineration	Lead	secondary	9.60e-06	1.06e-06
US electric grid	PM-10	model/secondary	8.18e-06	9.08e-07
LPG Production	Methane	secondary	6.61e-06	7.33e-07
US electric grid	Selenium	model/secondary	6.57e-06	7.29e-07
LPG Production	Sulfur oxides	secondary	6.31e-06	7.00e-07
US electric grid	Vanadium	model/secondary	4.94e-06	5.48e-07
LPG Production	Nitrogen oxides	secondary	4.51e-06	5.01e-07
LPG Production	Vanadium	secondary	4.12e-06	4.58e-07
LPG Production	Benzene	secondary	3.38e-06	3.75e-07
LCD landfilling	Silver compounds	primary	2.52e-06	2.79e-07
LCD incineration	Barium cmpds	secondary	2.33e-06	2.58e-07
LCD landfilling	Barium cmpds	primary	1.96e-06	2.17e-07

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LCD incineration	Silver compounds	secondary	1.95e-06	2.17e-07
US electric grid	Hydrofluoric acid	model/secondary	1.91e-06	2.11e-07
LCD landfilling	Hydrochloric acid	primary	1.13e-06	1.25e-07
LPG Production	PM	secondary	1.02e-06	1.13e-07
LCD landfilling	Ammonia	primary	9.17e-07	1.02e-07
LPG Production	Arsenic	secondary	8.13e-07	9.02e-08
US electric grid	Formaldehyde	model/secondary	6.87e-07	7.62e-08
LPG Production	Formaldehyde	secondary	5.28e-07	5.86e-08
US electric grid	Benzene	model/secondary	4.94e-07	5.48e-08
US electric grid	Nitrous oxide	model/secondary	4.81e-07	5.34e-08
LCD incineration	Cadmium cmpds	secondary	3.54e-07	3.92e-08
LCD landfilling	Cadmium cmpds	primary	3.27e-07	3.62e-08
US electric grid	Phosphorus (yellow or white)	model/secondary	2.78e-07	3.09e-08
LPG Production	Hydrochloric acid	secondary	1.45e-07	1.61e-08
US electric grid	Zinc (elemental)	model/secondary	1.28e-07	1.42e-08
LPG Production	Nitrous oxide	secondary	1.28e-07	1.42e-08
LCD landfilling	Hydrogen sulfide	primary	1.11e-07	1.23e-08
US electric grid	Antimony	model/secondary	1.05e-07	1.17e-08
LCD landfilling	Chromium (VI)	primary	7.27e-08	8.07e-09
LPG Production	Phosphorus (yellow or white)	secondary	3.86e-08	4.29e-09
US electric grid	Chromium (VI)	model/secondary	3.80e-08	4.22e-09
US electric grid	Molybdenum	model/secondary	3.52e-08	3.90e-09
US electric grid	Methyl hydrazine	model/secondary	3.26e-08	3.62e-09
US electric grid	2-Chloroacetophenone	model/secondary	3.06e-08	3.39e-09
US electric grid	Bromomethane	model/secondary	3.02e-08	3.35e-09
LPG Production	Fluorides (F-)	secondary	2.97e-08	3.29e-09
LPG Production	Selenium	secondary	2.92e-08	3.24e-09
LPG Production	Hydrogen sulfide	secondary	2.42e-08	2.68e-09
LPG Production	Ammonia	secondary	2.33e-08	2.58e-09
US electric grid	Nickel	model/secondary	1.64e-08	1.82e-09
US electric grid	Cyanide (-1)	model/secondary	1.59e-08	1.76e-09
US electric grid	2,3,7,8-TCDD	model/secondary	1.20e-08	1.33e-09
LCD landfilling	Selenium	primary	1.05e-08	1.16e-09
US electric grid	Naphthalene	model/secondary	9.69e-09	1.08e-09
US electric grid	Barium	model/secondary	8.25e-09	9.15e-10
LPG Production	Hydrofluoric acid	secondary	7.91e-09	8.77e-10
US electric grid	Carbon disulfide	model/secondary	6.50e-09	7.21e-10
LPG Production	Molybdenum	secondary	6.49e-09	7.20e-10
LPG Production	Chromium (VI)	secondary	6.21e-09	6.89e-10
LPG Production	Ethane	secondary	6.11e-09	6.78e-10
US electric grid	Benzyl chloride	model/secondary	4.97e-09	5.52e-10
LPG Production	Zinc (elemental)	secondary	4.72e-09	5.24e-10
LCD incineration	Mercury compounds	secondary	4.57e-09	5.07e-10
LCD landfilling	Carbon tetrachloride	primary	4.07e-09	4.52e-10
LCD landfilling	Mercury compounds	primary	3.96e-09	4.39e-10
US electric grid	Cadmium	model/secondary	3.88e-09	4.30e-10
LPG Production	Hexane	secondary	3.55e-09	3.94e-10
US electric grid	Chloroform	model/secondary	3.51e-09	3.89e-10
US electric grid	Propionaldehyde	model/secondary	3.24e-09	3.60e-10
US electric grid	Manganese	model/secondary	3.23e-09	3.58e-10
LCD landfilling	Chloroform	primary	3.18e-09	3.53e-10

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LCD incineration	Carbon tetrachloride	secondary	3.16e-09	3.50e-10
LPG Production	Phenol	secondary	2.82e-09	3.12e-10
US electric grid	Fluoride	model/secondary	2.77e-09	3.07e-10
LPG Production	Pentane	secondary	2.56e-09	2.84e-10
US electric grid	Beryllium	model/secondary	2.06e-09	2.29e-10
LCD landfilling	Toluene	primary	1.98e-09	2.20e-10
US electric grid	Acrolein	model/secondary	1.84e-09	2.04e-10
US electric grid	Lead	model/secondary	1.81e-09	2.00e-10
LPG Production	PM-10	secondary	1.77e-09	1.97e-10
US electric grid	Cobalt	model/secondary	1.72e-09	1.91e-10
LPG Production	Nickel	secondary	1.62e-09	1.80e-10
US electric grid	Copper	model/secondary	1.58e-09	1.76e-10
US electric grid	Methyl chloride	model/secondary	1.53e-09	1.69e-10
LPG Production	Aluminum (+3)	secondary	1.12e-09	1.24e-10
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	1.10e-09	1.22e-10
US electric grid	Acetaldehyde	model/secondary	8.76e-10	9.72e-11
US electric grid	Hexane	model/secondary	8.51e-10	9.44e-11
LPG Production	Antimony	secondary	8.44e-10	9.37e-11
US electric grid	Dimethyl sulfate	model/secondary	6.10e-10	6.76e-11
US electric grid	Mercury	model/secondary	5.32e-10	5.90e-11
LCD incineration	Lead cmpds	secondary	5.19e-10	5.75e-11
LCD landfilling	Lead cmpds	primary	4.80e-10	5.33e-11
LPG Production	Nitrate	secondary	4.77e-10	5.29e-11
LCD landfilling	Xylene (mixed isomers)	primary	4.08e-10	4.53e-11
US electric grid	Toluene	model/secondary	3.01e-10	3.34e-11
US electric grid	Isophorone	model/secondary	2.95e-10	3.27e-11
LCD landfilling	Tetrachloroethylene	primary	2.90e-10	3.21e-11
LCD landfilling	1,2-Dichloroethane	primary	2.77e-10	3.07e-11
US electric grid	Methyl ethyl ketone	model/secondary	2.36e-10	2.62e-11
US electric grid	Tetrachloroethylene	model/secondary	2.33e-10	2.59e-11
US electric grid	1,2-Dichloroethane	model/secondary	2.07e-10	2.30e-11
US electric grid	Methyl methacrylate	model/secondary	2.02e-10	2.24e-11
US electric grid	Styrene	model/secondary	1.78e-10	1.98e-11
LCD landfilling	Trichloroethylene	primary	1.72e-10	1.91e-11
US electric grid	Bromoform	model/secondary	1.66e-10	1.84e-11
US electric grid	Dichloromethane	model/secondary	1.64e-10	1.82e-11
LPG Production	Copper	secondary	1.37e-10	1.52e-11
LPG Production	Methyl hydrazine	secondary	1.35e-10	1.50e-11
LPG Production	Silicon	secondary	1.33e-10	1.48e-11
LCD incineration	Trichloroethylene	secondary	1.33e-10	1.48e-11
US electric grid	Chlorobenzene	model/secondary	1.33e-10	1.48e-11
LPG Production	2-Chloroacetophenone	secondary	1.27e-10	1.41e-11
LPG Production	Dimethylbenzanthracene	secondary	1.26e-10	1.39e-11
LPG Production	Bromomethane	secondary	1.25e-10	1.39e-11
LCD landfilling	Ethylbenzene	primary	1.07e-10	1.19e-11
US electric grid	2,4-Dinitrotoluene	model/secondary	1.07e-10	1.18e-11
LPG Production	Naphthalene	secondary	1.03e-10	1.14e-11
US electric grid	Acetophenone	model/secondary	9.79e-11	1.09e-11
LPG Production	Lead	secondary	9.74e-11	1.08e-11

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	Manganese	secondary	8.79e-11	9.75e-12
LPG Production	Beryllium	secondary	8.45e-11	9.37e-12
LPG Production	Barium	secondary	7.34e-11	8.14e-12
LPG Production	Cyanide (-1)	secondary	6.59e-11	7.31e-12
LPG Production	Barium cmpds	secondary	6.25e-11	6.93e-12
US electric grid	Ethylbenzene	model/secondary	5.24e-11	5.82e-12
LCD landfilling	Dichloromethane	primary	4.84e-11	5.36e-12
LPG Production	Cadmium	secondary	3.63e-11	4.02e-12
LCD landfilling	Vinyl chloride	primary	3.62e-11	4.01e-12
LCD incineration	Vinyl chloride	secondary	2.81e-11	3.11e-12
LPG Production	Carbon disulfide	secondary	2.70e-11	2.99e-12
US electric grid	Methyl tert-butyl ether	model/secondary	2.65e-11	2.93e-12
LPG Production	Benzyl chloride	secondary	2.06e-11	2.29e-12
US electric grid	Phenol	model/secondary	2.02e-11	2.24e-12
LPG Production	Cobalt	secondary	1.98e-11	2.19e-12
US electric grid	Vinyl acetate	model/secondary	1.88e-11	2.09e-12
US electric grid	Phenanthrene	model/secondary	1.77e-11	1.97e-12
US electric grid	Ethylene dibromide	model/secondary	1.75e-11	1.94e-12
US electric grid	Xylene (mixed isomers)	model/secondary	1.56e-11	1.73e-12
LPG Production	Aluminum (elemental)	secondary	1.52e-11	1.69e-12
LPG Production	Chloroform	secondary	1.46e-11	1.61e-12
US electric grid	Chromium (III)	model/secondary	1.40e-11	1.55e-12
LPG Production	Propionaldehyde	secondary	1.35e-11	1.49e-12
LCD incineration	o-xylene	secondary	9.08e-12	1.01e-12
US electric grid	2,3,7,8-TCDF	model/secondary	8.26e-12	9.16e-13
LCD landfilling	Chromium (III)	primary	7.92e-12	8.78e-13
US electric grid	1,1,1-Trichloroethane	model/secondary	7.68e-12	8.52e-13
LPG Production	Acrolein	secondary	7.64e-12	8.48e-13
LPG Production	Methyl chloride	secondary	6.34e-12	7.03e-13
US electric grid	Acenaphthene	model/secondary	5.39e-12	5.98e-13
US electric grid	Ethyl Chloride	model/secondary	5.09e-12	5.65e-13
LPG Production	Di(2-ethylhexyl)phthalate	secondary	4.57e-12	5.07e-13
US electric grid	Cumene	model/secondary	4.31e-12	4.78e-13
LPG Production	Acetaldehyde	secondary	3.64e-12	4.03e-13
LPG Production	Mercury	secondary	3.42e-12	3.80e-13
LPG Production	Cadmium cmpds	secondary	2.74e-12	3.04e-13
US electric grid	Biphenyl	model/secondary	2.57e-12	2.85e-13
LPG Production	Dimethyl sulfate	secondary	2.53e-12	2.81e-13
LPG Production	Toluene	secondary	2.45e-12	2.72e-13
US electric grid	Acenaphthylene	model/secondary	1.60e-12	1.77e-13
US electric grid	Benzo[a]pyrene	model/secondary	1.51e-12	1.68e-13
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	1.51e-12	1.67e-13
LPG Production	1,4-Dichlorobenzene	secondary	1.43e-12	1.58e-13
US electric grid	Anthracene	model/secondary	1.40e-12	1.55e-13
LPG Production	Isophorone	secondary	1.22e-12	1.36e-13
LPG Production	Aromatic hydrocarbons	secondary	1.10e-12	1.22e-13
US electric grid	Benzo[a]anthracene	model/secondary	1.00e-12	1.11e-13
LPG Production	Methyl ethyl ketone	secondary	9.79e-13	1.09e-13
LPG Production	Tetrachloroethylene	secondary	9.67e-13	1.07e-13
LPG Production	1,2-Dichloroethane	secondary	8.60e-13	9.54e-14
LPG Production	Methyl methacrylate	secondary	8.36e-13	9.28e-14

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	Styrene	secondary	7.39e-13	8.20e-14
US electric grid	Chrysene	model/secondary	7.27e-13	8.07e-14
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	7.13e-13	7.91e-14
LPG Production	Bromoform	secondary	6.90e-13	7.66e-14
LPG Production	Dichloromethane	secondary	6.81e-13	7.55e-14
LPG Production	Chromium (III)	secondary	6.76e-13	7.50e-14
US electric grid	Fluorene	model/secondary	5.66e-13	6.28e-14
LPG Production	Chlorobenzene	secondary	5.52e-13	6.12e-14
LPG Production	Copper (+1 & +2)	secondary	5.16e-13	5.72e-14
US electric grid	Fluoranthene	model/secondary	4.52e-13	5.02e-14
LPG Production	2,4-Dinitrotoluene	secondary	4.43e-13	4.91e-14
LPG Production	Acetophenone	secondary	4.06e-13	4.51e-14
US electric grid	Dibenzo[a,h]anthracene	model/secondary	3.88e-13	4.31e-14
US electric grid	2-Methylnaphthalene	model/secondary	3.78e-13	4.19e-14
US electric grid	Pyrene	model/secondary	3.74e-13	4.15e-14
US electric grid	5-Methyl chrysene	model/secondary	2.79e-13	3.10e-14
LPG Production	o-xylene	secondary	2.70e-13	3.00e-14
US electric grid	o-xylene	model/secondary	2.69e-13	2.98e-14
US electric grid	Benzo[g,h,i]perylene	model/secondary	2.55e-13	2.83e-14
LPG Production	Ethylbenzene	secondary	2.19e-13	2.43e-14
LPG Production	Methyl tert-butyl ether	secondary	1.10e-13	1.22e-14
LPG Production	Zinc (+2)	secondary	9.24e-14	1.03e-14
LPG Production	Phenanthrene	secondary	8.93e-14	9.90e-15
LPG Production	Vinyl acetate	secondary	7.82e-14	8.67e-15
LPG Production	3-Methylcholanthrene	secondary	7.56e-14	8.38e-15
LPG Production	Ethylene dibromide	secondary	7.25e-14	8.04e-15
LPG Production	2-Methylnaphthalene	secondary	4.73e-14	5.25e-15
LPG Production	Chlorine	secondary	4.19e-14	4.65e-15
LPG Production	1,1,1-Trichloroethane	secondary	2.98e-14	3.31e-15
LPG Production	Acenaphthene	secondary	2.77e-14	3.07e-15
LPG Production	Ethyl Chloride	secondary	2.11e-14	2.34e-15
LPG Production	Cumene	secondary	1.79e-14	1.98e-15
LPG Production	Benzo[a]pyrene	secondary	1.69e-14	1.87e-15
LPG Production	Biphenyl	secondary	1.07e-14	1.18e-15
LPG Production	Lead cmpds	secondary	9.19e-15	1.02e-15
LPG Production	Dibenzo[a,h]anthracene	secondary	8.77e-15	9.72e-16
LPG Production	Acenaphthylene	secondary	8.43e-15	9.35e-16
LPG Production	Anthracene	secondary	8.31e-15	9.22e-16
LPG Production	Nickel cmpds	secondary	7.77e-15	8.62e-16
LPG Production	Benzo[a]anthracene	secondary	7.51e-15	8.33e-16
LPG Production	Benzo[b,j,k]fluoranthene	secondary	5.80e-15	6.43e-16
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	5.59e-15	6.20e-16
LPG Production	Chrysene	secondary	4.74e-15	5.26e-16
LPG Production	HALON-1301	secondary	4.00e-15	4.44e-16
LPG Production	Benzo[b]fluoranthene	secondary	3.00e-15	3.33e-16
LPG Production	Mercury compounds	secondary	2.79e-15	3.09e-16
LPG Production	Fluorene	secondary	2.60e-15	2.88e-16
LPG Production	Pyrene	secondary	2.25e-15	2.49e-16
LPG Production	Benzo[g,h,i]perylene	secondary	2.19e-15	2.42e-16

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LPG Production	Fluoranthene	secondary	2.12e-15	2.35e-16
LPG Production	5-Methyl chrysene	secondary	1.16e-15	1.29e-16
LPG Production	Halogenated matter (organic)	secondary	9.19e-16	1.02e-16
LPG Production	Halogenated hydrocarbons (unspecified)	secondary	2.30e-18	2.55e-19
Natural Gas Prod.	Halogenated hydrocarbons (unspecified)	secondary	-3.90e-18	-4.33e-19
LCD incineration	Halogenated hydrocarbons (unspecified)	secondary	-4.13e-17	-4.58e-18
Fuel Oil #4 Prod.	Halogenated hydrocarbons (unspecified)	secondary	-9.44e-16	-1.05e-16
Natural Gas Prod.	Halogenated matter (organic)	secondary	-1.56e-15	-1.73e-16
Natural Gas Prod.	Mercury compounds	secondary	-4.74e-15	-5.25e-16
Natural Gas Prod.	HALON-1301	secondary	-6.79e-15	-7.54e-16
Natural Gas Prod.	Nickel cmpds	secondary	-1.32e-14	-1.46e-15
Natural Gas Prod.	Lead cmpds	secondary	-1.56e-14	-1.73e-15
LCD incineration	Halogenated matter (organic)	secondary	-2.38e-14	-2.64e-15
LCD incineration	HALON-1301	secondary	-1.03e-13	-1.15e-14
Natural Gas Prod.	5-Methyl chrysene	secondary	-1.69e-13	-1.88e-14
LCD incineration	Nickel cmpds	secondary	-2.01e-13	-2.23e-14
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	-3.78e-13	-4.19e-14
Natural Gas Prod.	Fluoranthene	secondary	-4.85e-13	-5.38e-14
Natural Gas Prod.	Fluorene	secondary	-5.43e-13	-6.02e-14
LCD incineration	Benzo[b]fluoranthene	secondary	-6.58e-13	-7.30e-14
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	-6.99e-13	-7.76e-14
Natural Gas Prod.	Pyrene	secondary	-8.10e-13	-8.99e-14
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	-8.45e-13	-9.38e-14
Natural Gas Prod.	Copper (+1 & +2)	secondary	-8.77e-13	-9.72e-14
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	-1.06e-12	-1.17e-13
Fuel Oil #4 Prod.	Mercury compounds	secondary	-1.15e-12	-1.27e-13
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	-1.15e-12	-1.27e-13
Fuel Oil #4 Prod.	Fluoranthene	secondary	-1.24e-12	-1.38e-13
Fuel Oil #4 Prod.	Pyrene	secondary	-1.26e-12	-1.40e-13
Fuel Oil #4 Prod.	Benzo[b]fluoranthene	secondary	-1.49e-12	-1.66e-13
Fuel Oil #4 Prod.	Fluorene	secondary	-1.53e-12	-1.70e-13
Natural Gas Prod.	Biphenyl	secondary	-1.55e-12	-1.72e-13
Fuel Oil #4 Prod.	HALON-1301	secondary	-1.64e-12	-1.82e-13
Natural Gas Prod.	Chrysene	secondary	-1.80e-12	-1.99e-13
LCD incineration	Dibenzo[a,h]anthracene	secondary	-1.83e-12	-2.02e-13
Natural Gas Prod.	Aromatic hydrocarbons	secondary	-1.87e-12	-2.08e-13
Natural Gas Prod.	Benzo[b]fluoranthene	secondary	-2.11e-12	-2.34e-13
Natural Gas Prod.	Acenaphthylene	secondary	-2.32e-12	-2.57e-13
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	-2.49e-12	-2.76e-13
Natural Gas Prod.	Cumene	secondary	-2.61e-12	-2.89e-13
Fuel Oil #4 Prod.	Chrysene	secondary	-2.63e-12	-2.92e-13
Natural Gas Prod.	Anthracene	secondary	-2.69e-12	-2.99e-13
Natural Gas Prod.	Benzo[a]anthracene	secondary	-2.83e-12	-3.14e-13
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	-3.03e-12	-3.36e-13
Natural Gas Prod.	Ethyl Chloride	secondary	-3.08e-12	-3.42e-13
Fuel Oil #4 Prod.	Nickel cmpds	secondary	-3.19e-12	-3.54e-13
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	-3.50e-12	-3.88e-13
Fuel Oil #4 Prod.	Lead cmpds	secondary	-3.78e-12	-4.19e-13
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	-3.97e-12	-4.40e-13
Fuel Oil #4 Prod.	Dibenzo[a,h]anthracene	secondary	-4.32e-12	-4.79e-13
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	-4.35e-12	-4.82e-13

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Cadmium cmpds	secondary	-4.65e-12	-5.16e-13
Fuel Oil #4 Prod.	Anthracene	secondary	-4.72e-12	-5.24e-13
Fuel Oil #4 Prod.	Acenaphthylene	secondary	-4.90e-12	-5.43e-13
Natural Gas Prod.	Acenaphthene	secondary	-5.87e-12	-6.52e-13
Natural Gas Prod.	Dibenzo[a,h]anthracene	secondary	-5.88e-12	-6.52e-13
Fuel Oil #4 Prod.	Biphenyl	secondary	-6.43e-12	-7.13e-13
Natural Gas Prod.	Benzo[a]pyrene	secondary	-6.53e-12	-7.25e-13
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	-9.76e-12	-1.08e-12
Natural Gas Prod.	Ethylene dibromide	secondary	-1.06e-11	-1.17e-12
Fuel Oil #4 Prod.	Cumene	secondary	-1.08e-11	-1.20e-12
LCD incineration	2-Methylnaphthalene	secondary	-1.13e-11	-1.25e-12
Natural Gas Prod.	Vinyl acetate	secondary	-1.14e-11	-1.26e-12
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	-1.27e-11	-1.41e-12
LCD incineration	Copper (+1 & +2)	secondary	-1.34e-11	-1.48e-12
Fuel Oil #4 Prod.	Acenaphthene	secondary	-1.51e-11	-1.67e-12
Natural Gas Prod.	Methyl tert-butyl ether	secondary	-1.60e-11	-1.78e-12
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	-1.80e-11	-1.99e-12
LCD incineration	3-Methylcholanthrene	secondary	-1.80e-11	-2.00e-12
Fuel Oil #4 Prod.	Chlorine	secondary	-2.08e-11	-2.31e-12
Natural Gas Prod.	Phenanthrene	secondary	-2.33e-11	-2.59e-12
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	-2.40e-11	-2.66e-12
LCD incineration	Chlorine	secondary	-2.51e-11	-2.79e-12
LCD incineration	Benzo[g,h,i]perylene	secondary	-2.63e-11	-2.92e-12
Natural Gas Prod.	Aluminum (elemental)	secondary	-2.81e-11	-3.12e-12
LCD incineration	Aromatic hydrocarbons	secondary	-2.86e-11	-3.17e-12
LCD incineration	Zinc (+2)	secondary	-2.90e-11	-3.22e-12
LCD incineration	Dichlorobenzene (mixed isomers)	secondary	-3.18e-11	-3.52e-12
Natural Gas Prod.	Ethylbenzene	secondary	-3.20e-11	-3.55e-12
Natural Gas Prod.	2-Methylnaphthalene	secondary	-3.58e-11	-3.97e-12
Fuel Oil #4 Prod.	3-Methylcholanthrene	secondary	-3.83e-11	-4.25e-12
Fuel Oil #4 Prod.	Zinc (+2)	secondary	-4.24e-11	-4.70e-12
LCD incineration	5-Methyl chrysene	secondary	-4.24e-11	-4.70e-12
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	-4.37e-11	-4.85e-12
Fuel Oil #4 Prod.	Vinyl acetate	secondary	-4.71e-11	-5.23e-12
LCD incineration	Pyrene	secondary	-5.06e-11	-5.62e-12
Fuel Oil #4 Prod.	Phenanthrene	secondary	-5.20e-11	-5.76e-12
Natural Gas Prod.	Chromium (III)	secondary	-5.33e-11	-5.91e-12
Natural Gas Prod.	3-Methylcholanthrene	secondary	-5.72e-11	-6.35e-12
Natural Gas Prod.	Acetophenone	secondary	-5.93e-11	-6.57e-12
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	-6.45e-11	-7.16e-12
LCD incineration	Fluoranthene	secondary	-6.52e-11	-7.23e-12
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	-6.62e-11	-7.34e-12
Natural Gas Prod.	Chlorobenzene	secondary	-8.05e-11	-8.93e-12
LCD incineration	Fluorene	secondary	-8.35e-11	-9.27e-12
LCD incineration	Indeno(1,2,3-cd)pyrene	secondary	-9.04e-11	-1.00e-11
LCD incineration	Chrysene	secondary	-9.73e-11	-1.08e-11
Natural Gas Prod.	Dichloromethane	secondary	-9.93e-11	-1.10e-11
Natural Gas Prod.	Bromoform	secondary	-1.01e-10	-1.12e-11
Natural Gas Prod.	Barium cmpds	secondary	-1.06e-10	-1.18e-11

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Styrene	secondary	-1.08e-10	-1.19e-11
LCD incineration	Benzo[a]anthracene	secondary	-1.18e-10	-1.31e-11
Natural Gas Prod.	Methyl methacrylate	secondary	-1.22e-10	-1.35e-11
Natural Gas Prod.	1,2-Dichloroethane	secondary	-1.25e-10	-1.39e-11
Fuel Oil #4 Prod.	Ethylbenzene	secondary	-1.32e-10	-1.46e-11
Natural Gas Prod.	Tetrachloroethylene	secondary	-1.41e-10	-1.56e-11
Natural Gas Prod.	Methyl ethyl ketone	secondary	-1.43e-10	-1.58e-11
Fuel Oil #4 Prod.	o-xylene	secondary	-1.43e-10	-1.58e-11
Natural Gas Prod.	Isophorone	secondary	-1.78e-10	-1.98e-11
Fuel Oil #4 Prod.	Chromium (III)	secondary	-2.04e-10	-2.27e-11
LCD incineration	Anthracene	secondary	-2.05e-10	-2.28e-11
LCD incineration	Benzo[b,j,k]fluoranthene	secondary	-2.12e-10	-2.35e-11
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	-2.12e-10	-2.35e-11
LCD incineration	Benzo[a]pyrene	secondary	-2.31e-10	-2.57e-11
LCD incineration	Acenaphthylene	secondary	-2.41e-10	-2.68e-11
Fuel Oil #4 Prod.	Acetophenone	secondary	-2.45e-10	-2.72e-11
Natural Gas Prod.	Silicon	secondary	-2.46e-10	-2.73e-11
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	-2.67e-10	-2.96e-11
Natural Gas Prod.	Chlorine	secondary	-3.13e-10	-3.48e-11
Fuel Oil #4 Prod.	Chlorobenzene	secondary	-3.33e-10	-3.69e-11
Natural Gas Prod.	Zinc (+2)	secondary	-3.47e-10	-3.85e-11
Natural Gas Prod.	Dimethyl sulfate	secondary	-3.69e-10	-4.09e-11
LCD incineration	Biphenyl	secondary	-3.90e-10	-4.32e-11
Fuel Oil #4 Prod.	Dichloromethane	secondary	-4.11e-10	-4.56e-11
Fuel Oil #4 Prod.	Bromoform	secondary	-4.16e-10	-4.62e-11
Fuel Oil #4 Prod.	Styrene	secondary	-4.46e-10	-4.94e-11
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	-4.53e-10	-5.03e-11
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	-5.04e-10	-5.59e-11
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	-5.19e-10	-5.75e-11
Natural Gas Prod.	Acetaldehyde	secondary	-5.30e-10	-5.88e-11
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	-5.83e-10	-6.47e-11
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	-5.90e-10	-6.54e-11
Natural Gas Prod.	Mercury	secondary	-6.23e-10	-6.92e-11
LCD incineration	Cumene	secondary	-6.53e-10	-7.25e-11
LCD incineration	Acenaphthene	secondary	-6.59e-10	-7.31e-11
Natural Gas Prod.	Di(2-ethylhexyl)phthalate	secondary	-6.66e-10	-7.39e-11
LCD incineration	Aluminum (elemental)	secondary	-7.02e-10	-7.79e-11
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	-7.23e-10	-8.02e-11
Fuel Oil #4 Prod.	Isophorone	secondary	-7.37e-10	-8.18e-11
LCD incineration	Ethyl Chloride	secondary	-7.72e-10	-8.57e-11
Natural Gas Prod.	Methyl chloride	secondary	-9.24e-10	-1.03e-10
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	-1.08e-09	-1.20e-10
LCD incineration	1,1,1-Trichloroethane	secondary	-1.09e-09	-1.21e-10
Natural Gas Prod.	Acrolein	secondary	-1.11e-09	-1.24e-10
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	-1.12e-09	-1.25e-10
Fuel Oil #4 Prod.	Toluene	secondary	-1.35e-09	-1.49e-10
Natural Gas Prod.	o-xylene	secondary	-1.52e-09	-1.69e-10
Fuel Oil #4 Prod.	Dimethyl sulfate	secondary	-1.53e-09	-1.69e-10
Natural Gas Prod.	Cobalt	secondary	-1.75e-09	-1.94e-10
Natural Gas Prod.	Aluminum (+3)	secondary	-1.90e-09	-2.10e-10
Natural Gas Prod.	Propionaldehyde	secondary	-1.96e-09	-2.18e-10

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	Mercury	secondary	-2.05e-09	-2.28e-10
Natural Gas Prod.	Chloroform	secondary	-2.12e-09	-2.35e-10
Fuel Oil #4 Prod.	Acetaldehyde	secondary	-2.19e-09	-2.43e-10
LCD incineration	Xylene (mixed isomers)	secondary	-2.22e-09	-2.46e-10
LCD incineration	Phenanthrene	secondary	-2.61e-09	-2.89e-10
LCD incineration	Ethylene dibromide	secondary	-2.65e-09	-2.94e-10
Fuel Oil #4 Prod.	Di(2-ethylhexyl)phthalate	secondary	-2.75e-09	-3.05e-10
Natural Gas Prod.	Toluene	secondary	-2.86e-09	-3.17e-10
LCD incineration	Vinyl acetate	secondary	-2.86e-09	-3.17e-10
Natural Gas Prod.	Benzyl chloride	secondary	-3.01e-09	-3.34e-10
Natural Gas Prod.	PM-10	secondary	-3.27e-09	-3.63e-10
Fuel Oil #4 Prod.	Methyl chloride	secondary	-3.82e-09	-4.24e-10
Natural Gas Prod.	Carbon disulfide	secondary	-3.93e-09	-4.36e-10
LCD incineration	Methyl tert-butyl ether	secondary	-4.01e-09	-4.45e-10
Fuel Oil #4 Prod.	Acrolein	secondary	-4.61e-09	-5.11e-10
Natural Gas Prod.	Phenol	secondary	-4.83e-09	-5.36e-10
Natural Gas Prod.	Cadmium	secondary	-5.28e-09	-5.86e-10
LCD incineration	Silicon	secondary	-6.14e-09	-6.81e-10
LCD incineration	Ethylbenzene	secondary	-7.87e-09	-8.73e-10
Fuel Oil #4 Prod.	Propionaldehyde	secondary	-8.11e-09	-9.00e-10
Fuel Oil #4 Prod.	Chloroform	secondary	-8.78e-09	-9.74e-10
Natural Gas Prod.	Cyanide (-1)	secondary	-9.61e-09	-1.07e-09
Natural Gas Prod.	Nitrate	secondary	-9.96e-09	-1.10e-09
Fuel Oil #4 Prod.	Aluminum (elemental)	secondary	-1.06e-08	-1.18e-09
LCD incineration	Chromium (III)	secondary	-1.13e-08	-1.26e-09
Fuel Oil #4 Prod.	Cobalt	secondary	-1.22e-08	-1.36e-09
Fuel Oil #4 Prod.	Benzyl chloride	secondary	-1.24e-08	-1.38e-09
Natural Gas Prod.	Manganese	secondary	-1.31e-08	-1.45e-09
LCD incineration	Chloroacetophenone	secondary	-1.35e-08	-1.50e-09
Natural Gas Prod.	Beryllium	secondary	-1.41e-08	-1.57e-09
Natural Gas Prod.	Lead	secondary	-1.43e-08	-1.59e-09
LCD incineration	Acetophenone	secondary	-1.49e-08	-1.65e-09
LCD incineration	2,4-Dinitrotoluene	secondary	-1.62e-08	-1.79e-09
Fuel Oil #4 Prod.	Carbon disulfide	secondary	-1.63e-08	-1.80e-09
Natural Gas Prod.	Copper	secondary	-1.75e-08	-1.94e-09
Natural Gas Prod.	Bromomethane	secondary	-1.83e-08	-2.03e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	-1.85e-08	-2.05e-09
Natural Gas Prod.	Barium	secondary	-1.95e-08	-2.17e-09
Natural Gas Prod.	Methyl hydrazine	secondary	-1.98e-08	-2.19e-09
LCD incineration	Chlorobenzene	secondary	-2.02e-08	-2.24e-09
Fuel Oil #4 Prod.	Cadmium	secondary	-2.16e-08	-2.39e-09
LCD incineration	Dichloromethane	secondary	-2.49e-08	-2.76e-09
LCD incineration	Bromoform	secondary	-2.52e-08	-2.80e-09
Fuel Oil #4 Prod.	Barium cmpds	secondary	-2.57e-08	-2.85e-09
LCD incineration	Styrene	secondary	-2.70e-08	-3.00e-09
LCD incineration	Aluminum (+3)	secondary	-2.89e-08	-3.20e-09
LCD incineration	Methyl methacrylate	secondary	-3.06e-08	-3.39e-09
LCD incineration	1,2-Dichloroethane	secondary	-3.12e-08	-3.46e-09
LCD incineration	Dimethylbenzanthracene	secondary	-3.12e-08	-3.47e-09

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LCD incineration	Tetrachloroethylene	secondary	-3.51e-08	-3.90e-09
LCD incineration	Methyl ethyl ketone	secondary	-3.58e-08	-3.97e-09
Fuel Oil #4 Prod.	Barium	secondary	-3.61e-08	-4.00e-09
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	-3.97e-08	-4.41e-09
Natural Gas Prod.	Naphthalene	secondary	-4.37e-08	-4.84e-09
Natural Gas Prod.	Hydrogen sulfide	secondary	-4.46e-08	-4.94e-09
LCD incineration	Isophorone	secondary	-4.47e-08	-4.96e-09
LCD incineration	Toluene	secondary	-4.73e-08	-5.24e-09
Fuel Oil #4 Prod.	Beryllium	secondary	-5.06e-08	-5.62e-09
Fuel Oil #4 Prod.	Manganese	secondary	-5.28e-08	-5.86e-09
Fuel Oil #4 Prod.	Naphthalene	secondary	-5.36e-08	-5.94e-09
Natural Gas Prod.	Nickel	secondary	-5.78e-08	-6.41e-09
Fuel Oil #4 Prod.	Lead	secondary	-5.88e-08	-6.52e-09
Fuel Oil #4 Prod.	Dimethylbenzanthracene	secondary	-6.37e-08	-7.06e-09
Fuel Oil #4 Prod.	Bromomethane	secondary	-7.56e-08	-8.39e-09
LCD incineration	Phenol	secondary	-7.60e-08	-8.43e-09
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	-7.65e-08	-8.49e-09
LCD incineration	PM-10	secondary	-8.16e-08	-9.05e-09
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	-8.17e-08	-9.06e-09
LCD incineration	Mercury	secondary	-8.42e-08	-9.34e-09
Fuel Oil #4 Prod.	Copper	secondary	-8.86e-08	-9.82e-09
LCD incineration	Dimethyl sulfate	secondary	-9.25e-08	-1.03e-08
Fuel Oil #4 Prod.	Silicon	secondary	-9.29e-08	-1.03e-08
Natural Gas Prod.	Dimethylbenzanthracene	secondary	-9.51e-08	-1.06e-08
LCD incineration	Acetaldehyde	secondary	-1.33e-07	-1.47e-08
Natural Gas Prod.	Antimony	secondary	-1.48e-07	-1.64e-08
LCD incineration	Di(2-ethylhexyl)phthalate	secondary	-1.67e-07	-1.85e-08
Fuel Oil #4 Prod.	Nitrate	secondary	-2.08e-07	-2.31e-08
LCD incineration	Methyl chloride	secondary	-2.32e-07	-2.57e-08
LCD incineration	Cobalt	secondary	-2.48e-07	-2.76e-08
LCD incineration	Copper	secondary	-2.67e-07	-2.96e-08
LCD incineration	Acrolein	secondary	-2.79e-07	-3.10e-08
Fuel Oil #4 Prod.	Antimony	secondary	-4.22e-07	-4.68e-08
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	-4.59e-07	-5.09e-08
Natural Gas Prod.	Chromium (VI)	secondary	-4.90e-07	-5.43e-08
LCD incineration	Propionaldehyde	secondary	-4.92e-07	-5.46e-08
LCD incineration	Chloroform	secondary	-5.30e-07	-5.88e-08
Natural Gas Prod.	Phosphorus (yellow or white)	secondary	-5.86e-07	-6.50e-08
LCD incineration	Pentane	secondary	-6.12e-07	-6.78e-08
LCD incineration	Cadmium	secondary	-7.25e-07	-8.04e-08
LCD incineration	Benzyl chloride	secondary	-7.55e-07	-8.37e-08
Natural Gas Prod.	Molybdenum	secondary	-7.66e-07	-8.50e-08
LCD incineration	Barium	secondary	-8.87e-07	-9.84e-08
LCD incineration	Hexane	secondary	-9.76e-07	-1.08e-07
LCD incineration	Carbon disulfide	secondary	-9.86e-07	-1.09e-07
LCD incineration	Hydrogen sulfide	secondary	-1.03e-06	-1.14e-07
Fuel Oil #4 Prod.	Nickel	secondary	-1.09e-06	-1.20e-07
Natural Gas Prod.	Hydrofluoric acid	secondary	-1.15e-06	-1.28e-07
Fuel Oil #4 Prod.	Phenol	secondary	-1.16e-06	-1.28e-07
Fuel Oil #4 Prod.	PM-10	secondary	-1.24e-06	-1.37e-07
Fuel Oil #4 Prod.	Pentane	secondary	-1.30e-06	-1.44e-07

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LCD incineration	Naphthalene	secondary	-1.33e-06	-1.48e-07
LCD incineration	Ethane	secondary	-1.46e-06	-1.62e-07
Fuel Oil #4 Prod.	Hexane	secondary	-1.80e-06	-2.00e-07
Fuel Oil #4 Prod.	Chromium (VI)	secondary	-1.88e-06	-2.08e-07
Natural Gas Prod.	Pentane	secondary	-1.94e-06	-2.15e-07
LCD incineration	Nitrate	secondary	-2.33e-06	-2.58e-07
Fuel Oil #4 Prod.	Zinc (elemental)	secondary	-2.35e-06	-2.61e-07
LCD incineration	Cyanide (-1)	secondary	-2.41e-06	-2.67e-07
Natural Gas Prod.	Hexane	secondary	-2.69e-06	-2.98e-07
Natural Gas Prod.	Zinc (elemental)	secondary	-2.81e-06	-3.12e-07
LCD incineration	Beryllium	secondary	-2.97e-06	-3.30e-07
Fuel Oil #4 Prod.	Ethane	secondary	-3.10e-06	-3.43e-07
LCD incineration	Manganese	secondary	-3.17e-06	-3.52e-07
Natural Gas Prod.	Selenium	secondary	-4.02e-06	-4.46e-07
Fuel Oil #4 Prod.	Molybdenum	secondary	-4.28e-06	-4.75e-07
Natural Gas Prod.	Fluorides (F-)	secondary	-4.50e-06	-4.99e-07
LCD incineration	Bromomethane	secondary	-4.59e-06	-5.09e-07
Natural Gas Prod.	Ethane	secondary	-4.63e-06	-5.13e-07
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	-4.77e-06	-5.29e-07
LCD incineration	Methyl hydrazine	secondary	-4.95e-06	-5.49e-07
LCD incineration	Molybdenum	secondary	-6.45e-06	-7.16e-07
Natural Gas Prod.	Nitrous oxide	secondary	-7.65e-06	-8.48e-07
LCD incineration	Nickel	secondary	-8.94e-06	-9.91e-07
Natural Gas Prod.	Formaldehyde	secondary	-9.17e-06	-1.02e-06
Fuel Oil #4 Prod.	Ammonia	secondary	-1.15e-05	-1.27e-06
LCD incineration	Antimony	secondary	-1.40e-05	-1.55e-06
LCD incineration	Zinc (elemental)	secondary	-1.65e-05	-1.83e-06
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	-1.68e-05	-1.87e-06
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	-1.76e-05	-1.95e-06
Fuel Oil #4 Prod.	Selenium	secondary	-1.77e-05	-1.97e-06
Natural Gas Prod.	Hydrochloric acid	secondary	-2.11e-05	-2.35e-06
Natural Gas Prod.	Vanadium	secondary	-2.30e-05	-2.56e-06
Fuel Oil #4 Prod.	Phosphorus (yellow or white)	secondary	-2.63e-05	-2.92e-06
LCD incineration	Phosphorus (yellow or white)	secondary	-3.56e-05	-3.95e-06
LCD incineration	Ammonia	secondary	-4.82e-05	-5.34e-06
Fuel Oil #4 Prod.	Nitrous oxide	secondary	-8.16e-05	-9.05e-06
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	-8.74e-05	-9.69e-06
LCD incineration	Chromium (VI)	secondary	-1.04e-04	-1.15e-05
Natural Gas Prod.	Arsenic	secondary	-1.04e-04	-1.16e-05
Natural Gas Prod.	Ammonia	secondary	-1.41e-04	-1.56e-05
Natural Gas Prod.	Sulfur oxides	secondary	-1.83e-04	-2.02e-05
Natural Gas Prod.	PM	secondary	-2.74e-04	-3.04e-05
LCD incineration	Hydrofluoric acid	secondary	-2.89e-04	-3.21e-05
LCD incineration	Formaldehyde	secondary	-2.90e-04	-3.21e-05
Fuel Oil #4 Prod.	Formaldehyde	secondary	-3.65e-04	-4.05e-05
Fuel Oil #4 Prod.	Arsenic	secondary	-5.00e-04	-5.55e-05
Fuel Oil #4 Prod.	PM	secondary	-5.75e-04	-6.37e-05
LCD incineration	Vanadium	secondary	-7.60e-04	-8.43e-05
LCD incineration	Selenium	secondary	-9.94e-04	-1.10e-04

Table M-34. LCD LCIA Results for the Chronic Public Health Effects Impact Category

Process Group	Material	LCI Data Type	Chronic Public Toxicity (tox-kg)	% of Total
LCD incineration	Fluorides (F-)	secondary	-1.02e-03	-1.13e-04
LCD incineration	Nitrous oxide	secondary	-1.35e-03	-1.50e-04
Fuel Oil #4 Prod.	Benzene	secondary	-1.71e-03	-1.90e-04
LCD incineration	Benzene	secondary	-2.08e-03	-2.31e-04
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	-2.55e-03	-2.83e-04
Fuel Oil #4 Prod.	Vanadium	secondary	-2.86e-03	-3.17e-04
LCD incineration	Hydrochloric acid	secondary	-3.08e-03	-3.41e-04
Fuel Oil #4 Prod.	Sulfur oxides	secondary	-3.48e-03	-3.86e-04
Fuel Oil #4 Prod.	Methane	secondary	-3.70e-03	-4.10e-04
Natural Gas Prod.	Nitrogen oxides	secondary	-6.17e-03	-6.85e-04
Fuel Oil #4 Prod.	Carbon monoxide	secondary	-1.08e-02	-1.19e-03
LCD incineration	Carbon monoxide	secondary	-1.55e-02	-1.72e-03
LCD incineration	Nitrogen oxides	secondary	-1.86e-02	-2.07e-03
LCD incineration	Methane	secondary	-1.97e-02	-2.18e-03
Natural Gas Prod.	Carbon monoxide	secondary	-2.27e-02	-2.52e-03
LCD incineration	PM	secondary	-2.40e-02	-2.66e-03
LCD incineration	Arsenic	secondary	-2.50e-02	-2.78e-03
Natural Gas Prod.	Benzene	secondary	-2.51e-02	-2.78e-03
Natural Gas Prod.	Methane	secondary	-3.32e-02	-3.68e-03
LCD incineration	Sulfur oxides	secondary	-3.50e-02	-3.88e-03
Total End-of-life			**-6.30e-02**	**-6.99e-03**
Total All Life-cycle Stages			**9.02e+02**	**1.00e+02**

Table M-35. CRT LCIA Results for the Aesthetics Impacts Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Hydrogen sulfide	secondary	3.17e+04	4.18e-01
ABS Production	Hydrogen sulfide	secondary	2.36e+04	3.11e-01
Invar	Hydrogen sulfide	secondary	1.69e+04	2.24e-01
Ferrite mfg.	Hydrogen sulfide	secondary	1.21e+04	1.59e-01
Polycarbonate Production	Ethanethiol	secondary	1.05e+04	1.39e-01
Aluminum Prod.	Hydrogen sulfide	secondary	8.78e+03	1.16e-01
Lead	Hydrogen sulfide	secondary	6.91e+03	9.12e-02
ABS Production	Ethanethiol	secondary	4.82e+03	6.37e-02
Polycarbonate Production	Hydrogen sulfide	secondary	4.30e+03	5.68e-02
Invar	Acetaldehyde	secondary	4.27e+03	5.64e-02
Steel Prod., cold-rolled, semi-finished	Acetaldehyde	secondary	2.48e+03	3.28e-02
Ferrite mfg.	Acetaldehyde	secondary	7.11e+02	9.38e-03
Lead	Acetaldehyde	secondary	5.50e+02	7.26e-03
Styrene-butadiene Copolymer Prod.	Hydrogen sulfide	secondary	4.82e+02	6.37e-03
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	4.15e+02	5.48e-03
Aluminum Prod.	Acetic acid	secondary	1.14e+02	1.50e-03
Invar	Acetic acid	secondary	9.41e+01	1.24e-03
Steel Prod., cold-rolled, semi-finished	Acetic acid	secondary	5.51e+01	7.27e-04
Steel Prod., cold-rolled, semi-finished	Phenol	secondary	4.82e+01	6.37e-04
Aluminum Prod.	Xylene (mixed isomers)	secondary	3.04e+01	4.01e-04
ABS Production	Formaldehyde	secondary	2.86e+01	3.77e-04
Ferrite mfg.	Acetic acid	secondary	2.35e+01	3.10e-04
Lead	Acetic acid	secondary	1.96e+01	2.59e-04
Aluminum Prod.	Toluene	secondary	1.39e+01	1.83e-04
Invar	Phenol	secondary	1.37e+01	1.81e-04
Ferrite mfg.	Phenol	secondary	1.33e+01	1.76e-04
Steel Prod., cold-rolled, semi-finished	Toluene	secondary	1.30e+01	1.71e-04
Invar	Xylene (mixed isomers)	secondary	1.19e+01	1.58e-04
Aluminum Prod.	Ammonia	secondary	9.03e+00	1.19e-04
Steel Prod., cold-rolled, semi-finished	Xylene (mixed isomers)	secondary	8.98e+00	1.19e-04
ABS Production	Ethanol	secondary	8.17e+00	1.08e-04
Steel Prod., cold-rolled, semi-finished	Formaldehyde	secondary	7.41e+00	9.78e-05
Lead	Ammonia	secondary	6.93e+00	9.15e-05
Lead	Xylene (mixed isomers)	secondary	5.59e+00	7.37e-05
Invar	Toluene	secondary	4.74e+00	6.25e-05
Ferrite mfg.	Toluene	secondary	4.62e+00	6.10e-05
Invar	Ethanol	secondary	3.58e+00	4.73e-05
Invar	Ammonia	secondary	3.55e+00	4.69e-05
Ferrite mfg.	Xylene (mixed isomers)	secondary	3.10e+00	4.09e-05
Invar	Formaldehyde	secondary	2.86e+00	3.77e-05
Ferrite mfg.	Formaldehyde	secondary	2.79e+00	3.68e-05
Steel Prod., cold-rolled, semi-finished	Ethanol	secondary	2.08e+00	2.74e-05
Polycarbonate Production	Chlorine	secondary	2.01e+00	2.66e-05
Invar	Ethanethiol	secondary	1.98e+00	2.62e-05
Ferrite mfg.	Ethanethiol	secondary	1.94e+00	2.56e-05
ABS Production	Chlorine	secondary	1.85e+00	2.44e-05
Ferrite mfg.	Ammonia	secondary	1.17e+00	1.55e-05
Styrene-butadiene Copolymer Prod.	Chlorine	secondary	9.01e-01	1.19e-05
ABS Production	Ammonia	secondary	8.49e-01	1.12e-05
Invar	Methanol	secondary	6.43e-01	8.49e-06

Table M-35. CRT LCIA Results for the Aesthetics Impacts Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Ferrite mfg.	Ethanol	secondary	5.85e-01	7.73e-06
Lead	Ethanol	secondary	4.54e-01	5.99e-06
Steel Prod., cold-rolled, semi-finished	Methanol	secondary	4.11e-01	5.43e-06
Steel Prod., cold-rolled, semi-finished	Benzene	secondary	2.58e-01	3.41e-06
Styrene-butadiene Copolymer Prod.	Ammonia	secondary	2.07e-01	2.74e-06
Invar	Benzene	secondary	1.27e-01	1.68e-06
Ferrite mfg.	Methanol	secondary	1.16e-01	1.53e-06
Aluminum Prod.	Phenol	secondary	1.03e-01	1.36e-06
Ferrite mfg.	Benzene	secondary	8.64e-02	1.14e-06
Steel Prod., cold-rolled, semi-finished	Naphthalene	secondary	7.46e-02	9.84e-07
Aluminum Prod.	Benzene	secondary	6.00e-02	7.92e-07
Lead	Methanol	secondary	5.60e-02	7.39e-07
Lead	Benzene	secondary	4.09e-02	5.40e-07
Invar	Propionic acid	secondary	3.92e-02	5.18e-07
Invar	Acetone	secondary	1.59e-02	2.10e-07
Steel Prod., cold-rolled, semi-finished	Acetone	secondary	9.25e-03	1.22e-07
Ferrite mfg.	Acetone	secondary	2.61e-03	3.44e-08
Lead	Acetone	secondary	2.01e-03	2.65e-08
Invar	Chlorine	secondary	6.89e-04	9.09e-09
Ferrite mfg.	Chlorine	secondary	6.72e-04	8.88e-09
Steel Prod., cold-rolled, semi-finished	Isopropylpropionate	secondary	6.34e-04	8.36e-09
Ferrite mfg.	Isopropylpropionate	secondary	6.22e-04	8.21e-09
Lead	Acrolein	secondary	3.46e-04	4.57e-09
Steel Prod., cold-rolled, semi-finished	Chlorine	secondary	8.13e-05	1.07e-09
Invar	Propionaldehyde	secondary	4.43e-05	5.85e-10
Steel Prod., cold-rolled, semi-finished	Propionaldehyde	secondary	4.43e-05	5.85e-10
Ferrite mfg.	Propionaldehyde	secondary	4.33e-05	5.71e-10
Invar	Acrolein	secondary	1.44e-07	1.90e-12
Total Materials Processing			**1.29e+05**	**1.70e+00**
Manufacturing Life-cycle Stage				
LPG Production	Hydrogen sulfide	secondary	7.15e+06	9.43e+01
Fuel Oil #6 Prod.	Hydrogen sulfide	secondary	7.40e+04	9.77e-01
Fuel Oil #2 Prod.	Hydrogen sulfide	secondary	2.36e+04	3.11e-01
LPG Production	Acetaldehyde	secondary	1.42e+04	1.87e-01
CRT tube mfg.	Toluene	primary	6.41e+03	8.46e-02
US electric grid	Acetaldehyde	model/secondary	3.03e+03	4.00e-02
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	2.76e+03	3.65e-02
Japanese Electric Grid	Acetaldehyde	model/secondary	2.42e+03	3.19e-02
LPG Production	Formaldehyde	secondary	2.39e+03	3.16e-02
LPG Production	Ammonia	secondary	2.18e+03	2.88e-02
LPG Production	Propionaldehyde	secondary	7.28e+02	9.61e-03
CRT tube mfg.	Xylene (mixed isomers)	primary	6.31e+02	8.33e-03
Natural Gas Prod.	Ammonia	secondary	1.57e+02	2.07e-03
Natural Gas Prod.	Hydrogen sulfide	secondary	1.57e+02	2.07e-03
US electric grid	Propionaldehyde	model/secondary	1.56e+02	2.06e-03
LPG Production	Benzene	secondary	1.33e+02	1.76e-03
Japanese Electric Grid	Propionaldehyde	model/secondary	1.24e+02	1.64e-03
Fuel Oil #6 Prod.	Acetaldehyde	secondary	1.14e+02	1.51e-03
PWB Mfg.	Formaldehyde	model/secondary	7.94e+01	1.05e-03
Fuel Oil #2 Prod.	Acetaldehyde	secondary	4.44e+01	5.86e-04
LPG Production	Acrolein	secondary	2.82e+01	3.72e-04

Table M-35. CRT LCIA Results for the Aesthetics Impacts Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Natural Gas Prod.	Acetaldehyde	secondary	2.46e+01	3.24e-04
Fuel Oil #6 Prod.	Formaldehyde	secondary	2.45e+01	3.23e-04
LPG Production	Benzyl chloride	secondary	2.24e+01	2.95e-04
Japanese Electric Grid	Formaldehyde	model/secondary	2.09e+01	2.76e-04
Natural Gas Prod.	Benzene	secondary	1.18e+01	1.55e-04
Fuel Oil #6 Prod.	Ammonia	secondary	1.17e+01	1.55e-04
Fuel Oil #2 Prod.	Formaldehyde	secondary	7.87e+00	1.04e-04
Fuel Oil #2 Prod.	Ammonia	secondary	6.43e+00	8.49e-05
LPG Production	Toluene	secondary	6.21e+00	8.19e-05
US electric grid	Acrolein	model/secondary	6.03e+00	7.96e-05
Fuel Oil #6 Prod.	Propionaldehyde	secondary	5.87e+00	7.76e-05
LPG Production	Carbon disulfide	secondary	4.84e+00	6.39e-05
Japanese Electric Grid	Acrolein	model/secondary	4.81e+00	6.36e-05
US electric grid	Benzyl chloride	model/secondary	4.78e+00	6.31e-05
Fuel Oil #4 Prod.	Acetaldehyde	secondary	4.74e+00	6.25e-05
LPG Production	Methyl ethyl ketone	secondary	3.85e+00	5.08e-05
Japanese Electric Grid	Benzyl chloride	model/secondary	3.82e+00	5.04e-05
LPG Production	Isophorone	secondary	3.54e+00	4.67e-05
US electric grid	Formaldehyde	model/secondary	2.76e+00	3.65e-05
LPG Production	Phenol	secondary	2.75e+00	3.63e-05
LPG Production	Styrene	secondary	2.47e+00	3.25e-05
Japanese Electric Grid	Toluene	model/secondary	2.39e+00	3.15e-05
Fuel Oil #2 Prod.	Propionaldehyde	secondary	2.28e+00	3.02e-05
LPG Production	Naphthalene	secondary	1.75e+00	2.31e-05
LPG Production	o-xylene	secondary	1.33e+00	1.75e-05
Natural Gas Prod.	Propionaldehyde	secondary	1.26e+00	1.67e-05
Japanese Electric Grid	Naphthalene	model/secondary	1.11e+00	1.46e-05
US electric grid	Carbon disulfide	model/secondary	1.04e+00	1.37e-05
Fuel Oil #4 Prod.	Formaldehyde	secondary	9.18e-01	1.21e-05
LPG Production	Cumene	secondary	8.89e-01	1.17e-05
Japanese Electric Grid	Carbon disulfide	model/secondary	8.27e-01	1.09e-05
US electric grid	Methyl ethyl ketone	model/secondary	8.23e-01	1.09e-05
Fuel Oil #6 Prod.	Benzene	secondary	7.61e-01	1.00e-05
US electric grid	Isophorone	model/secondary	7.57e-01	9.99e-06
US electric grid	Toluene	model/secondary	6.78e-01	8.95e-06
LPG Production	Methyl methacrylate	secondary	6.71e-01	8.85e-06
Japanese Electric Grid	Methyl ethyl ketone	model/secondary	6.57e-01	8.67e-06
Japanese Electric Grid	Isophorone	model/secondary	6.04e-01	7.97e-06
LPG Production	Methyl hydrazine	secondary	6.00e-01	7.92e-06
Fuel Oil #4 Prod.	Ammonia	secondary	5.97e-01	7.88e-06
US electric grid	Phenol	model/secondary	5.89e-01	7.77e-06
US electric grid	Styrene	model/secondary	5.27e-01	6.96e-06
Natural Gas Prod.	Formaldehyde	secondary	4.95e-01	6.53e-06
Japanese Electric Grid	Phenol	model/secondary	4.70e-01	6.20e-06
LPG Production	2-Chloroacetophenone	secondary	4.69e-01	6.20e-06
Japanese Electric Grid	Styrene	model/secondary	4.21e-01	5.56e-06
LPG Production	1,4-Dichlorobenzene	secondary	4.12e-01	5.44e-06
Fuel Oil #2 Prod.	Benzene	secondary	3.96e-01	5.22e-06
Fuel Oil #4 Prod.	Propionaldehyde	secondary	2.44e-01	3.22e-06
Fuel Oil #6 Prod.	Acrolein	secondary	2.27e-01	3.00e-06
US electric grid	Cumene	model/secondary	1.90e-01	2.51e-06

Table M-35. CRT LCIA Results for the Aesthetics Impacts Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Fuel Oil #6 Prod.	Benzyl chloride	secondary	1.80e-01	2.38e-06
LPG Production	Chlorobenzene	secondary	1.48e-01	1.95e-06
US electric grid	Naphthalene	model/secondary	1.46e-01	1.93e-06
US electric grid	Methyl methacrylate	model/secondary	1.43e-01	1.89e-06
US electric grid	Methyl hydrazine	model/secondary	1.28e-01	1.69e-06
LPG Production	Vinyl acetate	secondary	1.27e-01	1.68e-06
Japanese Electric Grid	Methyl methacrylate	model/secondary	1.15e-01	1.51e-06
Japanese Electric Grid	Methyl hydrazine	model/secondary	1.03e-01	1.35e-06
US electric grid	2-Chloroacetophenone	model/secondary	1.00e-01	1.33e-06
Natural Gas Prod.	o-xylene	secondary	8.89e-02	1.17e-06
Fuel Oil #2 Prod.	Acrolein	secondary	8.84e-02	1.17e-06
US electric grid	Xylene (mixed isomers)	model/secondary	8.70e-02	1.15e-06
Natural Gas Prod.	Toluene	secondary	8.63e-02	1.14e-06
Japanese Electric Grid	2-Chloroacetophenone	model/secondary	8.02e-02	1.06e-06
Fuel Oil #2 Prod.	Benzyl chloride	secondary	7.01e-02	9.26e-07
Japanese Electric Grid	Xylene (mixed isomers)	model/secondary	6.95e-02	9.17e-07
LPG Production	Acetophenone	secondary	6.71e-02	8.85e-07
Natural Gas Prod.	Acrolein	secondary	4.89e-02	6.45e-07
Fuel Oil #6 Prod.	Toluene	secondary	4.18e-02	5.52e-07
Fuel Oil #6 Prod.	Carbon disulfide	secondary	3.91e-02	5.16e-07
Natural Gas Prod.	Benzyl chloride	secondary	3.88e-02	5.12e-07
Fuel Oil #4 Prod.	Benzene	secondary	3.74e-02	4.94e-07
LPG Production	Tetrachloroethylene	secondary	3.47e-02	4.59e-07
US electric grid	Chlorobenzene	model/secondary	3.16e-02	4.17e-07
Fuel Oil #6 Prod.	Methyl ethyl ketone	secondary	3.10e-02	4.10e-07
Fuel Oil #6 Prod.	Isophorone	secondary	2.85e-02	3.77e-07
US electric grid	Vinyl acetate	model/secondary	2.73e-02	3.60e-07
LPG Production	1,1,1-Trichloroethane	secondary	2.53e-02	3.34e-07
Japanese Electric Grid	Chlorobenzene	model/secondary	2.52e-02	3.33e-07
Japanese Electric Grid	o-xylene	model/secondary	2.48e-02	3.27e-07
LPG Production	Chlorine	secondary	2.32e-02	3.06e-07
Fuel Oil #6 Prod.	Phenol	secondary	2.22e-02	2.93e-07
Japanese Electric Grid	Vinyl acetate	model/secondary	2.17e-02	2.87e-07
Fuel Oil #6 Prod.	Styrene	secondary	1.99e-02	2.63e-07
Fuel Oil #2 Prod.	Toluene	secondary	1.89e-02	2.49e-07
US electric grid	Benzene	model/secondary	1.73e-02	2.28e-07
Fuel Oil #2 Prod.	Carbon disulfide	secondary	1.52e-02	2.01e-07
US electric grid	Acetophenone	model/secondary	1.43e-02	1.89e-07
Japanese Electric Grid	Benzene	model/secondary	1.41e-02	1.87e-07
Japanese Electric Grid	1,1,1-Trichloroethane	model/secondary	1.22e-02	1.61e-07
Fuel Oil #2 Prod.	Methyl ethyl ketone	secondary	1.21e-02	1.59e-07
Japanese Electric Grid	Acetophenone	model/secondary	1.15e-02	1.51e-07
Fuel Oil #2 Prod.	Isophorone	secondary	1.11e-02	1.46e-07
LPG Production	1,2-Dichloroethane	secondary	1.07e-02	1.42e-07
Fuel Oil #6 Prod.	Naphthalene	secondary	1.06e-02	1.40e-07
Fuel Oil #4 Prod.	Acrolein	secondary	9.43e-03	1.24e-07
Natural Gas Prod.	Naphthalene	secondary	8.83e-03	1.17e-07
Fuel Oil #2 Prod.	Phenol	secondary	8.63e-03	1.14e-07
Natural Gas Prod.	Carbon disulfide	secondary	8.40e-03	1.11e-07
Fuel Oil #6 Prod.	o-xylene	secondary	8.28e-03	1.09e-07
Fuel Oil #2 Prod.	Styrene	secondary	7.73e-03	1.02e-07

Table M-35. CRT LCIA Results for the Aesthetics Impacts Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Fuel Oil #4 Prod.	Benzyl chloride	secondary	7.48e-03	9.87e-08
US electric grid	Tetrachloroethylene	model/secondary	7.43e-03	9.81e-08
Fuel Oil #6 Prod.	Cumene	secondary	7.17e-03	9.46e-08
Natural Gas Prod.	Methyl ethyl ketone	secondary	6.67e-03	8.81e-08
Natural Gas Prod.	Isophorone	secondary	6.13e-03	8.10e-08
Japanese Electric Grid	Tetrachloroethylene	model/secondary	5.94e-03	7.83e-08
US electric grid	1,1,1-Trichloroethane	model/secondary	5.79e-03	7.64e-08
Fuel Oil #6 Prod.	Methyl methacrylate	secondary	5.41e-03	7.14e-08
Fuel Oil #2 Prod.	Naphthalene	secondary	5.24e-03	6.92e-08
Fuel Oil #6 Prod.	Methyl hydrazine	secondary	4.84e-03	6.39e-08
Natural Gas Prod.	Phenol	secondary	4.77e-03	6.30e-08
Natural Gas Prod.	Styrene	secondary	4.28e-03	5.65e-08
Fuel Oil #2 Prod.	o-xylene	secondary	3.99e-03	5.27e-08
Fuel Oil #6 Prod.	2-Chloroacetophenone	secondary	3.79e-03	5.00e-08
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	3.71e-03	4.90e-08
LPG Production	Dichloromethane	secondary	3.04e-03	4.01e-08
Fuel Oil #2 Prod.	Cumene	secondary	2.79e-03	3.68e-08
Fuel Oil #6 Prod.	1,4-Dichlorobenzene	secondary	2.36e-03	3.11e-08
US electric grid	1,2-Dichloroethane	model/secondary	2.30e-03	3.03e-08
Fuel Oil #2 Prod.	Methyl methacrylate	secondary	2.10e-03	2.78e-08
Natural Gas Prod.	Chlorine	secondary	2.06e-03	2.72e-08
Fuel Oil #4 Prod.	Toluene	secondary	1.89e-03	2.49e-08
Fuel Oil #2 Prod.	Methyl hydrazine	secondary	1.88e-03	2.48e-08
Japanese Electric Grid	1,2-Dichloroethane	model/secondary	1.83e-03	2.42e-08
Fuel Oil #4 Prod.	Carbon disulfide	secondary	1.62e-03	2.14e-08
Natural Gas Prod.	Cumene	secondary	1.54e-03	2.03e-08
Fuel Oil #2 Prod.	2-Chloroacetophenone	secondary	1.47e-03	1.94e-08
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	1.29e-03	1.70e-08
Fuel Oil #2 Prod.	1,4-Dichlorobenzene	secondary	1.22e-03	1.62e-08
Fuel Oil #6 Prod.	Chlorobenzene	secondary	1.19e-03	1.57e-08
Fuel Oil #4 Prod.	Isophorone	secondary	1.18e-03	1.56e-08
US electric grid	o-xylene	model/secondary	1.17e-03	1.55e-08
Natural Gas Prod.	Methyl methacrylate	secondary	1.16e-03	1.54e-08
Natural Gas Prod.	Methyl hydrazine	secondary	1.04e-03	1.37e-08
Fuel Oil #6 Prod.	Vinyl acetate	secondary	1.03e-03	1.36e-08
Fuel Oil #4 Prod.	Phenol	secondary	9.20e-04	1.21e-08
Fuel Oil #4 Prod.	Styrene	secondary	8.25e-04	1.09e-08
Natural Gas Prod.	2-Chloroacetophenone	secondary	8.14e-04	1.07e-08
US electric grid	Dichloromethane	model/secondary	6.50e-04	8.58e-09
LPG Production	Chloroform	secondary	6.09e-04	8.04e-09
Fuel Oil #6 Prod.	Acetophenone	secondary	5.41e-04	7.14e-09
Japanese Electric Grid	Dichloromethane	model/secondary	5.19e-04	6.85e-09
Fuel Oil #4 Prod.	Naphthalene	secondary	5.05e-04	6.67e-09
Fuel Oil #2 Prod.	Chlorobenzene	secondary	4.63e-04	6.11e-09
Fuel Oil #2 Prod.	Vinyl acetate	secondary	4.00e-04	5.28e-09
Fuel Oil #4 Prod.	o-xylene	secondary	3.89e-04	5.13e-09
Fuel Oil #4 Prod.	Cumene	secondary	2.97e-04	3.92e-09
Fuel Oil #6 Prod.	Tetrachloroethylene	secondary	2.80e-04	3.70e-09
Natural Gas Prod.	Chlorobenzene	secondary	2.56e-04	3.38e-09
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	2.24e-04	2.96e-09
Natural Gas Prod.	Vinyl acetate	secondary	2.21e-04	2.92e-09

Table M-35. CRT LCIA Results for the Aesthetics Impacts Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Fuel Oil #2 Prod.	Acetophenone	secondary	2.10e-04	2.78e-09
Fuel Oil #6 Prod.	1,1,1-Trichloroethane	secondary	2.04e-04	2.70e-09
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	2.01e-04	2.65e-09
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	1.57e-04	2.07e-09
US electric grid	Chloroform	model/secondary	1.30e-04	1.72e-09
Fuel Oil #6 Prod.	Chlorine	secondary	1.29e-04	1.70e-09
Natural Gas Prod.	Acetophenone	secondary	1.16e-04	1.54e-09
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	1.16e-04	1.53e-09
Fuel Oil #2 Prod.	Tetrachloroethylene	secondary	1.09e-04	1.44e-09
Japanese Electric Grid	Chloroform	model/secondary	1.04e-04	1.37e-09
Fuel Oil #6 Prod.	1,2-Dichloroethane	secondary	8.66e-05	1.14e-09
Fuel Oil #2 Prod.	1,1,1-Trichloroethane	secondary	7.94e-05	1.05e-09
Fuel Oil #2 Prod.	Chlorine	secondary	6.80e-05	8.97e-10
Natural Gas Prod.	Tetrachloroethylene	secondary	6.03e-05	7.96e-10
Fuel Oil #4 Prod.	Chlorobenzene	secondary	4.94e-05	6.52e-10
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	4.39e-05	5.79e-10
Fuel Oil #4 Prod.	Vinyl acetate	secondary	4.26e-05	5.63e-10
Fuel Oil #2 Prod.	1,2-Dichloroethane	secondary	3.37e-05	4.44e-10
Fuel Oil #6 Prod.	Dichloromethane	secondary	2.45e-05	3.24e-10
Fuel Oil #4 Prod.	Acetophenone	secondary	2.24e-05	2.96e-10
Natural Gas Prod.	1,2-Dichloroethane	secondary	1.86e-05	2.46e-10
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	1.16e-05	1.53e-10
Fuel Oil #2 Prod.	Dichloromethane	secondary	9.53e-06	1.26e-10
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	8.47e-06	1.12e-10
Fuel Oil #4 Prod.	Chlorine	secondary	6.40e-06	8.44e-11
Natural Gas Prod.	Dichloromethane	secondary	5.27e-06	6.96e-11
Fuel Oil #6 Prod.	Chloroform	secondary	4.91e-06	6.48e-11
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	3.59e-06	4.74e-11
Fuel Oil #2 Prod.	Chloroform	secondary	1.91e-06	2.52e-11
Natural Gas Prod.	Chloroform	secondary	1.06e-06	1.39e-11
Fuel Oil #4 Prod.	Dichloromethane	secondary	1.02e-06	1.34e-11
Fuel Oil #4 Prod.	Chloroform	secondary	2.04e-07	2.69e-12
Total Manufacturing			**7.41e+06**	**9.78e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Acetaldehyde	model/secondary	1.90e+05	2.50e+00
US electric grid	Propionaldehyde	model/secondary	9.76e+03	1.29e-01
US electric grid	Acrolein	model/secondary	3.78e+02	4.99e-03
US electric grid	Benzyl chloride	model/secondary	3.00e+02	3.96e-03
US electric grid	Formaldehyde	model/secondary	1.73e+02	2.29e-03
US electric grid	Carbon disulfide	model/secondary	6.49e+01	8.57e-04
US electric grid	Methyl ethyl ketone	model/secondary	5.16e+01	6.81e-04
US electric grid	Isophorone	model/secondary	4.74e+01	6.26e-04
US electric grid	Toluene	model/secondary	4.25e+01	5.61e-04
US electric grid	Phenol	model/secondary	3.69e+01	4.87e-04
US electric grid	Styrene	model/secondary	3.30e+01	4.36e-04
US electric grid	Cumene	model/secondary	1.19e+01	1.57e-04
US electric grid	Naphthalene	model/secondary	9.16e+00	1.21e-04
US electric grid	Methyl methacrylate	model/secondary	8.99e+00	1.19e-04
US electric grid	Methyl hydrazine	model/secondary	8.04e+00	1.06e-04
US electric grid	2-Chloroacetophenone	model/secondary	6.29e+00	8.31e-05
US electric grid	Xylene (mixed isomers)	model/secondary	5.45e+00	7.20e-05

Table M-35. CRT LCIA Results for the Aesthetics Impacts Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
US electric grid	Chlorobenzene	model/secondary	1.98e+00	2.61e-05
US electric grid	Vinyl acetate	model/secondary	1.71e+00	2.25e-05
US electric grid	Benzene	model/secondary	1.08e+00	1.43e-05
US electric grid	Acetophenone	model/secondary	8.99e-01	1.19e-05
US electric grid	Tetrachloroethylene	model/secondary	4.66e-01	6.15e-06
US electric grid	1,1,1-Trichloroethane	model/secondary	3.63e-01	4.79e-06
US electric grid	1,2-Dichloroethane	model/secondary	1.44e-01	1.90e-06
US electric grid	o-xylene	model/secondary	7.33e-02	9.68e-07
US electric grid	Dichloromethane	model/secondary	4.07e-02	5.38e-07
US electric grid	Chloroform	model/secondary	8.16e-03	1.08e-07
Total Use, Maintenance and Repair			**2.01e+05**	**2.65e+00**
End-of-life Life-cycle Stage				
CRT landfilling	Hydrogen sulfide	primary	5.37e+02	7.09e-03
LPG Production	Hydrogen sulfide	secondary	6.17e+01	8.14e-04
US electric grid	Acetaldehyde	model/secondary	1.90e+01	2.51e-04
US electric grid	Propionaldehyde	model/secondary	9.76e-01	1.29e-05
LPG Production	Acetaldehyde	secondary	1.22e-01	1.61e-06
CRT landfilling	Toluene	primary	7.98e-02	1.05e-06
CRT landfilling	Xylene (mixed isomers)	primary	4.07e-02	5.37e-07
US electric grid	Acrolein	model/secondary	3.78e-02	4.99e-07
US electric grid	Benzyl chloride	model/secondary	3.00e-02	3.96e-07
LPG Production	Formaldehyde	secondary	2.07e-02	2.73e-07
LPG Production	Ammonia	secondary	1.88e-02	2.49e-07
US electric grid	Formaldehyde	model/secondary	1.73e-02	2.29e-07
US electric grid	Carbon disulfide	model/secondary	6.50e-03	8.57e-08
LPG Production	Propionaldehyde	secondary	6.28e-03	8.30e-08
CRT landfilling	Benzene	primary	6.28e-03	8.29e-08
US electric grid	Methyl ethyl ketone	model/secondary	5.16e-03	6.81e-08
US electric grid	Isophorone	model/secondary	4.74e-03	6.26e-08
US electric grid	Toluene	model/secondary	4.25e-03	5.61e-08
US electric grid	Phenol	model/secondary	3.69e-03	4.87e-08
US electric grid	Styrene	model/secondary	3.31e-03	4.36e-08
US electric grid	Cumene	model/secondary	1.19e-03	1.57e-08
LPG Production	Benzene	secondary	1.15e-03	1.52e-08
US electric grid	Naphthalene	model/secondary	9.17e-04	1.21e-08
US electric grid	Methyl methacrylate	model/secondary	8.99e-04	1.19e-08
US electric grid	Methyl hydrazine	model/secondary	8.05e-04	1.06e-08
US electric grid	2-Chloroacetophenone	model/secondary	6.30e-04	8.31e-09
US electric grid	Xylene (mixed isomers)	model/secondary	5.45e-04	7.20e-09
CRT Incineration	Trichloroethylene	secondary	3.77e-04	4.98e-09
CRT landfilling	Trichloroethylene	primary	3.52e-04	4.64e-09
LPG Production	Acrolein	secondary	2.43e-04	3.21e-09
US electric grid	Chlorobenzene	model/secondary	1.98e-04	2.61e-09
LPG Production	Benzyl chloride	secondary	1.93e-04	2.55e-09
US electric grid	Vinyl acetate	model/secondary	1.71e-04	2.26e-09
CRT landfilling	Tetrachloroethylene	primary	1.65e-04	2.18e-09
US electric grid	Benzene	model/secondary	1.08e-04	1.43e-09
US electric grid	Acetophenone	model/secondary	8.99e-05	1.19e-09
CRT landfilling	1,2-Dichloroethane	primary	5.49e-05	7.25e-10
LPG Production	Toluene	secondary	5.36e-05	7.07e-10

Table M-35. CRT LCIA Results for the Aesthetics Impacts Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
US electric grid	Tetrachloroethylene	model/secondary	4.66e-05	6.15e-10
LPG Production	Carbon disulfide	secondary	4.18e-05	5.52e-10
US electric grid	1,1,1-Trichloroethane	model/secondary	3.63e-05	4.79e-10
LPG Production	Methyl ethyl ketone	secondary	3.32e-05	4.38e-10
LPG Production	Isophorone	secondary	3.05e-05	4.03e-10
LPG Production	Phenol	secondary	2.37e-05	3.13e-10
LPG Production	Styrene	secondary	2.13e-05	2.81e-10
LPG Production	Naphthalene	secondary	1.51e-05	1.99e-10
US electric grid	1,2-Dichloroethane	model/secondary	1.44e-05	1.90e-10
LPG Production	o-xylene	secondary	1.14e-05	1.51e-10
LPG Production	Cumene	secondary	7.67e-06	1.01e-10
US electric grid	o-xylene	model/secondary	7.34e-06	9.69e-11
LPG Production	Methyl methacrylate	secondary	5.79e-06	7.64e-11
LPG Production	Methyl hydrazine	secondary	5.18e-06	6.84e-11
US electric grid	Dichloromethane	model/secondary	4.08e-06	5.38e-11
LPG Production	2-Chloroacetophenone	secondary	4.05e-06	5.35e-11
LPG Production	1,4-Dichlorobenzene	secondary	3.56e-06	4.70e-11
CRT landfilling	Dichloromethane	primary	3.43e-06	4.52e-11
CRT landfilling	Chloroform	primary	2.11e-06	2.79e-11
CRT Incineration	Carbon tetrachloride	secondary	1.66e-06	2.20e-11
CRT landfilling	Carbon tetrachloride	primary	1.55e-06	2.05e-11
LPG Production	Chlorobenzene	secondary	1.27e-06	1.68e-11
LPG Production	Vinyl acetate	secondary	1.10e-06	1.45e-11
US electric grid	Chloroform	model/secondary	8.16e-07	1.08e-11
LPG Production	Acetophenone	secondary	5.79e-07	7.64e-12
LPG Production	Tetrachloroethylene	secondary	3.00e-07	3.96e-12
LPG Production	1,1,1-Trichloroethane	secondary	2.18e-07	2.88e-12
LPG Production	Chlorine	secondary	2.00e-07	2.64e-12
LPG Production	1,2-Dichloroethane	secondary	9.26e-08	1.22e-12
LPG Production	Dichloromethane	secondary	2.62e-08	3.46e-13
LPG Production	Chloroform	secondary	5.25e-09	6.94e-14
Natural Gas Prod.	Chloroform	secondary	-5.29e-07	-6.99e-12
Fuel Oil #4 Prod.	Chloroform	secondary	-2.19e-06	-2.89e-11
Natural Gas Prod.	Dichloromethane	secondary	-2.64e-06	-3.49e-11
Natural Gas Prod.	1,2-Dichloroethane	secondary	-9.33e-06	-1.23e-10
Fuel Oil #4 Prod.	Dichloromethane	secondary	-1.09e-05	-1.44e-10
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	-2.20e-05	-2.91e-10
Natural Gas Prod.	Tetrachloroethylene	secondary	-3.02e-05	-3.99e-10
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	-3.86e-05	-5.09e-10
Natural Gas Prod.	Acetophenone	secondary	-5.83e-05	-7.70e-10
Fuel Oil #4 Prod.	Chlorine	secondary	-6.88e-05	-9.08e-10
CRT Incineration	Chlorine	secondary	-8.44e-05	-1.11e-09
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	-9.10e-05	-1.20e-09
Natural Gas Prod.	Vinyl acetate	secondary	-1.11e-04	-1.46e-09
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	-1.25e-04	-1.65e-09
Natural Gas Prod.	Chlorobenzene	secondary	-1.28e-04	-1.69e-09
CRT Incineration	Chloroform	secondary	-1.33e-04	-1.76e-09
Fuel Oil #4 Prod.	Acetophenone	secondary	-2.41e-04	-3.18e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	-4.08e-04	-5.39e-09
Fuel Oil #4 Prod.	Vinyl acetate	secondary	-4.58e-04	-6.05e-09
Natural Gas Prod.	Methyl hydrazine	secondary	-5.22e-04	-6.89e-09

Table M-35. CRT LCIA Results for the Aesthetics Impacts Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Fuel Oil #4 Prod.	Chlorobenzene	secondary	-5.31e-04	-7.00e-09
Natural Gas Prod.	Methyl methacrylate	secondary	-5.83e-04	-7.70e-09
CRT Incineration	Dichloromethane	secondary	-6.72e-04	-8.87e-09
Natural Gas Prod.	Cumene	secondary	-7.73e-04	-1.02e-08
Natural Gas Prod.	Chlorine	secondary	-1.03e-03	-1.37e-08
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	-1.25e-03	-1.64e-08
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	-1.69e-03	-2.23e-08
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	-1.86e-03	-2.46e-08
Natural Gas Prod.	Styrene	secondary	-2.14e-03	-2.83e-08
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	-2.16e-03	-2.85e-08
CRT Incineration	1,2-Dichloroethane	secondary	-2.33e-03	-3.07e-08
Natural Gas Prod.	Phenol	secondary	-2.39e-03	-3.16e-08
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	-2.41e-03	-3.18e-08
Natural Gas Prod.	Isophorone	secondary	-3.08e-03	-4.06e-08
Fuel Oil #4 Prod.	Cumene	secondary	-3.20e-03	-4.22e-08
Natural Gas Prod.	Methyl ethyl ketone	secondary	-3.35e-03	-4.42e-08
Fuel Oil #4 Prod.	o-xylene	secondary	-4.18e-03	-5.52e-08
Natural Gas Prod.	Carbon disulfide	secondary	-4.21e-03	-5.56e-08
Natural Gas Prod.	Naphthalene	secondary	-4.43e-03	-5.84e-08
Fuel Oil #4 Prod.	Naphthalene	secondary	-5.43e-03	-7.17e-08
CRT Incineration	1,1,1-Trichloroethane	secondary	-5.62e-03	-7.42e-08
CRT Incineration	Tetrachloroethylene	secondary	-7.54e-03	-9.96e-08
Fuel Oil #4 Prod.	Styrene	secondary	-8.87e-03	-1.17e-07
Fuel Oil #4 Prod.	Phenol	secondary	-9.89e-03	-1.31e-07
Fuel Oil #4 Prod.	Isophorone	secondary	-1.27e-02	-1.68e-07
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	-1.38e-02	-1.83e-07
CRT Incineration	Acetophenone	secondary	-1.49e-02	-1.97e-07
Fuel Oil #4 Prod.	Carbon disulfide	secondary	-1.74e-02	-2.30e-07
Natural Gas Prod.	Benzyl chloride	secondary	-1.94e-02	-2.57e-07
Fuel Oil #4 Prod.	Toluene	secondary	-2.03e-02	-2.68e-07
Natural Gas Prod.	Acrolein	secondary	-2.45e-02	-3.24e-07
CRT Incineration	Vinyl acetate	secondary	-2.83e-02	-3.74e-07
CRT Incineration	Chlorobenzene	secondary	-3.28e-02	-4.33e-07
Natural Gas Prod.	Toluene	secondary	-4.33e-02	-5.71e-07
Natural Gas Prod.	o-xylene	secondary	-4.46e-02	-5.89e-07
CRT Incineration	Xylene (mixed isomers)	secondary	-5.26e-02	-6.95e-07
Fuel Oil #4 Prod.	Benzyl chloride	secondary	-8.04e-02	-1.06e-06
Fuel Oil #4 Prod.	Acrolein	secondary	-1.01e-01	-1.34e-06
CRT Incineration	Methyl hydrazine	secondary	-1.33e-01	-1.76e-06
CRT Incineration	Naphthalene	secondary	-1.38e-01	-1.82e-06
CRT Incineration	Methyl methacrylate	secondary	-1.49e-01	-1.97e-06
CRT Incineration	Cumene	secondary	-1.97e-01	-2.61e-06
Natural Gas Prod.	Formaldehyde	secondary	-2.48e-01	-3.28e-06
Fuel Oil #4 Prod.	Benzene	secondary	-4.02e-01	-5.31e-06
CRT Incineration	Benzene	secondary	-4.93e-01	-6.51e-06
CRT Incineration	Styrene	secondary	-5.48e-01	-7.23e-06
CRT Incineration	Phenol	secondary	-6.11e-01	-8.07e-06
Natural Gas Prod.	Propionaldehyde	secondary	-6.33e-01	-8.36e-06
CRT Incineration	Toluene	secondary	-6.67e-01	-8.81e-06
CRT Incineration	Isophorone	secondary	-7.86e-01	-1.04e-05
CRT Incineration	Methyl ethyl ketone	secondary	-8.55e-01	-1.13e-05

Table M-35. CRT LCIA Results for the Aesthetics Impacts Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
CRT Incineration	Carbon disulfide	secondary	-1.08e+00	-1.42e-05
Fuel Oil #4 Prod.	Propionaldehyde	secondary	-2.62e+00	-3.46e-05
CRT Incineration	Benzyl chloride	secondary	-4.97e+00	-6.56e-05
Natural Gas Prod.	Benzene	secondary	-5.89e+00	-7.78e-05
CRT Incineration	Acrolein	secondary	-6.26e+00	-8.27e-05
Fuel Oil #4 Prod.	Ammonia	secondary	-6.41e+00	-8.47e-05
CRT Incineration	Formaldehyde	secondary	-7.98e+00	-1.05e-04
Fuel Oil #4 Prod.	Formaldehyde	secondary	-9.86e+00	-1.30e-04
Natural Gas Prod.	Acetaldehyde	secondary	-1.23e+01	-1.63e-04
CRT Incineration	Ammonia	secondary	-2.08e+01	-2.75e-04
Fuel Oil #4 Prod.	Acetaldehyde	secondary	-5.09e+01	-6.72e-04
Natural Gas Prod.	Hydrogen sulfide	secondary	-7.86e+01	-1.04e-03
Natural Gas Prod.	Ammonia	secondary	-7.87e+01	-1.04e-03
CRT Incineration	Propionaldehyde	secondary	-1.62e+02	-2.14e-03
CRT Incineration	Hydrogen sulfide	secondary	-1.42e+03	-1.88e-02
CRT Incineration	Acetaldehyde	secondary		-4.15e-02
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	-2.97e+04	-3.92e-01
Total End-of-life			**-3.41e+04**	**-4.50e-01**
Total All Life-cycle Stages			**7.58e+06**	**1.00e+02**

Table M-36. LCD LCIA Results for the Aesthetics Impact Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Hydrogen sulfide	secondary	1.55e+04	3.08e-01
Natural Gas Prod.	Ammonia	secondary	1.10e+04	2.17e-01
Natural Gas Prod.	Hydrogen sulfide	secondary	1.10e+04	2.17e-01
Polycarbonate Production	Ethanethiol	secondary	5.87e+03	1.16e-01
PMMA Sheet Prod.	Ethanethiol	secondary	4.37e+03	8.66e-02
PMMA Sheet Prod.	Hydrogen sulfide	secondary	3.58e+03	7.09e-02
Aluminum Prod.	Hydrogen sulfide	secondary	3.27e+03	6.48e-02
Polycarbonate Production	Hydrogen sulfide	secondary	2.40e+03	4.77e-02
Natural Gas Prod.	Acetaldehyde	secondary	1.72e+03	3.40e-02
Steel Prod., cold-rolled, semi-finished	Acetaldehyde	secondary	1.22e+03	2.41e-02
Natural Gas Prod.	Benzene	secondary	8.21e+02	1.63e-02
PET Resin Production	Hydrogen sulfide	secondary	2.12e+02	4.19e-03
Styrene-butadiene Copolymer Prod.	Hydrogen sulfide	secondary	2.11e+02	4.18e-03
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	2.03e+02	4.03e-03
Natural Gas Prod.	Propionaldehyde	secondary	8.82e+01	1.75e-03
Aluminum Prod.	Acetic acid	secondary	4.23e+01	8.38e-04
Natural Gas Prod.	Formaldehyde	secondary	3.46e+01	6.85e-04
Steel Prod., cold-rolled, semi-finished	Acetic acid	secondary	2.70e+01	5.35e-04
Steel Prod., cold-rolled, semi-finished	Phenol	secondary	2.36e+01	4.69e-04
Aluminum Prod.	Xylene (mixed isomers)	secondary	1.13e+01	2.24e-04
PMMA Sheet Prod.	Ammonia	secondary	8.07e+00	1.60e-04
Steel Prod., cold-rolled, semi-finished	Toluene	secondary	6.35e+00	1.26e-04
Natural Gas Prod.	o-xylene	secondary	6.21e+00	1.23e-04
Natural Gas Prod.	Toluene	secondary	6.03e+00	1.19e-04
Aluminum Prod.	Toluene	secondary	5.16e+00	1.02e-04
Steel Prod., cold-rolled, semi-finished	Xylene (mixed isomers)	secondary	4.40e+00	8.73e-05
Steel Prod., cold-rolled, semi-finished	Formaldehyde	secondary	3.63e+00	7.20e-05
Natural Gas Prod.	Acrolein	secondary	3.41e+00	6.77e-05
Aluminum Prod.	Ammonia	secondary	3.36e+00	6.66e-05
Natural Gas Prod.	Benzyl chloride	secondary	2.71e+00	5.37e-05
Polycarbonate Production	Chlorine	secondary	1.12e+00	2.23e-05
Steel Prod., cold-rolled, semi-finished	Ethanol	secondary	1.02e+00	2.02e-05
PMMA Sheet Prod.	Chlorine	secondary	8.36e-01	1.66e-05
Natural Gas Prod.	Naphthalene	secondary	6.17e-01	1.22e-05
Natural Gas Prod.	Carbon disulfide	secondary	5.87e-01	1.16e-05
Natural Gas Prod.	Methyl ethyl ketone	secondary	4.66e-01	9.24e-06
Natural Gas Prod.	Isophorone	secondary	4.28e-01	8.50e-06
PET Resin Production	Chlorine	secondary	3.95e-01	7.84e-06
Styrene-butadiene Copolymer Prod.	Chlorine	secondary	3.94e-01	7.81e-06
Natural Gas Prod.	Phenol	secondary	3.33e-01	6.61e-06
Natural Gas Prod.	Styrene	secondary	2.99e-01	5.92e-06
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	2.59e-01	5.14e-06
Steel Prod., cold-rolled, semi-finished	Methanol	secondary	2.02e-01	4.00e-06
Natural Gas Prod.	Chlorine	secondary	1.44e-01	2.86e-06
Steel Prod., cold-rolled, semi-finished	Benzene	secondary	1.27e-01	2.51e-06
Natural Gas Prod.	Cumene	secondary	1.08e-01	2.13e-06
PET Resin Production	Ammonia	secondary	9.10e-02	1.80e-06
Styrene-butadiene Copolymer Prod.	Ammonia	secondary	9.06e-02	1.80e-06
Natural Gas Prod.	Methyl methacrylate	secondary	8.13e-02	1.61e-06
Natural Gas Prod.	Methyl hydrazine	secondary	7.27e-02	1.44e-06

Table M-36. LCD LCIA Results for the Aesthetics Impact Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Natural Gas Prod.	2-Chloroacetophenone	secondary	5.69e-02	1.13e-06
Aluminum Prod.	Phenol	secondary	3.82e-02	7.58e-07
Steel Prod., cold-rolled, semi-finished	Naphthalene	secondary	3.65e-02	7.24e-07
Aluminum Prod.	Benzene	secondary	2.23e-02	4.43e-07
Natural Gas Prod.	Chlorobenzene	secondary	1.79e-02	3.54e-07
Natural Gas Prod.	Vinyl acetate	secondary	1.54e-02	3.06e-07
Natural Gas Prod.	Acetophenone	secondary	8.13e-03	1.61e-07
Steel Prod., cold-rolled, semi-finished	Acetone	secondary	4.53e-03	8.99e-08
Natural Gas Prod.	Tetrachloroethylene	secondary	4.21e-03	8.35e-08
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	3.07e-03	6.08e-08
Natural Gas Prod.	1,2-Dichloroethane	secondary	1.30e-03	2.58e-08
Natural Gas Prod.	Dichloromethane	secondary	3.68e-04	7.30e-09
Steel Prod., cold-rolled, semi-finished	Isopropylpropionate	secondary	3.10e-04	6.16e-09
Natural Gas Prod.	Chloroform	secondary	7.38e-05	1.46e-09
Steel Prod., cold-rolled, semi-finished	Chlorine	secondary	3.98e-05	7.90e-10
Steel Prod., cold-rolled, semi-finished	Propionaldehyde	secondary	2.17e-05	4.31e-10
Total Materials Processing			**6.16e+04**	**1.22e+00**
Manufacturing Life-cycle Stage				
Monitor/module	Phosphine	primary	4.48e+06	8.89e+01
LPG Production	Hydrogen sulfide	secondary	3.43e+05	6.80e+00
Monitor/module	Ammonia	primary	6.24e+04	1.24e+00
Monitor/module	Acetic acid	primary	2.23e+04	4.42e-01
Japanese Electric Grid	Acetaldehyde	model/secondary	8.13e+03	1.61e-01
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	4.26e+03	8.44e-02
Fuel Oil #6 Prod.	Hydrogen sulfide	secondary	2.52e+03	5.00e-02
Fuel Oil #2 Prod.	Hydrogen sulfide	secondary	1.10e+03	2.18e-02
LPG Production	Acetaldehyde	secondary	6.79e+02	1.35e-02
Japanese Electric Grid	Propionaldehyde	model/secondary	4.18e+02	8.30e-03
US electric grid	Acetaldehyde	model/secondary	3.67e+02	7.29e-03
Natural Gas Prod.	Ammonia	secondary	2.47e+02	4.91e-03
Natural Gas Prod.	Hydrogen sulfide	secondary	2.47e+02	4.90e-03
LPG Production	Formaldehyde	secondary	1.15e+02	2.28e-03
LPG Production	Ammonia	secondary	1.05e+02	2.08e-03
Panel components	Toluene	primary	9.09e+01	1.80e-03
Backlight	Ethanol	primary	7.24e+01	1.44e-03
Japanese Electric Grid	Formaldehyde	model/secondary	7.02e+01	1.39e-03
Natural Gas Prod.	Acetaldehyde	secondary	3.87e+01	7.68e-04
PWB Mfg.	Formaldehyde	model/secondary	3.50e+01	6.94e-04
LPG Production	Propionaldehyde	secondary	3.49e+01	6.93e-04
US electric grid	Propionaldehyde	model/secondary	1.89e+01	3.75e-04
Natural Gas Prod.	Benzene	secondary	1.85e+01	3.67e-04
Japanese Electric Grid	Acrolein	model/secondary	1.62e+01	3.21e-04
Japanese Electric Grid	Benzyl chloride	model/secondary	1.28e+01	2.55e-04
Japanese Electric Grid	Toluene	model/secondary	8.03e+00	1.59e-04
Fuel Oil #4 Prod.	Acetaldehyde	secondary	7.30e+00	1.45e-04
LPG Production	Benzene	secondary	6.39e+00	1.27e-04
Fuel Oil #6 Prod.	Acetaldehyde	secondary	3.89e+00	7.71e-05
Japanese Electric Grid	Naphthalene	model/secondary	3.73e+00	7.39e-05
Japanese Electric Grid	Carbon disulfide	model/secondary	2.78e+00	5.52e-05
Monitor/module	Acetone	primary	2.59e+00	5.14e-05
Japanese Electric Grid	Methyl ethyl ketone	model/secondary	2.21e+00	4.38e-05

Table M-36. LCD LCIA Results for the Aesthetics Impact Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Fuel Oil #2 Prod.	Acetaldehyde	secondary	2.07e+00	4.11e-05
Japanese Electric Grid	Isophorone	model/secondary	2.03e+00	4.03e-05
Natural Gas Prod.	Propionaldehyde	secondary	1.99e+00	3.95e-05
Japanese Electric Grid	Phenol	model/secondary	1.58e+00	3.13e-05
Japanese Electric Grid	Styrene	model/secondary	1.42e+00	2.81e-05
Fuel Oil #4 Prod.	Formaldehyde	secondary	1.41e+00	2.80e-05
LPG Production	Acrolein	secondary	1.35e+00	2.68e-05
Panel components	Methyl ethyl ketone	primary	1.08e+00	2.14e-05
LPG Production	Benzyl chloride	secondary	1.07e+00	2.13e-05
Fuel Oil #4 Prod.	Ammonia	secondary	9.19e-01	1.82e-05
Fuel Oil #6 Prod.	Formaldehyde	secondary	8.33e-01	1.65e-05
Natural Gas Prod.	Formaldehyde	secondary	7.80e-01	1.55e-05
US electric grid	Acrolein	model/secondary	7.31e-01	1.45e-05
US electric grid	Benzyl chloride	model/secondary	5.80e-01	1.15e-05
Fuel Oil #6 Prod.	Ammonia	secondary	4.00e-01	7.93e-06
Japanese Electric Grid	Methyl methacrylate	model/secondary	3.85e-01	7.64e-06
Fuel Oil #4 Prod.	Propionaldehyde	secondary	3.75e-01	7.44e-06
Fuel Oil #2 Prod.	Formaldehyde	secondary	3.67e-01	7.29e-06
Japanese Electric Grid	Methyl hydrazine	model/secondary	3.45e-01	6.84e-06
US electric grid	Formaldehyde	model/secondary	3.35e-01	6.65e-06
Fuel Oil #2 Prod.	Ammonia	secondary	3.00e-01	5.95e-06
LPG Production	Toluene	secondary	2.98e-01	5.91e-06
Japanese Electric Grid	2-Chloroacetophenone	model/secondary	2.70e-01	5.35e-06
Japanese Electric Grid	Xylene (mixed isomers)	model/secondary	2.34e-01	4.63e-06
LPG Production	Carbon disulfide	secondary	2.32e-01	4.61e-06
Fuel Oil #6 Prod.	Propionaldehyde	secondary	2.00e-01	3.97e-06
LPG Production	Methyl ethyl ketone	secondary	1.85e-01	3.66e-06
LPG Production	Isophorone	secondary	1.70e-01	3.36e-06
Natural Gas Prod.	o-xylene	secondary	1.40e-01	2.78e-06
Natural Gas Prod.	Toluene	secondary	1.36e-01	2.70e-06
LPG Production	Phenol	secondary	1.32e-01	2.62e-06
US electric grid	Carbon disulfide	model/secondary	1.26e-01	2.49e-06
LPG Production	Styrene	secondary	1.18e-01	2.35e-06
Fuel Oil #2 Prod.	Propionaldehyde	secondary	1.07e-01	2.11e-06
US electric grid	Methyl ethyl ketone	model/secondary	9.98e-02	1.98e-06
US electric grid	Isophorone	model/secondary	9.18e-02	1.82e-06
Japanese Electric Grid	Chlorobenzene	model/secondary	8.48e-02	1.68e-06
LPG Production	Naphthalene	secondary	8.39e-02	1.66e-06
Japanese Electric Grid	o-xylene	model/secondary	8.34e-02	1.65e-06
US electric grid	Toluene	model/secondary	8.22e-02	1.63e-06
Natural Gas Prod.	Acrolein	secondary	7.71e-02	1.53e-06
Japanese Electric Grid	Vinyl acetate	model/secondary	7.31e-02	1.45e-06
US electric grid	Phenol	model/secondary	7.14e-02	1.42e-06
US electric grid	Styrene	model/secondary	6.40e-02	1.27e-06
LPG Production	o-xylene	secondary	6.36e-02	1.26e-06
Natural Gas Prod.	Benzyl chloride	secondary	6.11e-02	1.21e-06
Panel components	Ethylacetate	primary	5.82e-02	1.15e-06
Fuel Oil #4 Prod.	Benzene	secondary	5.77e-02	1.14e-06
Japanese Electric Grid	Benzene	model/secondary	4.76e-02	9.43e-07
LPG Production	Cumene	secondary	4.26e-02	8.45e-07
Japanese Electric Grid	1,1,1-Trichloroethane	model/secondary	4.11e-02	8.15e-07

Table M-36. LCD LCIA Results for the Aesthetics Impact Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Japanese Electric Grid	Acetophenone	model/secondary	3.85e-02	7.64e-07
LPG Production	Methyl methacrylate	secondary	3.22e-02	6.38e-07
LPG Production	Methyl hydrazine	secondary	2.88e-02	5.71e-07
Fuel Oil #6 Prod.	Benzene	secondary	2.59e-02	5.13e-07
US electric grid	Cumene	model/secondary	2.31e-02	4.57e-07
LPG Production	2-Chloroacetophenone	secondary	2.25e-02	4.47e-07
Japanese Electric Grid	Tetrachloroethylene	model/secondary	2.00e-02	3.96e-07
LPG Production	1,4-Dichlorobenzene	secondary	1.98e-02	3.92e-07
Fuel Oil #2 Prod.	Benzene	secondary	1.85e-02	3.66e-07
US electric grid	Naphthalene	model/secondary	1.77e-02	3.52e-07
US electric grid	Methyl methacrylate	model/secondary	1.74e-02	3.45e-07
US electric grid	Methyl hydrazine	model/secondary	1.56e-02	3.09e-07
Fuel Oil #4 Prod.	Acrolein	secondary	1.45e-02	2.88e-07
Natural Gas Prod.	Naphthalene	secondary	1.39e-02	2.76e-07
Natural Gas Prod.	Carbon disulfide	secondary	1.32e-02	2.63e-07
US electric grid	2-Chloroacetophenone	model/secondary	1.22e-02	2.42e-07
Fuel Oil #4 Prod.	Benzyl chloride	secondary	1.15e-02	2.28e-07
US electric grid	Xylene (mixed isomers)	model/secondary	1.06e-02	2.09e-07
Natural Gas Prod.	Methyl ethyl ketone	secondary	1.05e-02	2.09e-07
Natural Gas Prod.	Isophorone	secondary	9.67e-03	1.92e-07
Fuel Oil #6 Prod.	Acrolein	secondary	7.74e-03	1.54e-07
Natural Gas Prod.	Phenol	secondary	7.52e-03	1.49e-07
LPG Production	Chlorobenzene	secondary	7.08e-03	1.40e-07
Natural Gas Prod.	Styrene	secondary	6.74e-03	1.34e-07
Japanese Electric Grid	1,2-Dichloroethane	model/secondary	6.17e-03	1.22e-07
Fuel Oil #6 Prod.	Benzyl chloride	secondary	6.14e-03	1.22e-07
LPG Production	Vinyl acetate	secondary	6.11e-03	1.21e-07
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	5.85e-03	1.16e-07
Fuel Oil #2 Prod.	Acrolein	secondary	4.13e-03	8.18e-08
US electric grid	Chlorobenzene	model/secondary	3.83e-03	7.59e-08
US electric grid	Vinyl acetate	model/secondary	3.31e-03	6.56e-08
Fuel Oil #2 Prod.	Benzyl chloride	secondary	3.27e-03	6.49e-08
Natural Gas Prod.	Chlorine	secondary	3.25e-03	6.45e-08
LPG Production	Acetophenone	secondary	3.22e-03	6.38e-08
Fuel Oil #4 Prod.	Toluene	secondary	2.91e-03	5.77e-08
Fuel Oil #4 Prod.	Carbon disulfide	secondary	2.50e-03	4.95e-08
Natural Gas Prod.	Cumene	secondary	2.43e-03	4.82e-08
US electric grid	Benzene	model/secondary	2.10e-03	4.16e-08
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	1.98e-03	3.93e-08
Natural Gas Prod.	Methyl methacrylate	secondary	1.83e-03	3.64e-08
Fuel Oil #4 Prod.	Isophorone	secondary	1.82e-03	3.61e-08
Japanese Electric Grid	Dichloromethane	model/secondary	1.75e-03	3.46e-08
US electric grid	Acetophenone	model/secondary	1.74e-03	3.45e-08
LPG Production	Tetrachloroethylene	secondary	1.67e-03	3.31e-08
Natural Gas Prod.	Methyl hydrazine	secondary	1.64e-03	3.25e-08
Fuel Oil #6 Prod.	Toluene	secondary	1.42e-03	2.83e-08
Fuel Oil #4 Prod.	Phenol	secondary	1.42e-03	2.81e-08
Fuel Oil #6 Prod.	Carbon disulfide	secondary	1.33e-03	2.64e-08
Natural Gas Prod.	2-Chloroacetophenone	secondary	1.28e-03	2.55e-08
Fuel Oil #4 Prod.	Styrene	secondary	1.27e-03	2.52e-08
LPG Production	1,1,1-Trichloroethane	secondary	1.21e-03	2.41e-08

Table M-36. LCD LCIA Results for the Aesthetics Impact Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
LPG Production	Chlorine	secondary	1.11e-03	2.21e-08
Fuel Oil #6 Prod.	Methyl ethyl ketone	secondary	1.06e-03	2.10e-08
Fuel Oil #6 Prod.	Isophorone	secondary	9.71e-04	1.93e-08
US electric grid	Tetrachloroethylene	model/secondary	9.02e-04	1.79e-08
Fuel Oil #2 Prod.	Toluene	secondary	8.82e-04	1.75e-08
Fuel Oil #4 Prod.	Naphthalene	secondary	7.79e-04	1.54e-08
Fuel Oil #6 Prod.	Phenol	secondary	7.56e-04	1.50e-08
Fuel Oil #2 Prod.	Carbon disulfide	secondary	7.09e-04	1.41e-08
US electric grid	1,1,1-Trichloroethane	model/secondary	7.02e-04	1.39e-08
Fuel Oil #6 Prod.	Styrene	secondary	6.77e-04	1.34e-08
Fuel Oil #4 Prod.	o-xylene	secondary	5.99e-04	1.19e-08
Fuel Oil #2 Prod.	Methyl ethyl ketone	secondary	5.63e-04	1.12e-08
Fuel Oil #2 Prod.	Isophorone	secondary	5.18e-04	1.03e-08
LPG Production	1,2-Dichloroethane	secondary	5.15e-04	1.02e-08
Fuel Oil #4 Prod.	Cumene	secondary	4.58e-04	9.08e-09
Natural Gas Prod.	Chlorobenzene	secondary	4.03e-04	8.00e-09
Fuel Oil #2 Prod.	Phenol	secondary	4.03e-04	7.99e-09
Fuel Oil #2 Prod.	Styrene	secondary	3.61e-04	7.16e-09
Fuel Oil #6 Prod.	Naphthalene	secondary	3.61e-04	7.16e-09
Japanese Electric Grid	Chloroform	model/secondary	3.50e-04	6.94e-09
Natural Gas Prod.	Vinyl acetate	secondary	3.48e-04	6.91e-09
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	3.46e-04	6.85e-09
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	3.09e-04	6.13e-09
Fuel Oil #6 Prod.	o-xylene	secondary	2.82e-04	5.59e-09
US electric grid	1,2-Dichloroethane	model/secondary	2.78e-04	5.52e-09
Fuel Oil #2 Prod.	Naphthalene	secondary	2.45e-04	4.85e-09
Fuel Oil #6 Prod.	Cumene	secondary	2.44e-04	4.84e-09
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	2.42e-04	4.80e-09
Fuel Oil #2 Prod.	o-xylene	secondary	1.86e-04	3.69e-09
Fuel Oil #6 Prod.	Methyl methacrylate	secondary	1.84e-04	3.65e-09
Natural Gas Prod.	Acetophenone	secondary	1.83e-04	3.64e-09
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	1.79e-04	3.54e-09
Fuel Oil #6 Prod.	Methyl hydrazine	secondary	1.65e-04	3.27e-09
LPG Production	Dichloromethane	secondary	1.46e-04	2.89e-09
US electric grid	o-xylene	model/secondary	1.42e-04	2.82e-09
Fuel Oil #2 Prod.	Cumene	secondary	1.30e-04	2.58e-09
Fuel Oil #6 Prod.	2-Chloroacetophenone	secondary	1.29e-04	2.56e-09
Fuel Oil #2 Prod.	Methyl methacrylate	secondary	9.82e-05	1.95e-09
Natural Gas Prod.	Tetrachloroethylene	secondary	9.50e-05	1.88e-09
Fuel Oil #2 Prod.	Methyl hydrazine	secondary	8.79e-05	1.74e-09
Fuel Oil #6 Prod.	1,4-Dichlorobenzene	secondary	8.02e-05	1.59e-09
US electric grid	Dichloromethane	model/secondary	7.89e-05	1.56e-09
Fuel Oil #4 Prod.	Chlorobenzene	secondary	7.60e-05	1.51e-09
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	6.92e-05	1.37e-09
Fuel Oil #2 Prod.	2-Chloroacetophenone	secondary	6.87e-05	1.36e-09
Fuel Oil #4 Prod.	Vinyl acetate	secondary	6.57e-05	1.30e-09
Fuel Oil #2 Prod.	1,4-Dichlorobenzene	secondary	5.72e-05	1.13e-09
Fuel Oil #6 Prod.	Chlorobenzene	secondary	4.05e-05	8.04e-10
Fuel Oil #6 Prod.	Vinyl acetate	secondary	3.50e-05	6.94e-10
Fuel Oil #4 Prod.	Acetophenone	secondary	3.46e-05	6.85e-10
Natural Gas Prod.	1,2-Dichloroethane	secondary	2.93e-05	5.82e-10

Table M-36. LCD LCIA Results for the Aesthetics Impact Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
LPG Production	Chloroform	secondary	2.92e-05	5.79e-10
Fuel Oil #2 Prod.	Chlorobenzene	secondary	2.16e-05	4.28e-10
Fuel Oil #2 Prod.	Vinyl acetate	secondary	1.87e-05	3.70e-10
Fuel Oil #6 Prod.	Acetophenone	secondary	1.84e-05	3.65e-10
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	1.79e-05	3.55e-10
US electric grid	Chloroform	model/secondary	1.58e-05	3.13e-10
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	1.30e-05	2.59e-10
Fuel Oil #4 Prod.	Chlorine	secondary	9.86e-06	1.95e-10
Fuel Oil #2 Prod.	Acetophenone	secondary	9.82e-06	1.95e-10
Fuel Oil #6 Prod.	Tetrachloroethylene	secondary	9.54e-06	1.89e-10
Natural Gas Prod.	Dichloromethane	secondary	8.31e-06	1.65e-10
Fuel Oil #6 Prod.	1,1,1-Trichloroethane	secondary	6.95e-06	1.38e-10
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	5.53e-06	1.10e-10
Fuel Oil #2 Prod.	Tetrachloroethylene	secondary	5.09e-06	1.01e-10
Fuel Oil #6 Prod.	Chlorine	secondary	4.39e-06	8.71e-11
Fuel Oil #2 Prod.	1,1,1-Trichloroethane	secondary	3.71e-06	7.35e-11
Fuel Oil #2 Prod.	Chlorine	secondary	3.17e-06	6.29e-11
Fuel Oil #6 Prod.	1,2-Dichloroethane	secondary	2.95e-06	5.85e-11
Natural Gas Prod.	Chloroform	secondary	1.66e-06	3.30e-11
Fuel Oil #2 Prod.	1,2-Dichloroethane	secondary	1.57e-06	3.12e-11
Fuel Oil #4 Prod.	Dichloromethane	secondary	1.57e-06	3.11e-11
Fuel Oil #6 Prod.	Dichloromethane	secondary	8.35e-07	1.66e-11
Fuel Oil #2 Prod.	Dichloromethane	secondary	4.45e-07	8.82e-12
Fuel Oil #4 Prod.	Chloroform	secondary	3.14e-07	6.22e-12
Fuel Oil #6 Prod.	Chloroform	secondary	1.67e-07	3.32e-12
Fuel Oil #2 Prod.	Chloroform	secondary	8.91e-08	1.77e-12
Total Manufacturing			**4.93e+06**	**9.77e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Acetaldehyde	model/secondary	7.08e+04	1.40e+00
US electric grid	Propionaldehyde	model/secondary	3.64e+03	7.22e-02
US electric grid	Acrolein	model/secondary	1.41e+02	2.80e-03
US electric grid	Benzyl chloride	model/secondary	1.12e+02	2.22e-03
US electric grid	Formaldehyde	model/secondary	6.46e+01	1.28e-03
US electric grid	Carbon disulfide	model/secondary	2.42e+01	4.80e-04
US electric grid	Methyl ethyl ketone	model/secondary	1.92e+01	3.82e-04
US electric grid	Isophorone	model/secondary	1.77e+01	3.51e-04
US electric grid	Toluene	model/secondary	1.58e+01	3.14e-04
US electric grid	Phenol	model/secondary	1.38e+01	2.73e-04
US electric grid	Styrene	model/secondary	1.23e+01	2.45e-04
US electric grid	Cumene	model/secondary	4.45e+00	8.81e-05
US electric grid	Naphthalene	model/secondary	3.42e+00	6.78e-05
US electric grid	Methyl methacrylate	model/secondary	3.35e+00	6.65e-05
US electric grid	Methyl hydrazine	model/secondary	3.00e+00	5.95e-05
US electric grid	2-Chloroacetophenone	model/secondary	2.35e+00	4.66e-05
US electric grid	Xylene (mixed isomers)	model/secondary	2.03e+00	4.04e-05
US electric grid	Chlorobenzene	model/secondary	7.38e-01	1.46e-05
US electric grid	Vinyl acetate	model/secondary	6.37e-01	1.26e-05
US electric grid	Benzene	model/secondary	4.04e-01	8.02e-06
US electric grid	Acetophenone	model/secondary	3.35e-01	6.65e-06
US electric grid	Tetrachloroethylene	model/secondary	1.74e-01	3.45e-06
US electric grid	1,1,1-Trichloroethane	model/secondary	1.35e-01	2.68e-06

Table M-36. LCD LCIA Results for the Aesthetics Impact Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
US electric grid	1,2-Dichloroethane	model/secondary	5.37e-02	1.06e-06
US electric grid	o-xylene	model/secondary	2.74e-02	5.43e-07
US electric grid	Dichloromethane	model/secondary	1.52e-02	3.01e-07
US electric grid	Chloroform	model/secondary	3.05e-03	6.04e-08
Total Use, Maintenance and Repair			**7.49e+04**	**1.49e+00**
End-of-life Life-cycle Stage				
LCD landfilling	Hydrogen sulfide	primary	1.29e+02	2.56e-03
LPG Production	Hydrogen sulfide	secondary	2.81e+01	5.58e-04
US electric grid	Acetaldehyde	model/secondary	1.34e+01	2.66e-04
US electric grid	Propionaldehyde	model/secondary	6.91e-01	1.37e-05
LPG Production	Acetaldehyde	secondary	5.58e-02	1.11e-06
US electric grid	Acrolein	model/secondary	2.68e-02	5.31e-07
US electric grid	Benzyl chloride	model/secondary	2.12e-02	4.21e-07
LCD landfilling	Toluene	primary	1.92e-02	3.81e-07
US electric grid	Formaldehyde	model/secondary	1.23e-02	2.43e-07
LCD landfilling	Xylene (mixed isomers)	primary	9.80e-03	1.94e-07
LPG Production	Formaldehyde	secondary	9.43e-03	1.87e-07
LPG Production	Ammonia	secondary	8.59e-03	1.70e-07
US electric grid	Carbon disulfide	model/secondary	4.60e-03	9.12e-08
US electric grid	Methyl ethyl ketone	model/secondary	3.65e-03	7.24e-08
US electric grid	Isophorone	model/secondary	3.36e-03	6.66e-08
US electric grid	Toluene	model/secondary	3.01e-03	5.96e-08
LPG Production	Propionaldehyde	secondary	2.87e-03	5.69e-08
US electric grid	Phenol	model/secondary	2.61e-03	5.18e-08
US electric grid	Styrene	model/secondary	2.34e-03	4.64e-08
LCD landfilling	Benzene	primary	1.51e-03	3.00e-08
US electric grid	Cumene	model/secondary	8.43e-04	1.67e-08
US electric grid	Naphthalene	model/secondary	6.49e-04	1.29e-08
US electric grid	Methyl methacrylate	model/secondary	6.37e-04	1.26e-08
US electric grid	Methyl hydrazine	model/secondary	5.70e-04	1.13e-08
LPG Production	Benzene	secondary	5.25e-04	1.04e-08
US electric grid	2-Chloroacetophenone	model/secondary	4.46e-04	8.84e-09
US electric grid	Xylene (mixed isomers)	model/secondary	3.86e-04	7.66e-09
US electric grid	Chlorobenzene	model/secondary	1.40e-04	2.78e-09
US electric grid	Vinyl acetate	model/secondary	1.21e-04	2.40e-09
LPG Production	Acrolein	secondary	1.11e-04	2.20e-09
LPG Production	Benzyl chloride	secondary	8.81e-05	1.75e-09
LCD landfilling	Trichloroethylene	primary	8.47e-05	1.68e-09
US electric grid	Benzene	model/secondary	7.67e-05	1.52e-09
LCD incineration	Trichloroethylene	secondary	6.57e-05	1.30e-09
US electric grid	Acetophenone	model/secondary	6.37e-05	1.26e-09
LCD landfilling	Tetrachloroethylene	primary	3.98e-05	7.90e-10
US electric grid	Tetrachloroethylene	model/secondary	3.30e-05	6.54e-10
US electric grid	1,1,1-Trichloroethane	model/secondary	2.57e-05	5.09e-10
LPG Production	Toluene	secondary	2.45e-05	4.85e-10
LPG Production	Carbon disulfide	secondary	1.91e-05	3.78e-10
LPG Production	Methyl ethyl ketone	secondary	1.52e-05	3.00e-10
LPG Production	Isophorone	secondary	1.39e-05	2.76e-10
LCD landfilling	1,2-Dichloroethane	primary	1.32e-05	2.62e-10
LPG Production	Phenol	secondary	1.08e-05	2.15e-10

Table M-36. LCD LCIA Results for the Aesthetics Impact Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
US electric grid	1,2-Dichloroethane	model/secondary	1.02e-05	2.02e-10
LPG Production	Styrene	secondary	9.71e-06	1.93e-10
LPG Production	Naphthalene	secondary	6.89e-06	1.37e-10
LPG Production	o-xylene	secondary	5.22e-06	1.04e-10
US electric grid	o-xylene	model/secondary	5.19e-06	1.03e-10
LPG Production	Cumene	secondary	3.50e-06	6.94e-11
US electric grid	Dichloromethane	model/secondary	2.88e-06	5.72e-11
LPG Production	Methyl methacrylate	secondary	2.64e-06	5.24e-11
LPG Production	Methyl hydrazine	secondary	2.36e-06	4.69e-11
LPG Production	2-Chloroacetophenone	secondary	1.85e-06	3.67e-11
LPG Production	1,4-Dichlorobenzene	secondary	1.62e-06	3.22e-11
LCD landfilling	Dichloromethane	primary	8.25e-07	1.64e-11
LPG Production	Chlorobenzene	secondary	5.81e-07	1.15e-11
US electric grid	Chloroform	model/secondary	5.78e-07	1.15e-11
LCD landfilling	Chloroform	primary	5.08e-07	1.01e-11
LPG Production	Vinyl acetate	secondary	5.02e-07	9.95e-12
LCD landfilling	Carbon tetrachloride	primary	3.74e-07	7.41e-12
LCD incineration	Carbon tetrachloride	secondary	2.90e-07	5.75e-12
LPG Production	Acetophenone	secondary	2.64e-07	5.24e-12
LPG Production	Tetrachloroethylene	secondary	1.37e-07	2.71e-12
LPG Production	1,1,1-Trichloroethane	secondary	9.97e-08	1.98e-12
LPG Production	Chlorine	secondary	9.13e-08	1.81e-12
LPG Production	1,2-Dichloroethane	secondary	4.23e-08	8.38e-13
LPG Production	Dichloromethane	secondary	1.20e-08	2.37e-13
LPG Production	Chloroform	secondary	2.40e-09	4.75e-14
Natural Gas Prod.	Chloroform	secondary	-3.50e-07	-6.93e-12
Fuel Oil #4 Prod.	Chloroform	secondary	-1.45e-06	-2.87e-11
Natural Gas Prod.	Dichloromethane	secondary	-1.74e-06	-3.46e-11
Natural Gas Prod.	1,2-Dichloroethane	secondary	-6.16e-06	-1.22e-10
Fuel Oil #4 Prod.	Dichloromethane	secondary	-7.22e-06	-1.43e-10
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	-1.45e-05	-2.88e-10
Natural Gas Prod.	Tetrachloroethylene	secondary	-2.00e-05	-3.96e-10
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	-2.55e-05	-5.05e-10
Natural Gas Prod.	Acetophenone	secondary	-3.85e-05	-7.64e-10
Fuel Oil #4 Prod.	Chlorine	secondary	-4.54e-05	-9.01e-10
LCD incineration	Chlorine	secondary	-5.47e-05	-1.08e-09
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	-6.01e-05	-1.19e-09
Natural Gas Prod.	Vinyl acetate	secondary	-7.32e-05	-1.45e-09
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	-8.25e-05	-1.64e-09
Natural Gas Prod.	Chlorobenzene	secondary	-8.47e-05	-1.68e-09
LCD incineration	Chloroform	secondary	-8.73e-05	-1.73e-09
Fuel Oil #4 Prod.	Acetophenone	secondary	-1.59e-04	-3.16e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	-2.70e-04	-5.35e-09
Fuel Oil #4 Prod.	Vinyl acetate	secondary	-3.03e-04	-6.00e-09
Natural Gas Prod.	Methyl hydrazine	secondary	-3.45e-04	-6.83e-09
Fuel Oil #4 Prod.	Chlorobenzene	secondary	-3.50e-04	-6.95e-09
Natural Gas Prod.	Methyl methacrylate	secondary	-3.85e-04	-7.64e-09
LCD incineration	Dichloromethane	secondary	-4.37e-04	-8.66e-09
Natural Gas Prod.	Cumene	secondary	-5.10e-04	-1.01e-08
Natural Gas Prod.	Chlorine	secondary	-6.83e-04	-1.35e-08
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	-8.23e-04	-1.63e-08

Table M-36. LCD LCIA Results for the Aesthetics Impact Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	-1.11e-03	-2.21e-08
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	-1.23e-03	-2.44e-08
Natural Gas Prod.	Styrene	secondary	-1.42e-03	-2.81e-08
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	-1.43e-03	-2.83e-08
LCD incineration	1,2-Dichloroethane	secondary	-1.53e-03	-3.04e-08
Natural Gas Prod.	Phenol	secondary	-1.58e-03	-3.13e-08
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	-1.59e-03	-3.16e-08
Natural Gas Prod.	Isophorone	secondary	-2.03e-03	-4.03e-08
Fuel Oil #4 Prod.	Cumene	secondary	-2.11e-03	-4.18e-08
Natural Gas Prod.	Methyl ethyl ketone	secondary	-2.21e-03	-4.38e-08
Fuel Oil #4 Prod.	o-xylene	secondary	-2.76e-03	-5.47e-08
Natural Gas Prod.	Carbon disulfide	secondary	-2.78e-03	-5.52e-08
Natural Gas Prod.	Naphthalene	secondary	-2.92e-03	-5.80e-08
Fuel Oil #4 Prod.	Naphthalene	secondary	-3.59e-03	-7.11e-08
LCD incineration	1,1,1-Trichloroethane	secondary	-3.64e-03	-7.23e-08
LCD incineration	Tetrachloroethylene	secondary	-4.97e-03	-9.86e-08
Fuel Oil #4 Prod.	Styrene	secondary	-5.86e-03	-1.16e-07
Fuel Oil #4 Prod.	Phenol	secondary	-6.53e-03	-1.30e-07
Fuel Oil #4 Prod.	Isophorone	secondary	-8.40e-03	-1.67e-07
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	-9.13e-03	-1.81e-07
LCD incineration	Acetophenone	secondary	-9.66e-03	-1.91e-07
Fuel Oil #4 Prod.	Carbon disulfide	secondary	-1.15e-02	-2.28e-07
Natural Gas Prod.	Benzyl chloride	secondary	-1.28e-02	-2.55e-07
Fuel Oil #4 Prod.	Toluene	secondary	-1.34e-02	-2.66e-07
Natural Gas Prod.	Acrolein	secondary	-1.62e-02	-3.21e-07
LCD incineration	Vinyl acetate	secondary	-1.83e-02	-3.64e-07
LCD incineration	Chlorobenzene	secondary	-2.12e-02	-4.21e-07
Natural Gas Prod.	Toluene	secondary	-2.86e-02	-5.66e-07
Natural Gas Prod.	o-xylene	secondary	-2.94e-02	-5.84e-07
Fuel Oil #4 Prod.	Benzyl chloride	secondary	-5.31e-02	-1.05e-06
LCD incineration	Xylene (mixed isomers)	secondary	-5.48e-02	-1.09e-06
Fuel Oil #4 Prod.	Acrolein	secondary	-6.69e-02	-1.33e-06
LCD incineration	Methyl hydrazine	secondary	-8.64e-02	-1.71e-06
LCD incineration	Naphthalene	secondary	-8.91e-02	-1.77e-06
LCD incineration	Methyl methacrylate	secondary	-9.66e-02	-1.91e-06
LCD incineration	Cumene	secondary	-1.28e-01	-2.54e-06
Natural Gas Prod.	Formaldehyde	secondary	-1.64e-01	-3.25e-06
Fuel Oil #4 Prod.	Benzene	secondary	-2.66e-01	-5.27e-06
LCD incineration	Benzene	secondary	-3.23e-01	-6.40e-06
LCD incineration	Styrene	secondary	-3.55e-01	-7.04e-06
LCD incineration	Phenol	secondary	-3.96e-01	-7.86e-06
Natural Gas Prod.	Propionaldehyde	secondary	-4.18e-01	-8.29e-06
LCD incineration	Toluene	secondary	-4.73e-01	-9.38e-06
LCD incineration	Isophorone	secondary	-5.09e-01	-1.01e-05
LCD incineration	Methyl ethyl ketone	secondary	-5.54e-01	-1.10e-05
LCD incineration	Carbon disulfide	secondary	-6.97e-01	-1.38e-05
Fuel Oil #4 Prod.	Propionaldehyde	secondary	-1.73e+00	-3.43e-05
LCD incineration	Benzyl chloride	secondary	-3.22e+00	-6.38e-05
Natural Gas Prod.	Benzene	secondary	-3.89e+00	-7.72e-05
LCD incineration	Acrolein	secondary	-4.06e+00	-8.05e-05
Fuel Oil #4 Prod.	Ammonia	secondary	-4.24e+00	-8.40e-05

Table M-36. LCD LCIA Results for the Aesthetics Impact Category

Process Group	Material	LCI Data Type	Odor (m3)	% of Total
LCD incineration	Formaldehyde	secondary	-5.17e+00	-1.03e-04
Fuel Oil #4 Prod.	Formaldehyde	secondary	-6.51e+00	-1.29e-04
Natural Gas Prod.	Acetaldehyde	secondary	-8.13e+00	-1.61e-04
LCD incineration	Ammonia	secondary	-1.35e+01	-2.68e-04
Fuel Oil #4 Prod.	Acetaldehyde	secondary	-3.36e+01	-6.67e-04
Natural Gas Prod.	Hydrogen sulfide	secondary	-5.19e+01	-1.03e-03
Natural Gas Prod.	Ammonia	secondary	-5.20e+01	-1.03e-03
LCD incineration	Propionaldehyde	secondary	-1.05e+02	-2.08e-03
LCD incineration	Hydrogen sulfide	secondary	-1.20e+03	-2.37e-02
LCD incineration	Acetaldehyde	secondary	-2.04e+03	-4.04e-02
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	-1.96e+04	-3.89e-01
Total End-of-life			**-2.30e+04**	**-4.56e-01**
Total All Life-cycle Stages			**5.04e+06**	**1.00e+02**

Table M-37. CRT LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Materials Processing Life-cycle Stage				
Aluminum Prod.	Aluminum (+3)	secondary	2.76e-02	1.23e+01
Aluminum Prod.	Copper (+1 & +2)	secondary	2.13e-02	9.46e+00
Invar	Copper (+1 & +2)	secondary	1.11e-02	4.96e+00
Invar	Aluminum (+3)	secondary	9.89e-03	4.40e+00
Invar	Zinc (+2)	secondary	9.00e-03	4.00e+00
Lead	Aluminum (+3)	secondary	8.03e-03	3.57e+00
Ferrite mfg.	Zinc (+2)	secondary	6.81e-03	3.03e+00
Aluminum Prod.	Zinc (+2)	secondary	6.44e-03	2.86e+00
ABS Production	Ammonia	secondary	6.17e-03	2.74e+00
Lead	Copper (+1 & +2)	secondary	6.15e-03	2.73e+00
Steel Prod., cold-rolled, semi-finished	Phosphorus (yellow or white)	secondary	4.60e-03	2.04e+00
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	2.80e-03	1.24e+00
Lead	Zinc (+2)	secondary	1.83e-03	8.16e-01
Polycarbonate Production	Copper (+1 & +2)	secondary	1.23e-03	5.45e-01
Steel Prod., cold-rolled, semi-finished	Copper (+1 & +2)	secondary	1.02e-03	4.52e-01
Ferrite mfg.	Aluminum (+3)	secondary	9.68e-04	4.31e-01
Aluminum Prod.	Barium sulfate	secondary	9.07e-04	4.03e-01
ABS Production	Aluminum (+3)	secondary	8.82e-04	3.92e-01
Invar	Ammonia	secondary	8.20e-04	3.65e-01
Ferrite mfg.	Copper (+1 & +2)	secondary	7.04e-04	3.13e-01
ABS Production	Copper (+1 & +2)	secondary	5.62e-04	2.50e-01
Styrene-butadiene Copolymer Prod.	Copper (+1 & +2)	secondary	5.49e-04	2.44e-01
Aluminum Prod.	Titanium tetrachloride	secondary	4.56e-04	2.03e-01
Polycarbonate Production	Mercury compounds	secondary	4.30e-04	1.91e-01
Aluminum Prod.	Strontium (Sr II)	secondary	3.19e-04	1.42e-01
Steel Prod., cold-rolled, semi-finished	Aluminum (+3)	secondary	2.74e-04	1.22e-01
Ferrite mfg.	Ammonia	secondary	2.64e-04	1.18e-01
Lead	Barium sulfate	secondary	2.29e-04	1.02e-01
Steel Prod., cold-rolled, semi-finished	Nitrogen dioxide	secondary	1.98e-04	8.79e-02
ABS Production	Mercury compounds	secondary	1.97e-04	8.77e-02
Steel Prod., cold-rolled, semi-finished	Zinc (+2)	secondary	1.96e-04	8.72e-02
Styrene-butadiene Copolymer Prod.	Mercury compounds	secondary	1.93e-04	8.57e-02
Steel Prod., cold-rolled, semi-finished	Fluorides (F-)	secondary	1.93e-04	8.57e-02
Aluminum Prod.	Lead cmpds	secondary	1.72e-04	7.64e-02
Polycarbonate Production	Zinc (+2)	secondary	1.71e-04	7.59e-02
Invar	Strontium (Sr II)	secondary	1.65e-04	7.36e-02
Invar	Titanium tetrachloride	secondary	1.62e-04	7.22e-02
Aluminum Prod.	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	1.55e-04	6.89e-02
Steel Prod., cold-rolled, semi-finished	Strontium (Sr II)	secondary	1.49e-04	6.63e-02
Lead	Titanium tetrachloride	secondary	1.33e-04	5.93e-02
Polycarbonate Production	Chlorine	secondary	1.22e-04	5.42e-02
Polycarbonate Production	Ammonia	secondary	1.19e-04	5.28e-02
Aluminum Prod.	Cadmium cmpds	secondary	1.16e-04	5.16e-02
Aluminum Prod.	Barium cmpds	secondary	9.35e-05	4.16e-02
Aluminum Prod.	Nitrate	secondary	9.13e-05	4.06e-02
Steel Prod., cold-rolled, semi-finished	Mercury compounds	secondary	8.00e-05	3.56e-02
ABS Production	Zinc (+2)	secondary	7.82e-05	3.48e-02
Styrene-butadiene Copolymer Prod.	Zinc (+2)	secondary	7.64e-05	3.40e-02
Invar	Barium sulfate	secondary	6.91e-05	3.08e-02

Table M-37. CRT LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Steel Prod., cold-rolled, semi-finished	Barium sulfate	secondary	6.87e-05	3.05e-02
Ferrite mfg.	Barium sulfate	secondary	6.75e-05	3.00e-02
Steel Prod., cold-rolled, semi-finished	Xylene (mixed isomers)	secondary	6.51e-05	2.89e-02
Lead	Strontium (Sr II)	secondary	6.40e-05	2.84e-02
ABS Production	Nitrate	secondary	6.01e-05	2.67e-02
Invar	Lead cmpds	secondary	5.87e-05	2.61e-02
ABS Production	Chlorine	secondary	5.59e-05	2.49e-02
Polycarbonate Production	Phenol	secondary	5.55e-05	2.47e-02
Styrene-butadiene Copolymer Prod.	Chlorine	secondary	5.46e-05	2.43e-02
Lead	Lead cmpds	secondary	5.41e-05	2.41e-02
Invar	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	5.40e-05	2.40e-02
Polystyrene Prod., high-impact	Ammonia	secondary	5.18e-05	2.30e-02
Ferrite mfg.	Strontium (Sr II)	secondary	4.84e-05	2.15e-02
Lead	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	4.68e-05	2.08e-02
Invar	Barium cmpds	secondary	3.86e-05	1.72e-02
Aluminum Prod.	Nickel cmpds	secondary	3.82e-05	1.70e-02
Aluminum Prod.	Chromium (III)	secondary	3.20e-05	1.42e-02
Invar	Nickel cmpds	secondary	3.03e-05	1.35e-02
Steel Prod., cold-rolled, semi-finished	Silver compounds	secondary	2.83e-05	1.26e-02
Aluminum Prod.	Aromatic hydrocarbons	secondary	2.83e-05	1.26e-02
Invar	Xylene (mixed isomers)	secondary	2.44e-05	1.08e-02
Lead	Barium cmpds	secondary	2.43e-05	1.08e-02
Aluminum Prod.	Manganese cmpds	secondary	2.28e-05	1.01e-02
Ferrite mfg.	Phosphorus (yellow or white)	secondary	2.21e-05	9.85e-03
Invar	Manganese cmpds	secondary	2.10e-05	9.36e-03
Ferrite mfg.	Xylene (mixed isomers)	secondary	1.93e-05	8.56e-03
Invar	Phosphorus (yellow or white)	secondary	1.86e-05	8.29e-03
Aluminum Prod.	Fluoride	secondary	1.82e-05	8.09e-03
Lead	Nitrate	secondary	1.80e-05	8.01e-03
Steel Prod., cold-rolled, semi-finished	Lead cmpds	secondary	1.74e-05	7.74e-03
Aluminum Prod.	Vanadium (V3+, V5+)	secondary	1.63e-05	7.24e-03
Aluminum Prod.	Selenium	secondary	1.59e-05	7.05e-03
Steel Prod., cold-rolled, semi-finished	Barium cmpds	secondary	1.55e-05	6.90e-03
Ferrite mfg.	Titanium tetrachloride	secondary	1.50e-05	6.66e-03
Invar	Aromatic hydrocarbons	secondary	1.47e-05	6.52e-03
Styrene-butadiene Copolymer Prod.	Aluminum (+3)	secondary	1.44e-05	6.39e-03
Ferrite mfg.	Manganese cmpds	secondary	1.32e-05	5.87e-03
Steel Prod., cold-rolled, semi-finished	Aromatic hydrocarbons	secondary	1.30e-05	5.78e-03
Aluminum Prod.	Xylene (mixed isomers)	secondary	1.26e-05	5.61e-03
Invar	Cadmium cmpds	secondary	1.26e-05	5.60e-03
Invar	Chromium (III)	secondary	1.14e-05	5.09e-03
Lead	Nickel cmpds	secondary	1.12e-05	4.99e-03
Steel Prod., cold-rolled, semi-finished	Tin (Sn++, Sn4+)	secondary	1.04e-05	4.63e-03
Ferrite mfg.	Lead cmpds	secondary	1.02e-05	4.55e-03
Lead	Chromium (III)	secondary	9.38e-06	4.17e-03
Lead	Fluoride	secondary	8.91e-06	3.96e-03
Invar	Fluoride	secondary	8.80e-06	3.91e-03
Aluminum Prod.	Arsenic cmpds	secondary	8.57e-06	3.81e-03
Invar	Silver compounds	secondary	8.56e-06	3.81e-03
Ferrite mfg.	Silver compounds	secondary	8.35e-06	3.72e-03

Table M-37. CRT LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Ferrite mfg.	Nitrate	secondary	8.08e-06	3.59e-03
Polycarbonate Production	Aluminum (+3)	secondary	8.02e-06	3.56e-03
Ferrite mfg.	Barium cmpds	secondary	7.00e-06	3.11e-03
Aluminum Prod.	Benzene	secondary	6.79e-06	3.02e-03
Lead	Manganese cmpds	secondary	6.47e-06	2.88e-03
Invar	Toluene	secondary	6.23e-06	2.77e-03
Invar	Vanadium (V3+, V5+)	secondary	6.00e-06	2.67e-03
Styrene-butadiene Copolymer Prod.	Nitrate	secondary	5.79e-06	2.58e-03
Invar	Selenium	secondary	5.69e-06	2.53e-03
Lead	Vanadium (V3+, V5+)	secondary	4.75e-06	2.11e-03
Lead	Selenium	secondary	4.63e-06	2.06e-03
Aluminum Prod.	Toluene	secondary	4.24e-06	1.89e-03
Ferrite mfg.	Aromatic hydrocarbons	secondary	4.10e-06	1.82e-03
Aluminum Prod.	Phenol	secondary	3.79e-06	1.69e-03
Invar	Benzene	secondary	3.63e-06	1.61e-03
Steel Prod., cold-rolled, semi-finished	Phenol	secondary	3.55e-06	1.58e-03
Steel Prod., cold-rolled, semi-finished	Benzene	secondary	3.54e-06	1.58e-03
ABS Production	Phenol	secondary	3.49e-06	1.55e-03
Invar	Arsenic cmpds	secondary	3.05e-06	1.35e-03
Invar	Tin (Sn++, Sn4+)	secondary	3.03e-06	1.35e-03
Steel Prod., cold-rolled, semi-finished	Chlorine	secondary	3.01e-06	1.34e-03
Styrene-butadiene Copolymer Prod.	Phenol	secondary	2.93e-06	1.30e-03
Invar	Cobalt (Co I, Co II, Co III)	secondary	2.88e-06	1.28e-03
Steel Prod., cold-rolled, semi-finished	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	2.84e-06	1.26e-03
Steel Prod., cold-rolled, semi-finished	Cadmium cmpds	secondary	2.68e-06	1.19e-03
Lead	Arsenic cmpds	secondary	2.49e-06	1.11e-03
Lead	Xylene (mixed isomers)	secondary	2.44e-06	1.08e-03
Steel Prod., cold-rolled, semi-finished	Cyanide (-1)	secondary	2.37e-06	1.05e-03
Steel Prod., cold-rolled, semi-finished	Boric acid	secondary	2.27e-06	1.01e-03
Steel Prod., cold-rolled, semi-finished	Toluene	secondary	2.22e-06	9.87e-04
Steel Prod., cold-rolled, semi-finished	Manganese cmpds	secondary	2.10e-06	9.32e-04
Invar	Phenol	secondary	1.99e-06	8.85e-04
Ferrite mfg.	Fluoride	secondary	1.85e-06	8.21e-04
Lead	Cobalt (Co I, Co II, Co III)	secondary	1.84e-06	8.16e-04
Invar	Ethylbenzene	secondary	1.77e-06	7.87e-04
Steel Prod., cold-rolled, semi-finished	Ethylbenzene	secondary	1.76e-06	7.81e-04
Ferrite mfg.	Nickel cmpds	secondary	1.60e-06	7.10e-04
Lead	Mercury compounds	secondary	1.39e-06	6.20e-04
Lead	Benzene	secondary	1.32e-06	5.86e-04
Aluminum Prod.	Nitrites	secondary	1.25e-06	5.58e-04
Steel Prod., cold-rolled, semi-finished	Chromium (VI)	secondary	1.23e-06	5.48e-04
Steel Prod., cold-rolled, semi-finished	Nickel cmpds	secondary	1.19e-06	5.31e-04
Ferrite mfg.	Benzene	secondary	1.08e-06	4.82e-04
Ferrite mfg.	Chromium (III)	secondary	1.08e-06	4.81e-04
Polystyrene Prod., high-impact	Phenol	secondary	1.07e-06	4.75e-04
ABS Production	Nickel cmpds	secondary	1.01e-06	4.49e-04
Polycarbonate Production	Nickel (+2)	secondary	9.23e-07	4.11e-04
Polycarbonate Production	Nitrate	secondary	9.23e-07	4.11e-04
Lead	Toluene	secondary	8.22e-07	3.66e-04
Lead	Phenol	secondary	8.16e-07	3.63e-04

Table M-37. CRT LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Steel Prod., cold-rolled, semi-finished	Chromium (III)	secondary	8.02e-07	3.57e-04
Ferrite mfg.	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	7.99e-07	3.55e-04
Ferrite mfg.	Vanadium (V3+, V5+)	secondary	6.83e-07	3.04e-04
Ferrite mfg.	Toluene	secondary	6.82e-07	3.04e-04
Invar	Boric acid	secondary	6.44e-07	2.86e-04
Ferrite mfg.	Boric acid	secondary	6.29e-07	2.80e-04
Polystyrene Prod., high-impact	Nitrate	secondary	6.05e-07	2.69e-04
Steel Prod., cold-rolled, semi-finished	Vanadium (V3+, V5+)	secondary	5.94e-07	2.64e-04
Ferrite mfg.	Cadmium cmpds	secondary	5.89e-07	2.62e-04
Invar	Cyanide (-1)	secondary	5.64e-07	2.51e-04
Invar	Nitrites	secondary	5.52e-07	2.46e-04
Ferrite mfg.	Selenium	secondary	5.52e-07	2.45e-04
Ferrite mfg.	Phenol	secondary	5.50e-07	2.45e-04
Steel Prod., cold-rolled, semi-finished	Titanium tetrachloride	secondary	5.28e-07	2.35e-04
Ferrite mfg.	Ethylbenzene	secondary	5.20e-07	2.31e-04
Invar	Nitrates/nitrites	secondary	4.69e-07	2.09e-04
Styrene-butadiene Copolymer Prod.	Nickel (+2)	secondary	4.14e-07	1.84e-04
Ferrite mfg.	Cyanide (-1)	secondary	3.97e-07	1.77e-04
Aluminum Prod.	Cyanide (-1)	secondary	3.79e-07	1.69e-04
Invar	Boron (B III)	secondary	3.27e-07	1.46e-04
Ferrite mfg.	Arsenic cmpds	secondary	2.96e-07	1.31e-04
Steel Prod., cold-rolled, semi-finished	Arsenic cmpds	secondary	2.77e-07	1.23e-04
Lead	Nitrites	secondary	2.65e-07	1.18e-04
Invar	Chlorine	secondary	2.51e-07	1.12e-04
Ferrite mfg.	Chlorine	secondary	2.45e-07	1.09e-04
Steel Prod., cold-rolled, semi-finished	Rubidium ion (Rb+)	secondary	2.42e-07	1.08e-04
Lead	Boron (B III)	secondary	1.97e-07	8.74e-05
Steel Prod., cold-rolled, semi-finished	Nitrates/nitrites	secondary	1.94e-07	8.63e-05
Ferrite mfg.	Cobalt (Co I, Co II, Co III)	secondary	1.76e-07	7.82e-05
Steel Prod., cold-rolled, semi-finished	Selenium	secondary	1.59e-07	7.09e-05
Invar	Mercury compounds	secondary	9.86e-08	4.39e-05
Ferrite mfg.	Mercury compounds	secondary	9.63e-08	4.28e-05
Invar	Rubidium ion (Rb+)	secondary	7.31e-08	3.25e-05
Ferrite mfg.	Rubidium ion (Rb+)	secondary	7.14e-08	3.17e-05
Steel Prod., cold-rolled, semi-finished	Boron (B III)	secondary	7.04e-08	3.13e-05
Ferrite mfg.	Nitrites	secondary	3.83e-08	1.71e-05
Invar	Chromium (VI)	secondary	3.25e-08	1.45e-05
Steel Prod., cold-rolled, semi-finished	Phosphorus pentoxide	secondary	3.11e-08	1.38e-05
Ferrite mfg.	Chromium (VI)	secondary	2.76e-08	1.23e-05
Ferrite mfg.	Boron (B III)	secondary	2.32e-08	1.03e-05
Steel Prod., cold-rolled, semi-finished	Hydrazine	secondary	2.30e-08	1.02e-05
Steel Prod., cold-rolled, semi-finished	Morpholine	secondary	1.88e-08	8.35e-06
Aluminum Prod.	Chromium (VI)	secondary	9.21e-09	4.09e-06
Invar	Phosphorus pentoxide	secondary	9.09e-09	4.04e-06
Ferrite mfg.	Phosphorus pentoxide	secondary	8.87e-09	3.94e-06
Invar	Hydrazine	secondary	6.52e-09	2.90e-06
Ferrite mfg.	Hydrazine	secondary	6.37e-09	2.83e-06
Invar	Morpholine	secondary	5.32e-09	2.36e-06
Ferrite mfg.	Morpholine	secondary	5.19e-09	2.31e-06
Lead	Chromium (VI)	secondary	4.46e-09	1.99e-06

Table M-37. CRT LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Invar	Hypochlorous acid	secondary	3.54e-09	1.58e-06
Steel Prod., cold-rolled, semi-finished	Hypochlorous acid	secondary	3.52e-09	1.56e-06
Ferrite mfg.	Hypochlorous acid	secondary	3.46e-09	1.54e-06
Steel Prod., cold-rolled, semi-finished	Cobalt (Co I, Co II, Co III)	secondary	3.14e-09	1.40e-06
Invar	Dichloromethane	secondary	2.00e-09	8.88e-07
Steel Prod., cold-rolled, semi-finished	Dichloromethane	secondary	1.98e-09	8.82e-07
Ferrite mfg.	Dichloromethane	secondary	1.95e-09	8.67e-07
Aluminum Prod.	Triethylene glycol	secondary	1.73e-09	7.71e-07
Invar	Acetic acid	secondary	1.51e-09	6.73e-07
Ferrite mfg.	Acetic acid	secondary	1.48e-09	6.57e-07
Invar	Triethylene glycol	secondary	1.38e-09	6.14e-07
Steel Prod., cold-rolled, semi-finished	Triethylene glycol	secondary	1.37e-09	6.09e-07
Ferrite mfg.	Triethylene glycol	secondary	1.35e-09	5.99e-07
Lead	Triethylene glycol	secondary	1.30e-09	5.76e-07
Steel Prod., cold-rolled, semi-finished	Nitrites	secondary	4.82e-10	2.14e-07
Invar	Halogenated matter (organic)	secondary	2.74e-10	1.22e-07
Ferrite mfg.	Halogenated matter (organic)	secondary	2.68e-10	1.19e-07
Steel Prod., cold-rolled, semi-finished	Edetic acid (EDTA)	secondary	1.27e-10	5.66e-08
Invar	Edetic acid (EDTA)	secondary	3.60e-11	1.60e-08
Ferrite mfg.	Edetic acid (EDTA)	secondary	3.52e-11	1.56e-08
Ferrite mfg.	Tin (Sn++, Sn4+)	secondary	7.28e-12	3.24e-09
Invar	Chloroform	secondary	3.23e-12	1.44e-09
Steel Prod., cold-rolled, semi-finished	Chloroform	secondary	3.21e-12	1.43e-09
Ferrite mfg.	Chloroform	secondary	3.15e-12	1.40e-09
Steel Prod., cold-rolled, semi-finished	Lithium salts	secondary	2.38e-12	1.06e-09
Invar	Trichloroethylene	secondary	1.61e-12	7.16e-10
Steel Prod., cold-rolled, semi-finished	Trichloroethylene	secondary	1.60e-12	7.10e-10
Ferrite mfg.	Trichloroethylene	secondary	1.57e-12	6.99e-10
Invar	Lithium salts	secondary	6.75e-13	3.00e-10
Ferrite mfg.	Lithium salts	secondary	6.59e-13	2.93e-10
Invar	Formaldehyde	secondary	1.22e-13	5.42e-11
Ferrite mfg.	Formaldehyde	secondary	1.19e-13	5.29e-11
Steel Prod., cold-rolled, semi-finished	Formaldehyde	secondary	1.18e-13	5.23e-11
Steel Prod., cold-rolled, semi-finished	Tetrachloroethylene	secondary	8.60e-14	3.82e-11
Invar	Tetrachloroethylene	secondary	8.47e-14	3.77e-11
Ferrite mfg.	Tetrachloroethylene	secondary	8.27e-14	3.68e-11
Invar	1,1,1-Trichloroethane	secondary	6.01e-14	2.67e-11
Steel Prod., cold-rolled, semi-finished	1,1,1-Trichloroethane	secondary	5.94e-14	2.64e-11
Ferrite mfg.	1,1,1-Trichloroethane	secondary	5.86e-14	2.60e-11
Invar	Hexachloroethane	secondary	3.60e-16	1.60e-13
Steel Prod., cold-rolled, semi-finished	Hexachloroethane	secondary	3.58e-16	1.59e-13
Ferrite mfg.	Hexachloroethane	secondary	3.52e-16	1.56e-13
Total Materials Processing			**1.36e-01**	**6.04e+01**
Manufacturing Life-cycle Stage				
CRT tube mfg.	Phosphorus (yellow or white)	primary	5.94e-02	2.64e+01
CRT tube mfg.	Fluoride	primary	6.91e-03	3.07e+00
Glass/frit	Fluorides (F-)	primary	5.87e-03	2.61e+00
CRT tube mfg.	Zinc (elemental)	primary	5.12e-03	2.28e+00
CRT tube mfg.	Copper	primary	4.78e-03	2.13e+00

Table M-37. CRT LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
LPG Production	Phenol	secondary	4.25e-03	1.89e+00
LPG Production	Aluminum (+3)	secondary	2.46e-03	1.09e+00
CRT tube mfg.	Nickel	primary	1.59e-04	7.05e-02
LPG Production	Nitrate	secondary	1.21e-04	5.39e-02
Glass/frit	Lead	primary	8.68e-05	3.86e-02
LPG Production	Fluorides (F-)	secondary	6.81e-05	3.03e-02
LPG Production	Copper (+1 & +2)	secondary	1.55e-05	6.89e-03
Fuel Oil #6 Prod.	Phenol	secondary	1.44e-05	6.39e-03
Fuel Oil #2 Prod.	Phenol	secondary	1.19e-05	5.30e-03
Fuel Oil #6 Prod.	Aluminum (+3)	secondary	8.32e-06	3.70e-03
CRT tube mfg.	Manganese	primary	7.21e-06	3.21e-03
Fuel Oil #2 Prod.	Aluminum (+3)	secondary	6.90e-06	3.07e-03
CRT tube mfg.	Lead	primary	6.03e-06	2.68e-03
LPG Production	Zinc (+2)	secondary	4.34e-06	1.93e-03
CRT tube mfg.	Molybdenum	primary	3.77e-06	1.68e-03
CRT tube mfg.	Cyanide (-1)	primary	1.21e-06	5.39e-04
Fuel Oil #4 Prod.	Phenol	secondary	9.69e-07	4.31e-04
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	5.61e-07	2.49e-04
Fuel Oil #6 Prod.	Fluorides (F-)	secondary	5.50e-07	2.44e-04
Fuel Oil #6 Prod.	Nitrate	secondary	4.85e-07	2.16e-04
Fuel Oil #2 Prod.	Nitrate	secondary	3.45e-07	1.54e-04
Fuel Oil #2 Prod.	Fluorides (F-)	secondary	2.14e-07	9.50e-05
Natural Gas Prod.	Zinc (+2)	secondary	1.94e-07	8.61e-05
LPG Production	Aromatic hydrocarbons	secondary	1.75e-07	7.78e-05
Glass/frit	Nickel	primary	1.64e-07	7.30e-05
LPG Production	Barium cmpds	secondary	1.42e-07	6.32e-05
Natural Gas Prod.	Fluorides (F-)	secondary	1.19e-07	5.30e-05
Glass/frit	Nitrates/nitrites	primary	1.14e-07	5.09e-05
LPG Production	Chromium (VI)	secondary	1.02e-07	4.52e-05
Glass/frit	Chromium	primary	9.86e-08	4.39e-05
Natural Gas Prod.	Phenol	secondary	8.65e-08	3.85e-05
LPG Production	Chromium (III)	secondary	7.28e-08	3.24e-05
LPG Production	Cadmium cmpds	secondary	6.89e-08	3.06e-05
Fuel Oil #6 Prod.	Copper (+1 & +2)	secondary	5.24e-08	2.33e-05
Natural Gas Prod.	Aluminum (+3)	secondary	4.97e-08	2.21e-05
Fuel Oil #2 Prod.	Copper (+1 & +2)	secondary	4.34e-08	1.93e-05
Natural Gas Prod.	Nitrate	secondary	3.01e-08	1.34e-05
Fuel Oil #4 Prod.	Nitrate	secondary	2.93e-08	1.31e-05
LPG Production	Lead cmpds	secondary	2.30e-08	1.02e-05
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	2.28e-08	1.01e-05
LPG Production	Toluene	secondary	2.14e-08	9.51e-06
Fuel Oil #6 Prod.	Zinc (+2)	secondary	1.97e-08	8.75e-06
Fuel Oil #2 Prod.	Zinc (+2)	secondary	1.25e-08	5.57e-06
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	3.53e-09	1.57e-06
Natural Gas Prod.	Chromium (VI)	secondary	3.06e-09	1.36e-06
LPG Production	Nickel cmpds	secondary	2.78e-09	1.24e-06
Natural Gas Prod.	Chromium (III)	secondary	2.20e-09	9.77e-07
LPG Production	Mercury compounds	secondary	1.25e-09	5.56e-07
Fuel Oil #4 Prod.	Zinc (+2)	secondary	1.10e-09	4.90e-07
LPG Production	Cyanide (-1)	secondary	8.17e-10	3.63e-07

Table M-37. CRT LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Fuel Oil #6 Prod.	Aromatic hydrocarbons	secondary	5.92e-10	2.63e-07
Fuel Oil #2 Prod.	Aromatic hydrocarbons	secondary	4.91e-10	2.18e-07
Fuel Oil #6 Prod.	Barium cmpds	secondary	4.81e-10	2.14e-07
Fuel Oil #2 Prod.	Barium cmpds	secondary	3.99e-10	1.77e-07
Natural Gas Prod.	Copper (+1 & +2)	secondary	3.13e-10	1.39e-07
Fuel Oil #6 Prod.	Chromium (VI)	secondary	2.51e-10	1.12e-07
LPG Production	Halogenated matter (organic)	secondary	2.33e-10	1.04e-07
Fuel Oil #6 Prod.	Cadmium cmpds	secondary	2.33e-10	1.04e-07
Fuel Oil #2 Prod.	Cadmium cmpds	secondary	1.93e-10	8.59e-08
Fuel Oil #6 Prod.	Chromium (III)	secondary	1.80e-10	8.01e-08
Fuel Oil #2 Prod.	Chromium (VI)	secondary	1.48e-10	6.58e-08
Fuel Oil #2 Prod.	Chromium (III)	secondary	1.06e-10	4.72e-08
Fuel Oil #6 Prod.	Lead cmpds	secondary	7.78e-11	3.46e-08
Fuel Oil #6 Prod.	Toluene	secondary	7.23e-11	3.22e-08
Fuel Oil #2 Prod.	Lead cmpds	secondary	6.45e-11	2.87e-08
Fuel Oil #2 Prod.	Toluene	secondary	6.00e-11	2.67e-08
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	3.99e-11	1.78e-08
Fuel Oil #4 Prod.	Barium cmpds	secondary	3.24e-11	1.44e-08
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	1.57e-11	6.98e-09
Fuel Oil #4 Prod.	Chromium (VI)	secondary	1.34e-11	5.95e-09
Fuel Oil #4 Prod.	Chromium (III)	secondary	9.60e-12	4.27e-09
Fuel Oil #6 Prod.	Nickel cmpds	secondary	9.42e-12	4.19e-09
Fuel Oil #2 Prod.	Nickel cmpds	secondary	7.81e-12	3.47e-09
Fuel Oil #4 Prod.	Lead cmpds	secondary	5.24e-12	2.33e-09
Fuel Oil #4 Prod.	Toluene	secondary	4.88e-12	2.17e-09
Fuel Oil #6 Prod.	Mercury compounds	secondary	4.23e-12	1.88e-09
Natural Gas Prod.	Aromatic hydrocarbons	secondary	3.54e-12	1.57e-09
Fuel Oil #2 Prod.	Mercury compounds	secondary	3.51e-12	1.56e-09
Natural Gas Prod.	Barium cmpds	secondary	2.87e-12	1.28e-09
Fuel Oil #6 Prod.	Cyanide (-1)	secondary	2.76e-12	1.23e-09
Fuel Oil #2 Prod.	Cyanide (-1)	secondary	2.29e-12	1.02e-09
Natural Gas Prod.	Cadmium cmpds	secondary	1.39e-12	6.19e-10
Fuel Oil #6 Prod.	Halogenated matter (organic)	secondary	7.89e-13	3.51e-10
Fuel Oil #2 Prod.	Halogenated matter (organic)	secondary	6.55e-13	2.91e-10
Fuel Oil #4 Prod.	Nickel cmpds	secondary	6.35e-13	2.82e-10
Natural Gas Prod.	Lead cmpds	secondary	4.65e-13	2.07e-10
Natural Gas Prod.	Toluene	secondary	4.32e-13	1.92e-10
Fuel Oil #4 Prod.	Mercury compounds	secondary	2.85e-13	1.27e-10
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	1.86e-13	8.28e-11
Natural Gas Prod.	Nickel cmpds	secondary	5.63e-14	2.50e-11
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	5.32e-14	2.37e-11
Natural Gas Prod.	Mercury compounds	secondary	2.53e-14	1.12e-11
Natural Gas Prod.	Cyanide (-1)	secondary	1.65e-14	7.34e-12
Natural Gas Prod.	Halogenated matter (organic)	secondary	4.72e-15	2.10e-12
Total Manufacturing			**8.93e-02**	**3.97e+01**
Use, Maintenance and Repair Life-cycle Stage				
Total Use, Maintenance and Repair			**0.00e+00**	**0.00e+00**
End-of-life Life-cycle Stage				
CRT landfilling	Ammonia	primary	7.71e-05	3.43e-02

Table M-37. CRT LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
CRT Incineration	Silver compounds	secondary	5.15e-06	2.29e-03
CRT landfilling	Silver compounds	primary	4.80e-06	2.14e-03
CRT Incineration	Barium cmpds	secondary	1.14e-07	5.07e-05
CRT landfilling	Cadmium cmpds	primary	9.64e-08	4.29e-05
CRT Incineration	Cadmium cmpds	secondary	9.33e-08	4.15e-05
CRT landfilling	Barium cmpds	primary	9.07e-08	4.03e-05
LPG Production	Phenol	secondary	3.67e-08	1.63e-05
CRT Incineration	Chromium (VI)	secondary	2.19e-08	9.72e-06
LPG Production	Aluminum (+3)	secondary	2.12e-08	9.44e-06
CRT landfilling	Mercury compounds	primary	2.04e-08	9.07e-06
CRT Incineration	Mercury compounds	secondary	2.00e-08	8.89e-06
CRT landfilling	Arsenic cmpds	primary	1.84e-08	8.20e-06
CRT Incineration	Arsenic cmpds	secondary	1.77e-08	7.89e-06
CRT landfilling	Chromium (VI)	primary	1.66e-08	7.39e-06
CRT Incineration	Lead cmpds	secondary	1.60e-08	7.10e-06
CRT Incineration	Chromium (III)	secondary	1.57e-08	6.97e-06
CRT landfilling	Lead cmpds	primary	1.56e-08	6.92e-06
CRT landfilling	Chromium (III)	primary	1.19e-08	5.30e-06
CRT landfilling	Xylene (mixed isomers)	primary	4.17e-09	1.86e-06
CRT Incineration	o-xylene	secondary	2.68e-09	1.19e-06
CRT Incineration	Toluene	secondary	2.53e-09	1.12e-06
CRT landfilling	Toluene	primary	2.36e-09	1.05e-06
LPG Production	Nitrate	secondary	1.05e-09	4.65e-07
CRT Incineration	Ethylbenzene	secondary	9.51e-10	4.23e-07
CRT landfilling	Ethylbenzene	primary	8.86e-10	3.94e-07
LPG Production	Fluorides (F-)	secondary	5.88e-10	2.61e-07
CRT Incineration	Tetrachloroethylene	secondary	1.45e-10	6.45e-08
CRT landfilling	Tetrachloroethylene	primary	1.35e-10	6.02e-08
LPG Production	Copper (+1 & +2)	secondary	1.34e-10	5.94e-08
CRT Incineration	Benzene	secondary	9.63e-11	4.28e-08
CRT landfilling	Benzene	primary	8.98e-11	3.99e-08
CRT Incineration	Selenium	secondary	8.22e-11	3.66e-08
CRT landfilling	Selenium	primary	8.08e-11	3.59e-08
CRT Incineration	Carbon tetrachloride	secondary	5.89e-11	2.62e-08
CRT landfilling	Carbon tetrachloride	primary	5.49e-11	2.44e-08
CRT Incineration	Trichloroethylene	secondary	4.45e-11	1.98e-08
CRT landfilling	Trichloroethylene	primary	4.15e-11	1.84e-08
LPG Production	Zinc (+2)	secondary	3.74e-11	1.66e-08
CRT Incineration	Chloroform	secondary	2.38e-11	1.06e-08
CRT Incineration	Vinyl chloride	secondary	2.38e-11	1.06e-08
CRT landfilling	Chloroform	primary	2.22e-11	9.89e-09
CRT landfilling	Vinyl chloride	primary	2.22e-11	9.86e-09
CRT Incineration	1,2-Dichloroethane	secondary	1.25e-11	5.57e-09
CRT landfilling	1,2-Dichloroethane	primary	1.17e-11	5.19e-09
CRT Incineration	Dichloromethane	secondary	8.25e-12	3.67e-09
CRT landfilling	Dichloromethane	primary	7.69e-12	3.42e-09
LPG Production	Aromatic hydrocarbons	secondary	1.51e-12	6.72e-10
LPG Production	Barium cmpds	secondary	1.23e-12	5.46e-10
LPG Production	Chromium (VI)	secondary	8.76e-13	3.90e-10
LPG Production	Chromium (III)	secondary	6.29e-13	2.80e-10

Table M-37. CRT LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
LPG Production	Cadmium cmpds	secondary	5.94e-13	2.64e-10
LPG Production	Lead cmpds	secondary	1.98e-13	8.82e-11
LPG Production	Toluene	secondary	1.85e-13	8.21e-11
LPG Production	Nickel cmpds	secondary	2.40e-14	1.07e-11
LPG Production	Mercury compounds	secondary	1.08e-14	4.80e-12
LPG Production	Cyanide (-1)	secondary	7.05e-15	3.14e-12
LPG Production	Halogenated matter (organic)	secondary	2.01e-15	8.96e-13
Natural Gas Prod.	Halogenated matter (organic)	secondary	-2.37e-15	-1.05e-12
Natural Gas Prod.	Cyanide (-1)	secondary	-8.28e-15	-3.68e-12
Natural Gas Prod.	Mercury compounds	secondary	-1.27e-14	-5.64e-12
Natural Gas Prod.	Nickel cmpds	secondary	-2.82e-14	-1.25e-11
CRT Incineration	Halogenated matter (organic)	secondary	-3.67e-14	-1.63e-11
CRT Incineration	Cyanide (-1)	secondary	-1.29e-13	-5.71e-11
Natural Gas Prod.	Toluene	secondary	-2.17e-13	-9.64e-11
Natural Gas Prod.	Lead cmpds	secondary	-2.33e-13	-1.04e-10
CRT Incineration	Nickel cmpds	secondary	-4.38e-13	-1.95e-10
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	-5.72e-13	-2.54e-10
Natural Gas Prod.	Cadmium cmpds	secondary	-6.98e-13	-3.10e-10
Natural Gas Prod.	Barium cmpds	secondary	-1.44e-12	-6.41e-10
Natural Gas Prod.	Aromatic hydrocarbons	secondary	-1.77e-12	-7.89e-10
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	-2.00e-12	-8.91e-10
Fuel Oil #4 Prod.	Mercury compounds	secondary	-3.06e-12	-1.36e-09
Fuel Oil #4 Prod.	Nickel cmpds	secondary	-6.82e-12	-3.03e-09
CRT Incineration	Aromatic hydrocarbons	secondary	-2.75e-11	-1.22e-08
Fuel Oil #4 Prod.	Toluene	secondary	-5.24e-11	-2.33e-08
Fuel Oil #4 Prod.	Lead cmpds	secondary	-5.64e-11	-2.51e-08
Fuel Oil #4 Prod.	Chromium (III)	secondary	-1.03e-10	-4.59e-08
Fuel Oil #4 Prod.	Chromium (VI)	secondary	-1.44e-10	-6.40e-08
Natural Gas Prod.	Copper (+1 & +2)	secondary	-1.57e-10	-6.98e-08
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	-1.69e-10	-7.51e-08
Fuel Oil #4 Prod.	Barium cmpds	secondary	-3.48e-10	-1.55e-07
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	-4.29e-10	-1.91e-07
Natural Gas Prod.	Chromium (III)	secondary	-1.10e-09	-4.90e-07
Natural Gas Prod.	Chromium (VI)	secondary	-1.54e-09	-6.83e-07
CRT Incineration	Copper (+1 & +2)	secondary	-2.44e-09	-1.08e-06
CRT Incineration	Zinc (+2)	secondary	-8.28e-09	-3.68e-06
Fuel Oil #4 Prod.	Zinc (+2)	secondary	-1.19e-08	-5.27e-06
Natural Gas Prod.	Nitrate	secondary	-1.51e-08	-6.71e-06
Natural Gas Prod.	Aluminum (+3)	secondary	-2.49e-08	-1.11e-05
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	-3.80e-08	-1.69e-05
Natural Gas Prod.	Phenol	secondary	-4.34e-08	-1.93e-05
Natural Gas Prod.	Fluorides (F-)	secondary	-5.98e-08	-2.66e-05
Natural Gas Prod.	Zinc (+2)	secondary	-9.71e-08	-4.32e-05
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	-2.45e-07	-1.09e-04
Fuel Oil #4 Prod.	Nitrate	secondary	-3.15e-07	-1.40e-04
CRT Incineration	Aluminum (+3)	secondary	-3.87e-07	-1.72e-04
CRT Incineration	Phenol	secondary	-6.69e-07	-2.97e-04
CRT Incineration	Nitrate	secondary	-3.60e-06	-1.60e-03
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	-6.03e-06	-2.68e-03

Table M-37. CRT LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	Phenol	secondary	-1.04e-05	-4.63e-03
CRT Incineration	Fluorides (F-)	secondary	-1.51e-05	-6.73e-03
CRT Incineration	Ammonia	secondary	-3.00e-04	-1.34e-01
Total End-of-life			**-2.50e-04**	**-1.11e-01**
Total All Life-cycle Stages			**2.25e-01**	**1.00e+02**

Table M-38. LCD LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Materials Processing Life-cycle Stage				
PMMA Sheet Prod.	Ammonia	secondary	3.29e-02	6.34e-01
Aluminum Prod.	Aluminum (+3)	secondary	1.03e-02	1.98e-01
Aluminum Prod.	Copper (+1 & +2)	secondary	7.92e-03	1.53e-01
Aluminum Prod.	Zinc (+2)	secondary	2.40e-03	4.62e-02
Steel Prod., cold-rolled, semi-finished	Phosphorus (yellow or white)	secondary	2.25e-03	4.34e-02
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	1.37e-03	2.64e-02
Polycarbonate Production	Copper (+1 & +2)	secondary	6.84e-04	1.32e-02
PMMA Sheet Prod.	Copper (+1 & +2)	secondary	5.09e-04	9.81e-03
Steel Prod., cold-rolled, semi-finished	Copper (+1 & +2)	secondary	4.98e-04	9.60e-03
Aluminum Prod.	Barium sulfate	secondary	3.38e-04	6.51e-03
PET Resin Production	Copper (+1 & +2)	secondary	2.41e-04	4.64e-03
Polycarbonate Production	Mercury compounds	secondary	2.40e-04	4.63e-03
Styrene-butadiene Copolymer Prod.	Copper (+1 & +2)	secondary	2.40e-04	4.63e-03
PMMA Sheet Prod.	Mercury compounds	secondary	1.79e-04	3.44e-03
Aluminum Prod.	Titanium tetrachloride	secondary	1.70e-04	3.28e-03
Steel Prod., cold-rolled, semi-finished	Aluminum (+3)	secondary	1.34e-04	2.58e-03
Aluminum Prod.	Strontium (Sr II)	secondary	1.19e-04	2.29e-03
Steel Prod., cold-rolled, semi-finished	Nitrogen dioxide	secondary	9.68e-05	1.87e-03
Steel Prod., cold-rolled, semi-finished	Zinc (+2)	secondary	9.60e-05	1.85e-03
Polycarbonate Production	Zinc (+2)	secondary	9.53e-05	1.84e-03
Steel Prod., cold-rolled, semi-finished	Fluorides (F-)	secondary	9.44e-05	1.82e-03
Styrene-butadiene Copolymer Prod.	Mercury compounds	secondary	8.42e-05	1.62e-03
Steel Prod., cold-rolled, semi-finished	Strontium (Sr II)	secondary	7.31e-05	1.41e-03
PMMA Sheet Prod.	Zinc (+2)	secondary	7.08e-05	1.37e-03
Polycarbonate Production	Chlorine	secondary	6.81e-05	1.31e-03
Polycarbonate Production	Ammonia	secondary	6.63e-05	1.28e-03
Aluminum Prod.	Lead cmpds	secondary	6.40e-05	1.23e-03
Aluminum Prod.	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	5.76e-05	1.11e-03
PMMA Sheet Prod.	Chlorine	secondary	5.06e-05	9.77e-04
Aluminum Prod.	Cadmium cmpds	secondary	4.32e-05	8.34e-04
Steel Prod., cold-rolled, semi-finished	Mercury compounds	secondary	3.92e-05	7.56e-04
Aluminum Prod.	Barium cmpds	secondary	3.48e-05	6.72e-04
Aluminum Prod.	Nitrate	secondary	3.40e-05	6.55e-04
Steel Prod., cold-rolled, semi-finished	Barium sulfate	secondary	3.36e-05	6.49e-04
PET Resin Production	Zinc (+2)	secondary	3.35e-05	6.47e-04
Styrene-butadiene Copolymer Prod.	Zinc (+2)	secondary	3.34e-05	6.44e-04
Steel Prod., cold-rolled, semi-finished	Xylene (mixed isomers)	secondary	3.19e-05	6.15e-04
Polycarbonate Production	Phenol	secondary	3.10e-05	5.98e-04
PET Resin Production	Chlorine	secondary	2.40e-05	4.62e-04
Styrene-butadiene Copolymer Prod.	Chlorine	secondary	2.39e-05	4.61e-04
Aluminum Prod.	Nickel cmpds	secondary	1.42e-05	2.74e-04
Steel Prod., cold-rolled, semi-finished	Silver compounds	secondary	1.39e-05	2.68e-04
Natural Gas Prod.	Zinc (+2)	secondary	1.35e-05	2.61e-04
Aluminum Prod.	Chromium (III)	secondary	1.19e-05	2.30e-04
Aluminum Prod.	Aromatic hydrocarbons	secondary	1.05e-05	2.03e-04
PMMA Sheet Prod.	Phenol	secondary	1.04e-05	2.00e-04
Steel Prod., cold-rolled, semi-finished	Lead cmpds	secondary	8.52e-06	1.64e-04
Aluminum Prod.	Manganese cmpds	secondary	8.48e-06	1.64e-04

Table M-38. LCD LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Fluorides (F-)	secondary	8.33e-06	1.61e-04
PMMA Sheet Prod.	Cyanide (-1)	secondary	7.67e-06	1.48e-04
Steel Prod., cold-rolled, semi-finished	Barium cmpds	secondary	7.60e-06	1.47e-04
Aluminum Prod.	Fluoride	secondary	6.78e-06	1.31e-04
Steel Prod., cold-rolled, semi-finished	Aromatic hydrocarbons	secondary	6.37e-06	1.23e-04
Styrene-butadiene Copolymer Prod.	Aluminum (+3)	secondary	6.28e-06	1.21e-04
Aluminum Prod.	Vanadium (V3+, V5+)	secondary	6.06e-06	1.17e-04
Natural Gas Prod.	Phenol	secondary	6.04e-06	1.17e-04
Aluminum Prod.	Selenium	secondary	5.90e-06	1.14e-04
Steel Prod., cold-rolled, semi-finished	Tin (Sn++, Sn4+)	secondary	5.10e-06	9.84e-05
Aluminum Prod.	Xylene (mixed isomers)	secondary	4.70e-06	9.06e-05
Polycarbonate Production	Aluminum (+3)	secondary	4.48e-06	8.63e-05
Natural Gas Prod.	Aluminum (+3)	secondary	3.47e-06	6.69e-05
PMMA Sheet Prod.	Aluminum (+3)	secondary	3.33e-06	6.42e-05
Aluminum Prod.	Arsenic cmpds	secondary	3.19e-06	6.15e-05
Styrene-butadiene Copolymer Prod.	Nitrate	secondary	2.53e-06	4.88e-05
Aluminum Prod.	Benzene	secondary	2.53e-06	4.88e-05
PMMA Sheet Prod.	Nitrates/nitrites	secondary	2.22e-06	4.28e-05
Natural Gas Prod.	Nitrate	secondary	2.10e-06	4.05e-05
Steel Prod., cold-rolled, semi-finished	Phenol	secondary	1.74e-06	3.35e-05
Steel Prod., cold-rolled, semi-finished	Benzene	secondary	1.74e-06	3.35e-05
Aluminum Prod.	Toluene	secondary	1.58e-06	3.04e-05
PET Resin Production	Aluminum (+3)	secondary	1.58e-06	3.04e-05
Steel Prod., cold-rolled, semi-finished	Chlorine	secondary	1.47e-06	2.84e-05
Aluminum Prod.	Phenol	secondary	1.41e-06	2.72e-05
Steel Prod., cold-rolled, semi-finished	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	1.39e-06	2.69e-05
Steel Prod., cold-rolled, semi-finished	Cadmium cmpds	secondary	1.31e-06	2.53e-05
Styrene-butadiene Copolymer Prod.	Phenol	secondary	1.28e-06	2.47e-05
PET Resin Production	Phenol	secondary	1.18e-06	2.27e-05
Steel Prod., cold-rolled, semi-finished	Cyanide (-1)	secondary	1.16e-06	2.24e-05
Steel Prod., cold-rolled, semi-finished	Boric acid	secondary	1.11e-06	2.15e-05
Steel Prod., cold-rolled, semi-finished	Toluene	secondary	1.09e-06	2.10e-05
Steel Prod., cold-rolled, semi-finished	Manganese cmpds	secondary	1.03e-06	1.98e-05
PMMA Sheet Prod.	Nickel cmpds	secondary	9.15e-07	1.76e-05
Steel Prod., cold-rolled, semi-finished	Ethylbenzene	secondary	8.61e-07	1.66e-05
Steel Prod., cold-rolled, semi-finished	Chromium (VI)	secondary	6.04e-07	1.16e-05
Steel Prod., cold-rolled, semi-finished	Nickel cmpds	secondary	5.85e-07	1.13e-05
Polycarbonate Production	Nickel (+2)	secondary	5.16e-07	9.95e-06
Polycarbonate Production	Nitrate	secondary	5.16e-07	9.95e-06
Aluminum Prod.	Nitrites	secondary	4.67e-07	9.01e-06
Steel Prod., cold-rolled, semi-finished	Chromium (III)	secondary	3.93e-07	7.58e-06
Steel Prod., cold-rolled, semi-finished	Vanadium (V3+, V5+)	secondary	2.91e-07	5.61e-06
Steel Prod., cold-rolled, semi-finished	Titanium tetrachloride	secondary	2.59e-07	4.99e-06
Natural Gas Prod.	Chromium (VI)	secondary	2.14e-07	4.13e-06
PET Resin Production	Mercury	secondary	1.82e-07	3.50e-06
PET Resin Production	Nickel (+2)	secondary	1.82e-07	3.50e-06
PET Resin Production	Nitrate	secondary	1.82e-07	3.50e-06
Styrene-butadiene Copolymer Prod.	Nickel (+2)	secondary	1.81e-07	3.49e-06
Natural Gas Prod.	Chromium (III)	secondary	1.54e-07	2.96e-06
Aluminum Prod.	Cyanide (-1)	secondary	1.41e-07	2.72e-06
Steel Prod., cold-rolled, semi-finished	Arsenic cmpds	secondary	1.36e-07	2.62e-06

Table M-38. LCD LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Steel Prod., cold-rolled, semi-finished	Rubidium ion (Rb+)	secondary	1.19e-07	2.29e-06
Steel Prod., cold-rolled, semi-finished	Nitrates/nitrites	secondary	9.51e-08	1.83e-06
Steel Prod., cold-rolled, semi-finished	Selenium	secondary	7.81e-08	1.51e-06
Steel Prod., cold-rolled, semi-finished	Boron (B III)	secondary	3.45e-08	6.65e-07
Natural Gas Prod.	Copper (+1 & +2)	secondary	2.19e-08	4.22e-07
Steel Prod., cold-rolled, semi-finished	Phosphorus pentoxide	secondary	1.53e-08	2.94e-07
Steel Prod., cold-rolled, semi-finished	Hydrazine	secondary	1.13e-08	2.18e-07
Steel Prod., cold-rolled, semi-finished	Morpholine	secondary	9.20e-09	1.77e-07
Aluminum Prod.	Chromium (VI)	secondary	3.43e-09	6.61e-08
Steel Prod., cold-rolled, semi-finished	Hypochlorous acid	secondary	1.72e-09	3.33e-08
Steel Prod., cold-rolled, semi-finished	Cobalt (Co I, Co II, Co III)	secondary	1.54e-09	2.97e-08
Steel Prod., cold-rolled, semi-finished	Dichloromethane	secondary	9.72e-10	1.87e-08
Steel Prod., cold-rolled, semi-finished	Triethylene glycol	secondary	6.72e-10	1.29e-08
Aluminum Prod.	Triethylene glycol	secondary	6.46e-10	1.24e-08
Natural Gas Prod.	Aromatic hydrocarbons	secondary	2.47e-10	4.77e-09
Steel Prod., cold-rolled, semi-finished	Nitrites	secondary	2.36e-10	4.55e-09
Natural Gas Prod.	Barium cmpds	secondary	2.01e-10	3.87e-09
Natural Gas Prod.	Cadmium cmpds	secondary	9.72e-11	1.87e-09
Steel Prod., cold-rolled, semi-finished	Edetic acid (EDTA)	secondary	6.24e-11	1.20e-09
Natural Gas Prod.	Lead cmpds	secondary	3.25e-11	6.26e-10
Natural Gas Prod.	Toluene	secondary	3.02e-11	5.82e-10
Natural Gas Prod.	Nickel cmpds	secondary	3.93e-12	7.58e-11
Natural Gas Prod.	Mercury compounds	secondary	1.77e-12	3.40e-11
Steel Prod., cold-rolled, semi-finished	Chloroform	secondary	1.57e-12	3.03e-11
Steel Prod., cold-rolled, semi-finished	Lithium salts	secondary	1.17e-12	2.25e-11
Natural Gas Prod.	Cyanide (-1)	secondary	1.15e-12	2.22e-11
Steel Prod., cold-rolled, semi-finished	Trichloroethylene	secondary	7.83e-13	1.51e-11
Natural Gas Prod.	Halogenated matter (organic)	secondary	3.29e-13	6.35e-12
Steel Prod., cold-rolled, semi-finished	Formaldehyde	secondary	5.77e-14	1.11e-12
Steel Prod., cold-rolled, semi-finished	Tetrachloroethylene	secondary	4.21e-14	8.13e-13
Steel Prod., cold-rolled, semi-finished	1,1,1-Trichloroethane	secondary	2.91e-14	5.62e-13
Steel Prod., cold-rolled, semi-finished	Hexachloroethane	secondary	1.75e-16	3.38e-15
Total Materials Processing			**6.19e-02**	**1.19e+00**
Manufacturing Life-cycle Stage				
Monitor/module	Phosphorus (yellow or white)	primary	5.06e+00	9.77e+01
Panel components	Phosphorus (yellow or white)	primary	2.92e-02	5.63e-01
Monitor/module	Fluorides (F-)	primary	2.56e-02	4.93e-01
Monitor/module	Copper	primary	2.44e-03	4.70e-02
Monitor/module	Hexane	primary	1.18e-03	2.27e-02
Monitor/module	Zinc (elemental)	primary	9.73e-04	1.88e-02
LCD glass mfg.	Fluorides (F-)	primary	2.72e-04	5.24e-03
LPG Production	Phenol	secondary	2.04e-04	3.93e-03
LPG Production	Aluminum (+3)	secondary	1.18e-04	2.27e-03
Monitor/module	Lead	primary	1.23e-05	2.38e-04
Monitor/module	Chromium	primary	1.06e-05	2.05e-04
Monitor/module	Cyanide (-1)	primary	7.33e-06	1.41e-04
LPG Production	Nitrate	secondary	5.81e-06	1.12e-04
LCD glass mfg.	Lead	primary	4.02e-06	7.75e-05
LPG Production	Fluorides (F-)	secondary	3.27e-06	6.30e-05

Table M-38. LCD LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Monitor/module	Boron	primary	1.61e-06	3.11e-05
Fuel Oil #4 Prod.	Phenol	secondary	1.49e-06	2.88e-05
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	8.64e-07	1.67e-05
LPG Production	Copper (+1 & +2)	secondary	7.43e-07	1.43e-05
Monitor/module	Chromium (VI)	primary	6.39e-07	1.23e-05
Fuel Oil #2 Prod.	Phenol	secondary	5.57e-07	1.07e-05
Fuel Oil #6 Prod.	Phenol	secondary	4.90e-07	9.44e-06
Monitor/module	Antimony	primary	4.64e-07	8.95e-06
Monitor/module	Manganese	primary	4.58e-07	8.83e-06
Monitor/module	Nickel	primary	4.58e-07	8.83e-06
Monitor/module	Polychlorinated biphenyls	primary	4.07e-07	7.85e-06
LCD glass mfg.	Nitrate	primary	3.66e-07	7.06e-06
Fuel Oil #2 Prod.	Aluminum (+3)	secondary	3.22e-07	6.21e-06
Natural Gas Prod.	Zinc (+2)	secondary	3.05e-07	5.89e-06
Fuel Oil #6 Prod.	Aluminum (+3)	secondary	2.83e-07	5.46e-06
Monitor/module	Phenol	primary	2.70e-07	5.21e-06
Monitor/module	Arsenic	primary	2.28e-07	4.40e-06
Monitor/module	Cadmium	primary	2.28e-07	4.40e-06
LPG Production	Zinc (+2)	secondary	2.08e-07	4.01e-06
Monitor/module	Mercury	primary	1.94e-07	3.74e-06
Natural Gas Prod.	Fluorides (F-)	secondary	1.88e-07	3.62e-06
Natural Gas Prod.	Phenol	secondary	1.36e-07	2.63e-06
Natural Gas Prod.	Aluminum (+3)	secondary	7.83e-08	1.51e-06
Monitor/module	Tetrachloroethylene	primary	7.63e-08	1.47e-06
Natural Gas Prod.	Nitrate	secondary	4.74e-08	9.15e-07
Monitor/module	Tin	primary	4.57e-08	8.82e-07
Fuel Oil #4 Prod.	Nitrate	secondary	4.52e-08	8.72e-07
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	3.51e-08	6.77e-07
Monitor/module	1,1,1-Trichloroethane	primary	2.40e-08	4.62e-07
Monitor/module	Trichloroethylene	primary	2.34e-08	4.51e-07
Fuel Oil #6 Prod.	Fluorides (F-)	secondary	1.87e-08	3.61e-07
Fuel Oil #6 Prod.	Nitrate	secondary	1.65e-08	3.19e-07
Fuel Oil #2 Prod.	Nitrate	secondary	1.61e-08	3.11e-07
Fuel Oil #2 Prod.	Fluorides (F-)	secondary	9.97e-09	1.92e-07
LPG Production	Aromatic hydrocarbons	secondary	8.40e-09	1.62e-07
LCD glass mfg.	Nickel	primary	7.60e-09	1.47e-07
LPG Production	Barium cmpds	secondary	6.82e-09	1.32e-07
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	5.44e-09	1.05e-07
LPG Production	Chromium (VI)	secondary	4.87e-09	9.39e-08
Natural Gas Prod.	Chromium (VI)	secondary	4.83e-09	9.32e-08
LCD glass mfg.	Chromium	primary	4.57e-09	8.81e-08
LPG Production	Chromium (III)	secondary	3.49e-09	6.74e-08
Natural Gas Prod.	Chromium (III)	secondary	3.46e-09	6.68e-08
LPG Production	Cadmium cmpds	secondary	3.30e-09	6.37e-08
Fuel Oil #2 Prod.	Copper (+1 & +2)	secondary	2.03e-09	3.91e-08
Fuel Oil #6 Prod.	Copper (+1 & +2)	secondary	1.78e-09	3.44e-08
Fuel Oil #4 Prod.	Zinc (+2)	secondary	1.70e-09	3.28e-08
LPG Production	Lead cmpds	secondary	1.10e-09	2.13e-08
LPG Production	Toluene	secondary	1.03e-09	1.98e-08
Fuel Oil #6 Prod.	Zinc (+2)	secondary	6.70e-10	1.29e-08
Fuel Oil #2 Prod.	Zinc (+2)	secondary	5.84e-10	1.13e-08

Table M-38. LCD LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Copper (+1 & +2)	secondary	4.93e-10	9.51e-09
LPG Production	Nickel cmpds	secondary	1.34e-10	2.58e-09
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	6.15e-11	1.19e-09
LPG Production	Mercury compounds	secondary	6.00e-11	1.16e-09
Fuel Oil #4 Prod.	Barium cmpds	secondary	4.99e-11	9.63e-10
LPG Production	Cyanide (-1)	secondary	3.92e-11	7.56e-10
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	2.42e-11	4.67e-10
Fuel Oil #2 Prod.	Aromatic hydrocarbons	secondary	2.29e-11	4.42e-10
Fuel Oil #4 Prod.	Chromium (VI)	secondary	2.06e-11	3.98e-10
Fuel Oil #6 Prod.	Aromatic hydrocarbons	secondary	2.02e-11	3.89e-10
Fuel Oil #2 Prod.	Barium cmpds	secondary	1.86e-11	3.59e-10
Fuel Oil #6 Prod.	Barium cmpds	secondary	1.64e-11	3.16e-10
Fuel Oil #4 Prod.	Chromium (III)	secondary	1.48e-11	2.85e-10
LPG Production	Halogenated matter (organic)	secondary	1.12e-11	2.16e-10
Fuel Oil #2 Prod.	Cadmium cmpds	secondary	9.02e-12	1.74e-10
Fuel Oil #6 Prod.	Chromium (VI)	secondary	8.55e-12	1.65e-10
Fuel Oil #4 Prod.	Lead cmpds	secondary	8.08e-12	1.56e-10
Fuel Oil #6 Prod.	Cadmium cmpds	secondary	7.93e-12	1.53e-10
Fuel Oil #4 Prod.	Toluene	secondary	7.52e-12	1.45e-10
Fuel Oil #2 Prod.	Chromium (VI)	secondary	6.91e-12	1.33e-10
Fuel Oil #6 Prod.	Chromium (III)	secondary	6.13e-12	1.18e-10
Natural Gas Prod.	Aromatic hydrocarbons	secondary	5.58e-12	1.08e-10
Fuel Oil #2 Prod.	Chromium (III)	secondary	4.96e-12	9.56e-11
Natural Gas Prod.	Barium cmpds	secondary	4.53e-12	8.73e-11
Fuel Oil #2 Prod.	Lead cmpds	secondary	3.01e-12	5.81e-11
Fuel Oil #2 Prod.	Toluene	secondary	2.80e-12	5.40e-11
Fuel Oil #6 Prod.	Lead cmpds	secondary	2.65e-12	5.11e-11
Fuel Oil #6 Prod.	Toluene	secondary	2.46e-12	4.75e-11
Natural Gas Prod.	Cadmium cmpds	secondary	2.19e-12	4.23e-11
Fuel Oil #4 Prod.	Nickel cmpds	secondary	9.78e-13	1.89e-11
Natural Gas Prod.	Lead cmpds	secondary	7.33e-13	1.41e-11
Natural Gas Prod.	Toluene	secondary	6.82e-13	1.31e-11
Fuel Oil #4 Prod.	Mercury compounds	secondary	4.39e-13	8.47e-12
Fuel Oil #2 Prod.	Nickel cmpds	secondary	3.65e-13	7.03e-12
Fuel Oil #6 Prod.	Nickel cmpds	secondary	3.21e-13	6.18e-12
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	2.87e-13	5.54e-12
Fuel Oil #2 Prod.	Mercury compounds	secondary	1.64e-13	3.16e-12
Fuel Oil #6 Prod.	Mercury compounds	secondary	1.44e-13	2.78e-12
Fuel Oil #2 Prod.	Cyanide (-1)	secondary	1.07e-13	2.06e-12
Fuel Oil #6 Prod.	Cyanide (-1)	secondary	9.41e-14	1.81e-12
Natural Gas Prod.	Nickel cmpds	secondary	8.87e-14	1.71e-12
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	8.20e-14	1.58e-12
Natural Gas Prod.	Mercury compounds	secondary	3.98e-14	7.68e-13
Fuel Oil #2 Prod.	Halogenated matter (organic)	secondary	3.06e-14	5.89e-13
Fuel Oil #6 Prod.	Halogenated matter (organic)	secondary	2.69e-14	5.18e-13
Natural Gas Prod.	Cyanide (-1)	secondary	2.60e-14	5.02e-13
Natural Gas Prod.	Halogenated matter (organic)	secondary	7.44e-15	1.43e-13
Total Manufacturing			**5.12e+00**	**9.88e+01**
Use, Maintenance and Repair Life-cycle Stage				

Table M-38. LCD LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
Total Use, Maintenance and Repair			**0.00e+00**	**0.00e+00**
End-of-life Life-cycle Stage				
LCD landfilling	Ammonia	primary	1.86e-05	3.58e-04
LCD landfilling	Silver compounds	primary	1.16e-06	2.23e-05
LCD incineration	Silver compounds	secondary	8.97e-07	1.73e-05
LCD incineration	Cadmium cmpds	secondary	3.51e-08	6.76e-07
LCD landfilling	Cadmium cmpds	primary	3.24e-08	6.24e-07
LCD incineration	Barium cmpds	secondary	2.08e-08	4.02e-07
LCD landfilling	Barium cmpds	primary	1.75e-08	3.38e-07
LPG Production	Phenol	secondary	1.67e-08	3.23e-07
LPG Production	Aluminum (+3)	secondary	9.68e-09	1.87e-07
LCD incineration	Mercury compounds	secondary	8.08e-09	1.56e-07
LCD incineration	Arsenic cmpds	secondary	7.75e-09	1.50e-07
LCD landfilling	Mercury compounds	primary	6.99e-09	1.35e-07
LCD landfilling	Arsenic cmpds	primary	6.59e-09	1.27e-07
LCD incineration	Lead cmpds	secondary	5.11e-09	9.85e-08
LCD landfilling	Lead cmpds	primary	4.73e-09	9.12e-08
LCD incineration	Chromium (VI)	secondary	3.40e-09	6.55e-08
LCD landfilling	Chromium (VI)	primary	2.72e-09	5.25e-08
LCD incineration	Chromium (III)	secondary	2.44e-09	4.70e-08
LCD landfilling	Chromium (III)	primary	1.95e-09	3.77e-08
LCD landfilling	Xylene (mixed isomers)	primary	1.01e-09	1.94e-08
LCD landfilling	Toluene	primary	5.68e-10	1.10e-08
LPG Production	Nitrate	secondary	4.77e-10	9.20e-09
LCD incineration	o-xylene	secondary	4.67e-10	9.01e-09
LCD incineration	Toluene	secondary	4.38e-10	8.45e-09
LPG Production	Fluorides (F-)	secondary	2.68e-10	5.17e-09
LCD landfilling	Ethylbenzene	primary	2.13e-10	4.12e-09
LCD incineration	Ethylbenzene	secondary	1.66e-10	3.19e-09
LPG Production	Copper (+1 & +2)	secondary	6.10e-11	1.18e-09
LCD landfilling	Tetrachloroethylene	primary	3.26e-11	6.28e-10
LCD incineration	Selenium	secondary	3.12e-11	6.02e-10
LCD landfilling	Selenium	primary	2.64e-11	5.09e-10
LCD incineration	Tetrachloroethylene	secondary	2.53e-11	4.87e-10
LCD landfilling	Benzene	primary	2.16e-11	4.17e-10
LPG Production	Zinc (+2)	secondary	1.71e-11	3.29e-10
LCD incineration	Benzene	secondary	1.68e-11	3.23e-10
LCD landfilling	Carbon tetrachloride	primary	1.32e-11	2.55e-10
LCD incineration	Carbon tetrachloride	secondary	1.03e-11	1.98e-10
LCD landfilling	Trichloroethylene	primary	9.99e-12	1.93e-10
LCD incineration	Trichloroethylene	secondary	7.75e-12	1.49e-10
LCD landfilling	Chloroform	primary	5.35e-12	1.03e-10
LCD landfilling	Vinyl chloride	primary	5.34e-12	1.03e-10
LCD incineration	Chloroform	secondary	4.15e-12	8.01e-11
LCD incineration	Vinyl chloride	secondary	4.14e-12	7.99e-11
LCD landfilling	1,2-Dichloroethane	primary	2.81e-12	5.42e-11
LCD incineration	1,2-Dichloroethane	secondary	2.18e-12	4.20e-11
LCD landfilling	Dichloromethane	primary	1.85e-12	3.57e-11
LCD incineration	Dichloromethane	secondary	1.44e-12	2.77e-11
LPG Production	Aromatic hydrocarbons	secondary	6.90e-13	1.33e-11

Table M-38. LCD LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
LPG Production	Barium cmpds	secondary	5.60e-13	1.08e-11
LPG Production	Chromium (VI)	secondary	4.00e-13	7.71e-12
LPG Production	Chromium (III)	secondary	2.87e-13	5.53e-12
LPG Production	Cadmium cmpds	secondary	2.71e-13	5.23e-12
LPG Production	Lead cmpds	secondary	9.06e-14	1.75e-12
LPG Production	Toluene	secondary	8.42e-14	1.62e-12
LPG Production	Nickel cmpds	secondary	1.10e-14	2.11e-13
LPG Production	Mercury compounds	secondary	4.93e-15	9.50e-14
LPG Production	Cyanide (-1)	secondary	3.22e-15	6.20e-14
LPG Production	Halogenated matter (organic)	secondary	9.19e-16	1.77e-14
Natural Gas Prod.	Halogenated matter (organic)	secondary	-1.56e-15	-3.01e-14
Natural Gas Prod.	Cyanide (-1)	secondary	-5.47e-15	-1.05e-13
Natural Gas Prod.	Mercury compounds	secondary	-8.37e-15	-1.61e-13
Natural Gas Prod.	Nickel cmpds	secondary	-1.86e-14	-3.59e-13
LCD incineration	Halogenated matter (organic)	secondary	-2.38e-14	-4.59e-13
LCD incineration	Cyanide (-1)	secondary	-8.33e-14	-1.61e-12
Natural Gas Prod.	Toluene	secondary	-1.43e-13	-2.76e-12
Natural Gas Prod.	Lead cmpds	secondary	-1.54e-13	-2.97e-12
LCD incineration	Nickel cmpds	secondary	-2.84e-13	-5.47e-12
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	-3.78e-13	-7.29e-12
Natural Gas Prod.	Cadmium cmpds	secondary	-4.61e-13	-8.88e-12
Natural Gas Prod.	Barium cmpds	secondary	-9.51e-13	-1.83e-11
Natural Gas Prod.	Aromatic hydrocarbons	secondary	-1.17e-12	-2.26e-11
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	-1.32e-12	-2.55e-11
Fuel Oil #4 Prod.	Mercury compounds	secondary	-2.02e-12	-3.90e-11
Fuel Oil #4 Prod.	Nickel cmpds	secondary	-4.51e-12	-8.69e-11
LCD incineration	Aromatic hydrocarbons	secondary	-1.78e-11	-3.44e-10
Fuel Oil #4 Prod.	Toluene	secondary	-3.46e-11	-6.68e-10
Fuel Oil #4 Prod.	Lead cmpds	secondary	-3.72e-11	-7.18e-10
Fuel Oil #4 Prod.	Chromium (III)	secondary	-6.81e-11	-1.31e-09
Fuel Oil #4 Prod.	Chromium (VI)	secondary	-9.50e-11	-1.83e-09
Natural Gas Prod.	Copper (+1 & +2)	secondary	-1.04e-10	-2.00e-09
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	-1.11e-10	-2.15e-09
Fuel Oil #4 Prod.	Barium cmpds	secondary	-2.30e-10	-4.44e-09
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	-2.83e-10	-5.47e-09
Natural Gas Prod.	Chromium (III)	secondary	-7.28e-10	-1.40e-08
Natural Gas Prod.	Chromium (VI)	secondary	-1.01e-09	-1.96e-08
LCD incineration	Copper (+1 & +2)	secondary	-1.58e-09	-3.04e-08
LCD incineration	Zinc (+2)	secondary	-5.36e-09	-1.03e-07
Fuel Oil #4 Prod.	Zinc (+2)	secondary	-7.83e-09	-1.51e-07
Natural Gas Prod.	Nitrate	secondary	-9.96e-09	-1.92e-07
Natural Gas Prod.	Aluminum (+3)	secondary	-1.65e-08	-3.17e-07
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	-2.51e-08	-4.83e-07
Natural Gas Prod.	Phenol	secondary	-2.86e-08	-5.52e-07
Natural Gas Prod.	Fluorides (F-)	secondary	-3.95e-08	-7.61e-07
Natural Gas Prod.	Zinc (+2)	secondary	-6.41e-08	-1.24e-06
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	-1.62e-07	-3.12e-06
Fuel Oil #4 Prod.	Nitrate	secondary	-2.08e-07	-4.02e-06
LCD incineration	Aluminum (+3)	secondary	-2.51e-07	-4.83e-06

Table M-38. LCD LCIA Results for the Aquatic Toxicity Impact Category

Process Group	Material	LCI Data Type	Aquatic Toxicity (tox-kg)	% of Total
LCD incineration	Phenol	secondary	-4.33e-07	-8.36e-06
LCD incineration	Nitrate	secondary	-2.33e-06	-4.49e-05
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	-3.98e-06	-7.68e-05
Fuel Oil #4 Prod.	Phenol	secondary	-6.88e-06	-1.33e-04
LCD incineration	Fluorides (F-)	secondary	-9.81e-06	-1.89e-04
LCD incineration	Ammonia	secondary	-2.34e-04	-4.51e-03
Total End-of-life			**-2.37e-04**	**-4.58e-03**
Total All Life-cycle Stages			**5.19e+00**	**1.00e+02**

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Materials Processing Life-cycle Stage				
Invar	Sulfur dioxide	secondary	1.65e+02	8.35e+00
Steel Prod., cold-rolled, semi-finished	Sulfur dioxide	secondary	2.54e+01	1.28e+00
Aluminum Prod.	Sulfur dioxide	secondary	1.38e+01	6.99e-01
Polycarbonate Production	Sulfur dioxide	secondary	7.93e+00	4.02e-01
Lead	Sulfur dioxide	secondary	4.57e+00	2.32e-01
ABS Production	Sulfur dioxide	secondary	2.80e+00	1.42e-01
Ferrite mfg.	Sulfur dioxide	secondary	2.35e+00	1.19e-01
Lead	Arsenic	secondary	2.21e+00	1.12e-01
Polystyrene Prod., high-impact	Sulfur dioxide	secondary	1.20e+00	6.07e-02
Aluminum Prod.	Titanium tetrachloride	secondary	7.20e-01	3.65e-02
Steel Prod., cold-rolled, semi-finished	Carbon monoxide	secondary	2.78e-01	1.41e-02
Invar	Titanium tetrachloride	secondary	2.56e-01	1.30e-02
Lead	Titanium tetrachloride	secondary	2.10e-01	1.07e-02
Aluminum Prod.	Manganese cmpds	secondary	1.62e-01	8.20e-03
Invar	Manganese cmpds	secondary	1.50e-01	7.58e-03
Aluminum Prod.	Vanadium	secondary	1.07e-01	5.44e-03
Steel Prod., cold-rolled, semi-finished	PM	secondary	1.05e-01	5.31e-03
Ferrite mfg.	Manganese cmpds	secondary	9.39e-02	4.76e-03
Invar	Vanadium	secondary	7.40e-02	3.75e-03
Invar	Carbon monoxide	secondary	7.04e-02	3.56e-03
Ferrite mfg.	Carbon monoxide	secondary	5.85e-02	2.96e-03
Steel Prod., cold-rolled, semi-finished	Vanadium	secondary	5.15e-02	2.61e-03
Aluminum Prod.	Arsenic cmpds	secondary	4.75e-02	2.41e-03
Lead	Manganese cmpds	secondary	4.60e-02	2.33e-03
Polycarbonate Production	Carbon monoxide	secondary	4.15e-02	2.10e-03
Invar	Arsenic	secondary	3.21e-02	1.62e-03
Ferrite mfg.	Arsenic	secondary	2.90e-02	1.47e-03
Lead	Zinc (elemental)	secondary	2.42e-02	1.23e-03
Ferrite mfg.	Titanium tetrachloride	secondary	2.36e-02	1.20e-03
Invar	Zinc (elemental)	secondary	2.28e-02	1.15e-03
Ferrite mfg.	Zinc (elemental)	secondary	2.21e-02	1.12e-03
Lead	Vanadium	secondary	2.09e-02	1.06e-03
Polycarbonate Production	Methane	secondary	2.03e-02	1.03e-03
ABS Production	Carbon monoxide	secondary	2.01e-02	1.02e-03
Polycarbonate Production	Nitrogen dioxide	secondary	1.94e-02	9.82e-04
Steel Prod., cold-rolled, semi-finished	Fluorides (F-)	secondary	1.91e-02	9.68e-04
Lead	Carbon monoxide	secondary	1.89e-02	9.57e-04
Aluminum Prod.	Carbon monoxide	secondary	1.72e-02	8.74e-04
Invar	Arsenic cmpds	secondary	1.69e-02	8.55e-04
Styrene-butadiene Copolymer Prod.	Carbon monoxide	secondary	1.60e-02	8.12e-04
Steel Prod., cold-rolled, semi-finished	Manganese cmpds	secondary	1.49e-02	7.55e-04
Ferrite mfg.	Vanadium	secondary	1.45e-02	7.35e-04
Steel Prod., cold-rolled, semi-finished	Nitrogen dioxide	secondary	1.40e-02	7.09e-04
Lead	Arsenic cmpds	secondary	1.38e-02	6.99e-04
Steel Prod., cold-rolled, semi-finished	Methane	secondary	1.09e-02	5.52e-04
Aluminum Prod.	Barium cmpds	secondary	1.04e-02	5.29e-04
Aluminum Prod.	PM	secondary	8.90e-03	4.51e-04
Aluminum Prod.	Methane	secondary	8.05e-03	4.08e-04
Aluminum Prod.	Nitrogen dioxide	secondary	7.13e-03	3.61e-04

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Styrene-butadiene Copolymer Prod.	Nitrogen oxides	secondary	6.99e-03	3.54e-04
Styrene-butadiene Copolymer Prod.	Methane	secondary	6.87e-03	3.48e-04
Polycarbonate Production	PM	secondary	6.46e-03	3.27e-04
Aluminum Prod.	Selenium	secondary	6.29e-03	3.19e-04
Invar	Methane	secondary	5.76e-03	2.92e-04
Styrene-butadiene Copolymer Prod.	Sulfur oxides	secondary	5.71e-03	2.89e-04
ABS Production	Methane	secondary	5.08e-03	2.57e-04
Invar	Nitrogen dioxide	secondary	5.07e-03	2.57e-04
ABS Production	Nitrogen dioxide	secondary	4.66e-03	2.36e-04
Steel Prod., cold-rolled, semi-finished	Arsenic	secondary	4.52e-03	2.29e-04
Invar	Barium cmpds	secondary	4.31e-03	2.19e-04
Lead	Nitrogen dioxide	secondary	4.18e-03	2.12e-04
Steel Prod., cold-rolled, semi-finished	Phosphorus (yellow or white)	secondary	4.07e-03	2.06e-04
ABS Production	Hydrochloric acid	secondary	2.93e-03	1.48e-04
Ferrite mfg.	Methane	secondary	2.85e-03	1.45e-04
Invar	PM	secondary	2.76e-03	1.40e-04
Lead	Barium cmpds	secondary	2.71e-03	1.37e-04
Lead	Methane	secondary	2.52e-03	1.28e-04
Invar	Selenium	secondary	2.32e-03	1.18e-04
Polystyrene Prod., high-impact	Carbon monoxide	secondary	2.27e-03	1.15e-04
Steel Prod., cold-rolled, semi-finished	Hydrochloric acid	secondary	2.05e-03	1.04e-04
Ferrite mfg.	Nitrogen dioxide	secondary	2.03e-03	1.03e-04
Invar	Hydrochloric acid	secondary	1.85e-03	9.38e-05
Lead	Selenium	secondary	1.84e-03	9.30e-05
Polystyrene Prod., high-impact	Nitrogen dioxide	secondary	1.81e-03	9.19e-05
Aluminum Prod.	Hydrochloric acid	secondary	1.78e-03	9.04e-05
Steel Prod., cold-rolled, semi-finished	Benzene	secondary	1.76e-03	8.91e-05
Steel Prod., cold-rolled, semi-finished	Barium cmpds	secondary	1.73e-03	8.77e-05
Ferrite mfg.	PM	secondary	1.72e-03	8.72e-05
Polystyrene Prod., high-impact	Methane	secondary	1.66e-03	8.42e-05
Ferrite mfg.	Arsenic cmpds	secondary	1.64e-03	8.30e-05
ABS Production	Formaldehyde	secondary	1.60e-03	8.11e-05
Aluminum Prod.	Aluminum (+3)	secondary	1.59e-03	8.04e-05
Lead	Lead	secondary	1.58e-03	8.01e-05
Steel Prod., cold-rolled, semi-finished	Arsenic cmpds	secondary	1.54e-03	7.78e-05
ABS Production	PM	secondary	1.27e-03	6.44e-05
Aluminum Prod.	Cadmium cmpds	secondary	1.17e-03	5.93e-05
Lead	Hydrochloric acid	secondary	1.07e-03	5.42e-05
Styrene-butadiene Copolymer Prod.	PM	secondary	9.93e-04	5.03e-05
Invar	Copper	secondary	9.89e-04	5.01e-05
Invar	Benzene	secondary	9.17e-04	4.65e-05
Lead	PM	secondary	8.41e-04	4.26e-05
Steel Prod., cold-rolled, semi-finished	Titanium tetrachloride	secondary	8.33e-04	4.22e-05
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	7.99e-04	4.05e-05
Ferrite mfg.	Barium cmpds	secondary	7.81e-04	3.96e-05
Steel Prod., cold-rolled, semi-finished	Nitrous oxide	secondary	7.77e-04	3.94e-05
Ferrite mfg.	Hydrochloric acid	secondary	6.93e-04	3.51e-05
Ferrite mfg.	Benzene	secondary	5.85e-04	2.97e-05
Invar	Aluminum (+3)	secondary	5.70e-04	2.89e-05
Aluminum Prod.	Benzene	secondary	5.69e-04	2.88e-05

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Steel Prod., cold-rolled, semi-finished	Silicon	secondary	5.06e-04	2.56e-05
Polycarbonate Production	Hydrochloric acid	secondary	4.65e-04	2.36e-05
Lead	Aluminum (+3)	secondary	4.62e-04	2.34e-05
Aluminum Prod.	Barium sulfate	secondary	4.54e-04	2.30e-05
Steel Prod., cold-rolled, semi-finished	Formaldehyde	secondary	4.15e-04	2.10e-05
Steel Prod., cold-rolled, semi-finished	Titanium	secondary	3.26e-04	1.65e-05
Polycarbonate Production	Sulfuric acid	secondary	3.17e-04	1.61e-05
Polystyrene Prod., high-impact	PM	secondary	3.02e-04	1.53e-05
Steel Prod., cold-rolled, semi-finished	Selenium	secondary	3.00e-04	1.52e-05
Lead	Benzene	secondary	2.99e-04	1.51e-05
Invar	Phosphorus (yellow or white)	secondary	2.89e-04	1.46e-05
Ferrite mfg.	Selenium	secondary	2.86e-04	1.45e-05
Ferrite mfg.	Phosphorus (yellow or white)	secondary	2.85e-04	1.44e-05
Steel Prod., cold-rolled, semi-finished	Ethane	secondary	2.46e-04	1.25e-05
ABS Production	Hydrofluoric acid	secondary	2.44e-04	1.23e-05
Polycarbonate Production	Mercury compounds	secondary	2.43e-04	1.23e-05
Aluminum Prod.	Hydrofluoric acid	secondary	2.40e-04	1.22e-05
Aluminum Prod.	Zinc (elemental)	secondary	2.30e-04	1.16e-05
Aluminum Prod.	Titanium	secondary	2.28e-04	1.15e-05
Invar	Silicon	secondary	2.26e-04	1.15e-05
Steel Prod., cold-rolled, semi-finished	Zinc (elemental)	secondary	2.16e-04	1.10e-05
Invar	Titanium	secondary	2.13e-04	1.08e-05
ABS Production	Ammonia	secondary	1.94e-04	9.82e-06
ABS Production	Aromatic hydrocarbons	secondary	1.91e-04	9.65e-06
Steel Prod., cold-rolled, semi-finished	Molybdenum	secondary	1.88e-04	9.51e-06
Aluminum Prod.	Copper (+1 & +2)	secondary	1.80e-04	9.12e-06
Invar	Formaldehyde	secondary	1.60e-04	8.11e-06
Ferrite mfg.	Formaldehyde	secondary	1.56e-04	7.92e-06
Invar	Molybdenum	secondary	1.52e-04	7.70e-06
Ferrite mfg.	Silicon	secondary	1.48e-04	7.52e-06
ABS Production	Sulfuric acid	secondary	1.45e-04	7.37e-06
Styrene-butadiene Copolymer Prod.	Sulfuric acid	secondary	1.42e-04	7.20e-06
Aluminum Prod.	Nitrous oxide	secondary	1.38e-04	7.00e-06
Aluminum Prod.	Perfluoromethane	secondary	1.30e-04	6.57e-06
Invar	Cadmium cmpds	secondary	1.27e-04	6.43e-06
Steel Prod., cold-rolled, semi-finished	Barium	secondary	1.23e-04	6.23e-06
Invar	Nitrates/nitrites	secondary	1.21e-04	6.11e-06
ABS Production	Ethane	secondary	1.19e-04	6.01e-06
Lead	Barium sulfate	secondary	1.15e-04	5.81e-06
ABS Production	Mercury compounds	secondary	1.11e-04	5.65e-06
Aluminum Prod.	Silicon	secondary	1.09e-04	5.54e-06
Styrene-butadiene Copolymer Prod.	Mercury compounds	secondary	1.09e-04	5.52e-06
Steel Prod., cold-rolled, semi-finished	Tin (Sn++, Sn4+)	secondary	1.04e-04	5.28e-06
Steel Prod., cold-rolled, semi-finished	Antimony	secondary	9.51e-05	4.82e-06
Invar	Copper (+1 & +2)	secondary	9.43e-05	4.78e-06
Polycarbonate Production	Fluorides (F-)	secondary	9.16e-05	4.64e-06
Ferrite mfg.	Titanium	secondary	9.12e-05	4.62e-06
Invar	Ethane	secondary	8.26e-05	4.18e-06
Polycarbonate Production	Aromatic hydrocarbons	secondary	8.22e-05	4.16e-06
Ferrite mfg.	Ethane	secondary	8.06e-05	4.09e-06

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Lead	Silicon	secondary	7.13e-05	3.61e-06
Styrene-butadiene Copolymer Prod.	Hydrochloric acid	secondary	6.82e-05	3.46e-06
Styrene-butadiene Copolymer Prod.	Aromatic hydrocarbons	secondary	6.79e-05	3.44e-06
Invar	Nickel	secondary	6.54e-05	3.31e-06
Invar	Barium	secondary	6.53e-05	3.31e-06
Steel Prod., cold-rolled, semi-finished	Silver compounds	secondary	6.17e-05	3.13e-06
Ferrite mfg.	Aluminum (+3)	secondary	5.58e-05	2.82e-06
Ferrite mfg.	Molybdenum	secondary	5.23e-05	2.65e-06
Lead	Copper (+1 & +2)	secondary	5.20e-05	2.64e-06
ABS Production	Aluminum (+3)	secondary	5.08e-05	2.57e-06
Steel Prod., cold-rolled, semi-finished	Nitrates/nitrites	secondary	4.99e-05	2.53e-06
Steel Prod., cold-rolled, semi-finished	Boron	secondary	4.93e-05	2.50e-06
Aluminum Prod.	Nitrate	secondary	4.56e-05	2.31e-06
Steel Prod., cold-rolled, semi-finished	Mercury compounds	secondary	4.52e-05	2.29e-06
Styrene-butadiene Copolymer Prod.	Fluorides (F-)	secondary	4.10e-05	2.08e-06
Aluminum Prod.	Barium	secondary	3.91e-05	1.98e-06
Ferrite mfg.	Barium	secondary	3.73e-05	1.89e-06
Invar	Lead	secondary	3.62e-05	1.83e-06
Ferrite mfg.	Lead	secondary	3.46e-05	1.75e-06
Invar	Barium sulfate	secondary	3.46e-05	1.75e-06
Steel Prod., cold-rolled, semi-finished	Barium sulfate	secondary	3.43e-05	1.74e-06
Ferrite mfg.	Barium sulfate	secondary	3.38e-05	1.71e-06
Invar	Ammonia	secondary	3.16e-05	1.60e-06
Lead	Ethane	secondary	3.16e-05	1.60e-06
Invar	Tin (Sn++, Sn4+)	secondary	3.04e-05	1.54e-06
Polystyrene Prod., high-impact	Aromatic hydrocarbons	secondary	3.02e-05	1.53e-06
ABS Production	Nitrate	secondary	3.01e-05	1.52e-06
Lead	Barium	secondary	2.88e-05	1.46e-06
Lead	Copper	secondary	2.82e-05	1.43e-06
Invar	Boron	secondary	2.79e-05	1.41e-06
Steel Prod., cold-rolled, semi-finished	Cadmium cmpds	secondary	2.70e-05	1.37e-06
Invar	Antimony	secondary	2.69e-05	1.37e-06
Invar	Hydrofluoric acid	secondary	2.69e-05	1.36e-06
Ferrite mfg.	Antimony	secondary	2.63e-05	1.33e-06
Steel Prod., cold-rolled, semi-finished	Aluminum (elemental)	secondary	2.47e-05	1.25e-06
Invar	Zinc (+2)	secondary	2.44e-05	1.23e-06
Polystyrene Prod., high-impact	Hydrochloric acid	secondary	2.42e-05	1.23e-06
Aluminum Prod.	Copper	secondary	2.38e-05	1.21e-06
Steel Prod., cold-rolled, semi-finished	Acetylene	secondary	2.33e-05	1.18e-06
Lead	Nitrous oxide	secondary	2.03e-05	1.03e-06
Aluminum Prod.	Nickel cmpds	secondary	1.91e-05	9.65e-07
Steel Prod., cold-rolled, semi-finished	Hydrofluoric acid	secondary	1.89e-05	9.59e-07
Invar	Silver compounds	secondary	1.86e-05	9.44e-07
Ferrite mfg.	Zinc (+2)	secondary	1.84e-05	9.34e-07
Ferrite mfg.	Silver compounds	secondary	1.82e-05	9.22e-07
Aluminum Prod.	Nickel	secondary	1.78e-05	9.00e-07
Aluminum Prod.	Zinc (+2)	secondary	1.74e-05	8.83e-07
Steel Prod., cold-rolled, semi-finished	Pentane	secondary	1.70e-05	8.59e-07
Steel Prod., cold-rolled, semi-finished	Aluminum (+3)	secondary	1.58e-05	7.98e-07
Aluminum Prod.	Ammonia	secondary	1.55e-05	7.84e-07

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Invar	Aluminum (elemental)	secondary	1.52e-05	7.72e-07
Invar	Nickel cmpds	secondary	1.51e-05	7.66e-07
Ferrite mfg.	Boron	secondary	1.48e-05	7.51e-07
Aluminum Prod.	Aromatic hydrocarbons	secondary	1.41e-05	7.17e-07
Lead	Hydrofluoric acid	secondary	1.36e-05	6.91e-07
Steel Prod., cold-rolled, semi-finished	Hydrogen sulfide	secondary	1.36e-05	6.88e-07
Aluminum Prod.	Nitrites	secondary	1.35e-05	6.85e-07
Steel Prod., cold-rolled, semi-finished	Copper	secondary	1.22e-05	6.19e-07
Lead	Ammonia	secondary	1.19e-05	6.01e-07
Ferrite mfg.	Nitrous oxide	secondary	1.06e-05	5.38e-07
Aluminum Prod.	Aluminum (elemental)	secondary	1.05e-05	5.33e-07
Polycarbonate Production	Copper (+1 & +2)	secondary	1.04e-05	5.25e-07
Ferrite mfg.	Ammonia	secondary	1.03e-05	5.19e-07
ABS Production	Hydrogen sulfide	secondary	1.01e-05	5.13e-07
Aluminum Prod.	Strontium (Sr II)	secondary	1.00e-05	5.06e-07
Lead	Boron	secondary	9.53e-06	4.83e-07
Polycarbonate Production	Phenol	secondary	9.34e-06	4.73e-07
Aluminum Prod.	Fluoride	secondary	9.10e-06	4.61e-07
Lead	Nitrate	secondary	9.00e-06	4.56e-07
Invar	Pentane	secondary	8.97e-06	4.55e-07
Ferrite mfg.	Pentane	secondary	8.76e-06	4.44e-07
Aluminum Prod.	Lead cmpds	secondary	8.72e-06	4.42e-07
Steel Prod., cold-rolled, semi-finished	Copper (+1 & +2)	secondary	8.59e-06	4.35e-07
Invar	Aromatic hydrocarbons	secondary	8.36e-06	4.23e-07
Lead	Aluminum (elemental)	secondary	8.16e-06	4.13e-07
Steel Prod., cold-rolled, semi-finished	Nickel	secondary	8.14e-06	4.13e-07
Aluminum Prod.	Vanadium (V3+, V5+)	secondary	8.14e-06	4.13e-07
Ferrite mfg.	Aluminum (elemental)	secondary	7.77e-06	3.93e-07
Invar	Hydrogen sulfide	secondary	7.26e-06	3.68e-07
Steel Prod., cold-rolled, semi-finished	Aromatic hydrocarbons	secondary	7.17e-06	3.63e-07
Invar	Acetylene	secondary	6.61e-06	3.35e-07
Ferrite mfg.	Acetylene	secondary	6.46e-06	3.27e-07
Ferrite mfg.	Hydrofluoric acid	secondary	6.37e-06	3.23e-07
Ferrite mfg.	Copper (+1 & +2)	secondary	5.96e-06	3.02e-07
Invar	Nitrites	secondary	5.95e-06	3.01e-07
Ferrite mfg.	Cadmium cmpds	secondary	5.94e-06	3.01e-07
Lead	Nickel cmpds	secondary	5.60e-06	2.83e-07
Invar	Strontium (Sr II)	secondary	5.18e-06	2.62e-07
Ferrite mfg.	Hydrogen sulfide	secondary	5.17e-06	2.62e-07
ABS Production	Heptane	secondary	5.02e-06	2.54e-07
Lead	Zinc (+2)	secondary	4.96e-06	2.51e-07
Aluminum Prod.	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	4.94e-06	2.50e-07
ABS Production	Copper (+1 & +2)	secondary	4.75e-06	2.41e-07
Lead	Nickel	secondary	4.72e-06	2.39e-07
Steel Prod., cold-rolled, semi-finished	Strontium (Sr II)	secondary	4.67e-06	2.37e-07
Styrene-butadiene Copolymer Prod.	Copper (+1 & +2)	secondary	4.64e-06	2.35e-07
Ferrite mfg.	Copper	secondary	4.55e-06	2.31e-07
Lead	Fluoride	secondary	4.46e-06	2.26e-07
Steel Prod., cold-rolled, semi-finished	Hexane	secondary	4.43e-06	2.24e-07

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Invar	Fluoride	secondary	4.40e-06	2.23e-07
Ferrite mfg.	Nitrate	secondary	4.04e-06	2.05e-07
Lead	Cadmium	secondary	3.98e-06	2.02e-07
Aluminum Prod.	Hydrogen sulfide	secondary	3.77e-06	1.91e-07
Polycarbonate Production	Ammonia	secondary	3.70e-06	1.87e-07
Polycarbonate Production	Hydrofluoric acid	secondary	3.69e-06	1.87e-07
Steel Prod., cold-rolled, semi-finished	Chromium (VI)	secondary	3.30e-06	1.67e-07
Invar	Vanadium (V3+, V5+)	secondary	3.00e-06	1.52e-07
Invar	Lead cmpds	secondary	2.98e-06	1.51e-07
Lead	Hydrogen sulfide	secondary	2.96e-06	1.50e-07
Styrene-butadiene Copolymer Prod.	Nitrate	secondary	2.90e-06	1.47e-07
Lead	Nitrites	secondary	2.86e-06	1.45e-07
Lead	Lead cmpds	secondary	2.75e-06	1.39e-07
Lead	Vanadium (V3+, V5+)	secondary	2.37e-06	1.20e-07
Ferrite mfg.	Nickel	secondary	2.30e-06	1.16e-07
Ferrite mfg.	Aromatic hydrocarbons	secondary	2.26e-06	1.15e-07
Steel Prod., cold-rolled, semi-finished	Boric acid	secondary	2.17e-06	1.10e-07
Steel Prod., cold-rolled, semi-finished	Bromine	secondary	2.03e-06	1.03e-07
Lead	Strontium (Sr II)	secondary	2.00e-06	1.01e-07
Invar	Methanol	secondary	1.87e-06	9.45e-08
Polycarbonate Production	Halogenated hydrocarbons (unspecified)	secondary	1.85e-06	9.36e-08
Polycarbonate Production	Hydrogen sulfide	secondary	1.85e-06	9.36e-08
Aluminum Prod.	Toluene	secondary	1.81e-06	9.18e-08
Invar	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	1.72e-06	8.73e-08
Steel Prod., cold-rolled, semi-finished	Uranium	secondary	1.68e-06	8.53e-08
Polystyrene Prod., high-impact	Ammonia	secondary	1.62e-06	8.18e-08
Steel Prod., cold-rolled, semi-finished	Toluene	secondary	1.52e-06	7.69e-08
Ferrite mfg.	Strontium (Sr II)	secondary	1.52e-06	7.68e-08
Lead	Mercury	secondary	1.51e-06	7.66e-08
Lead	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	1.49e-06	7.57e-08
Invar	Cobalt (Co I, Co II, Co III)	secondary	1.44e-06	7.31e-08
Aluminum Prod.	Xylene (mixed isomers)	secondary	1.38e-06	6.98e-08
Invar	Hexane	secondary	1.29e-06	6.52e-08
Ferrite mfg.	Hexane	secondary	1.26e-06	6.37e-08
Invar	Boron (B III)	secondary	1.26e-06	6.36e-08
Invar	Benzo[a]pyrene	secondary	1.23e-06	6.23e-08
Steel Prod., cold-rolled, semi-finished	Ethylene	secondary	1.23e-06	6.22e-08
Steel Prod., cold-rolled, semi-finished	Cyanide (-1)	secondary	1.21e-06	6.11e-08
Aluminum Prod.	Lead	secondary	1.20e-06	6.08e-08
Steel Prod., cold-rolled, semi-finished	Methanol	secondary	1.19e-06	6.04e-08
Invar	Cadmium	secondary	1.18e-06	5.97e-08
Steel Prod., cold-rolled, semi-finished	Xylene (mixed isomers)	secondary	1.12e-06	5.68e-08
Steel Prod., cold-rolled, semi-finished	Lead	secondary	1.10e-06	5.58e-08
Steel Prod., cold-rolled, semi-finished	Naphthalene	secondary	1.10e-06	5.57e-08
Invar	Toluene	secondary	1.10e-06	5.57e-08
Lead	Bromine	secondary	1.08e-06	5.46e-08
Ferrite mfg.	Cadmium	secondary	9.76e-07	4.95e-08
Steel Prod., cold-rolled, semi-finished	Phenol	secondary	9.70e-07	4.91e-08
Steel Prod., cold-rolled, semi-finished	Heptane	secondary	9.33e-07	4.73e-08

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Invar	Chromium (VI)	secondary	9.25e-07	4.69e-08
Polycarbonate Production	Chlorine	secondary	9.23e-07	4.68e-08
Ferrite mfg.	Fluoride	secondary	9.23e-07	4.68e-08
Lead	Cobalt (Co I, Co II, Co III)	secondary	9.18e-07	4.65e-08
Aluminum Prod.	Chromium (VI)	secondary	8.90e-07	4.51e-08
Steel Prod., cold-rolled, semi-finished	Lead cmpds	secondary	8.83e-07	4.47e-08
Lead	Manganese	secondary	8.47e-07	4.29e-08
Styrene-butadiene Copolymer Prod.	Aluminum (+3)	secondary	8.27e-07	4.19e-08
Ferrite mfg.	Nickel cmpds	secondary	7.97e-07	4.04e-08
Lead	Mercury compounds	secondary	7.88e-07	3.99e-08
Invar	Xylene (mixed isomers)	secondary	7.67e-07	3.89e-08
Lead	Boron (B III)	secondary	7.54e-07	3.82e-08
Invar	Bromium (Br)	secondary	7.09e-07	3.59e-08
Ferrite mfg.	Bromine	secondary	6.92e-07	3.50e-08
Aluminum Prod.	Phenol	secondary	6.39e-07	3.24e-08
ABS Production	Chlorine	secondary	6.35e-07	3.22e-08
Invar	Manganese	secondary	6.32e-07	3.20e-08
Invar	Boric acid	secondary	6.13e-07	3.11e-08
Invar	Ethylene	secondary	6.01e-07	3.04e-08
Ferrite mfg.	Boric acid	secondary	5.99e-07	3.03e-08
Steel Prod., cold-rolled, semi-finished	Nickel cmpds	secondary	5.96e-07	3.02e-08
ABS Production	Phenol	secondary	5.88e-07	2.98e-08
Ferrite mfg.	Ethylene	secondary	5.79e-07	2.93e-08
Ferrite mfg.	Toluene	secondary	5.31e-07	2.69e-08
Steel Prod., cold-rolled, semi-finished	Zinc (+2)	secondary	5.30e-07	2.69e-08
Ferrite mfg.	Lead cmpds	secondary	5.19e-07	2.63e-08
ABS Production	Nickel cmpds	secondary	5.04e-07	2.55e-08
Styrene-butadiene Copolymer Prod.	Phenol	secondary	4.92e-07	2.49e-08
Invar	Uranium	secondary	4.81e-07	2.44e-08
Ferrite mfg.	Uranium	secondary	4.69e-07	2.38e-08
Polycarbonate Production	Aluminum (+3)	secondary	4.62e-07	2.34e-08
Polycarbonate Production	Ethanethiol	secondary	4.62e-07	2.34e-08
Polycarbonate Production	Lead	secondary	4.62e-07	2.34e-08
Polycarbonate Production	Mercury	secondary	4.62e-07	2.34e-08
Polycarbonate Production	Nickel (+2)	secondary	4.62e-07	2.34e-08
Polycarbonate Production	Nitrate	secondary	4.62e-07	2.34e-08
Polycarbonate Production	Nitrous oxide	secondary	4.62e-07	2.34e-08
Polycarbonate Production	Zinc (+2)	secondary	4.62e-07	2.34e-08
Invar	Phenol	secondary	4.41e-07	2.23e-08
Aluminum Prod.	Acetic acid	secondary	4.22e-07	2.14e-08
Ferrite mfg.	Chromium (VI)	secondary	4.17e-07	2.11e-08
Styrene-butadiene Copolymer Prod.	Chlorine	secondary	4.14e-07	2.10e-08
Styrene-butadiene Copolymer Prod.	Hydrofluoric acid	secondary	4.14e-07	2.10e-08
Ferrite mfg.	Nitrites	secondary	4.13e-07	2.09e-08
Aluminum Prod.	Cobalt	secondary	4.11e-07	2.08e-08
Steel Prod., cold-rolled, semi-finished	Cobalt	secondary	4.05e-07	2.05e-08
Lead	Chromium (VI)	secondary	3.70e-07	1.88e-08
Steel Prod., cold-rolled, semi-finished	Manganese	secondary	3.60e-07	1.82e-08
Styrene-butadiene Copolymer Prod.	Ammonia	secondary	3.55e-07	1.80e-08
Ferrite mfg.	Xylene (mixed isomers)	secondary	3.50e-07	1.77e-08

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Invar	Acetic acid	secondary	3.50e-07	1.77e-08
Ferrite mfg.	Vanadium (V3+, V5+)	secondary	3.42e-07	1.73e-08
Ferrite mfg.	Methanol	secondary	3.36e-07	1.70e-08
Polystyrene Prod., high-impact	Nitrate	secondary	3.02e-07	1.53e-08
Steel Prod., cold-rolled, semi-finished	Vanadium (V3+, V5+)	secondary	2.97e-07	1.50e-08
Aluminum Prod.	Cadmium	secondary	2.95e-07	1.50e-08
Invar	Cyanide (-1)	secondary	2.89e-07	1.46e-08
Invar	Heptane	secondary	2.83e-07	1.43e-08
Ferrite mfg.	Heptane	secondary	2.76e-07	1.40e-08
Steel Prod., cold-rolled, semi-finished	Boron (B III)	secondary	2.70e-07	1.37e-08
Invar	Acetaldehyde	secondary	2.64e-07	1.34e-08
ABS Production	HALON-1301	secondary	2.56e-07	1.30e-08
Lead	Xylene (mixed isomers)	secondary	2.54e-07	1.29e-08
Aluminum Prod.	Triethylene glycol	secondary	2.42e-07	1.23e-08
Invar	Mercury	secondary	2.12e-07	1.08e-08
ABS Production	Ethanethiol	secondary	2.12e-07	1.07e-08
ABS Production	Fluoride	secondary	2.12e-07	1.07e-08
ABS Production	Halogenated hydrocarbons (unspecified)	secondary	2.12e-07	1.07e-08
ABS Production	Lead	secondary	2.12e-07	1.07e-08
ABS Production	Mercury	secondary	2.12e-07	1.07e-08
ABS Production	Nitrous oxide	secondary	2.12e-07	1.07e-08
ABS Production	Zinc (+2)	secondary	2.12e-07	1.07e-08
Styrene-butadiene Copolymer Prod.	Halogenated hydrocarbons (unspecified)	secondary	2.07e-07	1.05e-08
Styrene-butadiene Copolymer Prod.	Hydrogen sulfide	secondary	2.07e-07	1.05e-08
Styrene-butadiene Copolymer Prod.	Lead	secondary	2.07e-07	1.05e-08
Styrene-butadiene Copolymer Prod.	Mercury	secondary	2.07e-07	1.05e-08
Styrene-butadiene Copolymer Prod.	Nickel (+2)	secondary	2.07e-07	1.05e-08
Styrene-butadiene Copolymer Prod.	Nitrous oxide	secondary	2.07e-07	1.05e-08
Styrene-butadiene Copolymer Prod.	Zinc (+2)	secondary	2.07e-07	1.05e-08
Ferrite mfg.	Cyanide (-1)	secondary	2.05e-07	1.04e-08
Steel Prod., cold-rolled, semi-finished	Acetic acid	secondary	2.05e-07	1.04e-08
Aluminum Prod.	Mercury	secondary	2.02e-07	1.02e-08
Ferrite mfg.	Phenol	secondary	1.95e-07	9.90e-09
Invar	Triethylene glycol	secondary	1.93e-07	9.77e-09
Steel Prod., cold-rolled, semi-finished	Triethylene glycol	secondary	1.92e-07	9.70e-09
Aluminum Prod.	Cyanide (-1)	secondary	1.89e-07	9.60e-09
Ferrite mfg.	Triethylene glycol	secondary	1.88e-07	9.54e-09
Lead	Triethylene glycol	secondary	1.81e-07	9.18e-09
Aluminum Prod.	HALON-1301	secondary	1.80e-07	9.14e-09
Polystyrene Prod., high-impact	Phenol	secondary	1.80e-07	9.11e-09
Steel Prod., cold-rolled, semi-finished	Morpholine	secondary	1.79e-07	9.08e-09
Steel Prod., cold-rolled, semi-finished	Strontium	secondary	1.77e-07	8.98e-09
Steel Prod., cold-rolled, semi-finished	Propylene	secondary	1.77e-07	8.97e-09
Steel Prod., cold-rolled, semi-finished	Cadmium	secondary	1.74e-07	8.83e-09
Lead	Methanol	secondary	1.62e-07	8.23e-09
Ferrite mfg.	Mercury	secondary	1.62e-07	8.18e-09
Steel Prod., cold-rolled, semi-finished	Acetaldehyde	secondary	1.53e-07	7.76e-09
ABS Production	Ethylene	secondary	1.52e-07	7.70e-09
Lead	Phenol	secondary	1.37e-07	6.96e-09
Invar	Ethylbenzene	secondary	1.37e-07	6.92e-09

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Invar	Acetone	secondary	1.36e-07	6.90e-09
Aluminum Prod.	Chromium (III)	secondary	1.31e-07	6.64e-09
Steel Prod., cold-rolled, semi-finished	Rubidium ion (Rb+)	secondary	1.21e-07	6.13e-09
Ferrite mfg.	Cobalt	secondary	1.20e-07	6.09e-09
Ferrite mfg.	Manganese	secondary	1.19e-07	6.01e-09
Steel Prod., cold-rolled, semi-finished	Fluorine	secondary	1.14e-07	5.76e-09
Lead	Cyanide (-1)	secondary	9.76e-08	4.94e-09
Lead	Ethylene	secondary	9.43e-08	4.78e-09
Invar	Strontium	secondary	9.37e-08	4.75e-09
Steel Prod., cold-rolled, semi-finished	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	9.07e-08	4.59e-09
Steel Prod., cold-rolled, semi-finished	Benzo[a]pyrene	secondary	8.92e-08	4.52e-09
Ferrite mfg.	Boron (B III)	secondary	8.91e-08	4.51e-09
Ferrite mfg.	Cobalt (Co I, Co II, Co III)	secondary	8.79e-08	4.45e-09
Ferrite mfg.	Acetic acid	secondary	8.74e-08	4.43e-09
Lead	Toluene	secondary	8.24e-08	4.18e-09
Steel Prod., cold-rolled, semi-finished	Acetone	secondary	7.91e-08	4.01e-09
Invar	HALON-1301	secondary	7.60e-08	3.85e-09
Lead	Cobalt	secondary	7.32e-08	3.71e-09
Lead	Acetic acid	secondary	7.30e-08	3.70e-09
Lead	Aromatic hydrocarbons	secondary	6.79e-08	3.44e-09
Invar	Sulfuric acid	secondary	5.98e-08	3.03e-09
Ferrite mfg.	Sulfuric acid	secondary	5.84e-08	2.96e-09
Invar	Mercury compounds	secondary	5.57e-08	2.82e-09
Ferrite mfg.	Mercury compounds	secondary	5.44e-08	2.76e-09
Steel Prod., cold-rolled, semi-finished	Lanthanum	secondary	5.37e-08	2.72e-09
Steel Prod., cold-rolled, semi-finished	Ethylbenzene	secondary	5.25e-08	2.66e-09
Invar	Morpholine	secondary	5.07e-08	2.57e-09
Invar	Propylene	secondary	5.03e-08	2.55e-09
Ferrite mfg.	Morpholine	secondary	4.95e-08	2.51e-09
Ferrite mfg.	Strontium	secondary	4.94e-08	2.50e-09
Ferrite mfg.	Propylene	secondary	4.91e-08	2.49e-09
Invar	Nitrous oxide	secondary	4.85e-08	2.46e-09
Invar	Chromium (III)	secondary	4.79e-08	2.42e-09
Lead	Ethylbenzene	secondary	4.72e-08	2.39e-09
Steel Prod., cold-rolled, semi-finished	Beryllium	secondary	4.72e-08	2.39e-09
Aluminum Prod.	Strontium	secondary	4.48e-08	2.27e-09
Ferrite mfg.	Acetaldehyde	secondary	4.38e-08	2.22e-09
Lead	Chromium (III)	secondary	3.86e-08	1.96e-09
Invar	Rubidium ion (Rb+)	secondary	3.66e-08	1.85e-09
Ferrite mfg.	Rubidium ion (Rb+)	secondary	3.57e-08	1.81e-09
Lead	Acetaldehyde	secondary	3.39e-08	1.72e-09
Lead	HALON-1301	secondary	3.39e-08	1.72e-09
Steel Prod., cold-rolled, semi-finished	Mercury	secondary	3.26e-08	1.65e-09
Invar	Fluorine	secondary	3.22e-08	1.63e-09
Ferrite mfg.	Fluorine	secondary	3.14e-08	1.59e-09
Steel Prod., cold-rolled, semi-finished	Thorium	secondary	2.88e-08	1.46e-09
Ferrite mfg.	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	2.55e-08	1.29e-09
Steel Prod., cold-rolled, semi-finished	HALON-1301	secondary	2.52e-08	1.28e-09

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Ferrite mfg.	Benzo[a]pyrene	secondary	2.48e-08	1.25e-09
Ferrite mfg.	Acetone	secondary	2.23e-08	1.13e-09
Ferrite mfg.	Ethylbenzene	secondary	1.94e-08	9.82e-10
Lead	Acetone	secondary	1.72e-08	8.70e-10
Steel Prod., cold-rolled, semi-finished	Tin	secondary	1.68e-08	8.49e-10
Steel Prod., cold-rolled, semi-finished	Phosphorus pentoxide	secondary	1.61e-08	8.15e-10
Invar	Lanthanum	secondary	1.53e-08	7.76e-10
Ferrite mfg.	Lanthanum	secondary	1.50e-08	7.58e-10
Invar	Beryllium	secondary	1.34e-08	6.80e-10
Ferrite mfg.	Beryllium	secondary	1.31e-08	6.64e-10
Steel Prod., cold-rolled, semi-finished	Scandium	secondary	1.31e-08	6.62e-10
Steel Prod., cold-rolled, semi-finished	Chlorine	secondary	1.14e-08	5.78e-10
Aluminum Prod.	1,2-Dichlorotetrafluoroethane	secondary	1.04e-08	5.28e-10
Ferrite mfg.	HALON-1301	secondary	9.52e-09	4.82e-10
Steel Prod., cold-rolled, semi-finished	Thallium	secondary	8.89e-09	4.51e-10
Aluminum Prod.	Perfluoroethane	secondary	8.46e-09	4.28e-10
Invar	Thorium	secondary	8.23e-09	4.17e-10
Ferrite mfg.	Thorium	secondary	8.03e-09	4.07e-10
Invar	Hydrogen cyanide	secondary	7.58e-09	3.84e-10
Ferrite mfg.	Hydrogen cyanide	secondary	7.40e-09	3.75e-10
Steel Prod., cold-rolled, semi-finished	Chromium (III)	secondary	5.29e-09	2.68e-10
Steel Prod., cold-rolled, semi-finished	Nitrites	secondary	5.19e-09	2.63e-10
Ferrite mfg.	Chromium (III)	secondary	5.01e-09	2.54e-10
Invar	Tin	secondary	4.77e-09	2.41e-10
Invar	Phosphorus pentoxide	secondary	4.69e-09	2.38e-10
Ferrite mfg.	Tin	secondary	4.65e-09	2.36e-10
Ferrite mfg.	Phosphorus pentoxide	secondary	4.58e-09	2.32e-10
Invar	1,2-Dichlorotetrafluoroethane	secondary	4.31e-09	2.19e-10
Invar	Scandium	secondary	3.74e-09	1.89e-10
Ferrite mfg.	Scandium	secondary	3.65e-09	1.85e-10
Invar	Perfluoromethane	secondary	2.85e-09	1.45e-10
Ferrite mfg.	Perfluoromethane	secondary	2.78e-09	1.41e-10
Invar	Thallium	secondary	2.55e-09	1.29e-10
Ferrite mfg.	Thallium	secondary	2.49e-09	1.26e-10
Invar	Trichlorofluoromethane	secondary	2.06e-09	1.04e-10
Lead	Benzo[a]pyrene	secondary	1.96e-09	9.94e-11
Steel Prod., cold-rolled, semi-finished	Edetic acid (EDTA)	secondary	1.93e-09	9.78e-11
Invar	Hypochlorous acid	secondary	1.77e-09	8.98e-11
Steel Prod., cold-rolled, semi-finished	Hypochlorous acid	secondary	1.76e-09	8.91e-11
Ferrite mfg.	Hypochlorous acid	secondary	1.73e-09	8.76e-11
Steel Prod., cold-rolled, semi-finished	Cobalt (Co I, Co II, Co III)	secondary	1.57e-09	7.96e-11
Invar	Dichloromethane	secondary	1.46e-09	7.39e-11
Steel Prod., cold-rolled, semi-finished	Dichloromethane	secondary	1.45e-09	7.34e-11
Ferrite mfg.	Dichloromethane	secondary	1.42e-09	7.21e-11
Invar	Chlorine	secondary	1.11e-09	5.62e-11
Ferrite mfg.	Chlorine	secondary	1.08e-09	5.49e-11
Ferrite mfg.	Trichlorofluoromethane	secondary	7.65e-10	3.87e-11
Invar	Dichlorodifluoromethane	secondary	6.37e-10	3.23e-11
Invar	Edetic acid (EDTA)	secondary	5.47e-10	2.77e-11
Ferrite mfg.	Edetic acid (EDTA)	secondary	5.34e-10	2.70e-11

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Invar	CFC-13	secondary	5.04e-10	2.55e-11
Steel Prod., cold-rolled, semi-finished	Isopropylpropionate	secondary	2.02e-10	1.02e-11
Ferrite mfg.	Isopropylpropionate	secondary	1.99e-10	1.01e-11
Invar	Halogenated matter (organic)	secondary	1.37e-10	6.95e-12
Ferrite mfg.	Halogenated matter (organic)	secondary	1.34e-10	6.78e-12
Steel Prod., cold-rolled, semi-finished	Lithium salts	secondary	9.91e-11	5.02e-12
Invar	Ethanethiol	secondary	8.71e-11	4.41e-12
Ferrite mfg.	Ethanethiol	secondary	8.50e-11	4.31e-12
Ferrite mfg.	Tin (Sn++, Sn4+)	secondary	7.29e-11	3.69e-12
Invar	Chloroform	secondary	5.44e-11	2.76e-12
Steel Prod., cold-rolled, semi-finished	Chloroform	secondary	5.40e-11	2.73e-12
Ferrite mfg.	Chloroform	secondary	5.31e-11	2.69e-12
Steel Prod., cold-rolled, semi-finished	Zirconium	secondary	4.66e-11	2.36e-12
Steel Prod., cold-rolled, semi-finished	Perfluoromethane	secondary	4.49e-11	2.28e-12
ABS Production	HCFC-22	secondary	3.47e-11	1.76e-12
Invar	Lithium salts	secondary	2.81e-11	1.42e-12
Ferrite mfg.	Lithium salts	secondary	2.74e-11	1.39e-12
Lead	Acrolein	secondary	2.38e-11	1.21e-12
Invar	Zirconium	secondary	1.34e-11	6.77e-13
Ferrite mfg.	Zirconium	secondary	1.30e-11	6.61e-13
Lead	Benzaldehyde	secondary	1.04e-12	5.25e-14
Invar	Trichloroethylene	secondary	7.82e-13	3.96e-14
Steel Prod., cold-rolled, semi-finished	Trichloroethylene	secondary	7.75e-13	3.93e-14
Ferrite mfg.	Trichloroethylene	secondary	7.63e-13	3.87e-14
Invar	HFC-125	secondary	6.44e-13	3.26e-14
Ferrite mfg.	HFC-125	secondary	6.29e-13	3.19e-14
Invar	Propionaldehyde	secondary	5.32e-14	2.69e-15
Steel Prod., cold-rolled, semi-finished	Propionaldehyde	secondary	5.32e-14	2.69e-15
Ferrite mfg.	Propionaldehyde	secondary	5.19e-14	2.63e-15
Invar	Pentachlorobenzene	secondary	2.77e-14	1.40e-15
Steel Prod., cold-rolled, semi-finished	Tetrachloroethylene	secondary	2.19e-14	1.11e-15
Invar	Tetrachloroethylene	secondary	2.16e-14	1.09e-15
Ferrite mfg.	Tetrachloroethylene	secondary	2.11e-14	1.07e-15
Invar	Acrolein	secondary	9.90e-15	5.01e-16
Steel Prod., cold-rolled, semi-finished	Benzaldehyde	secondary	4.72e-15	2.39e-16
Invar	Benzaldehyde	secondary	4.69e-15	2.38e-16
Ferrite mfg.	Benzaldehyde	secondary	4.57e-15	2.32e-16
Invar	1,1,1-Trichloroethane	secondary	3.25e-15	1.65e-16
Steel Prod., cold-rolled, semi-finished	1,1,1-Trichloroethane	secondary	3.21e-15	1.63e-16
Ferrite mfg.	1,1,1-Trichloroethane	secondary	3.16e-15	1.60e-16
Invar	Perfluoroethane	secondary	3.14e-15	1.59e-16
Invar	Pentachlorophenol	secondary	1.24e-15	6.28e-17
Ferrite mfg.	1,2-Dichlorotetrafluoroethane	secondary	3.19e-16	1.61e-17
Invar	Hexachloroethane	secondary	1.24e-16	6.27e-18
Steel Prod., cold-rolled, semi-finished	Hexachloroethane	secondary	1.23e-16	6.23e-18
Ferrite mfg.	Hexachloroethane	secondary	1.21e-16	6.12e-18
Ferrite mfg.	Dichlorodifluoromethane	secondary	4.72e-17	2.39e-18
Ferrite mfg.	CFC-13	secondary	3.74e-17	1.89e-18
Invar	HCFC-22	secondary	8.74e-19	4.43e-20
Ferrite mfg.	HCFC-22	secondary	8.54e-19	4.32e-20

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Total Materials Processing			**2.28e+02**	**1.16e+01**
Manufacturing Life-cycle Stage				
Japanese Electric Grid	Sulfur dioxide	model/secondary	5.69e+01	2.88e+00
US electric grid	Sulfur dioxide	model/secondary	2.63e+01	1.33e+00
LPG Production	Carbon monoxide	secondary	5.34e+00	2.71e-01
LPG Production	Vanadium	secondary	1.05e+00	5.30e-02
LPG Production	Benzene	secondary	8.57e-01	4.34e-02
LPG Production	Methane	secondary	8.39e-01	4.25e-02
LPG Production	Sulfur oxides	secondary	8.01e-01	4.06e-02
Glass/frit	Fluorides (F-)	primary	5.82e-01	2.95e-02
LPG Production	Nitrogen oxides	secondary	5.73e-01	2.90e-02
CRT tube mfg.	Carbon monoxide	primary	2.12e-01	1.07e-02
LPG Production	Arsenic	secondary	2.06e-01	1.05e-02
LPG Production	Formaldehyde	secondary	1.34e-01	6.79e-03
LPG Production	PM	secondary	1.29e-01	6.53e-03
Natural Gas Prod.	Benzene	secondary	7.57e-02	3.83e-03
Natural Gas Prod.	Carbon monoxide	secondary	6.36e-02	3.22e-03
Natural Gas Prod.	Methane	secondary	5.02e-02	2.54e-03
Glass/frit	Nitrogen oxides	primary	4.41e-02	2.24e-03
Japanese Electric Grid	Nitrogen oxides	model/secondary	4.07e-02	2.06e-03
CRT tube mfg.	Phosphorus (yellow or white)	primary	4.00e-02	2.03e-03
LPG Production	Hydrochloric acid	secondary	3.68e-02	1.86e-03
Japanese Electric Grid	Carbon monoxide	model/secondary	3.50e-02	1.77e-03
Fuel Oil #6 Prod.	Carbon monoxide	secondary	2.62e-02	1.33e-03
Japanese Electric Grid	Vanadium	model/secondary	2.27e-02	1.15e-03
US electric grid	Nitrogen oxides	model/secondary	1.88e-02	9.52e-04
LPG Production	Nitrous oxide	secondary	1.62e-02	8.22e-04
US electric grid	Carbon monoxide	model/secondary	1.61e-02	8.17e-04
Fuel Oil #2 Prod.	Carbon monoxide	secondary	1.56e-02	7.89e-04
Fuel Oil #6 Prod.	Vanadium	secondary	1.08e-02	5.45e-04
Japanese Electric Grid	Arsenic	model/secondary	1.04e-02	5.28e-04
US electric grid	Methane	model/secondary	1.03e-02	5.21e-04
CRT tube mfg.	Sulfur oxides	primary	9.96e-03	5.05e-04
LPG Production	Phosphorus (yellow or white)	secondary	9.81e-03	4.97e-04
Natural Gas Prod.	Nitrogen oxides	secondary	9.32e-03	4.72e-04
US electric grid	Arsenic	model/secondary	8.91e-03	4.51e-04
US electric grid	Hydrochloric acid	model/secondary	7.87e-03	3.99e-04
LPG Production	Fluorides (F-)	secondary	7.50e-03	3.80e-04
LPG Production	Selenium	secondary	7.41e-03	3.76e-04
Japanese Electric Grid	Hydrochloric acid	model/secondary	6.28e-03	3.18e-04
Fuel Oil #6 Prod.	Methane	secondary	5.89e-03	2.98e-04
Glass/frit	Fluorides (F-)	primary	5.82e-03	2.95e-04
Fuel Oil #6 Prod.	Sulfur oxides	secondary	5.47e-03	2.77e-04
Fuel Oil #6 Prod.	Benzene	secondary	4.90e-03	2.48e-04
PWB Mfg.	Formaldehyde	model/secondary	4.44e-03	2.25e-04
Fuel Oil #6 Prod.	Nitrogen oxides	secondary	4.09e-03	2.07e-04
LPG Production	Ammonia	secondary	3.74e-03	1.89e-04
CRT tube mfg.	Fluoride	primary	3.45e-03	1.75e-04
Fuel Oil #2 Prod.	Vanadium	secondary	3.45e-03	1.75e-04
LPG Production	Hydrogen sulfide	secondary	3.07e-03	1.55e-04

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
CRT tube mfg.	Dimethyl Formamide	primary	3.03e-03	1.54e-04
Fuel Oil #2 Prod.	Methane	secondary	2.57e-03	1.30e-04
Fuel Oil #2 Prod.	Benzene	secondary	2.55e-03	1.29e-04
Fuel Oil #2 Prod.	Sulfur oxides	secondary	2.44e-03	1.23e-04
CRT tube mfg.	Nitrogen oxides	primary	2.17e-03	1.10e-04
Japanese Electric Grid	PM-10	model/secondary	2.00e-03	1.01e-04
Glass/frit	Carbon monoxide	primary	2.00e-03	1.01e-04
Fuel Oil #2 Prod.	Nitrogen oxides	secondary	1.76e-03	8.90e-05
Fuel Oil #6 Prod.	Arsenic	secondary	1.72e-03	8.74e-05
CRT tube mfg.	Zinc (elemental)	primary	1.65e-03	8.35e-05
LPG Production	Molybdenum	secondary	1.65e-03	8.34e-05
US electric grid	Selenium	model/secondary	1.48e-03	7.50e-05
Fuel Oil #4 Prod.	Carbon monoxide	secondary	1.40e-03	7.11e-05
Fuel Oil #6 Prod.	Formaldehyde	secondary	1.37e-03	6.93e-05
Japanese Electric Grid	Fluorides (F-)	model/secondary	1.31e-03	6.63e-05
Japanese Electric Grid	Selenium	model/secondary	1.27e-03	6.46e-05
LPG Production	Zinc (elemental)	secondary	1.20e-03	6.08e-05
Japanese Electric Grid	Formaldehyde	model/secondary	1.17e-03	5.92e-05
US electric grid	Vanadium	model/secondary	1.11e-03	5.64e-05
LPG Production	Hydrofluoric acid	secondary	1.00e-03	5.08e-05
Fuel Oil #6 Prod.	PM	secondary	9.24e-04	4.68e-05
US electric grid	PM-10	model/secondary	9.22e-04	4.67e-05
LPG Production	Ethane	secondary	7.76e-04	3.93e-05
LPG Production	Phenol	secondary	7.15e-04	3.62e-05
Fuel Oil #2 Prod.	Arsenic	secondary	6.52e-04	3.30e-05
LPG Production	Pentane	secondary	6.51e-04	3.30e-05
CRT tube mfg.	Toluene	primary	6.41e-04	3.25e-05
Japanese Electric Grid	Zinc (elemental)	model/secondary	6.13e-04	3.11e-05
Glass/frit	Nitrogen oxides	primary	5.33e-04	2.70e-05
LPG Production	Hexane	secondary	4.51e-04	2.28e-05
Fuel Oil #2 Prod.	Formaldehyde	secondary	4.41e-04	2.23e-05
Natural Gas Prod.	PM	secondary	4.14e-04	2.10e-05
Fuel Oil #4 Prod.	Vanadium	secondary	4.03e-04	2.04e-05
Fuel Oil #2 Prod.	PM	secondary	3.96e-04	2.01e-05
Japanese Electric Grid	Antimony	model/secondary	3.23e-04	1.64e-05
Natural Gas Prod.	Arsenic	secondary	3.15e-04	1.59e-05
Fuel Oil #6 Prod.	Hydrochloric acid	secondary	2.97e-04	1.50e-05
LPG Production	Nickel	secondary	2.90e-04	1.47e-05
Natural Gas Prod.	Sulfur oxides	secondary	2.76e-04	1.40e-05
Natural Gas Prod.	Ammonia	secondary	2.69e-04	1.36e-05
Fuel Oil #4 Prod.	Methane	secondary	2.61e-04	1.32e-05
Fuel Oil #4 Prod.	Sulfur oxides	secondary	2.45e-04	1.24e-05
Fuel Oil #4 Prod.	Benzene	secondary	2.41e-04	1.22e-05
LPG Production	PM-10	secondary	2.25e-04	1.14e-05
US electric grid	Hydrofluoric acid	model/secondary	2.15e-04	1.09e-05
LPG Production	Antimony	secondary	2.14e-04	1.08e-05
CRT tube mfg.	Nickel	primary	1.89e-04	9.56e-06
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	1.79e-04	9.09e-06
Japanese Electric Grid	Hydrofluoric acid	model/secondary	1.71e-04	8.69e-06
US electric grid	Formaldehyde	model/secondary	1.55e-04	7.84e-06

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #6 Prod.	Nitrous oxide	secondary	1.45e-04	7.35e-06
LPG Production	Aluminum (+3)	secondary	1.42e-04	7.17e-06
Japanese Electric Grid	Molybdenum	model/secondary	1.31e-04	6.66e-06
Fuel Oil #2 Prod.	Hydrochloric acid	secondary	1.15e-04	5.85e-06
Japanese Electric Grid	Nitrous oxide	model/secondary	1.12e-04	5.66e-06
US electric grid	Benzene	model/secondary	1.11e-04	5.64e-06
Glass/frit	PM	primary	1.09e-04	5.53e-06
CRT tube mfg.	Molybdenum	primary	1.02e-04	5.18e-06
LPG Production	Chromium (VI)	secondary	1.01e-04	5.11e-06
Fuel Oil #6 Prod.	Phosphorus (yellow or white)	secondary	9.77e-05	4.95e-06
Japanese Electric Grid	Benzene	model/secondary	9.10e-05	4.61e-06
Japanese Electric Grid	Methane	model/secondary	8.13e-05	4.12e-06
Fuel Oil #4 Prod.	Arsenic	secondary	7.04e-05	3.57e-06
Natural Gas Prod.	Vanadium	secondary	6.96e-05	3.53e-06
Natural Gas Prod.	Hydrochloric acid	secondary	6.39e-05	3.24e-06
US electric grid	Phosphorus (yellow or white)	model/secondary	6.27e-05	3.18e-06
Fuel Oil #6 Prod.	Selenium	secondary	6.07e-05	3.07e-06
LPG Production	Nitrate	secondary	6.06e-05	3.07e-06
Fuel Oil #6 Prod.	Fluorides (F-)	secondary	5.83e-05	2.96e-06
Glass/frit	Carbon monoxide	primary	5.59e-05	2.83e-06
US electric grid	Nitrous oxide	model/secondary	5.42e-05	2.75e-06
Fuel Oil #2 Prod.	Nitrous oxide	secondary	5.19e-05	2.63e-06
Fuel Oil #4 Prod.	Formaldehyde	secondary	5.14e-05	2.60e-06
Glass/frit	Sulfur oxides	primary	5.08e-05	2.58e-06
Glass/frit	Lead	primary	4.37e-05	2.21e-06
CRT tube mfg.	Copper	primary	4.05e-05	2.05e-06
Fuel Oil #4 Prod.	PM	secondary	4.05e-05	2.05e-06
Japanese Electric Grid	Nickel	model/secondary	3.51e-05	1.78e-06
LPG Production	Copper	secondary	3.49e-05	1.77e-06
LPG Production	2-Chloroacetophenone	secondary	3.22e-05	1.63e-06
Fuel Oil #2 Prod.	Phosphorus (yellow or white)	secondary	3.21e-05	1.63e-06
LPG Production	Dimethylbenzanthracene	secondary	3.19e-05	1.62e-06
LPG Production	Bromomethane	secondary	3.18e-05	1.61e-06
Fuel Oil #6 Prod.	Hydrogen sulfide	secondary	3.18e-05	1.61e-06
Glass/frit	Nitrates/nitrites	primary	2.94e-05	1.49e-06
Japanese Electric Grid	Barium	model/secondary	2.94e-05	1.49e-06
US electric grid	Zinc (elemental)	model/secondary	2.89e-05	1.47e-06
Natural Gas Prod.	Formaldehyde	secondary	2.77e-05	1.40e-06
LPG Production	Naphthalene	secondary	2.58e-05	1.31e-06
CRT tube mfg.	Xylene (mixed isomers)	primary	2.55e-05	1.29e-06
US electric grid	Antimony	model/secondary	2.37e-05	1.20e-06
Fuel Oil #2 Prod.	Fluorides (F-)	secondary	2.34e-05	1.18e-06
Fuel Oil #2 Prod.	Selenium	secondary	2.33e-05	1.18e-06
LPG Production	Manganese	secondary	2.23e-05	1.13e-06
Fuel Oil #6 Prod.	Ammonia	secondary	2.01e-05	1.02e-06
LPG Production	Barium	secondary	1.86e-05	9.44e-07
LPG Production	Silicon	secondary	1.69e-05	8.57e-07
LPG Production	Cyanide (-1)	secondary	1.67e-05	8.47e-07
Japanese Electric Grid	Naphthalene	model/secondary	1.63e-05	8.28e-07
LPG Production	Barium cmpds	secondary	1.59e-05	8.04e-07
Fuel Oil #6 Prod.	Molybdenum	secondary	1.56e-05	7.89e-07

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Fluorides (F-)	secondary	1.35e-05	6.85e-07
LPG Production	Lead	secondary	1.24e-05	6.26e-07
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	1.23e-05	6.24e-07
Natural Gas Prod.	Selenium	secondary	1.21e-05	6.15e-07
Natural Gas Prod.	Nitrous oxide	secondary	1.15e-05	5.85e-07
Fuel Oil #2 Prod.	Ammonia	secondary	1.10e-05	5.58e-07
Fuel Oil #2 Prod.	Hydrogen sulfide	secondary	1.01e-05	5.12e-07
Natural Gas Prod.	Zinc (elemental)	secondary	8.50e-06	4.31e-07
Fuel Oil #6 Prod.	Hydrofluoric acid	secondary	8.10e-06	4.10e-07
US electric grid	Molybdenum	model/secondary	7.92e-06	4.01e-07
Japanese Electric Grid	Copper	model/secondary	7.14e-06	3.62e-07
Natural Gas Prod.	Ethane	secondary	6.99e-06	3.54e-07
US electric grid	2-Chloroacetophenone	model/secondary	6.88e-06	3.49e-07
US electric grid	Bromomethane	model/secondary	6.81e-06	3.45e-07
Fuel Oil #6 Prod.	Zinc (elemental)	secondary	6.59e-06	3.34e-07
LPG Production	Carbon disulfide	secondary	5.98e-06	3.03e-07
Natural Gas Prod.	Pentane	secondary	5.86e-06	2.97e-07
Fuel Oil #4 Prod.	Nitrous oxide	secondary	5.75e-06	2.91e-07
Japanese Electric Grid	2-Chloroacetophenone	model/secondary	5.50e-06	2.79e-07
Japanese Electric Grid	Bromomethane	model/secondary	5.44e-06	2.76e-07
Fuel Oil #2 Prod.	Molybdenum	secondary	5.33e-06	2.70e-07
LPG Production	Benzyl chloride	secondary	4.68e-06	2.37e-07
Fuel Oil #6 Prod.	Ethane	secondary	4.43e-06	2.25e-07
Natural Gas Prod.	Hexane	secondary	4.06e-06	2.06e-07
LPG Production	Aluminum (elemental)	secondary	3.87e-06	1.96e-07
Fuel Oil #6 Prod.	Pentane	secondary	3.72e-06	1.88e-07
Fuel Oil #4 Prod.	Phosphorus (yellow or white)	secondary	3.70e-06	1.88e-07
LPG Production	Chloroform	secondary	3.64e-06	1.84e-07
CRT tube mfg.	Manganese	primary	3.60e-06	1.83e-07
US electric grid	Cyanide (-1)	model/secondary	3.58e-06	1.81e-07
Fuel Oil #2 Prod.	Zinc (elemental)	secondary	3.54e-06	1.80e-07
Fuel Oil #2 Prod.	Hydrofluoric acid	secondary	3.15e-06	1.60e-07
CRT tube mfg.	Lead	primary	3.01e-06	1.53e-07
Japanese Electric Grid	Cyanide (-1)	model/secondary	2.86e-06	1.45e-07
Fuel Oil #6 Prod.	Nickel	secondary	2.81e-06	1.42e-07
US electric grid	2,3,7,8-TCDD	model/secondary	2.71e-06	1.37e-07
US electric grid	Nickel	model/secondary	2.60e-06	1.32e-07
Fuel Oil #6 Prod.	Hexane	secondary	2.58e-06	1.31e-07
LPG Production	Cobalt	secondary	2.51e-06	1.27e-07
Fuel Oil #4 Prod.	Selenium	secondary	2.50e-06	1.27e-07
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	2.46e-06	1.25e-07
Fuel Oil #6 Prod.	Phenol	secondary	2.42e-06	1.23e-07
Fuel Oil #6 Prod.	PM-10	secondary	2.33e-06	1.18e-07
Natural Gas Prod.	Molybdenum	secondary	2.31e-06	1.17e-07
Fuel Oil #2 Prod.	Ethane	secondary	2.30e-06	1.17e-07
Japanese Electric Grid	2,3,7,8-TCDD	model/secondary	2.22e-06	1.13e-07
US electric grid	Naphthalene	model/secondary	2.16e-06	1.09e-07
Fuel Oil #2 Prod.	Phenol	secondary	2.01e-06	1.02e-07
LPG Production	Acrolein	secondary	1.94e-06	9.83e-08
Fuel Oil #2 Prod.	Pentane	secondary	1.93e-06	9.79e-08

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
US electric grid	Barium	model/secondary	1.86e-06	9.42e-08
Natural Gas Prod.	Phosphorus (yellow or white)	secondary	1.77e-06	8.96e-08
Natural Gas Prod.	Hydrofluoric acid	secondary	1.74e-06	8.83e-08
LPG Production	Methyl chloride	secondary	1.57e-06	7.96e-08
LPG Production	Beryllium	secondary	1.40e-06	7.11e-08
Fuel Oil #2 Prod.	Hexane	secondary	1.34e-06	6.79e-08
US electric grid	Carbon disulfide	model/secondary	1.28e-06	6.48e-08
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	1.19e-06	6.00e-08
Fuel Oil #6 Prod.	Antimony	secondary	1.18e-06	6.00e-08
Japanese Electric Grid	Cobalt	model/secondary	1.18e-06	5.99e-08
LPG Production	Methyl hydrazine	secondary	1.14e-06	5.76e-08
Fuel Oil #4 Prod.	Ammonia	secondary	1.02e-06	5.18e-08
Japanese Electric Grid	Carbon disulfide	model/secondary	1.02e-06	5.17e-08
US electric grid	Benzyl chloride	model/secondary	1.00e-06	5.08e-08
Fuel Oil #2 Prod.	Nickel	secondary	9.44e-07	4.78e-08
LPG Production	Acetaldehyde	secondary	8.73e-07	4.42e-08
LPG Production	Propionaldehyde	secondary	8.73e-07	4.42e-08
LPG Production	Mercury	secondary	8.69e-07	4.40e-08
LPG Production	Cadmium	secondary	8.10e-07	4.10e-08
Japanese Electric Grid	Benzyl chloride	model/secondary	8.00e-07	4.05e-08
US electric grid	Chloroform	model/secondary	7.79e-07	3.95e-08
Fuel Oil #2 Prod.	PM-10	secondary	7.42e-07	3.76e-08
US electric grid	Manganese	model/secondary	7.28e-07	3.69e-08
LPG Production	Cadmium cmpds	secondary	6.94e-07	3.52e-08
LPG Production	Di(2-ethylhexyl)phthalate	secondary	6.71e-07	3.40e-08
Glass/frit	PM	primary	6.67e-07	3.38e-08
Japanese Electric Grid	Chromium (VI)	model/secondary	6.39e-07	3.24e-08
Fuel Oil #2 Prod.	Antimony	secondary	6.32e-07	3.20e-08
LPG Production	Toluene	secondary	6.23e-07	3.16e-08
Japanese Electric Grid	Chloroform	model/secondary	6.22e-07	3.15e-08
CRT tube mfg.	Cyanide (-1)	primary	6.06e-07	3.07e-08
Fuel Oil #4 Prod.	Molybdenum	secondary	6.03e-07	3.05e-08
Glass/frit	Zinc (elemental)	primary	5.55e-07	2.81e-08
US electric grid	Chromium (VI)	model/secondary	5.48e-07	2.78e-08
Fuel Oil #6 Prod.	Aluminum (+3)	secondary	4.79e-07	2.43e-08
Natural Gas Prod.	Antimony	secondary	4.44e-07	2.25e-08
US electric grid	Acrolein	model/secondary	4.15e-07	2.10e-08
Fuel Oil #6 Prod.	Chromium (VI)	secondary	4.09e-07	2.07e-08
Fuel Oil #2 Prod.	Aluminum (+3)	secondary	3.97e-07	2.01e-08
LPG Production	1,4-Dichlorobenzene	secondary	3.57e-07	1.81e-08
US electric grid	Copper	model/secondary	3.57e-07	1.81e-08
US electric grid	Methyl chloride	model/secondary	3.36e-07	1.70e-08
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	3.36e-07	1.70e-08
Japanese Electric Grid	Acrolein	model/secondary	3.31e-07	1.68e-08
Fuel Oil #4 Prod.	Zinc (elemental)	secondary	3.31e-07	1.68e-08
LPG Production	Dimethyl sulfate	secondary	3.21e-07	1.63e-08
Fuel Oil #6 Prod.	Copper	secondary	3.17e-07	1.61e-08
US electric grid	Fluoride	model/secondary	3.12e-07	1.58e-08
LPG Production	Isophorone	secondary	3.08e-07	1.56e-08
Natural Gas Prod.	Dimethylbenzanthracene	secondary	2.87e-07	1.46e-08

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Japanese Electric Grid	Methyl chloride	model/secondary	2.69e-07	1.36e-08
Fuel Oil #6 Prod.	2-Chloroacetophenone	secondary	2.60e-07	1.32e-08
Fuel Oil #6 Prod.	Bromomethane	secondary	2.57e-07	1.30e-08
LPG Production	Methyl ethyl ketone	secondary	2.48e-07	1.26e-08
LPG Production	Tetrachloroethylene	secondary	2.45e-07	1.24e-08
US electric grid	Methyl hydrazine	model/secondary	2.43e-07	1.23e-08
Fuel Oil #6 Prod.	Nitrate	secondary	2.43e-07	1.23e-08
Japanese Electric Grid	Toluene	model/secondary	2.39e-07	1.21e-08
Glass/frit	Chromium	primary	2.20e-07	1.12e-08
Fuel Oil #4 Prod.	Ethane	secondary	2.18e-07	1.10e-08
LPG Production	Methyl methacrylate	secondary	2.12e-07	1.08e-08
US electric grid	Lead	model/secondary	2.04e-07	1.03e-08
Glass/frit	Nickel	primary	1.95e-07	9.89e-09
Japanese Electric Grid	Methyl hydrazine	model/secondary	1.94e-07	9.84e-09
US electric grid	Cobalt	model/secondary	1.94e-07	9.83e-09
US electric grid	Acetaldehyde	model/secondary	1.87e-07	9.47e-09
US electric grid	Propionaldehyde	model/secondary	1.87e-07	9.47e-09
Fuel Oil #4 Prod.	Pentane	secondary	1.83e-07	9.26e-09
Fuel Oil #6 Prod.	Dimethylbenzanthracene	secondary	1.82e-07	9.24e-09
Fuel Oil #6 Prod.	Manganese	secondary	1.79e-07	9.07e-09
LPG Production	1,2-Dichloroethane	secondary	1.77e-07	8.96e-09
Fuel Oil #6 Prod.	Silicon	secondary	1.75e-07	8.88e-09
LPG Production	Bromoform	secondary	1.73e-07	8.79e-09
Fuel Oil #2 Prod.	Nitrate	secondary	1.73e-07	8.75e-09
LPG Production	Chromium (III)	secondary	1.72e-07	8.70e-09
LPG Production	Dichloromethane	secondary	1.67e-07	8.48e-09
Fuel Oil #4 Prod.	Phenol	secondary	1.63e-07	8.26e-09
Fuel Oil #2 Prod.	Chromium (VI)	secondary	1.58e-07	8.02e-09
Fuel Oil #6 Prod.	Naphthalene	secondary	1.56e-07	7.91e-09
Japanese Electric Grid	Acetaldehyde	model/secondary	1.49e-07	7.56e-09
Japanese Electric Grid	Propionaldehyde	model/secondary	1.49e-07	7.56e-09
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	1.44e-07	7.27e-09
Japanese Electric Grid	Cadmium	model/secondary	1.41e-07	7.14e-09
LPG Production	Chlorobenzene	secondary	1.40e-07	7.10e-09
LPG Production	Aromatic hydrocarbons	secondary	1.40e-07	7.09e-09
Fuel Oil #6 Prod.	Cyanide (-1)	secondary	1.35e-07	6.84e-09
LPG Production	Copper (+1 & +2)	secondary	1.31e-07	6.64e-09
Natural Gas Prod.	Naphthalene	secondary	1.30e-07	6.59e-09
Fuel Oil #4 Prod.	Hexane	secondary	1.27e-07	6.42e-09
Natural Gas Prod.	Nickel	secondary	1.23e-07	6.22e-09
US electric grid	Mercury	model/secondary	1.20e-07	6.07e-09
Japanese Electric Grid	Mercury	model/secondary	1.18e-07	5.98e-09
Japanese Electric Grid	Di(2-ethylhexyl)phthalate	model/secondary	1.15e-07	5.81e-09
Fuel Oil #2 Prod.	Copper	secondary	1.12e-07	5.67e-09
LPG Production	2,4-Dinitrotoluene	secondary	1.11e-07	5.65e-09
Fuel Oil #4 Prod.	Nickel	secondary	1.08e-07	5.46e-09
Fuel Oil #2 Prod.	2-Chloroacetophenone	secondary	1.01e-07	5.11e-09
Fuel Oil #6 Prod.	Lead	secondary	9.99e-08	5.06e-09
Fuel Oil #2 Prod.	Bromomethane	secondary	9.99e-08	5.06e-09
Fuel Oil #6 Prod.	Barium	secondary	9.97e-08	5.05e-09

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
US electric grid	Hexane	model/secondary	9.59e-08	4.86e-09
Fuel Oil #2 Prod.	Dimethylbenzanthracene	secondary	9.48e-08	4.80e-09
Natural Gas Prod.	Chromium (VI)	secondary	9.46e-08	4.79e-09
Fuel Oil #4 Prod.	PM-10	secondary	8.70e-08	4.41e-09
Fuel Oil #2 Prod.	Naphthalene	secondary	7.72e-08	3.91e-09
US electric grid	Cadmium	model/secondary	7.69e-08	3.90e-09
Japanese Electric Grid	Hexane	model/secondary	7.66e-08	3.88e-09
Fuel Oil #2 Prod.	Manganese	secondary	7.00e-08	3.54e-09
US electric grid	Dimethyl sulfate	model/secondary	6.87e-08	3.48e-09
LPG Production	o-xylene	secondary	6.86e-08	3.48e-09
US electric grid	Toluene	model/secondary	6.78e-08	3.44e-09
Natural Gas Prod.	Hydrogen sulfide	secondary	6.73e-08	3.41e-09
US electric grid	Isophorone	model/secondary	6.59e-08	3.34e-09
Fuel Oil #4 Prod.	Antimony	secondary	5.92e-08	3.00e-09
Natural Gas Prod.	Barium	secondary	5.90e-08	2.99e-09
Fuel Oil #2 Prod.	Silicon	secondary	5.58e-08	2.83e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	5.58e-08	2.83e-09
LPG Production	Ethylbenzene	secondary	5.56e-08	2.82e-09
Natural Gas Prod.	Bromomethane	secondary	5.52e-08	2.80e-09
Fuel Oil #2 Prod.	Barium	secondary	5.49e-08	2.78e-09
Japanese Electric Grid	Dimethyl sulfate	model/secondary	5.49e-08	2.78e-09
Fuel Oil #6 Prod.	Barium cmpds	secondary	5.37e-08	2.72e-09
US electric grid	Methyl ethyl ketone	model/secondary	5.32e-08	2.69e-09
Glass/frit	Barium	primary	5.29e-08	2.68e-09
Natural Gas Prod.	Copper	secondary	5.28e-08	2.67e-09
Japanese Electric Grid	Isophorone	model/secondary	5.26e-08	2.66e-09
Fuel Oil #2 Prod.	Cyanide (-1)	secondary	5.25e-08	2.66e-09
US electric grid	Tetrachloroethylene	model/secondary	5.23e-08	2.65e-09
Fuel Oil #6 Prod.	Carbon disulfide	secondary	4.82e-08	2.44e-09
US electric grid	Methyl methacrylate	model/secondary	4.54e-08	2.30e-09
Fuel Oil #2 Prod.	Barium cmpds	secondary	4.45e-08	2.26e-09
Japanese Electric Grid	Methyl ethyl ketone	model/secondary	4.24e-08	2.15e-09
Japanese Electric Grid	Tetrachloroethylene	model/secondary	4.18e-08	2.12e-09
Fuel Oil #6 Prod.	Aluminum (elemental)	secondary	4.01e-08	2.03e-09
Natural Gas Prod.	Manganese	secondary	3.95e-08	2.00e-09
Fuel Oil #2 Prod.	Lead	secondary	3.88e-08	1.97e-09
US electric grid	1,2-Dichloroethane	model/secondary	3.79e-08	1.92e-09
Fuel Oil #6 Prod.	Benzyl chloride	secondary	3.78e-08	1.91e-09
US electric grid	Bromoform	model/secondary	3.71e-08	1.88e-09
Japanese Electric Grid	Methyl methacrylate	model/secondary	3.63e-08	1.84e-09
US electric grid	Dichloromethane	model/secondary	3.58e-08	1.82e-09
Japanese Electric Grid	Beryllium	model/secondary	3.23e-08	1.64e-09
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	3.23e-08	1.64e-09
US electric grid	Beryllium	model/secondary	3.05e-08	1.54e-09
Japanese Electric Grid	1,2-Dichloroethane	model/secondary	3.02e-08	1.53e-09
US electric grid	Chlorobenzene	model/secondary	3.00e-08	1.52e-09
Japanese Electric Grid	Bromoform	model/secondary	2.96e-08	1.50e-09
Fuel Oil #6 Prod.	Chloroform	secondary	2.94e-08	1.49e-09
Natural Gas Prod.	Cyanide (-1)	secondary	2.90e-08	1.47e-09
Japanese Electric Grid	Dichloromethane	model/secondary	2.86e-08	1.45e-09

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	Methyl tert-butyl ether	secondary	2.79e-08	1.41e-09
Japanese Electric Grid	Chlorobenzene	model/secondary	2.39e-08	1.21e-09
US electric grid	2,4-Dinitrotoluene	model/secondary	2.38e-08	1.21e-09
LPG Production	Phenanthrene	secondary	2.27e-08	1.15e-09
Natural Gas Prod.	Lead	secondary	2.17e-08	1.10e-09
Fuel Oil #6 Prod.	Cobalt	secondary	2.12e-08	1.08e-09
LPG Production	Styrene	secondary	2.03e-08	1.03e-09
LPG Production	Vinyl acetate	secondary	1.98e-08	1.01e-09
Japanese Electric Grid	2,4-Dinitrotoluene	model/secondary	1.90e-08	9.62e-10
Fuel Oil #2 Prod.	Carbon disulfide	secondary	1.87e-08	9.50e-10
LPG Production	3-Methylcholanthrene	secondary	1.87e-08	9.49e-10
Fuel Oil #4 Prod.	Chromium (VI)	secondary	1.69e-08	8.56e-10
Fuel Oil #6 Prod.	Acrolein	secondary	1.57e-08	7.93e-10
Natural Gas Prod.	Nitrate	secondary	1.50e-08	7.62e-10
Fuel Oil #2 Prod.	Benzyl chloride	secondary	1.47e-08	7.44e-10
Fuel Oil #4 Prod.	Nitrate	secondary	1.47e-08	7.43e-10
Natural Gas Prod.	Phenol	secondary	1.46e-08	7.39e-10
Glass/frit	Copper	primary	1.42e-08	7.20e-10
Japanese Electric Grid	Cumene hydroperoxide	model/secondary	1.34e-08	6.80e-10
Fuel Oil #2 Prod.	Aluminum (elemental)	secondary	1.28e-08	6.47e-10
Fuel Oil #6 Prod.	Methyl chloride	secondary	1.27e-08	6.42e-10
Fuel Oil #4 Prod.	Copper	secondary	1.25e-08	6.32e-10
US electric grid	Ethylbenzene	model/secondary	1.18e-08	5.99e-10
LPG Production	Zinc (+2)	secondary	1.17e-08	5.94e-10
Fuel Oil #2 Prod.	Chloroform	secondary	1.14e-08	5.79e-10
Fuel Oil #6 Prod.	Beryllium	secondary	1.12e-08	5.67e-10
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	1.08e-08	5.45e-10
Fuel Oil #4 Prod.	Bromomethane	secondary	1.07e-08	5.40e-10
Japanese Electric Grid	Ethylbenzene	model/secondary	1.04e-08	5.26e-10
Natural Gas Prod.	Carbon disulfide	secondary	1.04e-08	5.25e-10
Fuel Oil #6 Prod.	Methyl hydrazine	secondary	9.18e-09	4.65e-10
Fuel Oil #4 Prod.	Dimethylbenzanthracene	secondary	8.97e-09	4.54e-10
Natural Gas Prod.	Toluene	secondary	8.63e-09	4.37e-10
Natural Gas Prod.	Benzyl chloride	secondary	8.12e-09	4.12e-10
LPG Production	Ethylene dibromide	secondary	8.03e-09	4.07e-10
Fuel Oil #2 Prod.	Cobalt	secondary	7.95e-09	4.03e-10
LPG Production	1,1,1-Trichloroethane	secondary	7.57e-09	3.83e-10
Fuel Oil #4 Prod.	Naphthalene	secondary	7.45e-09	3.77e-10
Fuel Oil #4 Prod.	Manganese	secondary	7.44e-09	3.77e-10
Fuel Oil #6 Prod.	Acetaldehyde	secondary	7.05e-09	3.57e-10
Fuel Oil #6 Prod.	Propionaldehyde	secondary	7.05e-09	3.57e-10
Fuel Oil #6 Prod.	Mercury	secondary	6.94e-09	3.52e-10
Fuel Oil #4 Prod.	Silicon	secondary	6.54e-09	3.31e-10
Fuel Oil #6 Prod.	Cadmium	secondary	6.36e-09	3.22e-10
Natural Gas Prod.	Chloroform	secondary	6.32e-09	3.20e-10
Fuel Oil #2 Prod.	Acrolein	secondary	6.09e-09	3.08e-10
LPG Production	2-Methylnaphthalene	secondary	6.01e-09	3.04e-10
US electric grid	Methyl tert-butyl ether	model/secondary	5.96e-09	3.02e-10
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	5.60e-09	2.83e-10
Fuel Oil #6 Prod.	Di(2-ethylhexyl)phthalate	secondary	5.41e-09	2.74e-10

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	Ethyl Chloride	secondary	5.36e-09	2.72e-10
LPG Production	Chlorine	secondary	5.32e-09	2.70e-10
Japanese Electric Grid	Phenanthrene	model/secondary	5.21e-09	2.64e-10
Fuel Oil #4 Prod.	Barium	secondary	5.08e-09	2.58e-10
Natural Gas Prod.	PM-10	secondary	4.94e-09	2.50e-10
Fuel Oil #2 Prod.	Methyl chloride	secondary	4.93e-09	2.50e-10
Japanese Electric Grid	Methyl tert-butyl ether	model/secondary	4.75e-09	2.40e-10
Natural Gas Prod.	o-xylene	secondary	4.60e-09	2.33e-10
US electric grid	Phenol	model/secondary	4.54e-09	2.30e-10
LPG Production	Cumene	secondary	4.54e-09	2.30e-10
Japanese Electric Grid	Chromium (III)	model/secondary	4.48e-09	2.27e-10
Fuel Oil #2 Prod.	Beryllium	secondary	4.40e-09	2.23e-10
US electric grid	Styrene	model/secondary	4.35e-09	2.20e-10
US electric grid	Vinyl acetate	model/secondary	4.25e-09	2.15e-10
Fuel Oil #6 Prod.	Toluene	secondary	4.19e-09	2.12e-10
Fuel Oil #4 Prod.	Lead	secondary	4.14e-09	2.10e-10
US electric grid	Phenanthrene	model/secondary	4.00e-09	2.03e-10
Japanese Electric Grid	1,1,1-Trichloroethane	model/secondary	3.66e-09	1.85e-10
Japanese Electric Grid	Phenol	model/secondary	3.63e-09	1.84e-10
Fuel Oil #4 Prod.	Barium cmpds	secondary	3.62e-09	1.83e-10
Fuel Oil #2 Prod.	Methyl hydrazine	secondary	3.57e-09	1.81e-10
US electric grid	Xylene (mixed isomers)	model/secondary	3.52e-09	1.78e-10
Japanese Electric Grid	Styrene	model/secondary	3.47e-09	1.76e-10
Japanese Electric Grid	Vinyl acetate	model/secondary	3.38e-09	1.71e-10
Natural Gas Prod.	Acrolein	secondary	3.37e-09	1.71e-10
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	3.22e-09	1.63e-10
US electric grid	Chromium (III)	model/secondary	3.15e-09	1.59e-10
Natural Gas Prod.	Aluminum (+3)	secondary	2.86e-09	1.45e-10
LPG Production	Acetophenone	secondary	2.82e-09	1.43e-10
Japanese Electric Grid	Xylene (mixed isomers)	model/secondary	2.81e-09	1.42e-10
Natural Gas Prod.	Beryllium	secondary	2.80e-09	1.42e-10
Fuel Oil #2 Prod.	Acetaldehyde	secondary	2.74e-09	1.39e-10
Fuel Oil #2 Prod.	Propionaldehyde	secondary	2.74e-09	1.39e-10
Natural Gas Prod.	Methyl chloride	secondary	2.73e-09	1.38e-10
Fuel Oil #2 Prod.	Mercury	secondary	2.72e-09	1.38e-10
LPG Production	Biphenyl	secondary	2.71e-09	1.37e-10
Natural Gas Prod.	Cobalt	secondary	2.64e-09	1.34e-10
Fuel Oil #6 Prod.	Dimethyl sulfate	secondary	2.59e-09	1.31e-10
Fuel Oil #2 Prod.	Cadmium	secondary	2.53e-09	1.28e-10
Fuel Oil #6 Prod.	Isophorone	secondary	2.48e-09	1.26e-10
Fuel Oil #6 Prod.	Cadmium cmpds	secondary	2.35e-09	1.19e-10
LPG Production	Acenaphthylene	secondary	2.14e-09	1.08e-10
Fuel Oil #2 Prod.	Di(2-ethylhexyl)phthalate	secondary	2.11e-09	1.07e-10
Fuel Oil #6 Prod.	1,4-Dichlorobenzene	secondary	2.04e-09	1.03e-10
Fuel Oil #6 Prod.	Methyl ethyl ketone	secondary	2.00e-09	1.02e-10
Fuel Oil #4 Prod.	Carbon disulfide	secondary	2.00e-09	1.01e-10
Fuel Oil #6 Prod.	Tetrachloroethylene	secondary	1.97e-09	1.00e-10
Natural Gas Prod.	Methyl hydrazine	secondary	1.97e-09	1.00e-10
Fuel Oil #2 Prod.	Cadmium cmpds	secondary	1.95e-09	9.87e-11
Fuel Oil #2 Prod.	Toluene	secondary	1.90e-09	9.61e-11

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Mercury	secondary	1.88e-09	9.54e-11
LPG Production	Acenaphthene	secondary	1.78e-09	9.03e-11
US electric grid	1,1,1-Trichloroethane	model/secondary	1.73e-09	8.77e-11
US electric grid	Ethylene dibromide	model/secondary	1.72e-09	8.70e-11
Fuel Oil #6 Prod.	Methyl methacrylate	secondary	1.71e-09	8.68e-11
Fuel Oil #4 Prod.	Benzyl chloride	secondary	1.57e-09	7.94e-11
Natural Gas Prod.	Acetaldehyde	secondary	1.51e-09	7.67e-11
Natural Gas Prod.	Propionaldehyde	secondary	1.51e-09	7.67e-11
Fuel Oil #4 Prod.	Aluminum (elemental)	secondary	1.50e-09	7.58e-11
Japanese Electric Grid	Acenaphthene	model/secondary	1.47e-09	7.44e-11
Fuel Oil #6 Prod.	1,2-Dichloroethane	secondary	1.43e-09	7.23e-11
Natural Gas Prod.	Cadmium	secondary	1.40e-09	7.11e-11
Fuel Oil #6 Prod.	Bromoform	secondary	1.40e-09	7.09e-11
LPG Production	Nickel cmpds	secondary	1.39e-09	7.04e-11
Japanese Electric Grid	Ethylene dibromide	model/secondary	1.37e-09	6.95e-11
Fuel Oil #6 Prod.	Dichloromethane	secondary	1.35e-09	6.85e-11
Japanese Electric Grid	o-xylene	model/secondary	1.28e-09	6.50e-11
Glass/frit	Nickel	primary	1.27e-09	6.43e-11
LPG Production	Benzo[a]anthracene	secondary	1.25e-09	6.32e-11
Fuel Oil #4 Prod.	Chloroform	secondary	1.22e-09	6.17e-11
LPG Production	Chrysene	secondary	1.20e-09	6.07e-11
LPG Production	Lead cmpds	secondary	1.17e-09	5.91e-11
Natural Gas Prod.	Di(2-ethylhexyl)phthalate	secondary	1.16e-09	5.90e-11
US electric grid	Ethyl Chloride	model/secondary	1.15e-09	5.81e-11
Fuel Oil #6 Prod.	Chlorobenzene	secondary	1.13e-09	5.73e-11
Fuel Oil #2 Prod.	1,4-Dichlorobenzene	secondary	1.06e-09	5.38e-11
Fuel Oil #2 Prod.	Dimethyl sulfate	secondary	1.01e-09	5.10e-11
US electric grid	Cumene	model/secondary	9.71e-10	4.92e-11
Fuel Oil #2 Prod.	Isophorone	secondary	9.66e-10	4.89e-11
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	9.29e-10	4.70e-11
Japanese Electric Grid	Ethyl Chloride	model/secondary	9.16e-10	4.64e-11
Fuel Oil #6 Prod.	2,4-Dinitrotoluene	secondary	8.99e-10	4.56e-11
Fuel Oil #4 Prod.	Cobalt	secondary	8.62e-10	4.37e-11
Japanese Electric Grid	Benzo[a]anthracene	model/secondary	8.00e-10	4.05e-11
Fuel Oil #2 Prod.	Methyl ethyl ketone	secondary	7.79e-10	3.95e-11
Fuel Oil #2 Prod.	Tetrachloroethylene	secondary	7.67e-10	3.89e-11
LPG Production	Benzo[b,j,k]fluoranthene	secondary	7.36e-10	3.73e-11
LPG Production	Mercury compounds	secondary	7.07e-10	3.58e-11
Fuel Oil #6 Prod.	Chromium (III)	secondary	6.96e-10	3.52e-11
LPG Production	Benzo[a]pyrene	secondary	6.83e-10	3.46e-11
Fuel Oil #2 Prod.	Methyl methacrylate	secondary	6.66e-10	3.37e-11
LPG Production	Fluorene	secondary	6.60e-10	3.35e-11
Fuel Oil #4 Prod.	Acrolein	secondary	6.49e-10	3.29e-11
US electric grid	Acetophenone	model/secondary	6.04e-10	3.06e-11
US electric grid	Biphenyl	model/secondary	5.79e-10	2.93e-11
LPG Production	Pyrene	secondary	5.71e-10	2.89e-11
Natural Gas Prod.	Dimethyl sulfate	secondary	5.57e-10	2.82e-11
Fuel Oil #2 Prod.	1,2-Dichloroethane	secondary	5.55e-10	2.81e-11
LPG Production	Benzo[g,h,i]perylene	secondary	5.55e-10	2.81e-11
Fuel Oil #2 Prod.	Bromoform	secondary	5.44e-10	2.76e-11

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	Fluoranthene	secondary	5.39e-10	2.73e-11
Japanese Electric Grid	Chrysene	model/secondary	5.35e-10	2.71e-11
Natural Gas Prod.	Isophorone	secondary	5.34e-10	2.71e-11
Fuel Oil #4 Prod.	Methyl chloride	secondary	5.26e-10	2.66e-11
Fuel Oil #2 Prod.	Dichloromethane	secondary	5.25e-10	2.66e-11
Natural Gas Prod.	Zinc (+2)	secondary	5.24e-10	2.66e-11
LPG Production	HALON-1301	secondary	5.08e-10	2.57e-11
LPG Production	Benzo[b]fluoranthene	secondary	4.99e-10	2.53e-11
Japanese Electric Grid	Acetophenone	model/secondary	4.82e-10	2.44e-11
Fuel Oil #6 Prod.	Aromatic hydrocarbons	secondary	4.74e-10	2.40e-11
Natural Gas Prod.	Chlorine	secondary	4.73e-10	2.40e-11
Fuel Oil #4 Prod.	Beryllium	secondary	4.67e-10	2.36e-11
Glass/frit	Chromium	primary	4.67e-10	2.36e-11
Glass/frit	Manganese	primary	4.67e-10	2.36e-11
Japanese Electric Grid	Biphenyl	model/secondary	4.62e-10	2.34e-11
Japanese Electric Grid	Indeno(1,2,3-cd)pyrene	model/secondary	4.48e-10	2.27e-11
Fuel Oil #6 Prod.	Ethylbenzene	secondary	4.47e-10	2.26e-11
Fuel Oil #6 Prod.	Copper (+1 & +2)	secondary	4.43e-10	2.25e-11
Fuel Oil #2 Prod.	Chlorobenzene	secondary	4.40e-10	2.23e-11
Natural Gas Prod.	Methyl ethyl ketone	secondary	4.31e-10	2.18e-11
Japanese Electric Grid	Benzo[g,h,i]perylene	model/secondary	4.30e-10	2.18e-11
Fuel Oil #6 Prod.	o-xylene	secondary	4.29e-10	2.17e-11
Natural Gas Prod.	Tetrachloroethylene	secondary	4.24e-10	2.15e-11
Fuel Oil #2 Prod.	Aromatic hydrocarbons	secondary	3.93e-10	1.99e-11
Japanese Electric Grid	Benzo[b,j,k]fluoranthene	model/secondary	3.89e-10	1.97e-11
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	3.81e-10	1.93e-11
Natural Gas Prod.	Silicon	secondary	3.71e-10	1.88e-11
Natural Gas Prod.	Methyl methacrylate	secondary	3.68e-10	1.87e-11
Fuel Oil #2 Prod.	Copper (+1 & +2)	secondary	3.68e-10	1.86e-11
US electric grid	Acenaphthylene	model/secondary	3.60e-10	1.82e-11
LPG Production	Dibenzo[a,h]anthracene	secondary	3.55e-10	1.80e-11
Fuel Oil #2 Prod.	2,4-Dinitrotoluene	secondary	3.50e-10	1.77e-11
Japanese Electric Grid	Acenaphthylene	model/secondary	3.29e-10	1.67e-11
Natural Gas Prod.	Barium cmpds	secondary	3.21e-10	1.63e-11
Glass/frit	Lead	primary	3.20e-10	1.62e-11
US electric grid	Acenaphthene	model/secondary	3.08e-10	1.56e-11
Natural Gas Prod.	1,2-Dichloroethane	secondary	3.07e-10	1.55e-11
Natural Gas Prod.	Bromoform	secondary	3.01e-10	1.52e-11
Japanese Electric Grid	Dibenzo[a,h]anthracene	model/secondary	2.96e-10	1.50e-11
Fuel Oil #4 Prod.	Acetaldehyde	secondary	2.92e-10	1.48e-11
Fuel Oil #4 Prod.	Propionaldehyde	secondary	2.92e-10	1.48e-11
Natural Gas Prod.	Dichloromethane	secondary	2.90e-10	1.47e-11
Fuel Oil #4 Prod.	Mercury	secondary	2.89e-10	1.46e-11
Fuel Oil #2 Prod.	Chromium (III)	secondary	2.70e-10	1.37e-11
Fuel Oil #4 Prod.	Cadmium	secondary	2.67e-10	1.35e-11
Natural Gas Prod.	Chlorobenzene	secondary	2.43e-10	1.23e-11
Japanese Electric Grid	2-Methylnaphthalene	model/secondary	2.38e-10	1.20e-11
Fuel Oil #6 Prod.	Methyl tert-butyl ether	secondary	2.25e-10	1.14e-11
Fuel Oil #4 Prod.	Di(2-ethylhexyl)phthalate	secondary	2.25e-10	1.14e-11
Fuel Oil #2 Prod.	o-xylene	secondary	2.06e-10	1.05e-11

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Japanese Electric Grid	Pyrene	model/secondary	2.00e-10	1.01e-11
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	1.93e-10	9.80e-12
Fuel Oil #4 Prod.	Toluene	secondary	1.90e-10	9.60e-12
Fuel Oil #2 Prod.	Ethylbenzene	secondary	1.74e-10	8.83e-12
Japanese Electric Grid	Fluorene	model/secondary	1.74e-10	8.82e-12
Fuel Oil #6 Prod.	Phenanthrene	secondary	1.71e-10	8.68e-12
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	1.70e-10	8.60e-12
Natural Gas Prod.	3-Methylcholanthrene	secondary	1.69e-10	8.55e-12
Japanese Electric Grid	Fluoranthene	model/secondary	1.66e-10	8.43e-12
Fuel Oil #6 Prod.	Styrene	secondary	1.64e-10	8.31e-12
US electric grid	Chrysene	model/secondary	1.63e-10	8.26e-12
Natural Gas Prod.	Chromium (III)	secondary	1.61e-10	8.16e-12
Fuel Oil #6 Prod.	Vinyl acetate	secondary	1.60e-10	8.11e-12
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	1.58e-10	8.02e-12
US electric grid	Benzo[a]anthracene	model/secondary	1.48e-10	7.50e-12
LPG Production	5-Methyl chrysene	secondary	1.47e-10	7.46e-12
Glass/frit	Cobalt	primary	1.43e-10	7.26e-12
US electric grid	Fluorene	model/secondary	1.28e-10	6.46e-12
LPG Production	Halogenated matter (organic)	secondary	1.17e-10	5.91e-12
Fuel Oil #4 Prod.	Dimethyl sulfate	secondary	1.07e-10	5.44e-12
Fuel Oil #6 Prod.	3-Methylcholanthrene	secondary	1.07e-10	5.43e-12
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	1.05e-10	5.33e-12
Fuel Oil #4 Prod.	Isophorone	secondary	1.03e-10	5.22e-12
US electric grid	Fluoranthene	model/secondary	1.02e-10	5.17e-12
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	1.00e-10	5.09e-12
Natural Gas Prod.	Ethylbenzene	secondary	9.66e-11	4.89e-12
Fuel Oil #2 Prod.	Methyl tert-butyl ether	secondary	8.74e-11	4.43e-12
Natural Gas Prod.	Aluminum (elemental)	secondary	8.50e-11	4.30e-12
US electric grid	Pyrene	model/secondary	8.43e-11	4.27e-12
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	8.31e-11	4.21e-12
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	8.18e-11	4.14e-12
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	7.10e-11	3.60e-12
Natural Gas Prod.	Phenanthrene	secondary	7.05e-11	3.57e-12
Fuel Oil #2 Prod.	Phenanthrene	secondary	7.03e-11	3.56e-12
Fuel Oil #6 Prod.	Ethylene dibromide	secondary	6.48e-11	3.28e-12
Fuel Oil #2 Prod.	Styrene	secondary	6.38e-11	3.23e-12
Fuel Oil #2 Prod.	Vinyl acetate	secondary	6.23e-11	3.15e-12
Fuel Oil #6 Prod.	1,1,1-Trichloroethane	secondary	6.11e-11	3.09e-12
US electric grid	o-xylene	model/secondary	6.06e-11	3.07e-12
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	5.92e-11	3.00e-12
Fuel Oil #4 Prod.	Bromoform	secondary	5.80e-11	2.94e-12
US electric grid	Benzo[g,h,i]perylene	model/secondary	5.75e-11	2.91e-12
Fuel Oil #4 Prod.	Dichloromethane	secondary	5.60e-11	2.84e-12
Fuel Oil #2 Prod.	3-Methylcholanthrene	secondary	5.57e-11	2.82e-12
US electric grid	Benzo[a]pyrene	model/secondary	5.44e-11	2.76e-12
Natural Gas Prod.	2-Methylnaphthalene	secondary	5.41e-11	2.74e-12
Fuel Oil #6 Prod.	Zinc (+2)	secondary	5.33e-11	2.70e-12
Natural Gas Prod.	Methyl tert-butyl ether	secondary	4.83e-11	2.45e-12
Fuel Oil #4 Prod.	Chlorobenzene	secondary	4.69e-11	2.37e-12
Japanese Electric Grid	Benzo[a]pyrene	model/secondary	4.35e-11	2.20e-12

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #6 Prod.	Ethyl Chloride	secondary	4.33e-11	2.19e-12
US electric grid	2-Methylnaphthalene	model/secondary	4.26e-11	2.16e-12
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	3.73e-11	1.89e-12
Fuel Oil #6 Prod.	Cumene	secondary	3.66e-11	1.85e-12
Natural Gas Prod.	Styrene	secondary	3.53e-11	1.79e-12
Natural Gas Prod.	Vinyl acetate	secondary	3.44e-11	1.74e-12
Fuel Oil #6 Prod.	2-Methylnaphthalene	secondary	3.43e-11	1.74e-12
Fuel Oil #2 Prod.	Zinc (+2)	secondary	3.39e-11	1.72e-12
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	3.19e-11	1.62e-12
US electric grid	5-Methyl chrysene	model/secondary	3.15e-11	1.60e-12
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	2.99e-11	1.51e-12
Fuel Oil #6 Prod.	Chlorine	secondary	2.96e-11	1.50e-12
Fuel Oil #4 Prod.	Chromium (III)	secondary	2.88e-11	1.46e-12
Fuel Oil #2 Prod.	Ethylene dibromide	secondary	2.52e-11	1.28e-12
Japanese Electric Grid	5-Methyl chrysene	model/secondary	2.51e-11	1.27e-12
LPG Production	Anthracene	secondary	2.48e-11	1.26e-12
Fuel Oil #2 Prod.	1,1,1-Trichloroethane	secondary	2.37e-11	1.20e-12
Fuel Oil #6 Prod.	Acetophenone	secondary	2.28e-11	1.15e-12
Fuel Oil #6 Prod.	Biphenyl	secondary	2.18e-11	1.11e-12
Fuel Oil #4 Prod.	o-xylene	secondary	2.01e-11	1.02e-12
Fuel Oil #4 Prod.	Ethylbenzene	secondary	1.86e-11	9.40e-13
Fuel Oil #2 Prod.	2-Methylnaphthalene	secondary	1.78e-11	9.04e-13
Fuel Oil #2 Prod.	Ethyl Chloride	secondary	1.68e-11	8.52e-13
Fuel Oil #6 Prod.	Acenaphthylene	secondary	1.61e-11	8.17e-13
Fuel Oil #2 Prod.	Chlorine	secondary	1.56e-11	7.90e-13
Fuel Oil #2 Prod.	Cumene	secondary	1.42e-11	7.21e-13
Natural Gas Prod.	Cadmium cmpds	secondary	1.40e-11	7.11e-13
US electric grid	Dibenzo[a,h]anthracene	model/secondary	1.40e-11	7.07e-13
Natural Gas Prod.	Ethylene dibromide	secondary	1.39e-11	7.06e-13
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	1.31e-11	6.65e-13
Fuel Oil #6 Prod.	Acenaphthene	secondary	1.19e-11	6.01e-13
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	9.32e-12	4.72e-13
Natural Gas Prod.	Ethyl Chloride	secondary	9.30e-12	4.71e-13
Fuel Oil #2 Prod.	Acetophenone	secondary	8.86e-12	4.49e-13
Fuel Oil #2 Prod.	Biphenyl	secondary	8.49e-12	4.30e-13
Fuel Oil #6 Prod.	Chrysene	secondary	8.24e-12	4.18e-13
Natural Gas Prod.	Cumene	secondary	7.87e-12	3.99e-13
Fuel Oil #6 Prod.	Benzo[a]anthracene	secondary	7.80e-12	3.95e-13
Fuel Oil #4 Prod.	Phenanthrene	secondary	7.32e-12	3.71e-13
Natural Gas Prod.	Acenaphthylene	secondary	7.00e-12	3.54e-13
Fuel Oil #4 Prod.	Styrene	secondary	6.80e-12	3.45e-13
Fuel Oil #4 Prod.	Vinyl acetate	secondary	6.64e-12	3.36e-13
Fuel Oil #2 Prod.	Acenaphthylene	secondary	6.63e-12	3.36e-13
Fuel Oil #6 Prod.	Indeno(1,2,3-cd)pyrene	secondary	6.11e-12	3.09e-13
Fuel Oil #6 Prod.	Benzo[b,j,k]fluoranthene	secondary	5.94e-12	3.01e-13
Natural Gas Prod.	Benzo[a]anthracene	secondary	5.61e-12	2.84e-13
Japanese Electric Grid	Anthracene	model/secondary	5.42e-12	2.75e-13
Fuel Oil #2 Prod.	Acenaphthene	secondary	5.41e-12	2.74e-13
Natural Gas Prod.	Chrysene	secondary	5.40e-12	2.74e-13
Fuel Oil #4 Prod.	3-Methylcholanthrene	secondary	5.27e-12	2.67e-13

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #6 Prod.	Fluorene	secondary	5.11e-12	2.59e-13
Fuel Oil #6 Prod.	Benzo[a]pyrene	secondary	5.10e-12	2.58e-13
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	4.93e-12	2.50e-13
Natural Gas Prod.	Acetophenone	secondary	4.90e-12	2.48e-13
Fuel Oil #6 Prod.	Nickel cmpds	secondary	4.70e-12	2.38e-13
Natural Gas Prod.	Biphenyl	secondary	4.70e-12	2.38e-13
Natural Gas Prod.	Acenaphthene	secondary	4.50e-12	2.28e-13
Natural Gas Prod.	Benzo[b]fluoranthene	secondary	4.17e-12	2.11e-13
Fuel Oil #6 Prod.	Fluoranthene	secondary	4.11e-12	2.08e-13
Fuel Oil #6 Prod.	Pyrene	secondary	4.04e-12	2.05e-13
Fuel Oil #6 Prod.	Lead cmpds	secondary	3.95e-12	2.00e-13
Fuel Oil #2 Prod.	Nickel cmpds	secondary	3.90e-12	1.97e-13
Fuel Oil #2 Prod.	Benzo[a]anthracene	secondary	3.76e-12	1.90e-13
US electric grid	Anthracene	model/secondary	3.70e-12	1.87e-13
Fuel Oil #2 Prod.	Chrysene	secondary	3.66e-12	1.85e-13
Fuel Oil #6 Prod.	Benzo[g,h,i]perylene	secondary	3.43e-12	1.74e-13
Fuel Oil #2 Prod.	Lead cmpds	secondary	3.27e-12	1.66e-13
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	3.19e-12	1.62e-13
Natural Gas Prod.	Benzo[a]pyrene	secondary	3.15e-12	1.59e-13
Fuel Oil #4 Prod.	Zinc (+2)	secondary	2.98e-12	1.51e-13
Natural Gas Prod.	Dibenzo[a,h]anthracene	secondary	2.83e-12	1.44e-13
Natural Gas Prod.	Aromatic hydrocarbons	secondary	2.83e-12	1.43e-13
Fuel Oil #2 Prod.	Indeno(1,2,3-cd)pyrene	secondary	2.82e-12	1.43e-13
Fuel Oil #6 Prod.	Benzo[b]fluoranthene	secondary	2.74e-12	1.39e-13
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	2.69e-12	1.36e-13
Natural Gas Prod.	Copper (+1 & +2)	secondary	2.65e-12	1.34e-13
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	2.53e-12	1.28e-13
Natural Gas Prod.	Pyrene	secondary	2.45e-12	1.24e-13
Fuel Oil #6 Prod.	Mercury compounds	secondary	2.39e-12	1.21e-13
Fuel Oil #2 Prod.	Benzo[b,j,k]fluoranthene	secondary	2.31e-12	1.17e-13
Fuel Oil #2 Prod.	Benzo[a]pyrene	secondary	2.11e-12	1.07e-13
Fuel Oil #2 Prod.	Fluorene	secondary	2.06e-12	1.04e-13
Fuel Oil #2 Prod.	Mercury compounds	secondary	1.98e-12	1.00e-13
Fuel Oil #6 Prod.	Dibenzo[a,h]anthracene	secondary	1.90e-12	9.65e-14
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	1.79e-12	9.09e-14
Fuel Oil #2 Prod.	Pyrene	secondary	1.75e-12	8.87e-14
Fuel Oil #6 Prod.	HALON-1301	secondary	1.72e-12	8.70e-14
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	1.69e-12	8.55e-14
Fuel Oil #2 Prod.	Fluoranthene	secondary	1.67e-12	8.48e-14
Fuel Oil #2 Prod.	Benzo[g,h,i]perylene	secondary	1.67e-12	8.44e-14
Natural Gas Prod.	Fluorene	secondary	1.64e-12	8.30e-14
Fuel Oil #4 Prod.	Cumene	secondary	1.52e-12	7.69e-14
Fuel Oil #2 Prod.	Benzo[b]fluoranthene	secondary	1.47e-12	7.47e-14
Fuel Oil #4 Prod.	Chlorine	secondary	1.47e-12	7.44e-14
Natural Gas Prod.	Fluoranthene	secondary	1.46e-12	7.42e-14
Fuel Oil #2 Prod.	HALON-1301	secondary	1.42e-12	7.22e-14
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	1.28e-12	6.47e-14
Fuel Oil #6 Prod.	5-Methyl chrysene	secondary	1.19e-12	6.02e-14
Fuel Oil #2 Prod.	Dibenzo[a,h]anthracene	secondary	1.05e-12	5.30e-14
Fuel Oil #4 Prod.	Acetophenone	secondary	9.45e-13	4.78e-14

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	Biphenyl	secondary	9.06e-13	4.59e-14
Fuel Oil #4 Prod.	Acenaphthylene	secondary	6.90e-13	3.50e-14
Fuel Oil #4 Prod.	Acenaphthene	secondary	5.39e-13	2.73e-14
Fuel Oil #2 Prod.	5-Methyl chrysene	secondary	4.62e-13	2.34e-14
Fuel Oil #6 Prod.	Halogenated matter (organic)	secondary	3.95e-13	2.00e-14
Fuel Oil #4 Prod.	Chrysene	secondary	3.68e-13	1.87e-14
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	3.66e-13	1.85e-14
Fuel Oil #2 Prod.	Halogenated matter (organic)	secondary	3.27e-13	1.66e-14
Fuel Oil #4 Prod.	Nickel cmpds	secondary	3.17e-13	1.60e-14
LPG Production	Halogenated hydrocarbons (unspecified)	secondary	2.92e-13	1.48e-14
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	2.79e-13	1.41e-14
Fuel Oil #4 Prod.	Lead cmpds	secondary	2.66e-13	1.35e-14
Natural Gas Prod.	5-Methyl chrysene	secondary	2.55e-13	1.29e-14
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	2.46e-13	1.25e-14
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	2.19e-13	1.11e-14
Fuel Oil #4 Prod.	Fluorene	secondary	2.16e-13	1.09e-14
Fuel Oil #6 Prod.	Anthracene	secondary	1.79e-13	9.07e-15
Fuel Oil #4 Prod.	Pyrene	secondary	1.78e-13	9.02e-15
Fuel Oil #4 Prod.	Fluoranthene	secondary	1.75e-13	8.86e-15
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	1.62e-13	8.20e-15
Fuel Oil #4 Prod.	Mercury compounds	secondary	1.61e-13	8.16e-15
Fuel Oil #4 Prod.	Benzo[b]fluoranthene	secondary	1.38e-13	6.98e-15
Fuel Oil #4 Prod.	HALON-1301	secondary	1.16e-13	5.86e-15
Fuel Oil #4 Prod.	Dibenzo[a,h]anthracene	secondary	9.69e-14	4.91e-15
Natural Gas Prod.	Anthracene	secondary	9.56e-14	4.84e-15
Fuel Oil #2 Prod.	Anthracene	secondary	7.64e-14	3.87e-15
US electric grid	2,3,7,8-TCDF	model/secondary	7.30e-14	3.70e-15
Japanese Electric Grid	2,3,7,8-TCDF	model/secondary	5.84e-14	2.96e-15
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	4.92e-14	2.49e-15
Natural Gas Prod.	Nickel cmpds	secondary	2.81e-14	1.42e-15
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	2.66e-14	1.35e-15
Natural Gas Prod.	Lead cmpds	secondary	2.36e-14	1.19e-15
Natural Gas Prod.	Mercury compounds	secondary	1.43e-14	7.24e-16
Natural Gas Prod.	HALON-1301	secondary	1.03e-14	5.20e-16
Fuel Oil #4 Prod.	Anthracene	secondary	7.82e-15	3.96e-16
Natural Gas Prod.	Halogenated matter (organic)	secondary	2.36e-15	1.19e-16
Fuel Oil #6 Prod.	Halogenated hydrocarbons (unspecified)	secondary	9.87e-16	5.00e-17
Fuel Oil #2 Prod.	Halogenated hydrocarbons (unspecified)	secondary	8.19e-16	4.15e-17
Fuel Oil #4 Prod.	Halogenated hydrocarbons (unspecified)	secondary	6.65e-17	3.37e-18
Natural Gas Prod.	Halogenated hydrocarbons (unspecified)	secondary	5.89e-18	2.98e-19
Total Manufacturing			**9.46e+01**	**4.79e+00**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Sulfur dioxide	model/secondary	1.65e+03	8.34e+01
US electric grid	Nitrogen oxides	model/secondary	1.18e+00	5.96e-02
US electric grid	Carbon monoxide	model/secondary	1.01e+00	5.12e-02
US electric grid	Methane	model/secondary	6.45e-01	3.27e-02
US electric grid	Arsenic	model/secondary	5.58e-01	2.83e-02
US electric grid	Hydrochloric acid	model/secondary	4.93e-01	2.50e-02
US electric grid	Selenium	model/secondary	9.28e-02	4.70e-03

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
US electric grid	Vanadium	model/secondary	6.98e-02	3.54e-03
US electric grid	PM-10	model/secondary	5.78e-02	2.93e-03
US electric grid	Hydrofluoric acid	model/secondary	1.35e-02	6.81e-04
US electric grid	Formaldehyde	model/secondary	9.69e-03	4.91e-04
US electric grid	Benzene	model/secondary	6.97e-03	3.53e-04
US electric grid	Phosphorus (yellow or white)	model/secondary	3.93e-03	1.99e-04
US electric grid	Nitrous oxide	model/secondary	3.40e-03	1.72e-04
US electric grid	Zinc (elemental)	model/secondary	1.81e-03	9.18e-05
US electric grid	Antimony	model/secondary	1.48e-03	7.51e-05
US electric grid	Molybdenum	model/secondary	4.96e-04	2.51e-05
US electric grid	2-Chloroacetophenone	model/secondary	4.31e-04	2.18e-05
US electric grid	Bromomethane	model/secondary	4.27e-04	2.16e-05
US electric grid	Cyanide (-1)	model/secondary	2.24e-04	1.14e-05
US electric grid	2,3,7,8-TCDD	model/secondary	1.70e-04	8.59e-06
US electric grid	Nickel	model/secondary	1.63e-04	8.26e-06
US electric grid	Naphthalene	model/secondary	1.35e-04	6.84e-06
US electric grid	Barium	model/secondary	1.16e-04	5.90e-06
US electric grid	Carbon disulfide	model/secondary	8.01e-05	4.06e-06
US electric grid	Benzyl chloride	model/secondary	6.28e-05	3.18e-06
US electric grid	Chloroform	model/secondary	4.88e-05	2.47e-06
US electric grid	Manganese	model/secondary	4.56e-05	2.31e-06
US electric grid	Chromium (VI)	model/secondary	3.43e-05	1.74e-06
US electric grid	Acrolein	model/secondary	2.60e-05	1.32e-06
US electric grid	Copper	model/secondary	2.24e-05	1.13e-06
US electric grid	Methyl chloride	model/secondary	2.11e-05	1.07e-06
US electric grid	Fluoride	model/secondary	1.95e-05	9.89e-07
US electric grid	Methyl hydrazine	model/secondary	1.52e-05	7.72e-07
US electric grid	Lead	model/secondary	1.27e-05	6.46e-07
US electric grid	Cobalt	model/secondary	1.22e-05	6.16e-07
US electric grid	Propionaldehyde	model/secondary	1.17e-05	5.93e-07
US electric grid	Acetaldehyde	model/secondary	1.17e-05	5.93e-07
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	8.99e-06	4.56e-07
US electric grid	Mercury	model/secondary	7.51e-06	3.81e-07
US electric grid	Hexane	model/secondary	6.01e-06	3.04e-07
US electric grid	Cadmium	model/secondary	4.82e-06	2.44e-07
US electric grid	Dimethyl sulfate	model/secondary	4.30e-06	2.18e-07
US electric grid	Toluene	model/secondary	4.25e-06	2.15e-07
US electric grid	Isophorone	model/secondary	4.13e-06	2.09e-07
US electric grid	Methyl ethyl ketone	model/secondary	3.33e-06	1.69e-07
US electric grid	Tetrachloroethylene	model/secondary	3.28e-06	1.66e-07
US electric grid	Methyl methacrylate	model/secondary	2.85e-06	1.44e-07
US electric grid	1,2-Dichloroethane	model/secondary	2.37e-06	1.20e-07
US electric grid	Bromoform	model/secondary	2.33e-06	1.18e-07
US electric grid	Dichloromethane	model/secondary	2.24e-06	1.14e-07
US electric grid	Beryllium	model/secondary	1.91e-06	9.67e-08
US electric grid	Chlorobenzene	model/secondary	1.88e-06	9.52e-08
US electric grid	2,4-Dinitrotoluene	model/secondary	1.49e-06	7.57e-08
US electric grid	Ethylbenzene	model/secondary	7.41e-07	3.75e-08
US electric grid	Methyl tert-butyl ether	model/secondary	3.74e-07	1.89e-08
US electric grid	Phenol	model/secondary	2.85e-07	1.44e-08

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
US electric grid	Styrene	model/secondary	2.73e-07	1.38e-08
US electric grid	Vinyl acetate	model/secondary	2.66e-07	1.35e-08
US electric grid	Phenanthrene	model/secondary	2.51e-07	1.27e-08
US electric grid	Xylene (mixed isomers)	model/secondary	2.21e-07	1.12e-08
US electric grid	Chromium (III)	model/secondary	1.97e-07	9.98e-09
US electric grid	1,1,1-Trichloroethane	model/secondary	1.08e-07	5.49e-09
US electric grid	Ethylene dibromide	model/secondary	1.08e-07	5.45e-09
US electric grid	Ethyl Chloride	model/secondary	7.19e-08	3.64e-09
US electric grid	Cumene	model/secondary	6.08e-08	3.08e-09
US electric grid	Acetophenone	model/secondary	3.78e-08	1.92e-09
US electric grid	Biphenyl	model/secondary	3.63e-08	1.84e-09
US electric grid	Acenaphthylene	model/secondary	2.26e-08	1.14e-09
US electric grid	Acenaphthene	model/secondary	1.93e-08	9.78e-10
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	1.06e-08	5.39e-10
US electric grid	Chrysene	model/secondary	1.02e-08	5.17e-10
US electric grid	Benzo[a]anthracene	model/secondary	9.27e-09	4.70e-10
US electric grid	Fluorene	model/secondary	7.99e-09	4.05e-10
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	6.59e-09	3.34e-10
US electric grid	Fluoranthene	model/secondary	6.39e-09	3.24e-10
US electric grid	Pyrene	model/secondary	5.28e-09	2.68e-10
US electric grid	o-xylene	model/secondary	3.79e-09	1.92e-10
US electric grid	Benzo[g,h,i]perylene	model/secondary	3.60e-09	1.83e-10
US electric grid	Benzo[a]pyrene	model/secondary	3.41e-09	1.73e-10
US electric grid	2-Methylnaphthalene	model/secondary	2.67e-09	1.35e-10
US electric grid	5-Methyl chrysene	model/secondary	1.97e-09	1.00e-10
US electric grid	Dibenzo[a,h]anthracene	model/secondary	8.74e-10	4.43e-11
US electric grid	Anthracene	model/secondary	2.32e-10	1.17e-11
US electric grid	2,3,7,8-TCDF	model/secondary	4.57e-12	2.32e-13
Total Use, Maintenance and Repiar			**1.65e+03**	**8.36e+01**
End-of-life Life-cycle Stage				
CRT Incineration	Sulfur dioxide	secondary	1.98e-01	1.00e-02
CRT landfilling	Sulfur dioxide	primary	1.85e-01	9.37e-03
US electric grid	Sulfur dioxide	model/secondary	1.65e-01	8.35e-03
CRT landfilling	Carbon monoxide	primary	9.22e-03	4.67e-04
CRT landfilling	Nitrogen dioxide	primary	1.85e-03	9.38e-05
CRT landfilling	PM	primary	2.08e-04	1.06e-05
US electric grid	Nitrogen oxides	model/secondary	1.18e-04	5.97e-06
CRT landfilling	Arsenic cmpds	primary	1.02e-04	5.18e-06
US electric grid	Carbon monoxide	model/secondary	1.01e-04	5.12e-06
CRT Incineration	Arsenic cmpds	secondary	9.83e-05	4.98e-06
US electric grid	Methane	model/secondary	6.45e-05	3.27e-06
US electric grid	Arsenic	model/secondary	5.58e-05	2.83e-06
CRT landfilling	Methane	primary	5.44e-05	2.76e-06
US electric grid	Hydrochloric acid	model/secondary	4.93e-05	2.50e-06
LPG Production	Carbon monoxide	secondary	4.61e-05	2.34e-06
CRT landfilling	Benzene	primary	4.04e-05	2.05e-06
CRT Incineration	Lead	secondary	1.43e-05	7.24e-07
CRT Incineration	Barium cmpds	secondary	1.27e-05	6.45e-07
CRT Incineration	Silver compounds	secondary	1.12e-05	5.68e-07
CRT landfilling	Silver compounds	primary	1.05e-05	5.30e-07

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
CRT landfilling	Barium cmpds	primary	1.01e-05	5.13e-07
US electric grid	Selenium	model/secondary	9.28e-06	4.70e-07
LPG Production	Vanadium	secondary	9.04e-06	4.58e-07
LPG Production	Benzene	secondary	7.40e-06	3.75e-07
LPG Production	Methane	secondary	7.24e-06	3.67e-07
US electric grid	Vanadium	model/secondary	6.98e-06	3.54e-07
LPG Production	Sulfur oxides	secondary	6.92e-06	3.50e-07
US electric grid	PM-10	model/secondary	5.78e-06	2.93e-07
LPG Production	Nitrogen oxides	secondary	4.94e-06	2.51e-07
CRT landfilling	Hydrochloric acid	primary	4.69e-06	2.37e-07
CRT landfilling	Ammonia	primary	2.41e-06	1.22e-07
LPG Production	Arsenic	secondary	1.78e-06	9.03e-08
US electric grid	Hydrofluoric acid	model/secondary	1.35e-06	6.82e-08
LPG Production	Formaldehyde	secondary	1.16e-06	5.86e-08
LPG Production	PM	secondary	1.11e-06	5.64e-08
CRT landfilling	Cadmium cmpds	primary	9.72e-07	4.92e-08
US electric grid	Formaldehyde	model/secondary	9.70e-07	4.91e-08
CRT Incineration	Cadmium cmpds	secondary	9.41e-07	4.77e-08
US electric grid	Benzene	model/secondary	6.98e-07	3.53e-08
US electric grid	Phosphorus (yellow or white)	model/secondary	3.93e-07	1.99e-08
US electric grid	Nitrous oxide	model/secondary	3.40e-07	1.72e-08
LPG Production	Hydrochloric acid	secondary	3.18e-07	1.61e-08
CRT landfilling	Hydrogen sulfide	primary	2.30e-07	1.17e-08
US electric grid	Zinc (elemental)	model/secondary	1.81e-07	9.19e-09
US electric grid	Antimony	model/secondary	1.48e-07	7.52e-09
LPG Production	Nitrous oxide	secondary	1.40e-07	7.09e-09
LPG Production	Phosphorus (yellow or white)	secondary	8.47e-08	4.29e-09
LPG Production	Fluorides (F-)	secondary	6.48e-08	3.28e-09
LPG Production	Selenium	secondary	6.40e-08	3.24e-09
US electric grid	Molybdenum	model/secondary	4.97e-08	2.52e-09
US electric grid	2-Chloroacetophenone	model/secondary	4.32e-08	2.19e-09
US electric grid	Bromomethane	model/secondary	4.27e-08	2.16e-09
LPG Production	Ammonia	secondary	3.23e-08	1.63e-09
CRT landfilling	Selenium	primary	3.21e-08	1.62e-09
CRT landfilling	Chromium (VI)	primary	2.84e-08	1.44e-09
LPG Production	Hydrogen sulfide	secondary	2.65e-08	1.34e-09
US electric grid	Cyanide (-1)	model/secondary	2.24e-08	1.14e-09
CRT Incineration	Carbon tetrachloride	secondary	1.80e-08	9.11e-10
US electric grid	2,3,7,8-TCDD	model/secondary	1.70e-08	8.59e-10
CRT landfilling	Carbon tetrachloride	primary	1.68e-08	8.50e-10
US electric grid	Nickel	model/secondary	1.63e-08	8.26e-10
LPG Production	Molybdenum	secondary	1.42e-08	7.20e-10
US electric grid	Naphthalene	model/secondary	1.35e-08	6.85e-10
CRT landfilling	Chloroform	primary	1.30e-08	6.59e-10
US electric grid	Barium	model/secondary	1.17e-08	5.90e-10
CRT landfilling	Mercury compounds	primary	1.15e-08	5.84e-10
CRT Incineration	Mercury compounds	secondary	1.13e-08	5.72e-10
LPG Production	Zinc (elemental)	secondary	1.04e-08	5.24e-10
LPG Production	Hydrofluoric acid	secondary	8.66e-09	4.39e-10
CRT landfilling	Toluene	primary	8.22e-09	4.17e-10

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
US electric grid	Carbon disulfide	model/secondary	8.01e-09	4.06e-10
LPG Production	Ethane	secondary	6.70e-09	3.39e-10
US electric grid	Benzyl chloride	model/secondary	6.28e-09	3.18e-10
LPG Production	Phenol	secondary	6.17e-09	3.13e-10
LPG Production	Pentane	secondary	5.62e-09	2.84e-10
US electric grid	Chloroform	model/secondary	4.88e-09	2.47e-10
US electric grid	Manganese	model/secondary	4.56e-09	2.31e-10
LPG Production	Hexane	secondary	3.89e-09	1.97e-10
US electric grid	Chromium (VI)	model/secondary	3.44e-09	1.74e-10
US electric grid	Acrolein	model/secondary	2.60e-09	1.32e-10
LPG Production	Nickel	secondary	2.51e-09	1.27e-10
US electric grid	Copper	model/secondary	2.24e-09	1.13e-10
US electric grid	Methyl chloride	model/secondary	2.11e-09	1.07e-10
US electric grid	Fluoride	model/secondary	1.95e-09	9.90e-11
LPG Production	PM-10	secondary	1.94e-09	9.84e-11
LPG Production	Antimony	secondary	1.85e-09	9.35e-11
CRT landfilling	Xylene (mixed isomers)	primary	1.69e-09	8.59e-11
US electric grid	Methyl hydrazine	model/secondary	1.53e-09	7.73e-11
US electric grid	Lead	model/secondary	1.28e-09	6.46e-11
LPG Production	Aluminum (+3)	secondary	1.22e-09	6.19e-11
US electric grid	Cobalt	model/secondary	1.22e-09	6.16e-11
CRT landfilling	Tetrachloroethylene	primary	1.20e-09	6.07e-11
US electric grid	Propionaldehyde	model/secondary	1.17e-09	5.93e-11
US electric grid	Acetaldehyde	model/secondary	1.17e-09	5.93e-11
CRT landfilling	1,2-Dichloroethane	primary	9.32e-10	4.72e-11
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	9.00e-10	4.56e-11
LPG Production	Chromium (VI)	secondary	8.70e-10	4.41e-11
CRT Incineration	Lead cmpds	secondary	8.10e-10	4.11e-11
CRT landfilling	Lead cmpds	primary	7.89e-10	4.00e-11
US electric grid	Mercury	model/secondary	7.52e-10	3.81e-11
CRT Incineration	Trichloroethylene	secondary	7.50e-10	3.80e-11
CRT landfilling	Trichloroethylene	primary	6.99e-10	3.54e-11
US electric grid	Hexane	model/secondary	6.01e-10	3.05e-11
LPG Production	Nitrate	secondary	5.23e-10	2.65e-11
US electric grid	Cadmium	model/secondary	4.82e-10	2.44e-11
CRT landfilling	Ethylbenzene	primary	4.44e-10	2.25e-11
US electric grid	Dimethyl sulfate	model/secondary	4.31e-10	2.18e-11
US electric grid	Toluene	model/secondary	4.25e-10	2.15e-11
US electric grid	Isophorone	model/secondary	4.13e-10	2.09e-11
US electric grid	Methyl ethyl ketone	model/secondary	3.33e-10	1.69e-11
US electric grid	Tetrachloroethylene	model/secondary	3.28e-10	1.66e-11
LPG Production	Copper	secondary	3.01e-10	1.52e-11
US electric grid	Methyl methacrylate	model/secondary	2.85e-10	1.44e-11
LPG Production	2-Chloroacetophenone	secondary	2.78e-10	1.41e-11
LPG Production	Dimethylbenzanthracene	secondary	2.75e-10	1.40e-11
LPG Production	Bromomethane	secondary	2.75e-10	1.39e-11
US electric grid	1,2-Dichloroethane	model/secondary	2.37e-10	1.20e-11
US electric grid	Bromoform	model/secondary	2.33e-10	1.18e-11
US electric grid	Dichloromethane	model/secondary	2.25e-10	1.14e-11
LPG Production	Naphthalene	secondary	2.23e-10	1.13e-11
CRT landfilling	Dichloromethane	primary	1.94e-10	9.85e-12

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	Manganese	secondary	1.93e-10	9.76e-12
US electric grid	Beryllium	model/secondary	1.91e-10	9.67e-12
US electric grid	Chlorobenzene	model/secondary	1.88e-10	9.52e-12
LPG Production	Barium	secondary	1.61e-10	8.15e-12
US electric grid	2,4-Dinitrotoluene	model/secondary	1.49e-10	7.57e-12
LPG Production	Silicon	secondary	1.46e-10	7.40e-12
LPG Production	Cyanide (-1)	secondary	1.44e-10	7.31e-12
LPG Production	Barium cmpds	secondary	1.37e-10	6.94e-12
LPG Production	Lead	secondary	1.07e-10	5.40e-12
US electric grid	Ethylbenzene	model/secondary	7.41e-11	3.75e-12
CRT Incineration	o-xylene	secondary	5.21e-11	2.64e-12
LPG Production	Carbon disulfide	secondary	5.16e-11	2.61e-12
CRT landfilling	Chromium (III)	primary	4.83e-11	2.45e-12
LPG Production	Benzyl chloride	secondary	4.04e-11	2.05e-12
US electric grid	Methyl tert-butyl ether	model/secondary	3.74e-11	1.89e-12
LPG Production	Aluminum (elemental)	secondary	3.34e-11	1.69e-12
LPG Production	Chloroform	secondary	3.14e-11	1.59e-12
US electric grid	Phenol	model/secondary	2.85e-11	1.44e-12
US electric grid	Styrene	model/secondary	2.73e-11	1.38e-12
US electric grid	Vinyl acetate	model/secondary	2.66e-11	1.35e-12
US electric grid	Phenanthrene	model/secondary	2.51e-11	1.27e-12
US electric grid	Xylene (mixed isomers)	model/secondary	2.21e-11	1.12e-12
LPG Production	Cobalt	secondary	2.17e-11	1.10e-12
US electric grid	Chromium (III)	model/secondary	1.97e-11	9.99e-13
LPG Production	Acrolein	secondary	1.67e-11	8.48e-13
LPG Production	Methyl chloride	secondary	1.36e-11	6.87e-13
LPG Production	Beryllium	secondary	1.21e-11	6.14e-13
US electric grid	1,1,1-Trichloroethane	model/secondary	1.08e-11	5.50e-13
US electric grid	Ethylene dibromide	model/secondary	1.08e-11	5.45e-13
LPG Production	Methyl hydrazine	secondary	9.82e-12	4.97e-13
LPG Production	Acetaldehyde	secondary	7.54e-12	3.82e-13
LPG Production	Propionaldehyde	secondary	7.54e-12	3.82e-13
LPG Production	Mercury	secondary	7.50e-12	3.80e-13
US electric grid	Ethyl Chloride	model/secondary	7.19e-12	3.64e-13
LPG Production	Cadmium	secondary	6.99e-12	3.54e-13
US electric grid	Cumene	model/secondary	6.08e-12	3.08e-13
LPG Production	Cadmium cmpds	secondary	5.99e-12	3.04e-13
LPG Production	Di(2-ethylhexyl)phthalate	secondary	5.79e-12	2.93e-13
LPG Production	Toluene	secondary	5.38e-12	2.72e-13
US electric grid	Acetophenone	model/secondary	3.79e-12	1.92e-13
US electric grid	Biphenyl	model/secondary	3.63e-12	1.84e-13
LPG Production	1,4-Dichlorobenzene	secondary	3.08e-12	1.56e-13
CRT Incineration	Vinyl chloride	secondary	2.97e-12	1.51e-13
CRT landfilling	Vinyl chloride	primary	2.77e-12	1.41e-13
LPG Production	Dimethyl sulfate	secondary	2.77e-12	1.40e-13
LPG Production	Isophorone	secondary	2.66e-12	1.35e-13
US electric grid	Acenaphthylene	model/secondary	2.26e-12	1.14e-13
LPG Production	Methyl ethyl ketone	secondary	2.14e-12	1.09e-13
LPG Production	Tetrachloroethylene	secondary	2.11e-12	1.07e-13
US electric grid	Acenaphthene	model/secondary	1.93e-12	9.79e-14

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	Methyl methacrylate	secondary	1.83e-12	9.28e-14
LPG Production	1,2-Dichloroethane	secondary	1.53e-12	7.74e-14
LPG Production	Bromoform	secondary	1.50e-12	7.59e-14
LPG Production	Chromium (III)	secondary	1.48e-12	7.51e-14
LPG Production	Dichloromethane	secondary	1.45e-12	7.32e-14
LPG Production	Chlorobenzene	secondary	1.21e-12	6.13e-14
LPG Production	Aromatic hydrocarbons	secondary	1.21e-12	6.12e-14
LPG Production	Copper (+1 & +2)	secondary	1.13e-12	5.73e-14
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	1.06e-12	5.39e-14
US electric grid	Chrysene	model/secondary	1.02e-12	5.18e-14
LPG Production	2,4-Dinitrotoluene	secondary	9.62e-13	4.87e-14
US electric grid	Benzo[a]anthracene	model/secondary	9.28e-13	4.70e-14
US electric grid	Fluorene	model/secondary	8.00e-13	4.05e-14
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	6.59e-13	3.34e-14
US electric grid	Fluoranthene	model/secondary	6.39e-13	3.24e-14
LPG Production	o-xylene	secondary	5.92e-13	3.00e-14
US electric grid	Pyrene	model/secondary	5.29e-13	2.68e-14
LPG Production	Ethylbenzene	secondary	4.80e-13	2.43e-14
US electric grid	o-xylene	model/secondary	3.80e-13	1.92e-14
US electric grid	Benzo[g,h,i]perylene	model/secondary	3.61e-13	1.83e-14
US electric grid	Benzo[a]pyrene	model/secondary	3.41e-13	1.73e-14
US electric grid	2-Methylnaphthalene	model/secondary	2.67e-13	1.35e-14
LPG Production	Methyl tert-butyl ether	secondary	2.41e-13	1.22e-14
US electric grid	5-Methyl chrysene	model/secondary	1.97e-13	1.00e-14
LPG Production	Phenanthrene	secondary	1.96e-13	9.91e-15
LPG Production	Styrene	secondary	1.76e-13	8.89e-15
LPG Production	Vinyl acetate	secondary	1.71e-13	8.68e-15
LPG Production	3-Methylcholanthrene	secondary	1.62e-13	8.19e-15
LPG Production	Zinc (+2)	secondary	1.01e-13	5.13e-15
US electric grid	Dibenzo[a,h]anthracene	model/secondary	8.75e-14	4.43e-15
LPG Production	Ethylene dibromide	secondary	6.93e-14	3.51e-15
LPG Production	1,1,1-Trichloroethane	secondary	6.53e-14	3.31e-15
LPG Production	2-Methylnaphthalene	secondary	5.18e-14	2.63e-15
LPG Production	Ethyl Chloride	secondary	4.63e-14	2.35e-15
LPG Production	Chlorine	secondary	4.59e-14	2.33e-15
LPG Production	Cumene	secondary	3.92e-14	1.98e-15
LPG Production	Acetophenone	secondary	2.44e-14	1.23e-15
LPG Production	Biphenyl	secondary	2.34e-14	1.18e-15
US electric grid	Anthracene	model/secondary	2.32e-14	1.17e-15
LPG Production	Acenaphthylene	secondary	1.85e-14	9.36e-16
LPG Production	Acenaphthene	secondary	1.54e-14	7.80e-16
LPG Production	Nickel cmpds	secondary	1.20e-14	6.07e-16
LPG Production	Benzo[a]anthracene	secondary	1.08e-14	5.46e-16
LPG Production	Chrysene	secondary	1.03e-14	5.24e-16
LPG Production	Lead cmpds	secondary	1.01e-14	5.10e-16
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	8.02e-15	4.06e-16
LPG Production	Benzo[b,j,k]fluoranthene	secondary	6.35e-15	3.22e-16
LPG Production	Mercury compounds	secondary	6.10e-15	3.09e-16
LPG Production	Benzo[a]pyrene	secondary	5.90e-15	2.99e-16
LPG Production	Fluorene	secondary	5.70e-15	2.89e-16

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	Pyrene	secondary	4.93e-15	2.50e-16
LPG Production	Benzo[g,h,i]perylene	secondary	4.79e-15	2.43e-16
LPG Production	Fluoranthene	secondary	4.65e-15	2.36e-16
LPG Production	HALON-1301	secondary	4.38e-15	2.22e-16
LPG Production	Benzo[b]fluoranthene	secondary	4.31e-15	2.18e-16
LPG Production	Dibenzo[a,h]anthracene	secondary	3.06e-15	1.55e-16
LPG Production	5-Methyl chrysene	secondary	1.27e-15	6.44e-17
LPG Production	Halogenated matter (organic)	secondary	1.01e-15	5.10e-17
US electric grid	2,3,7,8-TCDF	model/secondary	4.58e-16	2.32e-17
LPG Production	Anthracene	secondary	2.14e-16	1.09e-17
LPG Production	Halogenated hydrocarbons (unspecified)	secondary	2.52e-18	1.28e-19
Natural Gas Prod.	Halogenated hydrocarbons (unspecified)	secondary	-2.95e-18	-1.50e-19
CRT Incineration	Halogenated hydrocarbons (unspecified)	secondary	-4.35e-17	-2.20e-18
Fuel Oil #4 Prod.	Halogenated hydrocarbons (unspecified)	secondary	-7.15e-16	-3.62e-17
Natural Gas Prod.	Halogenated matter (organic)	secondary	-1.18e-15	-5.99e-17
Natural Gas Prod.	HALON-1301	secondary	-5.15e-15	-2.61e-16
Natural Gas Prod.	Mercury compounds	secondary	-7.16e-15	-3.63e-16
Natural Gas Prod.	Lead cmpds	secondary	-1.18e-14	-5.99e-16
Natural Gas Prod.	Nickel cmpds	secondary	-1.41e-14	-7.13e-16
CRT Incineration	Halogenated matter (organic)	secondary	-1.84e-14	-9.30e-16
Natural Gas Prod.	Anthracene	secondary	-4.79e-14	-2.43e-15
CRT Incineration	HALON-1301	secondary	-7.99e-14	-4.05e-15
Fuel Oil #4 Prod.	Anthracene	secondary	-8.41e-14	-4.26e-15
Natural Gas Prod.	5-Methyl chrysene	secondary	-1.28e-13	-6.49e-15
CRT Incineration	Nickel cmpds	secondary	-2.18e-13	-1.11e-14
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	-2.86e-13	-1.45e-14
CRT Incineration	Dibenzo[a,h]anthracene	secondary	-4.49e-13	-2.28e-14
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	-5.29e-13	-2.68e-14
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	-6.40e-13	-3.24e-14
CRT Incineration	Benzo[b]fluoranthene	secondary	-6.65e-13	-3.37e-14
Natural Gas Prod.	Fluoranthene	secondary	-7.34e-13	-3.72e-14
Natural Gas Prod.	Fluorene	secondary	-8.22e-13	-4.16e-14
Fuel Oil #4 Prod.	Dibenzo[a,h]anthracene	secondary	-1.04e-12	-5.28e-14
Natural Gas Prod.	Pyrene	secondary	-1.23e-12	-6.22e-14
Fuel Oil #4 Prod.	HALON-1301	secondary	-1.24e-12	-6.30e-14
Natural Gas Prod.	Copper (+1 & +2)	secondary	-1.33e-12	-6.73e-14
Natural Gas Prod.	Aromatic hydrocarbons	secondary	-1.42e-12	-7.19e-14
Natural Gas Prod.	Dibenzo[a,h]anthracene	secondary	-1.42e-12	-7.20e-14
Fuel Oil #4 Prod.	Benzo[b]fluoranthene	secondary	-1.48e-12	-7.50e-14
Natural Gas Prod.	Benzo[a]pyrene	secondary	-1.58e-12	-8.00e-14
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	-1.60e-12	-8.11e-14
Fuel Oil #4 Prod.	Mercury compounds	secondary	-1.73e-12	-8.77e-14
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	-1.74e-12	-8.81e-14
Fuel Oil #4 Prod.	Fluoranthene	secondary	-1.88e-12	-9.52e-14
Fuel Oil #4 Prod.	Pyrene	secondary	-1.91e-12	-9.70e-14
Natural Gas Prod.	Benzo[b]fluoranthene	secondary	-2.09e-12	-1.06e-13
Natural Gas Prod.	Acenaphthene	secondary	-2.26e-12	-1.14e-13
Fuel Oil #4 Prod.	Fluorene	secondary	-2.32e-12	-1.18e-13
Natural Gas Prod.	Biphenyl	secondary	-2.35e-12	-1.19e-13
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	-2.36e-12	-1.19e-13

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Acetophenone	secondary	-2.46e-12	-1.24e-13
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	-2.47e-12	-1.25e-13
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	-2.65e-12	-1.34e-13
Natural Gas Prod.	Chrysene	secondary	-2.71e-12	-1.37e-13
Natural Gas Prod.	Benzo[a]anthracene	secondary	-2.81e-12	-1.42e-13
Fuel Oil #4 Prod.	Lead cmpds	secondary	-2.86e-12	-1.45e-13
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	-3.00e-12	-1.52e-13
Fuel Oil #4 Prod.	Nickel cmpds	secondary	-3.40e-12	-1.72e-13
Natural Gas Prod.	Acenaphthylene	secondary	-3.51e-12	-1.78e-13
CRT Incineration	Anthracene	secondary	-3.73e-12	-1.89e-13
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	-3.93e-12	-1.99e-13
Natural Gas Prod.	Cumene	secondary	-3.95e-12	-2.00e-13
Fuel Oil #4 Prod.	Chrysene	secondary	-3.96e-12	-2.01e-13
Natural Gas Prod.	Ethyl Chloride	secondary	-4.66e-12	-2.36e-13
Fuel Oil #4 Prod.	Acenaphthene	secondary	-5.79e-12	-2.93e-13
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	-6.58e-12	-3.33e-13
Natural Gas Prod.	Ethylene dibromide	secondary	-6.98e-12	-3.54e-13
Natural Gas Prod.	Cadmium cmpds	secondary	-7.04e-12	-3.57e-13
Fuel Oil #4 Prod.	Acenaphthylene	secondary	-7.42e-12	-3.76e-13
CRT Incineration	2-Methylnaphthalene	secondary	-8.71e-12	-4.41e-13
Fuel Oil #4 Prod.	Biphenyl	secondary	-9.73e-12	-4.93e-13
Fuel Oil #4 Prod.	Acetophenone	secondary	-1.02e-11	-5.14e-13
Fuel Oil #4 Prod.	Chlorine	secondary	-1.58e-11	-7.99e-13
Fuel Oil #4 Prod.	Cumene	secondary	-1.63e-11	-8.26e-13
Natural Gas Prod.	Vinyl acetate	secondary	-1.73e-11	-8.75e-13
Natural Gas Prod.	Styrene	secondary	-1.77e-11	-8.96e-13
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	-1.81e-11	-9.19e-13
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	-1.93e-11	-9.77e-13
CRT Incineration	Chlorine	secondary	-1.94e-11	-9.81e-13
CRT Incineration	Copper (+1 & +2)	secondary	-2.06e-11	-1.04e-12
CRT Incineration	Aromatic hydrocarbons	secondary	-2.20e-11	-1.12e-12
CRT Incineration	Zinc (+2)	secondary	-2.24e-11	-1.13e-12
Natural Gas Prod.	Methyl tert-butyl ether	secondary	-2.42e-11	-1.23e-12
Natural Gas Prod.	2-Methylnaphthalene	secondary	-2.71e-11	-1.37e-12
CRT Incineration	3-Methylcholanthrene	secondary	-2.72e-11	-1.38e-12
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	-2.72e-11	-1.38e-12
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	-2.89e-11	-1.46e-12
Fuel Oil #4 Prod.	Zinc (+2)	secondary	-3.21e-11	-1.63e-12
CRT Incineration	5-Methyl chrysene	secondary	-3.27e-11	-1.66e-12
Natural Gas Prod.	Phenanthrene	secondary	-3.53e-11	-1.79e-12
CRT Incineration	Benzo[g,h,i]perylene	secondary	-4.06e-11	-2.06e-12
Natural Gas Prod.	Aluminum (elemental)	secondary	-4.26e-11	-2.16e-12
Natural Gas Prod.	Ethylbenzene	secondary	-4.85e-11	-2.45e-12
CRT Incineration	Dichlorobenzene (mixed isomers)	secondary	-4.90e-11	-2.48e-12
Fuel Oil #4 Prod.	3-Methylcholanthrene	secondary	-5.66e-11	-2.87e-12
CRT Incineration	Benzo[a]pyrene	secondary	-5.70e-11	-2.89e-12
Fuel Oil #4 Prod.	Vinyl acetate	secondary	-7.14e-11	-3.62e-12
Fuel Oil #4 Prod.	Styrene	secondary	-7.31e-11	-3.71e-12
CRT Incineration	Pyrene	secondary	-7.81e-11	-3.96e-12
Fuel Oil #4 Prod.	Phenanthrene	secondary	-7.87e-11	-3.99e-12

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Chromium (III)	secondary	-8.08e-11	-4.09e-12
Natural Gas Prod.	3-Methylcholanthrene	secondary	-8.46e-11	-4.29e-12
CRT Incineration	Indeno(1,2,3-cd)pyrene	secondary	-9.14e-11	-4.63e-12
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	-9.70e-11	-4.91e-12
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	-1.00e-10	-5.08e-12
CRT Incineration	Fluoranthene	secondary	-1.01e-10	-5.10e-12
CRT Incineration	Benzo[a]anthracene	secondary	-1.20e-10	-6.06e-12
Natural Gas Prod.	Chlorobenzene	secondary	-1.22e-10	-6.17e-12
CRT Incineration	Fluorene	secondary	-1.29e-10	-6.53e-12
Natural Gas Prod.	Dichloromethane	secondary	-1.46e-10	-7.38e-12
CRT Incineration	Chrysene	secondary	-1.49e-10	-7.57e-12
Natural Gas Prod.	Bromoform	secondary	-1.51e-10	-7.64e-12
Natural Gas Prod.	1,2-Dichloroethane	secondary	-1.54e-10	-7.80e-12
Natural Gas Prod.	Barium cmpds	secondary	-1.61e-10	-8.15e-12
CRT Incineration	Benzo[b,j,k]fluoranthene	secondary	-1.64e-10	-8.29e-12
Natural Gas Prod.	Methyl methacrylate	secondary	-1.85e-10	-9.36e-12
Natural Gas Prod.	Silicon	secondary	-1.86e-10	-9.43e-12
Fuel Oil #4 Prod.	Ethylbenzene	secondary	-1.99e-10	-1.01e-11
Natural Gas Prod.	Tetrachloroethylene	secondary	-2.13e-10	-1.08e-11
Natural Gas Prod.	Methyl ethyl ketone	secondary	-2.16e-10	-1.09e-11
Fuel Oil #4 Prod.	o-xylene	secondary	-2.16e-10	-1.10e-11
Natural Gas Prod.	Chlorine	secondary	-2.37e-10	-1.20e-11
CRT Incineration	Acenaphthene	secondary	-2.58e-10	-1.31e-11
Natural Gas Prod.	Zinc (+2)	secondary	-2.63e-10	-1.33e-11
Natural Gas Prod.	Isophorone	secondary	-2.68e-10	-1.36e-11
Natural Gas Prod.	Dimethyl sulfate	secondary	-2.79e-10	-1.42e-11
Fuel Oil #4 Prod.	Chromium (III)	secondary	-3.09e-10	-1.57e-11
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	-3.21e-10	-1.63e-11
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	-3.43e-10	-1.74e-11
CRT Incineration	Acenaphthylene	secondary	-3.72e-10	-1.89e-11
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	-4.01e-10	-2.03e-11
Fuel Oil #4 Prod.	Chlorobenzene	secondary	-5.04e-10	-2.55e-11
Natural Gas Prod.	Di(2-ethylhexyl)phthalate	secondary	-5.84e-10	-2.96e-11
CRT Incineration	Biphenyl	secondary	-6.02e-10	-3.05e-11
Fuel Oil #4 Prod.	Dichloromethane	secondary	-6.02e-10	-3.05e-11
Fuel Oil #4 Prod.	Bromoform	secondary	-6.24e-10	-3.16e-11
CRT Incineration	Acetophenone	secondary	-6.27e-10	-3.18e-11
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	-6.36e-10	-3.22e-11
Natural Gas Prod.	Cadmium	secondary	-7.04e-10	-3.56e-11
Natural Gas Prod.	Propionaldehyde	secondary	-7.60e-10	-3.85e-11
Natural Gas Prod.	Acetaldehyde	secondary	-7.60e-10	-3.85e-11
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	-7.64e-10	-3.87e-11
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	-8.79e-10	-4.46e-11
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	-8.93e-10	-4.53e-11
Natural Gas Prod.	Mercury	secondary	-9.44e-10	-4.78e-11
Natural Gas Prod.	Methyl hydrazine	secondary	-9.89e-10	-5.01e-11
CRT Incineration	Cumene	secondary	-1.01e-09	-5.11e-11
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	-1.08e-09	-5.47e-11
CRT Incineration	Aluminum (elemental)	secondary	-1.08e-09	-5.49e-11
Fuel Oil #4 Prod.	Isophorone	secondary	-1.11e-09	-5.61e-11

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	Dimethyl sulfate	secondary	-1.15e-09	-5.85e-11
CRT Incineration	Ethyl Chloride	secondary	-1.19e-09	-6.04e-11
Natural Gas Prod.	Cobalt	secondary	-1.32e-09	-6.71e-11
Natural Gas Prod.	Methyl chloride	secondary	-1.37e-09	-6.93e-11
Natural Gas Prod.	Beryllium	secondary	-1.40e-09	-7.11e-11
Natural Gas Prod.	Aluminum (+3)	secondary	-1.44e-09	-7.27e-11
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	-1.61e-09	-8.18e-11
CRT Incineration	1,1,1-Trichloroethane	secondary	-1.68e-09	-8.52e-11
Natural Gas Prod.	Acrolein	secondary	-1.69e-09	-8.55e-11
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	-1.70e-09	-8.62e-11
CRT Incineration	Ethylene dibromide	secondary	-1.78e-09	-9.04e-11
Fuel Oil #4 Prod.	Toluene	secondary	-2.04e-09	-1.03e-10
CRT Incineration	Xylene (mixed isomers)	secondary	-2.13e-09	-1.08e-10
Natural Gas Prod.	o-xylene	secondary	-2.31e-09	-1.17e-10
Fuel Oil #4 Prod.	Di(2-ethylhexyl)phthalate	secondary	-2.41e-09	-1.22e-10
Natural Gas Prod.	PM-10	secondary	-2.48e-09	-1.25e-10
Fuel Oil #4 Prod.	Cadmium	secondary	-2.87e-09	-1.45e-10
Fuel Oil #4 Prod.	Mercury	secondary	-3.11e-09	-1.57e-10
Fuel Oil #4 Prod.	Propionaldehyde	secondary	-3.14e-09	-1.59e-10
Fuel Oil #4 Prod.	Acetaldehyde	secondary	-3.14e-09	-1.59e-10
Natural Gas Prod.	Chloroform	secondary	-3.17e-09	-1.60e-10
CRT Incineration	Phenanthrene	secondary	-4.02e-09	-2.04e-10
Natural Gas Prod.	Benzyl chloride	secondary	-4.07e-09	-2.06e-10
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	-4.09e-09	-2.07e-10
Natural Gas Prod.	Toluene	secondary	-4.33e-09	-2.19e-10
CRT Incineration	Vinyl acetate	secondary	-4.41e-09	-2.23e-10
CRT Incineration	Styrene	secondary	-4.52e-09	-2.29e-10
CRT Incineration	Silicon	secondary	-4.73e-09	-2.40e-10
Fuel Oil #4 Prod.	Beryllium	secondary	-5.02e-09	-2.54e-10
Natural Gas Prod.	Carbon disulfide	secondary	-5.20e-09	-2.63e-10
Fuel Oil #4 Prod.	Methyl chloride	secondary	-5.65e-09	-2.86e-10
CRT Incineration	Methyl tert-butyl ether	secondary	-6.19e-09	-3.14e-10
Fuel Oil #4 Prod.	Acrolein	secondary	-6.98e-09	-3.53e-10
Natural Gas Prod.	Phenol	secondary	-7.32e-09	-3.71e-10
Natural Gas Prod.	Nitrate	secondary	-7.54e-09	-3.82e-10
Fuel Oil #4 Prod.	Cobalt	secondary	-9.27e-09	-4.69e-10
CRT Incineration	Chloroacetophenone	secondary	-1.04e-08	-5.27e-10
Natural Gas Prod.	Lead	secondary	-1.09e-08	-5.50e-10
CRT Incineration	Ethylbenzene	secondary	-1.18e-08	-5.97e-10
Fuel Oil #4 Prod.	Chloroform	secondary	-1.31e-08	-6.63e-10
Natural Gas Prod.	Cyanide (-1)	secondary	-1.45e-08	-7.37e-10
Fuel Oil #4 Prod.	Aluminum (elemental)	secondary	-1.61e-08	-8.15e-10
Fuel Oil #4 Prod.	Benzyl chloride	secondary	-1.68e-08	-8.53e-10
CRT Incineration	Chromium (III)	secondary	-1.69e-08	-8.58e-10
Natural Gas Prod.	Manganese	secondary	-1.98e-08	-1.00e-09
Fuel Oil #4 Prod.	Carbon disulfide	secondary	-2.15e-08	-1.09e-09
CRT Incineration	Aluminum (+3)	secondary	-2.23e-08	-1.13e-09
CRT Incineration	2,4-Dinitrotoluene	secondary	-2.48e-08	-1.25e-09
Natural Gas Prod.	Copper	secondary	-2.65e-08	-1.34e-09
Natural Gas Prod.	Bromomethane	secondary	-2.77e-08	-1.40e-09

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	2-Chloroacetophenone	secondary	-2.80e-08	-1.42e-09
Natural Gas Prod.	Barium	secondary	-2.96e-08	-1.50e-09
CRT Incineration	Chlorobenzene	secondary	-3.11e-08	-1.58e-09
Natural Gas Prod.	Hydrogen sulfide	secondary	-3.37e-08	-1.71e-09
CRT Incineration	Dichloromethane	secondary	-3.70e-08	-1.87e-09
CRT Incineration	1,2-Dichloroethane	secondary	-3.83e-08	-1.94e-09
CRT Incineration	Bromoform	secondary	-3.85e-08	-1.95e-09
Fuel Oil #4 Prod.	Barium cmpds	secondary	-3.89e-08	-1.97e-09
Fuel Oil #4 Prod.	Lead	secondary	-4.45e-08	-2.25e-09
CRT Incineration	Methyl methacrylate	secondary	-4.72e-08	-2.39e-09
Natural Gas Prod.	Chromium (VI)	secondary	-4.74e-08	-2.40e-09
CRT Incineration	Dimethylbenzanthracene	secondary	-4.82e-08	-2.44e-09
CRT Incineration	Tetrachloroethylene	secondary	-5.31e-08	-2.69e-09
Fuel Oil #4 Prod.	Barium	secondary	-5.46e-08	-2.77e-09
CRT Incineration	Methyl ethyl ketone	secondary	-5.52e-08	-2.80e-09
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	-6.02e-08	-3.05e-09
CRT Incineration	Cadmium	secondary	-6.06e-08	-3.07e-09
Natural Gas Prod.	Nickel	secondary	-6.16e-08	-3.12e-09
CRT Incineration	PM-10	secondary	-6.30e-08	-3.19e-09
Natural Gas Prod.	Naphthalene	secondary	-6.53e-08	-3.31e-09
CRT Incineration	Toluene	secondary	-6.65e-08	-3.37e-09
CRT Incineration	Isophorone	secondary	-6.84e-08	-3.47e-09
Fuel Oil #4 Prod.	Silicon	secondary	-7.03e-08	-3.56e-09
CRT Incineration	Dimethyl sulfate	secondary	-7.14e-08	-3.62e-09
Fuel Oil #4 Prod.	Manganese	secondary	-8.00e-08	-4.05e-09
Fuel Oil #4 Prod.	Naphthalene	secondary	-8.01e-08	-4.06e-09
Fuel Oil #4 Prod.	Dimethylbenzanthracene	secondary	-9.64e-08	-4.88e-09
CRT Incineration	Mercury	secondary	-1.12e-07	-5.66e-09
Fuel Oil #4 Prod.	Bromomethane	secondary	-1.15e-07	-5.80e-09
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	-1.16e-07	-5.86e-09
CRT Incineration	Phenol	secondary	-1.17e-07	-5.94e-09
Fuel Oil #4 Prod.	Copper	secondary	-1.34e-07	-6.79e-09
Natural Gas Prod.	Dimethylbenzanthracene	secondary	-1.44e-07	-7.30e-09
CRT Incineration	Di(2-ethylhexyl)phthalate	secondary	-1.49e-07	-7.55e-09
Fuel Oil #4 Prod.	Nitrate	secondary	-1.58e-07	-7.99e-09
Fuel Oil #4 Prod.	Chromium (VI)	secondary	-1.82e-07	-9.21e-09
CRT Incineration	Cobalt	secondary	-1.92e-07	-9.71e-09
CRT Incineration	Acetaldehyde	secondary	-1.94e-07	-9.83e-09
CRT Incineration	Propionaldehyde	secondary	-1.94e-07	-9.83e-09
Natural Gas Prod.	Antimony	secondary	-2.23e-07	-1.13e-08
CRT Incineration	Methyl hydrazine	secondary	-2.53e-07	-1.28e-08
CRT Incineration	Beryllium	secondary	-3.00e-07	-1.52e-08
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	-3.47e-07	-1.76e-08
CRT Incineration	Methyl chloride	secondary	-3.49e-07	-1.77e-08
CRT Incineration	Copper	secondary	-4.12e-07	-2.09e-08
CRT Incineration	Acrolein	secondary	-4.31e-07	-2.18e-08
CRT Incineration	Hydrogen sulfide	secondary	-6.11e-07	-3.10e-08
Fuel Oil #4 Prod.	Antimony	secondary	-6.37e-07	-3.23e-08
CRT Incineration	Hexane	secondary	-7.53e-07	-3.81e-08
CRT Incineration	Chloroform	secondary	-7.95e-07	-4.03e-08

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Hydrofluoric acid	secondary	-8.74e-07	-4.43e-08
Natural Gas Prod.	Phosphorus (yellow or white)	secondary	-8.87e-07	-4.49e-08
Fuel Oil #4 Prod.	PM-10	secondary	-9.35e-07	-4.74e-08
CRT Incineration	Pentane	secondary	-9.44e-07	-4.78e-08
CRT Incineration	Benzyl chloride	secondary	-1.04e-06	-5.27e-08
CRT Incineration	Ethane	secondary	-1.13e-06	-5.70e-08
Fuel Oil #4 Prod.	Nickel	secondary	-1.16e-06	-5.87e-08
Natural Gas Prod.	Molybdenum	secondary	-1.16e-06	-5.87e-08
CRT Incineration	Barium	secondary	-1.31e-06	-6.66e-08
CRT Incineration	Carbon disulfide	secondary	-1.33e-06	-6.73e-08
Fuel Oil #4 Prod.	Hexane	secondary	-1.36e-06	-6.90e-08
Fuel Oil #4 Prod.	Phenol	secondary	-1.75e-06	-8.88e-08
CRT Incineration	Nitrate	secondary	-1.80e-06	-9.11e-08
Fuel Oil #4 Prod.	Pentane	secondary	-1.97e-06	-9.96e-08
CRT Incineration	Naphthalene	secondary	-2.03e-06	-1.03e-07
Natural Gas Prod.	Hexane	secondary	-2.03e-06	-1.03e-07
Fuel Oil #4 Prod.	Ethane	secondary	-2.34e-06	-1.19e-07
Natural Gas Prod.	Pentane	secondary	-2.94e-06	-1.49e-07
Natural Gas Prod.	Ethane	secondary	-3.50e-06	-1.77e-07
Fuel Oil #4 Prod.	Zinc (elemental)	secondary	-3.56e-06	-1.80e-07
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	-3.61e-06	-1.83e-07
CRT Incineration	Cyanide (-1)	secondary	-3.72e-06	-1.88e-07
Natural Gas Prod.	Zinc (elemental)	secondary	-4.26e-06	-2.16e-07
CRT Incineration	Manganese	secondary	-4.89e-06	-2.48e-07
Natural Gas Prod.	Nitrous oxide	secondary	-5.79e-06	-2.93e-07
Natural Gas Prod.	Selenium	secondary	-6.09e-06	-3.08e-07
Fuel Oil #4 Prod.	Molybdenum	secondary	-6.48e-06	-3.28e-07
Natural Gas Prod.	Fluorides (F-)	secondary	-6.78e-06	-3.44e-07
CRT Incineration	Bromomethane	secondary	-7.08e-06	-3.59e-07
CRT Incineration	Nickel	secondary	-9.71e-06	-4.92e-07
CRT Incineration	Chromium (VI)	secondary	-9.94e-06	-5.04e-07
CRT Incineration	Molybdenum	secondary	-9.95e-06	-5.04e-07
Fuel Oil #4 Prod.	Ammonia	secondary	-1.10e-05	-5.57e-07
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	-1.27e-05	-6.45e-07
Natural Gas Prod.	Formaldehyde	secondary	-1.39e-05	-7.04e-07
CRT Incineration	Antimony	secondary	-2.16e-05	-1.09e-06
CRT Incineration	Zinc (elemental)	secondary	-2.54e-05	-1.29e-06
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	-2.64e-05	-1.34e-06
Fuel Oil #4 Prod.	Selenium	secondary	-2.69e-05	-1.36e-06
Natural Gas Prod.	Hydrochloric acid	secondary	-3.20e-05	-1.62e-06
Natural Gas Prod.	Vanadium	secondary	-3.49e-05	-1.77e-06
Fuel Oil #4 Prod.	Phosphorus (yellow or white)	secondary	-3.98e-05	-2.02e-06
CRT Incineration	Ammonia	secondary	-4.51e-05	-2.28e-06
CRT Incineration	Phosphorus (yellow or white)	secondary	-5.50e-05	-2.78e-06
Fuel Oil #4 Prod.	Nitrous oxide	secondary	-6.18e-05	-3.13e-06
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	-1.32e-04	-6.70e-06
Natural Gas Prod.	Ammonia	secondary	-1.35e-04	-6.83e-06
Natural Gas Prod.	Sulfur oxides	secondary	-1.38e-04	-7.00e-06
Natural Gas Prod.	Arsenic	secondary	-1.58e-04	-7.99e-06
Natural Gas Prod.	PM	secondary	-2.08e-04	-1.05e-05

Table M-39. CRT LCIA Results for the Terrestrial Toxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
CRT Incineration	Hydrofluoric acid	secondary	-2.23e-04	-1.13e-05
Fuel Oil #4 Prod.	PM	secondary	-4.35e-04	-2.20e-05
CRT Incineration	Formaldehyde	secondary	-4.47e-04	-2.26e-05
Fuel Oil #4 Prod.	Formaldehyde	secondary	-5.52e-04	-2.80e-05
Fuel Oil #4 Prod.	Arsenic	secondary	-7.57e-04	-3.83e-05
CRT Incineration	Nitrous oxide	secondary	-1.04e-03	-5.27e-05
CRT Incineration	Vanadium	secondary	-1.17e-03	-5.94e-05
CRT Incineration	Selenium	secondary	-1.53e-03	-7.76e-05
CRT Incineration	Fluorides (F-)	secondary	-1.56e-03	-7.91e-05
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	-1.93e-03	-9.77e-05
Fuel Oil #4 Prod.	Benzene	secondary	-2.59e-03	-1.31e-04
Fuel Oil #4 Prod.	Sulfur oxides	secondary	-2.63e-03	-1.33e-04
Fuel Oil #4 Prod.	Methane	secondary	-2.80e-03	-1.42e-04
CRT Incineration	Benzene	secondary	-3.18e-03	-1.61e-04
Fuel Oil #4 Prod.	Vanadium	secondary	-4.33e-03	-2.19e-04
CRT Incineration	Hydrochloric acid	secondary	-4.66e-03	-2.36e-04
Natural Gas Prod.	Nitrogen oxides	secondary	-4.68e-03	-2.37e-04
CRT Incineration	Nitrogen oxides	secondary	-1.25e-02	-6.36e-04
CRT Incineration	Carbon monoxide	secondary	-1.44e-02	-7.31e-04
Fuel Oil #4 Prod.	Carbon monoxide	secondary	-1.51e-02	-7.64e-04
CRT Incineration	Methane	secondary	-1.52e-02	-7.68e-04
CRT Incineration	PM	secondary	-1.83e-02	-9.29e-04
Natural Gas Prod.	Methane	secondary	-2.52e-02	-1.27e-03
CRT Incineration	Sulfur oxides	secondary	-2.70e-02	-1.37e-03
Natural Gas Prod.	Carbon monoxide	secondary	-3.19e-02	-1.62e-03
Natural Gas Prod.	Benzene	secondary	-3.79e-02	-1.92e-03
CRT Incineration	Arsenic	secondary	-3.84e-02	-1.95e-03
Total End-of-life			**2.88e-01**	**1.46e-02**
Total All Life-cycle Stages			**1.97e+03**	**1.00e+02**

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Materials Processing Life-cycle Stage				
Steel Prod., cold-rolled, semi-finished	Sulfur dioxide	secondary	1.24e+01	1.39e+00
PMMA Sheet Prod.	Sulfur dioxide	secondary	8.61e+00	9.63e-01
Natural Gas Prod.	Benzene	secondary	5.28e+00	5.91e-01
Aluminum Prod.	Sulfur dioxide	secondary	5.13e+00	5.74e-01
Natural Gas Prod.	Carbon monoxide	secondary	4.44e+00	4.97e-01
Polycarbonate Production	Sulfur dioxide	secondary	4.43e+00	4.95e-01
Natural Gas Prod.	Methane	secondary	3.50e+00	3.92e-01
Natural Gas Prod.	Nitrogen oxides	secondary	6.51e-01	7.28e-02
Aluminum Prod.	Titanium tetrachloride	secondary	2.68e-01	3.00e-02
Steel Prod., cold-rolled, semi-finished	Carbon monoxide	secondary	1.36e-01	1.52e-02
Aluminum Prod.	Manganese cmpds	secondary	6.03e-02	6.74e-03
Steel Prod., cold-rolled, semi-finished	PM	secondary	5.14e-02	5.75e-03
Aluminum Prod.	Vanadium	secondary	4.00e-02	4.47e-03
Natural Gas Prod.	PM	secondary	2.89e-02	3.23e-03
PET Resin Production	Carbon monoxide	secondary	2.61e-02	2.92e-03
Steel Prod., cold-rolled, semi-finished	Vanadium	secondary	2.53e-02	2.82e-03
PMMA Sheet Prod.	Carbon monoxide	secondary	2.35e-02	2.62e-03
Polycarbonate Production	Carbon monoxide	secondary	2.32e-02	2.59e-03
Natural Gas Prod.	Arsenic	secondary	2.20e-02	2.46e-03
Natural Gas Prod.	Sulfur oxides	secondary	1.93e-02	2.15e-03
Natural Gas Prod.	Ammonia	secondary	1.88e-02	2.10e-03
Aluminum Prod.	Arsenic cmpds	secondary	1.77e-02	1.98e-03
PMMA Sheet Prod.	Methane	secondary	1.15e-02	1.29e-03
Polycarbonate Production	Methane	secondary	1.13e-02	1.27e-03
Polycarbonate Production	Nitrogen dioxide	secondary	1.08e-02	1.21e-03
PMMA Sheet Prod.	Nitrogen dioxide	secondary	1.07e-02	1.20e-03
Steel Prod., cold-rolled, semi-finished	Fluorides (F-)	secondary	9.36e-03	1.05e-03
Steel Prod., cold-rolled, semi-finished	Manganese cmpds	secondary	7.30e-03	8.17e-04
Styrene-butadiene Copolymer Prod.	Carbon monoxide	secondary	7.00e-03	7.83e-04
Steel Prod., cold-rolled, semi-finished	Nitrogen dioxide	secondary	6.86e-03	7.67e-04
Aluminum Prod.	Carbon monoxide	secondary	6.42e-03	7.18e-04
Steel Prod., cold-rolled, semi-finished	Methane	secondary	5.34e-03	5.97e-04
Natural Gas Prod.	Vanadium	secondary	4.86e-03	5.44e-04
Natural Gas Prod.	Hydrochloric acid	secondary	4.46e-03	4.99e-04
PET Resin Production	Sulfur oxides	secondary	3.99e-03	4.47e-04
Aluminum Prod.	Barium cmpds	secondary	3.89e-03	4.35e-04
Polycarbonate Production	PM	secondary	3.61e-03	4.04e-04
Aluminum Prod.	PM	secondary	3.31e-03	3.71e-04
PMMA Sheet Prod.	PM	secondary	3.22e-03	3.60e-04
Styrene-butadiene Copolymer Prod.	Nitrogen oxides	secondary	3.06e-03	3.42e-04
Styrene-butadiene Copolymer Prod.	Methane	secondary	3.00e-03	3.36e-04
Aluminum Prod.	Methane	secondary	3.00e-03	3.35e-04
Aluminum Prod.	Nitrogen dioxide	secondary	2.66e-03	2.97e-04
Styrene-butadiene Copolymer Prod.	Sulfur oxides	secondary	2.50e-03	2.79e-04
Aluminum Prod.	Selenium	secondary	2.34e-03	2.62e-04
Steel Prod., cold-rolled, semi-finished	Arsenic	secondary	2.22e-03	2.48e-04
Steel Prod., cold-rolled, semi-finished	Phosphorus (yellow or white)	secondary	1.99e-03	2.23e-04
Natural Gas Prod.	Formaldehyde	secondary	1.93e-03	2.16e-04
PET Resin Production	Nitrogen oxides	secondary	1.72e-03	1.93e-04

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
PMMA Sheet Prod.	Ammonia	secondary	1.04e-03	1.16e-04
Steel Prod., cold-rolled, semi-finished	Hydrochloric acid	secondary	1.00e-03	1.12e-04
PET Resin Production	Methane	secondary	9.98e-04	1.12e-04
Natural Gas Prod.	Fluorides (F-)	secondary	9.45e-04	1.06e-04
Steel Prod., cold-rolled, semi-finished	Benzene	secondary	8.62e-04	9.64e-05
Steel Prod., cold-rolled, semi-finished	Barium cmpds	secondary	8.49e-04	9.49e-05
Natural Gas Prod.	Selenium	secondary	8.48e-04	9.48e-05
Natural Gas Prod.	Nitrous oxide	secondary	8.07e-04	9.02e-05
Steel Prod., cold-rolled, semi-finished	Arsenic cmpds	secondary	7.53e-04	8.42e-05
PET Resin Production	PM	secondary	6.99e-04	7.82e-05
Aluminum Prod.	Hydrochloric acid	secondary	6.64e-04	7.43e-05
Natural Gas Prod.	Zinc (elemental)	secondary	5.94e-04	6.64e-05
Aluminum Prod.	Aluminum (+3)	secondary	5.91e-04	6.61e-05
PMMA Sheet Prod.	Nitrates/nitrites	secondary	5.70e-04	6.38e-05
Natural Gas Prod.	Ethane	secondary	4.88e-04	5.46e-05
Aluminum Prod.	Cadmium cmpds	secondary	4.36e-04	4.88e-05
Styrene-butadiene Copolymer Prod.	PM	secondary	4.34e-04	4.85e-05
Natural Gas Prod.	Pentane	secondary	4.09e-04	4.58e-05
Steel Prod., cold-rolled, semi-finished	Titanium tetrachloride	secondary	4.08e-04	4.56e-05
Steel Prod., cold-rolled, semi-finished	Ammonia	secondary	3.91e-04	4.38e-05
Steel Prod., cold-rolled, semi-finished	Nitrous oxide	secondary	3.81e-04	4.26e-05
PMMA Sheet Prod.	Hydrogen cyanide	secondary	3.73e-04	4.17e-05
PMMA Sheet Prod.	Hydrochloric acid	secondary	2.99e-04	3.34e-05
Natural Gas Prod.	Hexane	secondary	2.83e-04	3.17e-05
Polycarbonate Production	Hydrochloric acid	secondary	2.60e-04	2.91e-05
Steel Prod., cold-rolled, semi-finished	Silicon	secondary	2.48e-04	2.77e-05
Aluminum Prod.	Benzene	secondary	2.12e-04	2.37e-05
Steel Prod., cold-rolled, semi-finished	Formaldehyde	secondary	2.03e-04	2.27e-05
Polycarbonate Production	Sulfuric acid	secondary	1.77e-04	1.98e-05
Aluminum Prod.	Barium sulfate	secondary	1.69e-04	1.89e-05
Natural Gas Prod.	Molybdenum	secondary	1.61e-04	1.81e-05
Steel Prod., cold-rolled, semi-finished	Titanium	secondary	1.60e-04	1.79e-05
Steel Prod., cold-rolled, semi-finished	Selenium	secondary	1.47e-04	1.64e-05
PET Resin Production	Hydrochloric acid	secondary	1.45e-04	1.63e-05
Polycarbonate Production	Mercury compounds	secondary	1.36e-04	1.52e-05
PMMA Sheet Prod.	Sulfuric acid	secondary	1.32e-04	1.47e-05
Natural Gas Prod.	Phosphorus (yellow or white)	secondary	1.24e-04	1.38e-05
Natural Gas Prod.	Hydrofluoric acid	secondary	1.22e-04	1.36e-05
Steel Prod., cold-rolled, semi-finished	Ethane	secondary	1.20e-04	1.35e-05
Steel Prod., cold-rolled, semi-finished	Zinc (elemental)	secondary	1.06e-04	1.19e-05
PMMA Sheet Prod.	Mercury compounds	secondary	1.01e-04	1.13e-05
Steel Prod., cold-rolled, semi-finished	Molybdenum	secondary	9.20e-05	1.03e-05
Aluminum Prod.	Hydrofluoric acid	secondary	8.95e-05	1.00e-05
Aluminum Prod.	Zinc (elemental)	secondary	8.55e-05	9.56e-06
Aluminum Prod.	Titanium	secondary	8.47e-05	9.48e-06
Aluminum Prod.	Copper (+1 & +2)	secondary	6.70e-05	7.50e-06
PET Resin Production	Sulfuric acid	secondary	6.23e-05	6.97e-06
Styrene-butadiene Copolymer Prod.	Sulfuric acid	secondary	6.21e-05	6.95e-06
Steel Prod., cold-rolled, semi-finished	Barium	secondary	6.03e-05	6.74e-06

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Aluminum Prod.	Nitrous oxide	secondary	5.14e-05	5.75e-06
Polycarbonate Production	Fluorides (F-)	secondary	5.11e-05	5.72e-06
Steel Prod., cold-rolled, semi-finished	Tin (Sn++, Sn4+)	secondary	5.11e-05	5.71e-06
Aluminum Prod.	Perfluoromethane	secondary	4.83e-05	5.40e-06
Styrene-butadiene Copolymer Prod.	Mercury compounds	secondary	4.76e-05	5.32e-06
Steel Prod., cold-rolled, semi-finished	Antimony	secondary	4.66e-05	5.21e-06
Polycarbonate Production	Aromatic hydrocarbons	secondary	4.59e-05	5.13e-06
Aluminum Prod.	Silicon	secondary	4.07e-05	4.55e-06
PMMA Sheet Prod.	Fluorine	secondary	3.80e-05	4.25e-06
Natural Gas Prod.	Antimony	secondary	3.10e-05	3.47e-06
Steel Prod., cold-rolled, semi-finished	Silver compounds	secondary	3.03e-05	3.38e-06
Styrene-butadiene Copolymer Prod.	Hydrochloric acid	secondary	2.98e-05	3.33e-06
Styrene-butadiene Copolymer Prod.	Aromatic hydrocarbons	secondary	2.97e-05	3.32e-06
Steel Prod., cold-rolled, semi-finished	Nitrates/nitrites	secondary	2.45e-05	2.74e-06
Steel Prod., cold-rolled, semi-finished	Boron	secondary	2.41e-05	2.70e-06
Steel Prod., cold-rolled, semi-finished	Mercury compounds	secondary	2.22e-05	2.48e-06
Natural Gas Prod.	Dimethylbenzanthracene	secondary	2.01e-05	2.24e-06
PET Resin Production	Fluorine	secondary	1.80e-05	2.01e-06
Styrene-butadiene Copolymer Prod.	Fluorides (F-)	secondary	1.79e-05	2.01e-06
Aluminum Prod.	Nitrate	secondary	1.70e-05	1.90e-06
Steel Prod., cold-rolled, semi-finished	Barium sulfate	secondary	1.68e-05	1.88e-06
Aluminum Prod.	Barium	secondary	1.46e-05	1.63e-06
Steel Prod., cold-rolled, semi-finished	Cadmium cmpds	secondary	1.32e-05	1.48e-06
Steel Prod., cold-rolled, semi-finished	Aluminum (elemental)	secondary	1.21e-05	1.35e-06
Steel Prod., cold-rolled, semi-finished	Acetylene	secondary	1.14e-05	1.28e-06
Steel Prod., cold-rolled, semi-finished	Hydrofluoric acid	secondary	9.28e-06	1.04e-06
Natural Gas Prod.	Naphthalene	secondary	9.09e-06	1.02e-06
Aluminum Prod.	Copper	secondary	8.87e-06	9.92e-07
Natural Gas Prod.	Nickel	secondary	8.58e-06	9.60e-07
Steel Prod., cold-rolled, semi-finished	Pentane	secondary	8.31e-06	9.29e-07
Steel Prod., cold-rolled, semi-finished	Aluminum (+3)	secondary	7.72e-06	8.64e-07
Aluminum Prod.	Nickel cmpds	secondary	7.09e-06	7.93e-07
Steel Prod., cold-rolled, semi-finished	Hydrogen sulfide	secondary	6.66e-06	7.45e-07
Aluminum Prod.	Nickel	secondary	6.62e-06	7.40e-07
Natural Gas Prod.	Chromium (VI)	secondary	6.61e-06	7.39e-07
Aluminum Prod.	Zinc (+2)	secondary	6.49e-06	7.25e-07
Steel Prod., cold-rolled, semi-finished	Copper	secondary	5.99e-06	6.70e-07
Polycarbonate Production	Copper (+1 & +2)	secondary	5.79e-06	6.48e-07
Aluminum Prod.	Ammonia	secondary	5.76e-06	6.44e-07
Aluminum Prod.	Aromatic hydrocarbons	secondary	5.27e-06	5.89e-07
Polycarbonate Production	Phenol	secondary	5.22e-06	5.83e-07
Aluminum Prod.	Nitrites	secondary	5.03e-06	5.63e-07
Natural Gas Prod.	Hydrogen sulfide	secondary	4.70e-06	5.26e-07
PMMA Sheet Prod.	Copper (+1 & +2)	secondary	4.31e-06	4.81e-07
Steel Prod., cold-rolled, semi-finished	Copper (+1 & +2)	secondary	4.21e-06	4.71e-07
Natural Gas Prod.	Barium	secondary	4.12e-06	4.61e-07
Steel Prod., cold-rolled, semi-finished	Nickel	secondary	3.99e-06	4.46e-07
Aluminum Prod.	Aluminum (elemental)	secondary	3.92e-06	4.38e-07
Natural Gas Prod.	2-Chloroacetophenone	secondary	3.90e-06	4.36e-07
Natural Gas Prod.	Bromomethane	secondary	3.86e-06	4.32e-07

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
PMMA Sheet Prod.	Cyanide (-1)	secondary	3.83e-06	4.29e-07
Aluminum Prod.	Strontium (Sr II)	secondary	3.72e-06	4.16e-07
Natural Gas Prod.	Copper	secondary	3.69e-06	4.12e-07
Steel Prod., cold-rolled, semi-finished	Aromatic hydrocarbons	secondary	3.51e-06	3.93e-07
PMMA Sheet Prod.	Hydrofluoric acid	secondary	3.45e-06	3.86e-07
Aluminum Prod.	Fluoride	secondary	3.39e-06	3.79e-07
Aluminum Prod.	Lead cmpds	secondary	3.25e-06	3.63e-07
Aluminum Prod.	Vanadium (V3+, V5+)	secondary	3.03e-06	3.39e-07
Natural Gas Prod.	Manganese	secondary	2.76e-06	3.09e-07
Steel Prod., cold-rolled, semi-finished	Strontium (Sr II)	secondary	2.29e-06	2.56e-07
Steel Prod., cold-rolled, semi-finished	Hexane	secondary	2.17e-06	2.43e-07
Polycarbonate Production	Ammonia	secondary	2.07e-06	2.31e-07
Polycarbonate Production	Hydrofluoric acid	secondary	2.06e-06	2.31e-07
PET Resin Production	Copper (+1 & +2)	secondary	2.04e-06	2.28e-07
Styrene-butadiene Copolymer Prod.	Copper (+1 & +2)	secondary	2.03e-06	2.27e-07
Natural Gas Prod.	Cyanide (-1)	secondary	2.03e-06	2.27e-07
Aluminum Prod.	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	1.84e-06	2.06e-07
PMMA Sheet Prod.	Phenol	secondary	1.75e-06	1.96e-07
Steel Prod., cold-rolled, semi-finished	Chromium (VI)	secondary	1.62e-06	1.81e-07
PMMA Sheet Prod.	Hydrogen sulfide	secondary	1.53e-06	1.72e-07
Natural Gas Prod.	Lead	secondary	1.51e-06	1.69e-07
Aluminum Prod.	Hydrogen sulfide	secondary	1.40e-06	1.57e-07
Styrene-butadiene Copolymer Prod.	Nitrate	secondary	1.27e-06	1.42e-07
Steel Prod., cold-rolled, semi-finished	Boric acid	secondary	1.06e-06	1.19e-07
Natural Gas Prod.	Nitrate	secondary	1.05e-06	1.18e-07
Polycarbonate Production	Halogenated hydrocarbons (unspecified)	secondary	1.03e-06	1.15e-07
Polycarbonate Production	Hydrogen sulfide	secondary	1.03e-06	1.15e-07
Natural Gas Prod.	Phenol	secondary	1.02e-06	1.14e-07
Steel Prod., cold-rolled, semi-finished	Bromine	secondary	9.94e-07	1.11e-07
PET Resin Production	Hydrofluoric acid	secondary	9.08e-07	1.01e-07
Steel Prod., cold-rolled, semi-finished	Uranium	secondary	8.25e-07	9.23e-08
PMMA Sheet Prod.	Aromatic hydrocarbons	secondary	7.67e-07	8.58e-08
Steel Prod., cold-rolled, semi-finished	Toluene	secondary	7.44e-07	8.32e-08
Natural Gas Prod.	Carbon disulfide	secondary	7.24e-07	8.10e-08
Aluminum Prod.	Toluene	secondary	6.75e-07	7.55e-08
Natural Gas Prod.	Toluene	secondary	6.03e-07	6.74e-08
Steel Prod., cold-rolled, semi-finished	Ethylene	secondary	6.02e-07	6.73e-08
Steel Prod., cold-rolled, semi-finished	Cyanide (-1)	secondary	5.92e-07	6.62e-08
Steel Prod., cold-rolled, semi-finished	Methanol	secondary	5.84e-07	6.54e-08
Natural Gas Prod.	Benzyl chloride	secondary	5.67e-07	6.35e-08
Steel Prod., cold-rolled, semi-finished	Xylene (mixed isomers)	secondary	5.50e-07	6.15e-08
Steel Prod., cold-rolled, semi-finished	Lead	secondary	5.40e-07	6.04e-08
Steel Prod., cold-rolled, semi-finished	Naphthalene	secondary	5.39e-07	6.02e-08
Polycarbonate Production	Chlorine	secondary	5.16e-07	5.77e-08
Aluminum Prod.	Xylene (mixed isomers)	secondary	5.13e-07	5.73e-08
Steel Prod., cold-rolled, semi-finished	Phenol	secondary	4.75e-07	5.31e-08
Steel Prod., cold-rolled, semi-finished	Heptane	secondary	4.57e-07	5.12e-08
PMMA Sheet Prod.	Nickel cmpds	secondary	4.56e-07	5.10e-08

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Aluminum Prod.	Lead	secondary	4.47e-07	5.00e-08
Natural Gas Prod.	Chloroform	secondary	4.41e-07	4.93e-08
Steel Prod., cold-rolled, semi-finished	Lead cmpds	secondary	4.33e-07	4.84e-08
PMMA Sheet Prod.	Chlorine	secondary	3.83e-07	4.29e-08
Styrene-butadiene Copolymer Prod.	Aluminum (+3)	secondary	3.62e-07	4.05e-08
Natural Gas Prod.	PM-10	secondary	3.45e-07	3.86e-08
Aluminum Prod.	Chromium (VI)	secondary	3.31e-07	3.71e-08
Natural Gas Prod.	o-xylene	secondary	3.21e-07	3.59e-08
Steel Prod., cold-rolled, semi-finished	Nickel cmpds	secondary	2.92e-07	3.26e-08
Steel Prod., cold-rolled, semi-finished	Zinc (+2)	secondary	2.60e-07	2.91e-08
Polycarbonate Production	Aluminum (+3)	secondary	2.58e-07	2.88e-08
Polycarbonate Production	Ethanethiol	secondary	2.58e-07	2.88e-08
Polycarbonate Production	Lead	secondary	2.58e-07	2.88e-08
Polycarbonate Production	Mercury	secondary	2.58e-07	2.88e-08
Polycarbonate Production	Nickel (+2)	secondary	2.58e-07	2.88e-08
Polycarbonate Production	Nitrate	secondary	2.58e-07	2.88e-08
Polycarbonate Production	Nitrous oxide	secondary	2.58e-07	2.88e-08
Polycarbonate Production	Zinc (+2)	secondary	2.58e-07	2.88e-08
Aluminum Prod.	Phenol	secondary	2.38e-07	2.66e-08
Natural Gas Prod.	Acrolein	secondary	2.35e-07	2.63e-08
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	2.25e-07	2.51e-08
Styrene-butadiene Copolymer Prod.	Phenol	secondary	2.15e-07	2.41e-08
Natural Gas Prod.	Aluminum (+3)	secondary	2.00e-07	2.24e-08
Steel Prod., cold-rolled, semi-finished	Cobalt	secondary	1.98e-07	2.22e-08
PET Resin Production	Phenol	secondary	1.98e-07	2.21e-08
Natural Gas Prod.	Beryllium	secondary	1.95e-07	2.19e-08
PMMA Sheet Prod.	Aluminum (+3)	secondary	1.92e-07	2.14e-08
PMMA Sheet Prod.	Ethanethiol	secondary	1.92e-07	2.14e-08
PMMA Sheet Prod.	Lead	secondary	1.92e-07	2.14e-08
PMMA Sheet Prod.	Mercury	secondary	1.92e-07	2.14e-08
PMMA Sheet Prod.	Nitrous oxide	secondary	1.92e-07	2.14e-08
PMMA Sheet Prod.	Zinc (+2)	secondary	1.92e-07	2.14e-08
Natural Gas Prod.	Methyl chloride	secondary	1.90e-07	2.13e-08
Natural Gas Prod.	Cobalt	secondary	1.85e-07	2.06e-08
PET Resin Production	Chlorine	secondary	1.82e-07	2.03e-08
PET Resin Production	Mercury	secondary	1.82e-07	2.03e-08
Styrene-butadiene Copolymer Prod.	Chlorine	secondary	1.81e-07	2.02e-08
Styrene-butadiene Copolymer Prod.	Hydrofluoric acid	secondary	1.81e-07	2.02e-08
Steel Prod., cold-rolled, semi-finished	Manganese	secondary	1.76e-07	1.97e-08
Aluminum Prod.	Acetic acid	secondary	1.57e-07	1.76e-08
PET Resin Production	Ammonia	secondary	1.56e-07	1.74e-08
Styrene-butadiene Copolymer Prod.	Ammonia	secondary	1.55e-07	1.74e-08
Aluminum Prod.	Cobalt	secondary	1.53e-07	1.71e-08
Steel Prod., cold-rolled, semi-finished	Vanadium (V3+, V5+)	secondary	1.45e-07	1.63e-08
Natural Gas Prod.	Methyl hydrazine	secondary	1.38e-07	1.54e-08
Steel Prod., cold-rolled, semi-finished	Boron (B III)	secondary	1.32e-07	1.48e-08
Natural Gas Prod.	Mercury	secondary	1.32e-07	1.47e-08
Aluminum Prod.	Cadmium	secondary	1.10e-07	1.23e-08
Natural Gas Prod.	Acetaldehyde	secondary	1.06e-07	1.18e-08
Natural Gas Prod.	Propionaldehyde	secondary	1.06e-07	1.18e-08

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Steel Prod., cold-rolled, semi-finished	Acetic acid	secondary	1.00e-07	1.12e-08
Natural Gas Prod.	Cadmium	secondary	9.80e-08	1.10e-08
Steel Prod., cold-rolled, semi-finished	Triethylene glycol	secondary	9.39e-08	1.05e-08
PET Resin Production	Aluminum (+3)	secondary	9.08e-08	1.01e-08
PET Resin Production	Hydrogen sulfide	secondary	9.08e-08	1.01e-08
PET Resin Production	Lead	secondary	9.08e-08	1.01e-08
PET Resin Production	Nickel (+2)	secondary	9.08e-08	1.01e-08
PET Resin Production	Nitrate	secondary	9.08e-08	1.01e-08
PET Resin Production	Nitrous oxide	secondary	9.08e-08	1.01e-08
PET Resin Production	Zinc (+2)	secondary	9.08e-08	1.01e-08
Styrene-butadiene Copolymer Prod.	Halogenated hydrocarbons (unspecified)	secondary	9.04e-08	1.01e-08
Styrene-butadiene Copolymer Prod.	Hydrogen sulfide	secondary	9.04e-08	1.01e-08
Styrene-butadiene Copolymer Prod.	Lead	secondary	9.04e-08	1.01e-08
Styrene-butadiene Copolymer Prod.	Mercury	secondary	9.04e-08	1.01e-08
Styrene-butadiene Copolymer Prod.	Nickel (+2)	secondary	9.04e-08	1.01e-08
Styrene-butadiene Copolymer Prod.	Nitrous oxide	secondary	9.04e-08	1.01e-08
Styrene-butadiene Copolymer Prod.	Zinc (+2)	secondary	9.04e-08	1.01e-08
Aluminum Prod.	Triethylene glycol	secondary	9.03e-08	1.01e-08
Steel Prod., cold-rolled, semi-finished	Morpholine	secondary	8.78e-08	9.82e-09
Steel Prod., cold-rolled, semi-finished	Strontium	secondary	8.69e-08	9.72e-09
Steel Prod., cold-rolled, semi-finished	Propylene	secondary	8.67e-08	9.70e-09
Steel Prod., cold-rolled, semi-finished	Cadmium	secondary	8.54e-08	9.55e-09
Natural Gas Prod.	Di(2-ethylhexyl)phthalate	secondary	8.13e-08	9.09e-09
Aluminum Prod.	Mercury	secondary	7.51e-08	8.40e-09
Steel Prod., cold-rolled, semi-finished	Acetaldehyde	secondary	7.50e-08	8.39e-09
Aluminum Prod.	Cyanide (-1)	secondary	7.05e-08	7.89e-09
Aluminum Prod.	HALON-1301	secondary	6.72e-08	7.51e-09
Steel Prod., cold-rolled, semi-finished	Rubidium ion (Rb+)	secondary	5.93e-08	6.64e-09
Steel Prod., cold-rolled, semi-finished	Fluorine	secondary	5.57e-08	6.23e-09
Aluminum Prod.	Chromium (III)	secondary	4.88e-08	5.46e-09
Steel Prod., cold-rolled, semi-finished	Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	secondary	4.44e-08	4.97e-09
Steel Prod., cold-rolled, semi-finished	Benzo[a]pyrene	secondary	4.37e-08	4.89e-09
Natural Gas Prod.	Dimethyl sulfate	secondary	3.89e-08	4.35e-09
Steel Prod., cold-rolled, semi-finished	Acetone	secondary	3.87e-08	4.33e-09
Natural Gas Prod.	Isophorone	secondary	3.73e-08	4.17e-09
Natural Gas Prod.	Zinc (+2)	secondary	3.66e-08	4.09e-09
Natural Gas Prod.	Chlorine	secondary	3.31e-08	3.70e-09
Natural Gas Prod.	Methyl ethyl ketone	secondary	3.01e-08	3.37e-09
Natural Gas Prod.	Tetrachloroethylene	secondary	2.96e-08	3.31e-09
Steel Prod., cold-rolled, semi-finished	Lanthanum	secondary	2.63e-08	2.95e-09
Natural Gas Prod.	Silicon	secondary	2.59e-08	2.90e-09
Natural Gas Prod.	Methyl methacrylate	secondary	2.57e-08	2.88e-09
Steel Prod., cold-rolled, semi-finished	Ethylbenzene	secondary	2.57e-08	2.88e-09
Steel Prod., cold-rolled, semi-finished	Beryllium	secondary	2.31e-08	2.58e-09
Natural Gas Prod.	Barium cmpds	secondary	2.24e-08	2.51e-09
Natural Gas Prod.	1,2-Dichloroethane	secondary	2.14e-08	2.40e-09
Natural Gas Prod.	Bromoform	secondary	2.10e-08	2.35e-09
Natural Gas Prod.	Dichloromethane	secondary	2.03e-08	2.27e-09

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Chlorobenzene	secondary	1.70e-08	1.90e-09
Aluminum Prod.	Strontium	secondary	1.67e-08	1.87e-09
Steel Prod., cold-rolled, semi-finished	Mercury	secondary	1.60e-08	1.79e-09
Steel Prod., cold-rolled, semi-finished	Thorium	secondary	1.41e-08	1.58e-09
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	1.35e-08	1.51e-09
Steel Prod., cold-rolled, semi-finished	HALON-1301	secondary	1.23e-08	1.38e-09
Natural Gas Prod.	3-Methylcholanthrene	secondary	1.18e-08	1.32e-09
Natural Gas Prod.	Chromium (III)	secondary	1.13e-08	1.26e-09
Steel Prod., cold-rolled, semi-finished	Tin	secondary	8.21e-09	9.19e-10
Steel Prod., cold-rolled, semi-finished	Phosphorus pentoxide	secondary	7.88e-09	8.81e-10
Natural Gas Prod.	Ethylbenzene	secondary	6.75e-09	7.55e-10
Steel Prod., cold-rolled, semi-finished	Scandium	secondary	6.40e-09	7.16e-10
Natural Gas Prod.	Aluminum (elemental)	secondary	5.93e-09	6.64e-10
Steel Prod., cold-rolled, semi-finished	Chlorine	secondary	5.59e-09	6.25e-10
Natural Gas Prod.	Phenanthrene	secondary	4.92e-09	5.50e-10
Steel Prod., cold-rolled, semi-finished	Thallium	secondary	4.36e-09	4.87e-10
Aluminum Prod.	1,2-Dichlorotetrafluoroethane	secondary	3.88e-09	4.34e-10
Natural Gas Prod.	2-Methylnaphthalene	secondary	3.78e-09	4.23e-10
Natural Gas Prod.	Methyl tert-butyl ether	secondary	3.38e-09	3.78e-10
Aluminum Prod.	Perfluoroethane	secondary	3.15e-09	3.52e-10
Steel Prod., cold-rolled, semi-finished	Chromium (III)	secondary	2.59e-09	2.90e-10
Steel Prod., cold-rolled, semi-finished	Nitrites	secondary	2.54e-09	2.85e-10
Natural Gas Prod.	Styrene	secondary	2.46e-09	2.76e-10
Natural Gas Prod.	Vinyl acetate	secondary	2.40e-09	2.69e-10
Natural Gas Prod.	Cadmium cmpds	secondary	9.80e-10	1.10e-10
Natural Gas Prod.	Ethylene dibromide	secondary	9.73e-10	1.09e-10
Steel Prod., cold-rolled, semi-finished	Edetic acid (EDTA)	secondary	9.46e-10	1.06e-10
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	9.17e-10	1.03e-10
Steel Prod., cold-rolled, semi-finished	Hypochlorous acid	secondary	8.62e-10	9.64e-11
Steel Prod., cold-rolled, semi-finished	Cobalt (Co I, Co II, Co III)	secondary	7.70e-10	8.61e-11
Steel Prod., cold-rolled, semi-finished	Dichloromethane	secondary	7.10e-10	7.94e-11
Natural Gas Prod.	Ethyl Chloride	secondary	6.50e-10	7.27e-11
Natural Gas Prod.	Cumene	secondary	5.50e-10	6.15e-11
Natural Gas Prod.	Acenaphthylene	secondary	4.89e-10	5.47e-11
Natural Gas Prod.	Benzo[a]anthracene	secondary	3.92e-10	4.38e-11
Natural Gas Prod.	Chrysene	secondary	3.77e-10	4.22e-11
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	3.44e-10	3.85e-11
Natural Gas Prod.	Acetophenone	secondary	3.42e-10	3.83e-11
Natural Gas Prod.	Biphenyl	secondary	3.28e-10	3.67e-11
Natural Gas Prod.	Acenaphthene	secondary	3.14e-10	3.52e-11
Natural Gas Prod.	Benzo[b]fluoranthene	secondary	2.91e-10	3.26e-11
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	2.23e-10	2.49e-11
Natural Gas Prod.	Benzo[a]pyrene	secondary	2.20e-10	2.46e-11
Natural Gas Prod.	Dibenzo[a,h]anthracene	secondary	1.98e-10	2.21e-11
Natural Gas Prod.	Aromatic hydrocarbons	secondary	1.98e-10	2.21e-11
Natural Gas Prod.	Copper (+1 & +2)	secondary	1.85e-10	2.07e-11
Natural Gas Prod.	Pyrene	secondary	1.71e-10	1.91e-11
Natural Gas Prod.	Fluorene	secondary	1.14e-10	1.28e-11
Natural Gas Prod.	Fluoranthene	secondary	1.02e-10	1.14e-11
Steel Prod., cold-rolled, semi-finished	Isopropylpropionate	secondary	9.91e-11	1.11e-11

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	8.92e-11	9.97e-12
Steel Prod., cold-rolled, semi-finished	Lithium salts	secondary	4.86e-11	5.43e-12
Steel Prod., cold-rolled, semi-finished	Chloroform	secondary	2.65e-11	2.96e-12
Steel Prod., cold-rolled, semi-finished	Zirconium	secondary	2.28e-11	2.55e-12
Steel Prod., cold-rolled, semi-finished	Perfluoromethane	secondary	2.20e-11	2.46e-12
Natural Gas Prod.	5-Methyl chrysene	secondary	1.78e-11	1.99e-12
Natural Gas Prod.	Anthracene	secondary	6.68e-12	7.47e-13
Natural Gas Prod.	Nickel cmpds	secondary	1.96e-12	2.19e-13
Natural Gas Prod.	Lead cmpds	secondary	1.65e-12	1.84e-13
Natural Gas Prod.	Mercury compounds	secondary	9.98e-13	1.12e-13
Natural Gas Prod.	HALON-1301	secondary	7.17e-13	8.02e-14
Steel Prod., cold-rolled, semi-finished	Trichloroethylene	secondary	3.80e-13	4.25e-14
Natural Gas Prod.	Halogenated matter (organic)	secondary	1.65e-13	1.84e-14
Steel Prod., cold-rolled, semi-finished	Propionaldehyde	secondary	2.61e-14	2.91e-15
Steel Prod., cold-rolled, semi-finished	Tetrachloroethylene	secondary	1.07e-14	1.20e-15
Steel Prod., cold-rolled, semi-finished	Benzaldehyde	secondary	2.32e-15	2.59e-16
Steel Prod., cold-rolled, semi-finished	1,1,1-Trichloroethane	secondary	1.57e-15	1.76e-16
Natural Gas Prod.	Halogenated hydrocarbons (unspecified)	secondary	4.11e-16	4.60e-17
Steel Prod., cold-rolled, semi-finished	Hexachloroethane	secondary	6.02e-17	6.73e-18
Total Materials Processing			**4.54e+01**	**5.08e+00**
Manufacturing Life-cycle Stage				
Japanese Electric Grid	Sulfur dioxide	model/secondary	1.92e+02	2.14e+01
Monitor/module	Phosphine	primary	2.87e+01	3.21e+00
Monitor/module	Phosphorus (yellow or white)	primary	3.42e+00	3.82e-01
US electric grid	Sulfur dioxide	model/secondary	3.19e+00	3.57e-01
Monitor/module	Fluorides (F-)	primary	2.54e+00	2.84e-01
Monitor/module	Tetramethyl ammonium hydroxide	primary	6.43e-01	7.19e-02
Monitor/module	Nitrogen oxides	primary	5.48e-01	6.13e-02
Monitor/module	Hydrochloric acid	primary	2.77e-01	3.10e-02
LPG Production	Carbon monoxide	secondary	2.56e-01	2.87e-02
Monitor/module	Nitrogen fluoride	primary	2.45e-01	2.74e-02
Japanese Electric Grid	Nitrogen oxides	model/secondary	1.37e-01	1.53e-02
Natural Gas Prod.	Benzene	secondary	1.19e-01	1.33e-02
Japanese Electric Grid	Carbon monoxide	model/secondary	1.18e-01	1.32e-02
Monitor/module	Ammonia	primary	1.07e-01	1.20e-02
Natural Gas Prod.	Carbon monoxide	secondary	1.00e-01	1.12e-02
Natural Gas Prod.	Methane	secondary	7.91e-02	8.85e-03
Japanese Electric Grid	Vanadium	model/secondary	7.62e-02	8.53e-03
Monitor/module	Hydrofluoric acid	primary	5.21e-02	5.82e-03
LPG Production	Vanadium	secondary	5.02e-02	5.62e-03
LPG Production	Benzene	secondary	4.11e-02	4.60e-03
LPG Production	Methane	secondary	4.02e-02	4.50e-03
LPG Production	Sulfur oxides	secondary	3.85e-02	4.30e-03
Japanese Electric Grid	Arsenic	model/secondary	3.51e-02	3.92e-03
Backlight	Nitrogen oxides	primary	2.95e-02	3.29e-03
LPG Production	Nitrogen oxides	secondary	2.75e-02	3.07e-03
LCD glass mfg.	Fluorides (F-)	primary	2.70e-02	3.01e-03
Japanese Electric Grid	Hydrochloric acid	model/secondary	2.11e-02	2.36e-03
Panel components	Phosphorus (yellow or white)	primary	1.97e-02	2.20e-03

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Nitrogen oxides	secondary	1.47e-02	1.64e-03
LPG Production	Arsenic	secondary	9.91e-03	1.11e-03
Monitor/module	N-bromoacetamide	primary	9.18e-03	1.03e-03
Monitor/module	Sulfur hexafluoride	primary	7.30e-03	8.16e-04
Japanese Electric Grid	PM-10	model/secondary	6.72e-03	7.52e-04
LPG Production	Formaldehyde	secondary	6.43e-03	7.19e-04
LPG Production	PM	secondary	6.19e-03	6.92e-04
Monitor/module	Isopropyl alcohol	primary	4.55e-03	5.09e-04
Japanese Electric Grid	Fluorides (F-)	model/secondary	4.41e-03	4.93e-04
Japanese Electric Grid	Selenium	model/secondary	4.29e-03	4.80e-04
Japanese Electric Grid	Formaldehyde	model/secondary	3.93e-03	4.39e-04
US electric grid	Nitrogen oxides	model/secondary	2.28e-03	2.55e-04
Fuel Oil #4 Prod.	Carbon monoxide	secondary	2.16e-03	2.42e-04
Japanese Electric Grid	Zinc (elemental)	model/secondary	2.06e-03	2.31e-04
LCD glass mfg.	Nitrogen oxides	primary	2.04e-03	2.29e-04
PWB Mfg.	Formaldehyde	model/secondary	1.96e-03	2.19e-04
US electric grid	Carbon monoxide	model/secondary	1.96e-03	2.19e-04
LPG Production	Hydrochloric acid	secondary	1.77e-03	1.97e-04
Monitor/module	Arsenic	primary	1.70e-03	1.90e-04
Monitor/module	Monosilane	primary	1.54e-03	1.72e-04
US electric grid	Methane	model/secondary	1.25e-03	1.40e-04
Monitor/module	Sulfur oxides	primary	1.12e-03	1.25e-04
Japanese Electric Grid	Antimony	model/secondary	1.09e-03	1.22e-04
US electric grid	Arsenic	model/secondary	1.08e-03	1.21e-04
US electric grid	Hydrochloric acid	model/secondary	9.54e-04	1.07e-04
Fuel Oil #6 Prod.	Carbon monoxide	secondary	8.92e-04	9.98e-05
LPG Production	Nitrous oxide	secondary	7.78e-04	8.71e-05
Fuel Oil #2 Prod.	Carbon monoxide	secondary	7.27e-04	8.13e-05
Natural Gas Prod.	PM	secondary	6.53e-04	7.30e-05
Fuel Oil #4 Prod.	Vanadium	secondary	6.21e-04	6.94e-05
Monitor/module	Hexane	primary	5.88e-04	6.58e-05
Japanese Electric Grid	Hydrofluoric acid	model/secondary	5.77e-04	6.45e-05
Natural Gas Prod.	Arsenic	secondary	4.96e-04	5.55e-05
LPG Production	Phosphorus (yellow or white)	secondary	4.71e-04	5.27e-05
Japanese Electric Grid	Molybdenum	model/secondary	4.42e-04	4.94e-05
Natural Gas Prod.	Sulfur oxides	secondary	4.35e-04	4.86e-05
Natural Gas Prod.	Ammonia	secondary	4.24e-04	4.74e-05
Panel components	Nitrogen oxides	primary	4.11e-04	4.60e-05
Fuel Oil #4 Prod.	Methane	secondary	4.02e-04	4.49e-05
Fuel Oil #4 Prod.	Sulfur oxides	secondary	3.77e-04	4.22e-05
Japanese Electric Grid	Nitrous oxide	model/secondary	3.76e-04	4.20e-05
Fuel Oil #4 Prod.	Benzene	secondary	3.71e-04	4.15e-05
Fuel Oil #6 Prod.	Vanadium	secondary	3.67e-04	4.10e-05
LPG Production	Fluorides (F-)	secondary	3.60e-04	4.03e-05
LPG Production	Selenium	secondary	3.56e-04	3.98e-05
Monitor/module	Zinc (elemental)	primary	3.13e-04	3.50e-05
Japanese Electric Grid	Benzene	model/secondary	3.06e-04	3.42e-05
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	2.77e-04	3.09e-05
Japanese Electric Grid	Methane	model/secondary	2.73e-04	3.06e-05
Monitor/module	Nitric acid	primary	2.68e-04	3.00e-05

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #6 Prod.	Methane	secondary	2.01e-04	2.24e-05
Fuel Oil #6 Prod.	Sulfur oxides	secondary	1.86e-04	2.08e-05
Monitor/module	Phosphoric acid	primary	1.85e-04	2.07e-05
US electric grid	Selenium	model/secondary	1.80e-04	2.01e-05
LPG Production	Ammonia	secondary	1.79e-04	2.01e-05
Fuel Oil #6 Prod.	Benzene	secondary	1.67e-04	1.86e-05
Fuel Oil #2 Prod.	Vanadium	secondary	1.61e-04	1.80e-05
LPG Production	Hydrogen sulfide	secondary	1.47e-04	1.65e-05
Panel components	HCFC-225ca	primary	1.40e-04	1.56e-05
Panel components	HCFC-225cb	primary	1.40e-04	1.56e-05
Fuel Oil #6 Prod.	Nitrogen oxides	secondary	1.39e-04	1.56e-05
US electric grid	Vanadium	model/secondary	1.35e-04	1.51e-05
Fuel Oil #2 Prod.	Methane	secondary	1.20e-04	1.34e-05
Fuel Oil #2 Prod.	Benzene	secondary	1.19e-04	1.33e-05
Japanese Electric Grid	Nickel	model/secondary	1.18e-04	1.32e-05
Fuel Oil #2 Prod.	Sulfur oxides	secondary	1.14e-04	1.27e-05
US electric grid	PM-10	model/secondary	1.12e-04	1.25e-05
Natural Gas Prod.	Vanadium	secondary	1.10e-04	1.23e-05
Fuel Oil #4 Prod.	Arsenic	secondary	1.08e-04	1.21e-05
Natural Gas Prod.	Hydrochloric acid	secondary	1.01e-04	1.13e-05
Japanese Electric Grid	Barium	model/secondary	9.88e-05	1.10e-05
Monitor/module	Acetic acid	primary	8.27e-05	9.25e-06
Fuel Oil #2 Prod.	Nitrogen oxides	secondary	8.20e-05	9.17e-06
Fuel Oil #4 Prod.	Formaldehyde	secondary	7.91e-05	8.85e-06
LPG Production	Molybdenum	secondary	7.90e-05	8.84e-06
Fuel Oil #4 Prod.	PM	secondary	6.24e-05	6.97e-06
Fuel Oil #6 Prod.	Arsenic	secondary	5.87e-05	6.57e-06
LPG Production	Zinc (elemental)	secondary	5.75e-05	6.44e-06
Japanese Electric Grid	Naphthalene	model/secondary	5.50e-05	6.15e-06
LPG Production	Hydrofluoric acid	secondary	4.82e-05	5.39e-06
Fuel Oil #6 Prod.	Formaldehyde	secondary	4.66e-05	5.21e-06
Natural Gas Prod.	Formaldehyde	secondary	4.37e-05	4.88e-06
Monitor/module	Antimony	primary	3.88e-05	4.34e-06
LPG Production	Ethane	secondary	3.72e-05	4.16e-06
LPG Production	Phenol	secondary	3.43e-05	3.84e-06
Panel components	Hydrochloric acid	primary	3.35e-05	3.75e-06
Panel components	Heptane	primary	3.28e-05	3.66e-06
Fuel Oil #6 Prod.	PM	secondary	3.15e-05	3.52e-06
LPG Production	Pentane	secondary	3.12e-05	3.49e-06
Fuel Oil #2 Prod.	Arsenic	secondary	3.04e-05	3.40e-06
Panel components	PM	primary	2.74e-05	3.07e-06
US electric grid	Hydrofluoric acid	model/secondary	2.60e-05	2.91e-06
Japanese Electric Grid	Copper	model/secondary	2.40e-05	2.69e-06
Monitor/module	Acetone	primary	2.22e-05	2.48e-06
LPG Production	Hexane	secondary	2.16e-05	2.42e-06
Natural Gas Prod.	Fluorides (F-)	secondary	2.13e-05	2.38e-06
Monitor/module	Copper	primary	2.06e-05	2.30e-06
Fuel Oil #2 Prod.	Formaldehyde	secondary	2.06e-05	2.30e-06
Monitor/module	Polychlorinated biphenyls	primary	1.94e-05	2.17e-06

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Selenium	secondary	1.91e-05	2.14e-06
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	1.90e-05	2.12e-06
US electric grid	Formaldehyde	model/secondary	1.88e-05	2.10e-06
Japanese Electric Grid	2-Chloroacetophenone	model/secondary	1.85e-05	2.07e-06
Fuel Oil #2 Prod.	PM	secondary	1.85e-05	2.07e-06
Japanese Electric Grid	Bromomethane	model/secondary	1.83e-05	2.05e-06
Natural Gas Prod.	Nitrous oxide	secondary	1.82e-05	2.04e-06
LPG Production	Nickel	secondary	1.39e-05	1.56e-06
US electric grid	Benzene	model/secondary	1.35e-05	1.51e-06
Natural Gas Prod.	Zinc (elemental)	secondary	1.34e-05	1.50e-06
Natural Gas Prod.	Ethane	secondary	1.10e-05	1.23e-06
Monitor/module	PM	primary	1.10e-05	1.23e-06
LPG Production	PM-10	secondary	1.08e-05	1.21e-06
LPG Production	Antimony	secondary	1.03e-05	1.15e-06
Fuel Oil #6 Prod.	Hydrochloric acid	secondary	1.01e-05	1.13e-06
Japanese Electric Grid	Cyanide (-1)	model/secondary	9.61e-06	1.07e-06
Natural Gas Prod.	Pentane	secondary	9.24e-06	1.03e-06
Panel components	Toluene	primary	9.09e-06	1.02e-06
Fuel Oil #4 Prod.	Nitrous oxide	secondary	8.86e-06	9.91e-07
Monitor/module	Chromium	primary	8.84e-06	9.88e-07
US electric grid	Phosphorus (yellow or white)	model/secondary	7.61e-06	8.51e-07
Japanese Electric Grid	2,3,7,8-TCDD	model/secondary	7.47e-06	8.36e-07
LPG Production	Aluminum (+3)	secondary	6.79e-06	7.60e-07
US electric grid	Nitrous oxide	model/secondary	6.58e-06	7.36e-07
Natural Gas Prod.	Hexane	secondary	6.40e-06	7.15e-07
Monitor/module	Boron	primary	6.19e-06	6.93e-07
Monitor/module	Lead	primary	6.17e-06	6.90e-07
Fuel Oil #4 Prod.	Phosphorus (yellow or white)	secondary	5.71e-06	6.38e-07
Fuel Oil #2 Prod.	Hydrochloric acid	secondary	5.39e-06	6.02e-07
LCD glass mfg.	PM	primary	5.06e-06	5.66e-07
Fuel Oil #6 Prod.	Nitrous oxide	secondary	4.94e-06	5.53e-07
LPG Production	Chromium (VI)	secondary	4.84e-06	5.41e-07
Japanese Electric Grid	Cobalt	model/secondary	3.98e-06	4.45e-07
Fuel Oil #4 Prod.	Selenium	secondary	3.85e-06	4.31e-07
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	3.79e-06	4.24e-07
Monitor/module	Cyanide (-1)	primary	3.66e-06	4.10e-07
Natural Gas Prod.	Molybdenum	secondary	3.64e-06	4.08e-07
US electric grid	Zinc (elemental)	model/secondary	3.51e-06	3.93e-07
Japanese Electric Grid	Carbon disulfide	model/secondary	3.43e-06	3.84e-07
Fuel Oil #6 Prod.	Phosphorus (yellow or white)	secondary	3.33e-06	3.72e-07
LPG Production	Nitrate	secondary	2.91e-06	3.25e-07
US electric grid	Antimony	model/secondary	2.87e-06	3.21e-07
Natural Gas Prod.	Phosphorus (yellow or white)	secondary	2.79e-06	3.12e-07
Natural Gas Prod.	Hydrofluoric acid	secondary	2.75e-06	3.07e-07
Japanese Electric Grid	Benzyl chloride	model/secondary	2.69e-06	3.01e-07
LCD glass mfg.	Carbon monoxide	primary	2.59e-06	2.89e-07
Fuel Oil #2 Prod.	Nitrous oxide	secondary	2.42e-06	2.71e-07
LCD glass mfg.	Sulfur oxides	primary	2.35e-06	2.63e-07
Monitor/module	Cyclohexane	primary	2.22e-06	2.48e-07
Backlight	Diethyl ether	primary	2.20e-06	2.47e-07
Japanese Electric Grid	Chromium (VI)	model/secondary	2.15e-06	2.40e-07

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Japanese Electric Grid	Chloroform	model/secondary	2.09e-06	2.34e-07
Fuel Oil #6 Prod.	Selenium	secondary	2.07e-06	2.31e-07
LCD glass mfg.	Lead	primary	2.01e-06	2.25e-07
Fuel Oil #6 Prod.	Fluorides (F-)	secondary	1.99e-06	2.22e-07
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	1.83e-06	2.04e-07
LPG Production	Copper	secondary	1.67e-06	1.87e-07
Fuel Oil #4 Prod.	Ammonia	secondary	1.58e-06	1.76e-07
LPG Production	2-Chloroacetophenone	secondary	1.54e-06	1.73e-07
LPG Production	Dimethylbenzanthracene	secondary	1.53e-06	1.71e-07
LPG Production	Bromomethane	secondary	1.53e-06	1.71e-07
Fuel Oil #2 Prod.	Phosphorus (yellow or white)	secondary	1.50e-06	1.68e-07
Monitor/module	Hexamethyldisilizane	primary	1.37e-06	1.53e-07
LPG Production	Naphthalene	secondary	1.24e-06	1.38e-07
Japanese Electric Grid	Acrolein	model/secondary	1.11e-06	1.25e-07
Fuel Oil #2 Prod.	Fluorides (F-)	secondary	1.09e-06	1.22e-07
Monitor/module	Chromium (VI)	primary	1.09e-06	1.22e-07
Fuel Oil #2 Prod.	Selenium	secondary	1.09e-06	1.22e-07
Fuel Oil #6 Prod.	Hydrogen sulfide	secondary	1.08e-06	1.21e-07
LPG Production	Manganese	secondary	1.07e-06	1.20e-07
US electric grid	Molybdenum	model/secondary	9.61e-07	1.07e-07
Fuel Oil #4 Prod.	Molybdenum	secondary	9.29e-07	1.04e-07
Monitor/module	Diethylene glycol	primary	9.23e-07	1.03e-07
Japanese Electric Grid	Methyl chloride	model/secondary	9.03e-07	1.01e-07
LPG Production	Barium	secondary	8.94e-07	1.00e-07
US electric grid	2-Chloroacetophenone	model/secondary	8.35e-07	9.34e-08
US electric grid	Bromomethane	model/secondary	8.27e-07	9.24e-08
LPG Production	Silicon	secondary	8.12e-07	9.08e-08
Japanese Electric Grid	Toluene	model/secondary	8.04e-07	8.99e-08
LPG Production	Cyanide (-1)	secondary	8.03e-07	8.98e-08
LPG Production	Barium cmpds	secondary	7.62e-07	8.52e-08
Natural Gas Prod.	Antimony	secondary	7.01e-07	7.84e-08
Fuel Oil #6 Prod.	Ammonia	secondary	6.85e-07	7.66e-08
Japanese Electric Grid	Methyl hydrazine	model/secondary	6.54e-07	7.31e-08
LPG Production	Lead	secondary	5.93e-07	6.63e-08
Monitor/module	Nickel	primary	5.45e-07	6.10e-08
Fuel Oil #6 Prod.	Molybdenum	secondary	5.30e-07	5.93e-08
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	5.17e-07	5.79e-08
Fuel Oil #2 Prod.	Ammonia	secondary	5.14e-07	5.75e-08
Fuel Oil #4 Prod.	Zinc (elemental)	secondary	5.10e-07	5.71e-08
Japanese Electric Grid	Acetaldehyde	model/secondary	5.02e-07	5.61e-08
Japanese Electric Grid	Propionaldehyde	model/secondary	5.02e-07	5.61e-08
Japanese Electric Grid	Cadmium	model/secondary	4.74e-07	5.30e-08
Fuel Oil #2 Prod.	Hydrogen sulfide	secondary	4.72e-07	5.28e-08
Monitor/module	Tin	primary	4.58e-07	5.12e-08
Natural Gas Prod.	Dimethylbenzanthracene	secondary	4.53e-07	5.07e-08
US electric grid	Cyanide (-1)	model/secondary	4.34e-07	4.85e-08
Japanese Electric Grid	Mercury	model/secondary	3.97e-07	4.44e-08
Japanese Electric Grid	Di(2-ethylhexyl)phthalate	model/secondary	3.86e-07	4.31e-08
Fuel Oil #4 Prod.	Ethane	secondary	3.36e-07	3.76e-08

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
US electric grid	2,3,7,8-TCDD	model/secondary	3.28e-07	3.67e-08
US electric grid	Nickel	model/secondary	3.16e-07	3.53e-08
LPG Production	Carbon disulfide	secondary	2.87e-07	3.21e-08
Fuel Oil #4 Prod.	Pentane	secondary	2.82e-07	3.15e-08
Fuel Oil #6 Prod.	Hydrofluoric acid	secondary	2.76e-07	3.08e-08
US electric grid	Naphthalene	model/secondary	2.62e-07	2.92e-08
Japanese Electric Grid	Hexane	model/secondary	2.58e-07	2.88e-08
Fuel Oil #4 Prod.	Phenol	secondary	2.51e-07	2.81e-08
Fuel Oil #2 Prod.	Molybdenum	secondary	2.49e-07	2.78e-08
Monitor/module	Manganese	primary	2.29e-07	2.56e-08
US electric grid	Barium	model/secondary	2.25e-07	2.52e-08
LPG Production	Benzyl chloride	secondary	2.25e-07	2.51e-08
Fuel Oil #6 Prod.	Zinc (elemental)	secondary	2.25e-07	2.51e-08
Natural Gas Prod.	Naphthalene	secondary	2.05e-07	2.29e-08
Fuel Oil #4 Prod.	Hexane	secondary	1.95e-07	2.18e-08
Natural Gas Prod.	Nickel	secondary	1.94e-07	2.17e-08
LPG Production	Aluminum (elemental)	secondary	1.86e-07	2.08e-08
Japanese Electric Grid	Dimethyl sulfate	model/secondary	1.85e-07	2.06e-08
LCD glass mfg.	Nitrate	primary	1.83e-07	2.05e-08
Japanese Electric Grid	Isophorone	model/secondary	1.77e-07	1.98e-08
LPG Production	Chloroform	secondary	1.75e-07	1.95e-08
Fuel Oil #4 Prod.	Nickel	secondary	1.66e-07	1.86e-08
Fuel Oil #2 Prod.	Zinc (elemental)	secondary	1.65e-07	1.85e-08
US electric grid	Carbon disulfide	model/secondary	1.55e-07	1.73e-08
Fuel Oil #6 Prod.	Ethane	secondary	1.51e-07	1.69e-08
Natural Gas Prod.	Chromium (VI)	secondary	1.49e-07	1.67e-08
Fuel Oil #2 Prod.	Hydrofluoric acid	secondary	1.47e-07	1.64e-08
Japanese Electric Grid	Methyl ethyl ketone	model/secondary	1.43e-07	1.60e-08
Japanese Electric Grid	Tetrachloroethylene	model/secondary	1.41e-07	1.57e-08
Fuel Oil #4 Prod.	PM-10	secondary	1.34e-07	1.50e-08
Fuel Oil #6 Prod.	Pentane	secondary	1.27e-07	1.42e-08
Japanese Electric Grid	Methyl methacrylate	model/secondary	1.22e-07	1.36e-08
US electric grid	Benzyl chloride	model/secondary	1.22e-07	1.36e-08
LPG Production	Cobalt	secondary	1.21e-07	1.35e-08
Monitor/module	Cadmium	primary	1.14e-07	1.28e-08
Japanese Electric Grid	Beryllium	model/secondary	1.09e-07	1.22e-08
Fuel Oil #2 Prod.	Ethane	secondary	1.08e-07	1.20e-08
Natural Gas Prod.	Hydrogen sulfide	secondary	1.06e-07	1.19e-08
Japanese Electric Grid	1,2-Dichloroethane	model/secondary	1.02e-07	1.14e-08
Japanese Electric Grid	Bromoform	model/secondary	9.97e-08	1.11e-08
Monitor/module	Mercury	primary	9.69e-08	1.08e-08
Japanese Electric Grid	Dichloromethane	model/secondary	9.62e-08	1.08e-08
Fuel Oil #6 Prod.	Nickel	secondary	9.56e-08	1.07e-08
US electric grid	Chloroform	model/secondary	9.45e-08	1.06e-08
Fuel Oil #2 Prod.	Phenol	secondary	9.37e-08	1.05e-08
LPG Production	Acrolein	secondary	9.31e-08	1.04e-08
Natural Gas Prod.	Barium	secondary	9.30e-08	1.04e-08
Fuel Oil #4 Prod.	Antimony	secondary	9.13e-08	1.02e-08
Fuel Oil #2 Prod.	Pentane	secondary	9.02e-08	1.01e-08
US electric grid	Manganese	model/secondary	8.83e-08	9.87e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	8.80e-08	9.84e-09

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #6 Prod.	Hexane	secondary	8.78e-08	9.82e-09
Natural Gas Prod.	Bromomethane	secondary	8.71e-08	9.74e-09
Natural Gas Prod.	Copper	secondary	8.32e-08	9.31e-09
Fuel Oil #6 Prod.	Phenol	secondary	8.24e-08	9.21e-09
Japanese Electric Grid	Chlorobenzene	model/secondary	8.05e-08	9.01e-09
Fuel Oil #6 Prod.	PM-10	secondary	7.94e-08	8.88e-09
LPG Production	Methyl chloride	secondary	7.54e-08	8.43e-09
Panel components	Methyl ethyl ketone	primary	6.97e-08	7.79e-09
LPG Production	Beryllium	secondary	6.74e-08	7.54e-09
US electric grid	Chromium (VI)	model/secondary	6.65e-08	7.44e-09
Japanese Electric Grid	2,4-Dinitrotoluene	model/secondary	6.39e-08	7.14e-09
Fuel Oil #2 Prod.	Hexane	secondary	6.25e-08	6.99e-09
Natural Gas Prod.	Manganese	secondary	6.23e-08	6.97e-09
LPG Production	Methyl hydrazine	secondary	5.46e-08	6.10e-09
US electric grid	Acrolein	model/secondary	5.04e-08	5.63e-09
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	4.98e-08	5.57e-09
Natural Gas Prod.	Cyanide (-1)	secondary	4.57e-08	5.12e-09
Monitor/module	Phenol	primary	4.54e-08	5.08e-09
Japanese Electric Grid	Cumene hydroperoxide	model/secondary	4.51e-08	5.05e-09
Fuel Oil #2 Prod.	Nickel	secondary	4.40e-08	4.93e-09
US electric grid	Copper	model/secondary	4.33e-08	4.84e-09
LPG Production	Acetaldehyde	secondary	4.19e-08	4.69e-09
LPG Production	Propionaldehyde	secondary	4.19e-08	4.69e-09
LPG Production	Mercury	secondary	4.17e-08	4.66e-09
US electric grid	Methyl chloride	model/secondary	4.08e-08	4.56e-09
Fuel Oil #6 Prod.	Antimony	secondary	4.03e-08	4.51e-09
LPG Production	Cadmium	secondary	3.89e-08	4.35e-09
US electric grid	Fluoride	model/secondary	3.78e-08	4.23e-09
Japanese Electric Grid	Ethylbenzene	model/secondary	3.49e-08	3.91e-09
Fuel Oil #2 Prod.	PM-10	secondary	3.47e-08	3.88e-09
Natural Gas Prod.	Lead	secondary	3.42e-08	3.82e-09
LPG Production	Cadmium cmpds	secondary	3.33e-08	3.73e-09
LPG Production	Di(2-ethylhexyl)phthalate	secondary	3.22e-08	3.60e-09
LPG Production	Toluene	secondary	2.99e-08	3.34e-09
US electric grid	Methyl hydrazine	model/secondary	2.95e-08	3.30e-09
Fuel Oil #2 Prod.	Antimony	secondary	2.95e-08	3.30e-09
Fuel Oil #4 Prod.	Chromium (VI)	secondary	2.60e-08	2.91e-09
US electric grid	Lead	model/secondary	2.47e-08	2.76e-09
Natural Gas Prod.	Nitrate	secondary	2.37e-08	2.65e-09
US electric grid	Cobalt	model/secondary	2.35e-08	2.63e-09
Natural Gas Prod.	Phenol	secondary	2.30e-08	2.57e-09
US electric grid	Propionaldehyde	model/secondary	2.27e-08	2.53e-09
US electric grid	Acetaldehyde	model/secondary	2.27e-08	2.53e-09
Fuel Oil #4 Prod.	Nitrate	secondary	2.26e-08	2.53e-09
Monitor/module	Tetrachloroethylene	primary	1.95e-08	2.18e-09
Fuel Oil #4 Prod.	Copper	secondary	1.92e-08	2.15e-09
Fuel Oil #2 Prod.	Aluminum (+3)	secondary	1.85e-08	2.07e-09
Japanese Electric Grid	Phenanthrene	model/secondary	1.75e-08	1.96e-09
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	1.74e-08	1.95e-09

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	1,4-Dichlorobenzene	secondary	1.71e-08	1.92e-09
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	1.66e-08	1.85e-09
Fuel Oil #4 Prod.	Bromomethane	secondary	1.64e-08	1.84e-09
Natural Gas Prod.	Carbon disulfide	secondary	1.63e-08	1.83e-09
Fuel Oil #6 Prod.	Aluminum (+3)	secondary	1.63e-08	1.82e-09
Japanese Electric Grid	Methyl tert-butyl ether	model/secondary	1.60e-08	1.79e-09
LPG Production	Dimethyl sulfate	secondary	1.54e-08	1.72e-09
Japanese Electric Grid	Chromium (III)	model/secondary	1.51e-08	1.68e-09
LPG Production	Isophorone	secondary	1.48e-08	1.65e-09
US electric grid	Mercury	model/secondary	1.45e-08	1.63e-09
Fuel Oil #6 Prod.	Chromium (VI)	secondary	1.39e-08	1.56e-09
Fuel Oil #4 Prod.	Dimethylbenzanthracene	secondary	1.38e-08	1.55e-09
Natural Gas Prod.	Toluene	secondary	1.36e-08	1.52e-09
Natural Gas Prod.	Benzyl chloride	secondary	1.28e-08	1.43e-09
Japanese Electric Grid	1,1,1-Trichloroethane	model/secondary	1.23e-08	1.37e-09
Japanese Electric Grid	Phenol	model/secondary	1.22e-08	1.36e-09
LPG Production	Methyl ethyl ketone	secondary	1.19e-08	1.33e-09
LPG Production	Tetrachloroethylene	secondary	1.17e-08	1.31e-09
Japanese Electric Grid	Styrene	model/secondary	1.17e-08	1.31e-09
US electric grid	Hexane	model/secondary	1.16e-08	1.30e-09
Fuel Oil #4 Prod.	Naphthalene	secondary	1.15e-08	1.28e-09
Fuel Oil #4 Prod.	Manganese	secondary	1.15e-08	1.28e-09
Japanese Electric Grid	Vinyl acetate	model/secondary	1.14e-08	1.27e-09
Monitor/module	Trichloroethylene	primary	1.14e-08	1.27e-09
Fuel Oil #6 Prod.	Copper	secondary	1.08e-08	1.21e-09
LCD glass mfg.	Chromium	primary	1.02e-08	1.14e-09
LPG Production	Methyl methacrylate	secondary	1.02e-08	1.14e-09
Fuel Oil #4 Prod.	Silicon	secondary	1.01e-08	1.13e-09
Natural Gas Prod.	Chloroform	secondary	9.96e-09	1.11e-09
Japanese Electric Grid	Xylene (mixed isomers)	model/secondary	9.46e-09	1.06e-09
US electric grid	Cadmium	model/secondary	9.33e-09	1.04e-09
LCD glass mfg.	Nickel	primary	9.05e-09	1.01e-09
Fuel Oil #6 Prod.	2-Chloroacetophenone	secondary	8.84e-09	9.89e-10
Fuel Oil #6 Prod.	Bromomethane	secondary	8.75e-09	9.79e-10
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	8.62e-09	9.64e-10
LPG Production	1,2-Dichloroethane	secondary	8.49e-09	9.50e-10
US electric grid	Dimethyl sulfate	model/secondary	8.33e-09	9.32e-10
LPG Production	Bromoform	secondary	8.32e-09	9.31e-10
Fuel Oil #6 Prod.	Nitrate	secondary	8.26e-09	9.24e-10
LPG Production	Chromium (III)	secondary	8.24e-09	9.21e-10
US electric grid	Toluene	model/secondary	8.23e-09	9.20e-10
Fuel Oil #2 Prod.	Nitrate	secondary	8.06e-09	9.01e-10
LPG Production	Dichloromethane	secondary	8.04e-09	8.99e-10
US electric grid	Isophorone	model/secondary	7.99e-09	8.94e-10
Fuel Oil #4 Prod.	Barium	secondary	7.83e-09	8.76e-10
Natural Gas Prod.	PM-10	secondary	7.79e-09	8.71e-10
Fuel Oil #2 Prod.	Chromium (VI)	secondary	7.39e-09	8.26e-10
Natural Gas Prod.	o-xylene	secondary	7.25e-09	8.11e-10
LPG Production	Chlorobenzene	secondary	6.72e-09	7.52e-10
LPG Production	Aromatic hydrocarbons	secondary	6.72e-09	7.51e-10
US electric grid	Methyl ethyl ketone	model/secondary	6.45e-09	7.21e-10

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	Lead	secondary	6.38e-09	7.13e-10
US electric grid	Tetrachloroethylene	model/secondary	6.35e-09	7.10e-10
LPG Production	Copper (+1 & +2)	secondary	6.29e-09	7.03e-10
Fuel Oil #6 Prod.	Dimethylbenzanthracene	secondary	6.21e-09	6.95e-10
Fuel Oil #6 Prod.	Manganese	secondary	6.09e-09	6.81e-10
Fuel Oil #6 Prod.	Silicon	secondary	5.97e-09	6.67e-10
Fuel Oil #4 Prod.	Barium cmpds	secondary	5.58e-09	6.24e-10
US electric grid	Methyl methacrylate	model/secondary	5.51e-09	6.16e-10
LPG Production	2,4-Dinitrotoluene	secondary	5.35e-09	5.98e-10
Fuel Oil #6 Prod.	Naphthalene	secondary	5.32e-09	5.95e-10
Natural Gas Prod.	Acrolein	secondary	5.31e-09	5.93e-10
Fuel Oil #2 Prod.	Copper	secondary	5.22e-09	5.84e-10
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	5.07e-09	5.67e-10
Japanese Electric Grid	Acenaphthene	model/secondary	4.94e-09	5.52e-10
Fuel Oil #2 Prod.	2-Chloroacetophenone	secondary	4.71e-09	5.27e-10
Fuel Oil #2 Prod.	Bromomethane	secondary	4.66e-09	5.22e-10
Japanese Electric Grid	Ethylene dibromide	model/secondary	4.61e-09	5.16e-10
Fuel Oil #6 Prod.	Cyanide (-1)	secondary	4.60e-09	5.14e-10
US electric grid	1,2-Dichloroethane	model/secondary	4.59e-09	5.14e-10
Natural Gas Prod.	Aluminum (+3)	secondary	4.51e-09	5.05e-10
US electric grid	Bromoform	model/secondary	4.50e-09	5.04e-10
Fuel Oil #2 Prod.	Dimethylbenzanthracene	secondary	4.43e-09	4.95e-10
Natural Gas Prod.	Beryllium	secondary	4.41e-09	4.93e-10
US electric grid	Dichloromethane	model/secondary	4.35e-09	4.86e-10
Japanese Electric Grid	o-xylene	model/secondary	4.31e-09	4.83e-10
Natural Gas Prod.	Methyl chloride	secondary	4.30e-09	4.81e-10
Natural Gas Prod.	Cobalt	secondary	4.16e-09	4.66e-10
US electric grid	Beryllium	model/secondary	3.69e-09	4.13e-10
US electric grid	Chlorobenzene	model/secondary	3.64e-09	4.07e-10
Fuel Oil #2 Prod.	Naphthalene	secondary	3.60e-09	4.03e-10
Fuel Oil #6 Prod.	Lead	secondary	3.40e-09	3.81e-10
Fuel Oil #6 Prod.	Barium	secondary	3.39e-09	3.80e-10
LPG Production	o-xylene	secondary	3.29e-09	3.68e-10
Fuel Oil #2 Prod.	Manganese	secondary	3.26e-09	3.65e-10
Natural Gas Prod.	Methyl hydrazine	secondary	3.11e-09	3.48e-10
Japanese Electric Grid	Ethyl Chloride	model/secondary	3.08e-09	3.45e-10
Fuel Oil #4 Prod.	Carbon disulfide	secondary	3.08e-09	3.44e-10
Natural Gas Prod.	Mercury	secondary	2.97e-09	3.32e-10
US electric grid	2,4-Dinitrotoluene	model/secondary	2.89e-09	3.24e-10
Japanese Electric Grid	Benzo[a]anthracene	model/secondary	2.69e-09	3.01e-10
LPG Production	Ethylbenzene	secondary	2.67e-09	2.98e-10
Fuel Oil #2 Prod.	Silicon	secondary	2.60e-09	2.91e-10
Fuel Oil #2 Prod.	Barium	secondary	2.56e-09	2.87e-10
Fuel Oil #2 Prod.	Cyanide (-1)	secondary	2.45e-09	2.74e-10
Fuel Oil #4 Prod.	Benzyl chloride	secondary	2.41e-09	2.70e-10
Natural Gas Prod.	Acetaldehyde	secondary	2.39e-09	2.67e-10
Natural Gas Prod.	Propionaldehyde	secondary	2.39e-09	2.67e-10
Fuel Oil #4 Prod.	Aluminum (elemental)	secondary	2.31e-09	2.58e-10
Natural Gas Prod.	Cadmium	secondary	2.21e-09	2.47e-10

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #2 Prod.	Barium cmpds	secondary	2.08e-09	2.32e-10
Fuel Oil #4 Prod.	Chloroform	secondary	1.88e-09	2.10e-10
Natural Gas Prod.	Di(2-ethylhexyl)phthalate	secondary	1.84e-09	2.05e-10
Fuel Oil #6 Prod.	Barium cmpds	secondary	1.83e-09	2.04e-10
Fuel Oil #2 Prod.	Lead	secondary	1.81e-09	2.02e-10
Japanese Electric Grid	Chrysene	model/secondary	1.80e-09	2.01e-10
Fuel Oil #6 Prod.	Carbon disulfide	secondary	1.64e-09	1.84e-10
Japanese Electric Grid	Acetophenone	model/secondary	1.62e-09	1.81e-10
Japanese Electric Grid	Biphenyl	model/secondary	1.56e-09	1.74e-10
Japanese Electric Grid	Indeno(1,2,3-cd)pyrene	model/secondary	1.51e-09	1.68e-10
Japanese Electric Grid	Benzo[g,h,i]perylene	model/secondary	1.45e-09	1.62e-10
US electric grid	Ethylbenzene	model/secondary	1.43e-09	1.60e-10
Fuel Oil #6 Prod.	Aluminum (elemental)	secondary	1.37e-09	1.53e-10
LPG Production	Methyl tert-butyl ether	secondary	1.34e-09	1.50e-10
Fuel Oil #4 Prod.	Cobalt	secondary	1.33e-09	1.49e-10
Japanese Electric Grid	Benzo[b,j,k]fluoranthene	model/secondary	1.31e-09	1.46e-10
Monitor/module	1,1,1-Trichloroethane	primary	1.30e-09	1.45e-10
Fuel Oil #6 Prod.	Benzyl chloride	secondary	1.29e-09	1.44e-10
Japanese Electric Grid	Acenaphthylene	model/secondary	1.11e-09	1.24e-10
LPG Production	Phenanthrene	secondary	1.09e-09	1.22e-10
Fuel Oil #6 Prod.	Chloroform	secondary	1.00e-09	1.12e-10
Fuel Oil #4 Prod.	Acrolein	secondary	1.00e-09	1.12e-10
Japanese Electric Grid	Dibenzo[a,h]anthracene	model/secondary	9.95e-10	1.11e-10
LPG Production	Styrene	secondary	9.76e-10	1.09e-10
LPG Production	Vinyl acetate	secondary	9.52e-10	1.07e-10
LPG Production	3-Methylcholanthrene	secondary	8.99e-10	1.01e-10
Natural Gas Prod.	Dimethyl sulfate	secondary	8.78e-10	9.82e-11
Fuel Oil #2 Prod.	Carbon disulfide	secondary	8.75e-10	9.79e-11
Natural Gas Prod.	Isophorone	secondary	8.42e-10	9.42e-11
Natural Gas Prod.	Zinc (+2)	secondary	8.26e-10	9.24e-11
Fuel Oil #4 Prod.	Methyl chloride	secondary	8.10e-10	9.06e-11
Japanese Electric Grid	2-Methylnaphthalene	model/secondary	8.00e-10	8.94e-11
Natural Gas Prod.	Chlorine	secondary	7.46e-10	8.34e-11
US electric grid	Methyl tert-butyl ether	model/secondary	7.23e-10	8.09e-11
Fuel Oil #6 Prod.	Cobalt	secondary	7.23e-10	8.08e-11
Fuel Oil #4 Prod.	Beryllium	secondary	7.19e-10	8.04e-11
Fuel Oil #2 Prod.	Benzyl chloride	secondary	6.86e-10	7.67e-11
Natural Gas Prod.	Methyl ethyl ketone	secondary	6.79e-10	7.60e-11
Japanese Electric Grid	Pyrene	model/secondary	6.73e-10	7.52e-11
Natural Gas Prod.	Tetrachloroethylene	secondary	6.69e-10	7.48e-11
Fuel Oil #2 Prod.	Aluminum (elemental)	secondary	5.96e-10	6.67e-11
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	5.86e-10	6.56e-11
Japanese Electric Grid	Fluorene	model/secondary	5.86e-10	6.55e-11
Natural Gas Prod.	Silicon	secondary	5.85e-10	6.55e-11
Natural Gas Prod.	Methyl methacrylate	secondary	5.81e-10	6.49e-11
LPG Production	Zinc (+2)	secondary	5.63e-10	6.30e-11
Japanese Electric Grid	Fluoranthene	model/secondary	5.59e-10	6.26e-11
US electric grid	Phenol	model/secondary	5.51e-10	6.16e-11
Fuel Oil #2 Prod.	Chloroform	secondary	5.33e-10	5.96e-11
Fuel Oil #6 Prod.	Acrolein	secondary	5.33e-10	5.96e-11
US electric grid	Styrene	model/secondary	5.28e-10	5.90e-11

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
US electric grid	Vinyl acetate	model/secondary	5.15e-10	5.76e-11
Natural Gas Prod.	Barium cmpds	secondary	5.06e-10	5.66e-11
US electric grid	Phenanthrene	model/secondary	4.85e-10	5.43e-11
Natural Gas Prod.	1,2-Dichloroethane	secondary	4.84e-10	5.41e-11
Natural Gas Prod.	Bromoform	secondary	4.74e-10	5.31e-11
Natural Gas Prod.	Dichloromethane	secondary	4.58e-10	5.12e-11
Fuel Oil #4 Prod.	Acetaldehyde	secondary	4.50e-10	5.03e-11
Fuel Oil #4 Prod.	Propionaldehyde	secondary	4.50e-10	5.03e-11
Fuel Oil #4 Prod.	Mercury	secondary	4.46e-10	4.98e-11
Fuel Oil #6 Prod.	Methyl chloride	secondary	4.32e-10	4.83e-11
US electric grid	Xylene (mixed isomers)	model/secondary	4.27e-10	4.78e-11
Fuel Oil #4 Prod.	Cadmium	secondary	4.12e-10	4.60e-11
LPG Production	Ethylene dibromide	secondary	3.85e-10	4.31e-11
Natural Gas Prod.	Chlorobenzene	secondary	3.83e-10	4.29e-11
US electric grid	Chromium (III)	model/secondary	3.82e-10	4.27e-11
Fuel Oil #6 Prod.	Beryllium	secondary	3.81e-10	4.26e-11
Fuel Oil #2 Prod.	Cobalt	secondary	3.71e-10	4.15e-11
LPG Production	1,1,1-Trichloroethane	secondary	3.63e-10	4.06e-11
Fuel Oil #4 Prod.	Di(2-ethylhexyl)phthalate	secondary	3.46e-10	3.87e-11
Fuel Oil #6 Prod.	Methyl hydrazine	secondary	3.12e-10	3.49e-11
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	3.05e-10	3.41e-11
Fuel Oil #4 Prod.	Toluene	secondary	2.92e-10	3.27e-11
LPG Production	2-Methylnaphthalene	secondary	2.88e-10	3.22e-11
Fuel Oil #2 Prod.	Acrolein	secondary	2.84e-10	3.18e-11
Natural Gas Prod.	3-Methylcholanthrene	secondary	2.66e-10	2.98e-11
LPG Production	Ethyl Chloride	secondary	2.57e-10	2.88e-11
LPG Production	Chlorine	secondary	2.55e-10	2.86e-11
Natural Gas Prod.	Chromium (III)	secondary	2.54e-10	2.84e-11
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	2.44e-10	2.73e-11
Fuel Oil #6 Prod.	Acetaldehyde	secondary	2.40e-10	2.68e-11
Fuel Oil #6 Prod.	Propionaldehyde	secondary	2.40e-10	2.68e-11
Fuel Oil #6 Prod.	Mercury	secondary	2.36e-10	2.64e-11
Fuel Oil #2 Prod.	Methyl chloride	secondary	2.30e-10	2.57e-11
LPG Production	Cumene	secondary	2.18e-10	2.43e-11
Fuel Oil #6 Prod.	Cadmium	secondary	2.17e-10	2.42e-11
US electric grid	1,1,1-Trichloroethane	model/secondary	2.10e-10	2.35e-11
US electric grid	Ethylene dibromide	model/secondary	2.08e-10	2.33e-11
Fuel Oil #2 Prod.	Beryllium	secondary	2.05e-10	2.29e-11
Fuel Oil #6 Prod.	Di(2-ethylhexyl)phthalate	secondary	1.84e-10	2.06e-11
Fuel Oil #2 Prod.	Methyl hydrazine	secondary	1.67e-10	1.86e-11
Fuel Oil #4 Prod.	Dimethyl sulfate	secondary	1.66e-10	1.85e-11
Fuel Oil #4 Prod.	Isophorone	secondary	1.59e-10	1.77e-11
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	1.55e-10	1.73e-11
Natural Gas Prod.	Ethylbenzene	secondary	1.52e-10	1.70e-11
Japanese Electric Grid	Benzo[a]pyrene	model/secondary	1.46e-10	1.64e-11
Fuel Oil #6 Prod.	Toluene	secondary	1.43e-10	1.60e-11
US electric grid	Ethyl Chloride	model/secondary	1.39e-10	1.56e-11
LPG Production	Acetophenone	secondary	1.35e-10	1.52e-11
Natural Gas Prod.	Aluminum (elemental)	secondary	1.34e-10	1.50e-11

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	Biphenyl	secondary	1.30e-10	1.45e-11
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	1.28e-10	1.43e-11
Fuel Oil #2 Prod.	Acetaldehyde	secondary	1.28e-10	1.43e-11
Fuel Oil #2 Prod.	Propionaldehyde	secondary	1.28e-10	1.43e-11
Fuel Oil #2 Prod.	Mercury	secondary	1.27e-10	1.42e-11
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	1.26e-10	1.41e-11
Fuel Oil #2 Prod.	Cadmium	secondary	1.18e-10	1.32e-11
US electric grid	Cumene	model/secondary	1.18e-10	1.32e-11
Natural Gas Prod.	Phenanthrene	secondary	1.11e-10	1.24e-11
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	1.09e-10	1.22e-11
LPG Production	Acenaphthylene	secondary	1.03e-10	1.15e-11
Fuel Oil #2 Prod.	Di(2-ethylhexyl)phthalate	secondary	9.83e-11	1.10e-11
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	9.12e-11	1.02e-11
Fuel Oil #2 Prod.	Cadmium cmpds	secondary	9.09e-11	1.02e-11
Fuel Oil #4 Prod.	Bromoform	secondary	8.94e-11	1.00e-11
Fuel Oil #2 Prod.	Toluene	secondary	8.85e-11	9.90e-12
Fuel Oil #6 Prod.	Dimethyl sulfate	secondary	8.82e-11	9.87e-12
Fuel Oil #4 Prod.	Dichloromethane	secondary	8.63e-11	9.65e-12
LPG Production	Acenaphthene	secondary	8.56e-11	9.57e-12
Natural Gas Prod.	2-Methylnaphthalene	secondary	8.53e-11	9.54e-12
Fuel Oil #6 Prod.	Isophorone	secondary	8.46e-11	9.46e-12
Japanese Electric Grid	5-Methyl chrysene	model/secondary	8.46e-11	9.46e-12
Fuel Oil #6 Prod.	Cadmium cmpds	secondary	8.00e-11	8.94e-12
Natural Gas Prod.	Methyl tert-butyl ether	secondary	7.62e-11	8.52e-12
US electric grid	Acetophenone	model/secondary	7.33e-11	8.19e-12
Fuel Oil #4 Prod.	Chlorobenzene	secondary	7.22e-11	8.08e-12
US electric grid	Biphenyl	model/secondary	7.03e-11	7.86e-12
Fuel Oil #6 Prod.	1,4-Dichlorobenzene	secondary	6.95e-11	7.78e-12
Fuel Oil #6 Prod.	Methyl ethyl ketone	secondary	6.82e-11	7.63e-12
Fuel Oil #6 Prod.	Tetrachloroethylene	secondary	6.72e-11	7.51e-12
LPG Production	Nickel cmpds	secondary	6.66e-11	7.45e-12
LPG Production	Benzo[a]anthracene	secondary	5.99e-11	6.70e-12
Fuel Oil #6 Prod.	Methyl methacrylate	secondary	5.83e-11	6.52e-12
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	5.75e-11	6.43e-12
LPG Production	Chrysene	secondary	5.75e-11	6.43e-12
LPG Production	Lead cmpds	secondary	5.60e-11	6.26e-12
Natural Gas Prod.	Styrene	secondary	5.56e-11	6.22e-12
Natural Gas Prod.	Vinyl acetate	secondary	5.43e-11	6.07e-12
Fuel Oil #2 Prod.	1,4-Dichlorobenzene	secondary	4.95e-11	5.54e-12
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	4.92e-11	5.50e-12
Fuel Oil #6 Prod.	1,2-Dichloroethane	secondary	4.86e-11	5.44e-12
Fuel Oil #6 Prod.	Bromoform	secondary	4.77e-11	5.33e-12
Fuel Oil #2 Prod.	Dimethyl sulfate	secondary	4.70e-11	5.26e-12
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	4.60e-11	5.15e-12
Fuel Oil #6 Prod.	Dichloromethane	secondary	4.60e-11	5.15e-12
Fuel Oil #2 Prod.	Isophorone	secondary	4.51e-11	5.04e-12
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	4.46e-11	4.98e-12
Fuel Oil #4 Prod.	Chromium (III)	secondary	4.44e-11	4.96e-12
US electric grid	Acenaphthylene	model/secondary	4.37e-11	4.88e-12
Fuel Oil #6 Prod.	Chlorobenzene	secondary	3.85e-11	4.31e-12
US electric grid	Acenaphthene	model/secondary	3.74e-11	4.18e-12

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #2 Prod.	Methyl ethyl ketone	secondary	3.64e-11	4.07e-12
Fuel Oil #2 Prod.	Tetrachloroethylene	secondary	3.58e-11	4.00e-12
LPG Production	Benzo[b,j,k]fluoranthene	secondary	3.53e-11	3.95e-12
LPG Production	Mercury compounds	secondary	3.39e-11	3.79e-12
LPG Production	Benzo[a]pyrene	secondary	3.28e-11	3.67e-12
LPG Production	Fluorene	secondary	3.17e-11	3.54e-12
Fuel Oil #2 Prod.	Methyl methacrylate	secondary	3.11e-11	3.48e-12
Fuel Oil #4 Prod.	o-xylene	secondary	3.10e-11	3.47e-12
Fuel Oil #6 Prod.	2,4-Dinitrotoluene	secondary	3.06e-11	3.42e-12
Fuel Oil #4 Prod.	Ethylbenzene	secondary	2.86e-11	3.20e-12
LPG Production	Pyrene	secondary	2.74e-11	3.06e-12
LPG Production	Benzo[g,h,i]perylene	secondary	2.66e-11	2.98e-12
Fuel Oil #2 Prod.	1,2-Dichloroethane	secondary	2.59e-11	2.90e-12
LPG Production	Fluoranthene	secondary	2.59e-11	2.89e-12
Fuel Oil #2 Prod.	Bromoform	secondary	2.54e-11	2.84e-12
Fuel Oil #2 Prod.	Dichloromethane	secondary	2.45e-11	2.74e-12
LPG Production	HALON-1301	secondary	2.44e-11	2.72e-12
LPG Production	Benzo[b]fluoranthene	secondary	2.39e-11	2.68e-12
Fuel Oil #6 Prod.	Chromium (III)	secondary	2.37e-11	2.65e-12
Natural Gas Prod.	Cadmium cmpds	secondary	2.21e-11	2.47e-12
Natural Gas Prod.	Ethylene dibromide	secondary	2.20e-11	2.46e-12
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	2.07e-11	2.31e-12
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	2.06e-11	2.30e-12
Fuel Oil #2 Prod.	Chlorobenzene	secondary	2.05e-11	2.29e-12
US electric grid	Chrysene	model/secondary	1.98e-11	2.21e-12
Fuel Oil #2 Prod.	Aromatic hydrocarbons	secondary	1.83e-11	2.05e-12
Japanese Electric Grid	Anthracene	model/secondary	1.82e-11	2.04e-12
US electric grid	Benzo[a]anthracene	model/secondary	1.80e-11	2.01e-12
Fuel Oil #2 Prod.	Copper (+1 & +2)	secondary	1.72e-11	1.92e-12
LPG Production	Dibenzo[a,h]anthracene	secondary	1.70e-11	1.90e-12
Fuel Oil #2 Prod.	2,4-Dinitrotoluene	secondary	1.63e-11	1.83e-12
Fuel Oil #6 Prod.	Aromatic hydrocarbons	secondary	1.61e-11	1.80e-12
US electric grid	Fluorene	model/secondary	1.55e-11	1.73e-12
Fuel Oil #6 Prod.	Ethylbenzene	secondary	1.52e-11	1.70e-12
Fuel Oil #6 Prod.	Copper (+1 & +2)	secondary	1.51e-11	1.69e-12
Natural Gas Prod.	Ethyl Chloride	secondary	1.47e-11	1.64e-12
Fuel Oil #6 Prod.	o-xylene	secondary	1.46e-11	1.63e-12
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	1.44e-11	1.61e-12
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	1.28e-11	1.43e-12
Fuel Oil #2 Prod.	Chromium (III)	secondary	1.26e-11	1.41e-12
Natural Gas Prod.	Cumene	secondary	1.24e-11	1.39e-12
US electric grid	Fluoranthene	model/secondary	1.24e-11	1.38e-12
Fuel Oil #4 Prod.	Phenanthrene	secondary	1.13e-11	1.26e-12
Natural Gas Prod.	Acenaphthylene	secondary	1.10e-11	1.23e-12
Fuel Oil #4 Prod.	Styrene	secondary	1.05e-11	1.17e-12
Fuel Oil #4 Prod.	Vinyl acetate	secondary	1.02e-11	1.14e-12
US electric grid	Pyrene	model/secondary	1.02e-11	1.14e-12
Fuel Oil #2 Prod.	o-xylene	secondary	9.63e-12	1.08e-12
Natural Gas Prod.	Benzo[a]anthracene	secondary	8.84e-12	9.88e-13

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Chrysene	secondary	8.52e-12	9.52e-13
Fuel Oil #2 Prod.	Ethylbenzene	secondary	8.13e-12	9.09e-13
Fuel Oil #4 Prod.	3-Methylcholanthrene	secondary	8.12e-12	9.08e-13
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	7.77e-12	8.69e-13
Natural Gas Prod.	Acetophenone	secondary	7.72e-12	8.63e-13
Fuel Oil #6 Prod.	Methyl tert-butyl ether	secondary	7.66e-12	8.56e-13
Natural Gas Prod.	Biphenyl	secondary	7.40e-12	8.28e-13
US electric grid	o-xylene	model/secondary	7.35e-12	8.22e-13
Natural Gas Prod.	Acenaphthene	secondary	7.10e-12	7.94e-13
LPG Production	5-Methyl chrysene	secondary	7.06e-12	7.90e-13
US electric grid	Benzo[g,h,i]perylene	model/secondary	6.98e-12	7.81e-13
US electric grid	Benzo[a]pyrene	model/secondary	6.60e-12	7.38e-13
Natural Gas Prod.	Benzo[b]fluoranthene	secondary	6.58e-12	7.35e-13
Fuel Oil #6 Prod.	Phenanthrene	secondary	5.83e-12	6.52e-13
LPG Production	Halogenated matter (organic)	secondary	5.60e-12	6.26e-13
Fuel Oil #6 Prod.	Styrene	secondary	5.59e-12	6.25e-13
Fuel Oil #6 Prod.	Vinyl acetate	secondary	5.45e-12	6.10e-13
US electric grid	2-Methylnaphthalene	model/secondary	5.16e-12	5.78e-13
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	5.03e-12	5.63e-13
Natural Gas Prod.	Benzo[a]pyrene	secondary	4.96e-12	5.55e-13
Fuel Oil #4 Prod.	Zinc (+2)	secondary	4.60e-12	5.14e-13
Natural Gas Prod.	Dibenzo[a,h]anthracene	secondary	4.47e-12	5.00e-13
Natural Gas Prod.	Aromatic hydrocarbons	secondary	4.46e-12	4.99e-13
Natural Gas Prod.	Copper (+1 & +2)	secondary	4.17e-12	4.67e-13
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	4.14e-12	4.63e-13
Fuel Oil #2 Prod.	Methyl tert-butyl ether	secondary	4.08e-12	4.56e-13
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	3.90e-12	4.36e-13
Natural Gas Prod.	Pyrene	secondary	3.86e-12	4.32e-13
US electric grid	5-Methyl chrysene	model/secondary	3.82e-12	4.27e-13
Fuel Oil #6 Prod.	3-Methylcholanthrene	secondary	3.65e-12	4.08e-13
Fuel Oil #2 Prod.	Phenanthrene	secondary	3.28e-12	3.67e-13
Fuel Oil #2 Prod.	Styrene	secondary	2.98e-12	3.33e-13
Fuel Oil #2 Prod.	Vinyl acetate	secondary	2.91e-12	3.25e-13
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	2.76e-12	3.09e-13
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	2.60e-12	2.91e-13
Fuel Oil #2 Prod.	3-Methylcholanthrene	secondary	2.60e-12	2.91e-13
Natural Gas Prod.	Fluorene	secondary	2.58e-12	2.89e-13
Fuel Oil #4 Prod.	Cumene	secondary	2.34e-12	2.62e-13
Natural Gas Prod.	Fluoranthene	secondary	2.31e-12	2.58e-13
Fuel Oil #4 Prod.	Chlorine	secondary	2.26e-12	2.53e-13
Fuel Oil #6 Prod.	Ethylene dibromide	secondary	2.21e-12	2.47e-13
Fuel Oil #6 Prod.	1,1,1-Trichloroethane	secondary	2.08e-12	2.32e-13
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	2.01e-12	2.25e-13
Fuel Oil #6 Prod.	Zinc (+2)	secondary	1.81e-12	2.03e-13
US electric grid	Dibenzo[a,h]anthracene	model/secondary	1.69e-12	1.89e-13
Fuel Oil #2 Prod.	Zinc (+2)	secondary	1.58e-12	1.77e-13
Fuel Oil #6 Prod.	Ethyl Chloride	secondary	1.47e-12	1.65e-13
Fuel Oil #4 Prod.	Acetophenone	secondary	1.46e-12	1.63e-13
Fuel Oil #4 Prod.	Biphenyl	secondary	1.40e-12	1.56e-13
Fuel Oil #6 Prod.	Cumene	secondary	1.25e-12	1.39e-13
LPG Production	Anthracene	secondary	1.19e-12	1.33e-13

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #2 Prod.	Ethylene dibromide	secondary	1.18e-12	1.31e-13
Fuel Oil #6 Prod.	2-Methylnaphthalene	secondary	1.17e-12	1.31e-13
Fuel Oil #2 Prod.	1,1,1-Trichloroethane	secondary	1.11e-12	1.24e-13
Fuel Oil #4 Prod.	Acenaphthylene	secondary	1.06e-12	1.19e-13
Fuel Oil #6 Prod.	Chlorine	secondary	1.01e-12	1.13e-13
Fuel Oil #2 Prod.	2-Methylnaphthalene	secondary	8.33e-13	9.31e-14
Fuel Oil #4 Prod.	Acenaphthene	secondary	8.30e-13	9.29e-14
Fuel Oil #2 Prod.	Ethyl Chloride	secondary	7.85e-13	8.78e-14
Fuel Oil #6 Prod.	Acetophenone	secondary	7.76e-13	8.67e-14
Fuel Oil #6 Prod.	Biphenyl	secondary	7.44e-13	8.32e-14
Fuel Oil #2 Prod.	Chlorine	secondary	7.28e-13	8.14e-14
Fuel Oil #2 Prod.	Cumene	secondary	6.64e-13	7.43e-14
Fuel Oil #4 Prod.	Chrysene	secondary	5.68e-13	6.35e-14
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	5.64e-13	6.31e-14
Fuel Oil #6 Prod.	Acenaphthylene	secondary	5.49e-13	6.14e-14
Fuel Oil #4 Prod.	Nickel cmpds	secondary	4.88e-13	5.46e-14
US electric grid	Anthracene	model/secondary	4.49e-13	5.02e-14
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	4.30e-13	4.81e-14
Fuel Oil #2 Prod.	Acetophenone	secondary	4.13e-13	4.62e-14
Fuel Oil #4 Prod.	Lead cmpds	secondary	4.10e-13	4.59e-14
Fuel Oil #6 Prod.	Acenaphthene	secondary	4.04e-13	4.51e-14
Natural Gas Prod.	5-Methyl chrysene	secondary	4.03e-13	4.50e-14
Fuel Oil #2 Prod.	Biphenyl	secondary	3.96e-13	4.43e-14
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	3.79e-13	4.24e-14
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	3.38e-13	3.78e-14
Fuel Oil #4 Prod.	Fluorene	secondary	3.33e-13	3.72e-14
Fuel Oil #2 Prod.	Acenaphthylene	secondary	3.10e-13	3.46e-14
Fuel Oil #6 Prod.	Chrysene	secondary	2.81e-13	3.14e-14
Fuel Oil #4 Prod.	Pyrene	secondary	2.74e-13	3.07e-14
Fuel Oil #4 Prod.	Fluoranthene	secondary	2.69e-13	3.01e-14
Fuel Oil #6 Prod.	Benzo[a]anthracene	secondary	2.65e-13	2.97e-14
Fuel Oil #2 Prod.	Acenaphthene	secondary	2.53e-13	2.83e-14
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	2.49e-13	2.79e-14
Fuel Oil #4 Prod.	Mercury compounds	secondary	2.48e-13	2.78e-14
Fuel Oil #4 Prod.	Benzo[b]fluoranthene	secondary	2.12e-13	2.37e-14
Fuel Oil #6 Prod.	Indeno(1,2,3-cd)pyrene	secondary	2.08e-13	2.33e-14
Fuel Oil #6 Prod.	Benzo[b,j,k]fluoranthene	secondary	2.02e-13	2.26e-14
Japanese Electric Grid	2,3,7,8-TCDF	model/secondary	1.96e-13	2.20e-14
Fuel Oil #2 Prod.	Nickel cmpds	secondary	1.82e-13	2.03e-14
Fuel Oil #4 Prod.	HALON-1301	secondary	1.78e-13	2.00e-14
Fuel Oil #2 Prod.	Benzo[a]anthracene	secondary	1.75e-13	1.96e-14
Fuel Oil #6 Prod.	Fluorene	secondary	1.74e-13	1.94e-14
Fuel Oil #6 Prod.	Benzo[a]pyrene	secondary	1.74e-13	1.94e-14
Fuel Oil #2 Prod.	Chrysene	secondary	1.71e-13	1.91e-14
Fuel Oil #6 Prod.	Nickel cmpds	secondary	1.60e-13	1.79e-14
Fuel Oil #2 Prod.	Lead cmpds	secondary	1.53e-13	1.71e-14
Natural Gas Prod.	Anthracene	secondary	1.51e-13	1.69e-14
Fuel Oil #4 Prod.	Dibenzo[a,h]anthracene	secondary	1.49e-13	1.67e-14
Fuel Oil #6 Prod.	Fluoranthene	secondary	1.40e-13	1.56e-14

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #6 Prod.	Pyrene	secondary	1.37e-13	1.54e-14
Fuel Oil #6 Prod.	Lead cmpds	secondary	1.34e-13	1.50e-14
Fuel Oil #2 Prod.	Indeno(1,2,3-cd)pyrene	secondary	1.31e-13	1.47e-14
Fuel Oil #6 Prod.	Benzo[g,h,i]perylene	secondary	1.17e-13	1.31e-14
Fuel Oil #2 Prod.	Benzo[b,j,k]fluoranthene	secondary	1.08e-13	1.21e-14
Fuel Oil #2 Prod.	Benzo[a]pyrene	secondary	9.87e-14	1.10e-14
Fuel Oil #2 Prod.	Fluorene	secondary	9.59e-14	1.07e-14
Fuel Oil #6 Prod.	Benzo[b]fluoranthene	secondary	9.33e-14	1.04e-14
Fuel Oil #2 Prod.	Mercury compounds	secondary	9.25e-14	1.04e-14
Fuel Oil #2 Prod.	Pyrene	secondary	8.17e-14	9.14e-15
Fuel Oil #6 Prod.	Mercury compounds	secondary	8.14e-14	9.10e-15
Fuel Oil #2 Prod.	Fluoranthene	secondary	7.81e-14	8.74e-15
Fuel Oil #2 Prod.	Benzo[g,h,i]perylene	secondary	7.78e-14	8.70e-15
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	7.59e-14	8.49e-15
Fuel Oil #2 Prod.	Benzo[b]fluoranthene	secondary	6.88e-14	7.70e-15
Fuel Oil #2 Prod.	HALON-1301	secondary	6.65e-14	7.44e-15
Fuel Oil #6 Prod.	Dibenzo[a,h]anthracene	secondary	6.48e-14	7.25e-15
Fuel Oil #6 Prod.	HALON-1301	secondary	5.85e-14	6.54e-15
Fuel Oil #2 Prod.	Dibenzo[a,h]anthracene	secondary	4.88e-14	5.46e-15
Natural Gas Prod.	Nickel cmpds	secondary	4.43e-14	4.95e-15
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	4.10e-14	4.59e-15
Fuel Oil #6 Prod.	5-Methyl chrysene	secondary	4.04e-14	4.52e-15
Natural Gas Prod.	Lead cmpds	secondary	3.72e-14	4.16e-15
Natural Gas Prod.	Mercury compounds	secondary	2.25e-14	2.52e-15
Fuel Oil #2 Prod.	5-Methyl chrysene	secondary	2.16e-14	2.41e-15
Natural Gas Prod.	HALON-1301	secondary	1.62e-14	1.81e-15
Fuel Oil #2 Prod.	Halogenated matter (organic)	secondary	1.53e-14	1.71e-15
LPG Production	Halogenated hydrocarbons (unspecified)	secondary	1.40e-14	1.57e-15
Fuel Oil #6 Prod.	Halogenated matter (organic)	secondary	1.34e-14	1.50e-15
Fuel Oil #4 Prod.	Anthracene	secondary	1.21e-14	1.35e-15
US electric grid	2,3,7,8-TCDF	model/secondary	8.86e-15	9.90e-16
Fuel Oil #6 Prod.	Anthracene	secondary	6.10e-15	6.82e-16
Natural Gas Prod.	Halogenated matter (organic)	secondary	3.72e-15	4.16e-16
Fuel Oil #2 Prod.	Anthracene	secondary	3.56e-15	3.99e-16
Fuel Oil #4 Prod.	Halogenated hydrocarbons (unspecified)	secondary	1.02e-16	1.15e-17
Fuel Oil #2 Prod.	Halogenated hydrocarbons (unspecified)	secondary	3.82e-17	4.27e-18
Fuel Oil #6 Prod.	Halogenated hydrocarbons (unspecified)	secondary	3.36e-17	3.76e-18
Natural Gas Prod.	Halogenated hydrocarbons (unspecified)	secondary	9.28e-18	1.04e-18
Total Manufacturing			**2.33e+02**	**2.60e+01**
Use, Maintenance and Repair Life-cycle Stage				
US electric grid	Sulfur dioxide	model/secondary	6.15e+02	6.87e+01
US electric grid	Nitrogen oxides	model/secondary	4.39e-01	4.91e-02
US electric grid	Carbon monoxide	model/secondary	3.77e-01	4.22e-02
US electric grid	Methane	model/secondary	2.41e-01	2.69e-02
US electric grid	Arsenic	model/secondary	2.08e-01	2.33e-02
US electric grid	Hydrochloric acid	model/secondary	1.84e-01	2.06e-02
US electric grid	Selenium	model/secondary	3.46e-02	3.87e-03
US electric grid	Vanadium	model/secondary	2.61e-02	2.91e-03
US electric grid	PM-10	model/secondary	2.16e-02	2.41e-03
US electric grid	Hydrofluoric acid	model/secondary	5.02e-03	5.62e-04

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
US electric grid	Formaldehyde	model/secondary	3.62e-03	4.04e-04
US electric grid	Benzene	model/secondary	2.60e-03	2.91e-04
US electric grid	Phosphorus (yellow or white)	model/secondary	1.47e-03	1.64e-04
US electric grid	Nitrous oxide	model/secondary	1.27e-03	1.42e-04
US electric grid	Zinc (elemental)	model/secondary	6.77e-04	7.57e-05
US electric grid	Antimony	model/secondary	5.54e-04	6.19e-05
US electric grid	Molybdenum	model/secondary	1.85e-04	2.07e-05
US electric grid	2-Chloroacetophenone	model/secondary	1.61e-04	1.80e-05
US electric grid	Bromomethane	model/secondary	1.59e-04	1.78e-05
US electric grid	Cyanide (-1)	model/secondary	8.37e-05	9.36e-06
US electric grid	2,3,7,8-TCDD	model/secondary	6.33e-05	7.08e-06
US electric grid	Nickel	model/secondary	6.09e-05	6.81e-06
US electric grid	Naphthalene	model/secondary	5.04e-05	5.64e-06
US electric grid	Barium	model/secondary	4.35e-05	4.86e-06
US electric grid	Carbon disulfide	model/secondary	2.99e-05	3.34e-06
US electric grid	Benzyl chloride	model/secondary	2.34e-05	2.62e-06
US electric grid	Chloroform	model/secondary	1.82e-05	2.04e-06
US electric grid	Manganese	model/secondary	1.70e-05	1.90e-06
US electric grid	Chromium (VI)	model/secondary	1.28e-05	1.43e-06
US electric grid	Acrolein	model/secondary	9.71e-06	1.09e-06
US electric grid	Copper	model/secondary	8.34e-06	9.33e-07
US electric grid	Methyl chloride	model/secondary	7.86e-06	8.79e-07
US electric grid	Fluoride	model/secondary	7.29e-06	8.15e-07
US electric grid	Methyl hydrazine	model/secondary	5.69e-06	6.36e-07
US electric grid	Lead	model/secondary	4.76e-06	5.32e-07
US electric grid	Cobalt	model/secondary	4.54e-06	5.07e-07
US electric grid	Acetaldehyde	model/secondary	4.37e-06	4.89e-07
US electric grid	Propionaldehyde	model/secondary	4.37e-06	4.89e-07
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	3.36e-06	3.75e-07
US electric grid	Mercury	model/secondary	2.80e-06	3.14e-07
US electric grid	Hexane	model/secondary	2.24e-06	2.51e-07
US electric grid	Cadmium	model/secondary	1.80e-06	2.01e-07
US electric grid	Dimethyl sulfate	model/secondary	1.61e-06	1.80e-07
US electric grid	Toluene	model/secondary	1.59e-06	1.77e-07
US electric grid	Isophorone	model/secondary	1.54e-06	1.72e-07
US electric grid	Methyl ethyl ketone	model/secondary	1.24e-06	1.39e-07
US electric grid	Tetrachloroethylene	model/secondary	1.22e-06	1.37e-07
US electric grid	Methyl methacrylate	model/secondary	1.06e-06	1.19e-07
US electric grid	1,2-Dichloroethane	model/secondary	8.85e-07	9.90e-08
US electric grid	Bromoform	model/secondary	8.68e-07	9.71e-08
US electric grid	Dichloromethane	model/secondary	8.38e-07	9.37e-08
US electric grid	Beryllium	model/secondary	7.12e-07	7.96e-08
US electric grid	Chlorobenzene	model/secondary	7.01e-07	7.84e-08
US electric grid	2,4-Dinitrotoluene	model/secondary	5.58e-07	6.24e-08
US electric grid	Ethylbenzene	model/secondary	2.76e-07	3.09e-08
US electric grid	Methyl tert-butyl ether	model/secondary	1.39e-07	1.56e-08
US electric grid	Phenol	model/secondary	1.06e-07	1.19e-08
US electric grid	Styrene	model/secondary	1.02e-07	1.14e-08
US electric grid	Vinyl acetate	model/secondary	9.93e-08	1.11e-08

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
US electric grid	Phenanthrene	model/secondary	9.35e-08	1.05e-08
US electric grid	Xylene (mixed isomers)	model/secondary	8.23e-08	9.21e-09
US electric grid	Chromium (III)	model/secondary	7.36e-08	8.23e-09
US electric grid	1,1,1-Trichloroethane	model/secondary	4.05e-08	4.53e-09
US electric grid	Ethylene dibromide	model/secondary	4.02e-08	4.49e-09
US electric grid	Ethyl Chloride	model/secondary	2.68e-08	3.00e-09
US electric grid	Cumene	model/secondary	2.27e-08	2.54e-09
US electric grid	Acetophenone	model/secondary	1.41e-08	1.58e-09
US electric grid	Biphenyl	model/secondary	1.35e-08	1.51e-09
US electric grid	Acenaphthylene	model/secondary	8.42e-09	9.41e-10
US electric grid	Acenaphthene	model/secondary	7.21e-09	8.06e-10
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	3.97e-09	4.44e-10
US electric grid	Chrysene	model/secondary	3.81e-09	4.26e-10
US electric grid	Benzo[a]anthracene	model/secondary	3.46e-09	3.87e-10
US electric grid	Fluorene	model/secondary	2.98e-09	3.34e-10
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	2.46e-09	2.75e-10
US electric grid	Fluoranthene	model/secondary	2.38e-09	2.67e-10
US electric grid	Pyrene	model/secondary	1.97e-09	2.21e-10
US electric grid	o-xylene	model/secondary	1.42e-09	1.58e-10
US electric grid	Benzo[g,h,i]perylene	model/secondary	1.35e-09	1.50e-10
US electric grid	Benzo[a]pyrene	model/secondary	1.27e-09	1.42e-10
US electric grid	2-Methylnaphthalene	model/secondary	9.95e-10	1.11e-10
US electric grid	5-Methyl chrysene	model/secondary	7.36e-10	8.24e-11
US electric grid	Dibenzo[a,h]anthracene	model/secondary	3.26e-10	3.65e-11
US electric grid	Anthracene	model/secondary	8.65e-11	9.67e-12
US electric grid	2,3,7,8-TCDF	model/secondary	1.71e-12	1.91e-13
Total Use, Maintenance, and Repair			**6.16e+02**	**6.89e+01**
End-of-life Life-cycle Stage				
US electric grid	Sulfur dioxide	model/secondary	1.17e-01	1.30e-02
LCD landfilling	Sulfur dioxide	primary	4.45e-02	4.98e-03
LCD incineration	Sulfur dioxide	secondary	3.45e-02	3.86e-03
LCD landfilling	Carbon monoxide	primary	2.22e-03	2.48e-04
LCD landfilling	Nitrogen dioxide	primary	4.46e-04	4.99e-05
US electric grid	Nitrogen oxides	model/secondary	8.34e-05	9.32e-06
US electric grid	Carbon monoxide	model/secondary	7.15e-05	8.00e-06
LCD landfilling	PM	primary	5.02e-05	5.61e-06
US electric grid	Methane	model/secondary	4.57e-05	5.11e-06
LCD incineration	Arsenic cmpds	secondary	4.30e-05	4.80e-06
US electric grid	Arsenic	model/secondary	3.95e-05	4.42e-06
LCD landfilling	Arsenic cmpds	primary	3.65e-05	4.08e-06
US electric grid	Hydrochloric acid	model/secondary	3.49e-05	3.90e-06
LPG Production	Carbon monoxide	secondary	2.11e-05	2.35e-06
LCD landfilling	Methane	primary	1.31e-05	1.47e-06
LCD landfilling	Benzene	primary	9.74e-06	1.09e-06
US electric grid	Selenium	model/secondary	6.57e-06	7.35e-07
US electric grid	Vanadium	model/secondary	4.94e-06	5.53e-07
LCD incineration	Lead	secondary	4.80e-06	5.37e-07
LPG Production	Vanadium	secondary	4.12e-06	4.61e-07
US electric grid	PM-10	model/secondary	4.09e-06	4.58e-07
LPG Production	Benzene	secondary	3.38e-06	3.78e-07

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	Methane	secondary	3.30e-06	3.69e-07
LPG Production	Sulfur oxides	secondary	3.16e-06	3.53e-07
LCD landfilling	Silver compounds	primary	2.52e-06	2.82e-07
LCD incineration	Barium cmpds	secondary	2.33e-06	2.60e-07
LPG Production	Nitrogen oxides	secondary	2.26e-06	2.52e-07
LCD landfilling	Barium cmpds	primary	1.96e-06	2.19e-07
LCD incineration	Silver compounds	secondary	1.95e-06	2.19e-07
LCD landfilling	Hydrochloric acid	primary	1.13e-06	1.26e-07
US electric grid	Hydrofluoric acid	model/secondary	9.53e-07	1.07e-07
LPG Production	Arsenic	secondary	8.13e-07	9.10e-08
US electric grid	Formaldehyde	model/secondary	6.86e-07	7.67e-08
LCD landfilling	Ammonia	primary	5.79e-07	6.48e-08
LPG Production	Formaldehyde	secondary	5.28e-07	5.90e-08
LPG Production	PM	secondary	5.08e-07	5.68e-08
US electric grid	Benzene	model/secondary	4.94e-07	5.52e-08
LCD incineration	Cadmium cmpds	secondary	3.54e-07	3.96e-08
LCD landfilling	Cadmium cmpds	primary	3.27e-07	3.65e-08
US electric grid	Phosphorus (yellow or white)	model/secondary	2.78e-07	3.11e-08
US electric grid	Nitrous oxide	model/secondary	2.41e-07	2.69e-08
LPG Production	Hydrochloric acid	secondary	1.45e-07	1.62e-08
US electric grid	Zinc (elemental)	model/secondary	1.28e-07	1.44e-08
US electric grid	Antimony	model/secondary	1.05e-07	1.17e-08
LPG Production	Nitrous oxide	secondary	6.39e-08	7.15e-09
LCD landfilling	Hydrogen sulfide	primary	5.54e-08	6.20e-09
LPG Production	Phosphorus (yellow or white)	secondary	3.86e-08	4.32e-09
US electric grid	Molybdenum	model/secondary	3.51e-08	3.93e-09
US electric grid	2-Chloroacetophenone	model/secondary	3.05e-08	3.42e-09
US electric grid	Bromomethane	model/secondary	3.02e-08	3.38e-09
LPG Production	Fluorides (F-)	secondary	2.96e-08	3.31e-09
LPG Production	Selenium	secondary	2.92e-08	3.27e-09
US electric grid	Cyanide (-1)	model/secondary	1.59e-08	1.78e-09
LPG Production	Ammonia	secondary	1.47e-08	1.65e-09
LPG Production	Hydrogen sulfide	secondary	1.21e-08	1.35e-09
US electric grid	2,3,7,8-TCDD	model/secondary	1.20e-08	1.34e-09
US electric grid	Nickel	model/secondary	1.15e-08	1.29e-09
LCD landfilling	Selenium	primary	1.05e-08	1.17e-09
US electric grid	Naphthalene	model/secondary	9.56e-09	1.07e-09
US electric grid	Barium	model/secondary	8.25e-09	9.22e-10
LPG Production	Molybdenum	secondary	6.49e-09	7.25e-10
US electric grid	Carbon disulfide	model/secondary	5.67e-09	6.34e-10
LPG Production	Zinc (elemental)	secondary	4.72e-09	5.28e-10
LCD landfilling	Chromium (VI)	primary	4.65e-09	5.20e-10
LCD incineration	Mercury compounds	secondary	4.57e-09	5.11e-10
US electric grid	Benzyl chloride	model/secondary	4.45e-09	4.97e-10
LCD landfilling	Carbon tetrachloride	primary	4.04e-09	4.52e-10
LPG Production	Hydrofluoric acid	secondary	3.95e-09	4.42e-10
LCD landfilling	Mercury compounds	primary	3.95e-09	4.42e-10
US electric grid	Chloroform	model/secondary	3.46e-09	3.87e-10
US electric grid	Manganese	model/secondary	3.23e-09	3.61e-10

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LCD incineration	Carbon tetrachloride	secondary	3.13e-09	3.50e-10
LCD landfilling	Chloroform	primary	3.13e-09	3.50e-10
LPG Production	Ethane	secondary	3.06e-09	3.42e-10
LPG Production	Phenol	secondary	2.82e-09	3.15e-10
LPG Production	Pentane	secondary	2.56e-09	2.87e-10
US electric grid	Chromium (VI)	model/secondary	2.43e-09	2.72e-10
LCD landfilling	Toluene	primary	1.98e-09	2.21e-10
US electric grid	Acrolein	model/secondary	1.84e-09	2.06e-10
LPG Production	Hexane	secondary	1.78e-09	1.99e-10
US electric grid	Copper	model/secondary	1.58e-09	1.77e-10
US electric grid	Methyl chloride	model/secondary	1.49e-09	1.67e-10
US electric grid	Fluoride	model/secondary	1.38e-09	1.55e-10
LPG Production	Nickel	secondary	1.14e-09	1.28e-10
US electric grid	Methyl hydrazine	model/secondary	1.08e-09	1.21e-10
US electric grid	Lead	model/secondary	9.03e-10	1.01e-10
LPG Production	PM-10	secondary	8.86e-10	9.91e-11
US electric grid	Cobalt	model/secondary	8.61e-10	9.63e-11
LPG Production	Antimony	secondary	8.42e-10	9.42e-11
US electric grid	Propionaldehyde	model/secondary	8.29e-10	9.27e-11
US electric grid	Acetaldehyde	model/secondary	8.29e-10	9.27e-11
US electric grid	Di(2-ethylhexyl)phthalate	model/secondary	6.37e-10	7.12e-11
LPG Production	Aluminum (+3)	secondary	5.58e-10	6.24e-11
US electric grid	Mercury	model/secondary	5.32e-10	5.95e-11
US electric grid	Hexane	model/secondary	4.26e-10	4.76e-11
LCD landfilling	Xylene (mixed isomers)	primary	4.08e-10	4.56e-11
LPG Production	Chromium (VI)	secondary	3.97e-10	4.44e-11
US electric grid	Cadmium	model/secondary	3.41e-10	3.82e-11
US electric grid	Dimethyl sulfate	model/secondary	3.05e-10	3.41e-11
US electric grid	Toluene	model/secondary	3.01e-10	3.36e-11
US electric grid	Isophorone	model/secondary	2.92e-10	3.27e-11
LCD landfilling	Tetrachloroethylene	primary	2.89e-10	3.23e-11
LCD incineration	Lead cmpds	secondary	2.59e-10	2.90e-11
LCD landfilling	Lead cmpds	primary	2.40e-10	2.69e-11
LPG Production	Nitrate	secondary	2.39e-10	2.67e-11
US electric grid	Methyl ethyl ketone	model/secondary	2.36e-10	2.64e-11
US electric grid	Tetrachloroethylene	model/secondary	2.32e-10	2.60e-11
LCD landfilling	1,2-Dichloroethane	primary	2.24e-10	2.51e-11
US electric grid	Methyl methacrylate	model/secondary	2.02e-10	2.25e-11
LCD landfilling	Trichloroethylene	primary	1.68e-10	1.88e-11
US electric grid	1,2-Dichloroethane	model/secondary	1.68e-10	1.88e-11
US electric grid	Bromoform	model/secondary	1.65e-10	1.84e-11
US electric grid	Dichloromethane	model/secondary	1.59e-10	1.78e-11
LPG Production	Copper	secondary	1.37e-10	1.54e-11
US electric grid	Beryllium	model/secondary	1.35e-10	1.51e-11
US electric grid	Chlorobenzene	model/secondary	1.33e-10	1.49e-11
LCD incineration	Trichloroethylene	secondary	1.31e-10	1.46e-11
LPG Production	2-Chloroacetophenone	secondary	1.27e-10	1.42e-11
LPG Production	Dimethylbenzanthracene	secondary	1.26e-10	1.41e-11
LPG Production	Bromomethane	secondary	1.25e-10	1.40e-11
LCD landfilling	Ethylbenzene	primary	1.07e-10	1.19e-11
US electric grid	2,4-Dinitrotoluene	model/secondary	1.06e-10	1.18e-11

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	Naphthalene	secondary	1.02e-10	1.14e-11
LPG Production	Manganese	secondary	8.79e-11	9.83e-12
LPG Production	Barium	secondary	7.34e-11	8.21e-12
LPG Production	Silicon	secondary	6.66e-11	7.45e-12
LPG Production	Cyanide (-1)	secondary	6.59e-11	7.37e-12
LPG Production	Barium cmpds	secondary	6.25e-11	6.99e-12
US electric grid	Ethylbenzene	model/secondary	5.24e-11	5.86e-12
LPG Production	Lead	secondary	4.87e-11	5.44e-12
LCD landfilling	Dichloromethane	primary	4.68e-11	5.24e-12
US electric grid	Methyl tert-butyl ether	model/secondary	2.65e-11	2.96e-12
LPG Production	Carbon disulfide	secondary	2.35e-11	2.63e-12
US electric grid	Phenol	model/secondary	2.02e-11	2.25e-12
US electric grid	Styrene	model/secondary	1.93e-11	2.16e-12
US electric grid	Vinyl acetate	model/secondary	1.88e-11	2.11e-12
LPG Production	Benzyl chloride	secondary	1.84e-11	2.06e-12
US electric grid	Phenanthrene	model/secondary	1.77e-11	1.98e-12
US electric grid	Xylene (mixed isomers)	model/secondary	1.56e-11	1.75e-12
LPG Production	Aluminum (elemental)	secondary	1.52e-11	1.71e-12
LPG Production	Chloroform	secondary	1.43e-11	1.60e-12
US electric grid	Chromium (III)	model/secondary	1.40e-11	1.56e-12
LPG Production	Cobalt	secondary	9.89e-12	1.11e-12
LCD incineration	o-xylene	secondary	9.08e-12	1.02e-12
LCD landfilling	Chromium (III)	primary	7.92e-12	8.86e-13
US electric grid	1,1,1-Trichloroethane	model/secondary	7.68e-12	8.59e-13
LPG Production	Acrolein	secondary	7.64e-12	8.55e-13
US electric grid	Ethylene dibromide	model/secondary	7.62e-12	8.52e-13
LPG Production	Methyl chloride	secondary	6.19e-12	6.92e-13
LPG Production	Beryllium	secondary	5.53e-12	6.19e-13
US electric grid	Ethyl Chloride	model/secondary	5.09e-12	5.69e-13
LPG Production	Methyl hydrazine	secondary	4.48e-12	5.01e-13
US electric grid	Cumene	model/secondary	4.31e-12	4.82e-13
LPG Production	Acetaldehyde	secondary	3.44e-12	3.85e-13
LPG Production	Propionaldehyde	secondary	3.44e-12	3.85e-13
LPG Production	Mercury	secondary	3.42e-12	3.83e-13
LPG Production	Cadmium	secondary	3.19e-12	3.57e-13
LPG Production	Cadmium cmpds	secondary	2.74e-12	3.06e-13
US electric grid	Acetophenone	model/secondary	2.68e-12	3.00e-13
LPG Production	Di(2-ethylhexyl)phthalate	secondary	2.64e-12	2.96e-13
US electric grid	Biphenyl	model/secondary	2.57e-12	2.87e-13
LPG Production	Toluene	secondary	2.45e-12	2.75e-13
US electric grid	Acenaphthylene	model/secondary	1.60e-12	1.79e-13
LPG Production	1,4-Dichlorobenzene	secondary	1.41e-12	1.57e-13
US electric grid	Acenaphthene	model/secondary	1.37e-12	1.53e-13
LPG Production	Dimethyl sulfate	secondary	1.27e-12	1.41e-13
LPG Production	Isophorone	secondary	1.21e-12	1.36e-13
LPG Production	Methyl ethyl ketone	secondary	9.79e-13	1.09e-13
LPG Production	Tetrachloroethylene	secondary	9.63e-13	1.08e-13
LPG Production	Methyl methacrylate	secondary	8.36e-13	9.35e-14
US electric grid	Benzo[b,j,k]fluoranthene	model/secondary	7.53e-13	8.43e-14

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
US electric grid	Chrysene	model/secondary	7.23e-13	8.09e-14
LPG Production	1,2-Dichloroethane	secondary	6.97e-13	7.79e-14
LPG Production	Bromoform	secondary	6.83e-13	7.64e-14
LPG Production	Chromium (III)	secondary	6.76e-13	7.56e-14
LCD landfilling	Vinyl chloride	primary	6.68e-13	7.47e-14
LPG Production	Dichloromethane	secondary	6.60e-13	7.38e-14
US electric grid	Benzo[a]anthracene	model/secondary	6.57e-13	7.34e-14
US electric grid	Fluorene	model/secondary	5.66e-13	6.33e-14
LPG Production	Chlorobenzene	secondary	5.52e-13	6.17e-14
LPG Production	Aromatic hydrocarbons	secondary	5.52e-13	6.17e-14
LCD incineration	Vinyl chloride	secondary	5.18e-13	5.79e-14
LPG Production	Copper (+1 & +2)	secondary	5.16e-13	5.77e-14
US electric grid	Indeno(1,2,3-cd)pyrene	model/secondary	4.67e-13	5.22e-14
US electric grid	Fluoranthene	model/secondary	4.52e-13	5.06e-14
LPG Production	2,4-Dinitrotoluene	secondary	4.39e-13	4.91e-14
US electric grid	Pyrene	model/secondary	3.74e-13	4.18e-14
LPG Production	o-xylene	secondary	2.70e-13	3.02e-14
US electric grid	o-xylene	model/secondary	2.69e-13	3.00e-14
US electric grid	Benzo[g,h,i]perylene	model/secondary	2.55e-13	2.85e-14
US electric grid	Benzo[a]pyrene	model/secondary	2.41e-13	2.70e-14
LPG Production	Ethylbenzene	secondary	2.19e-13	2.45e-14
US electric grid	2-Methylnaphthalene	model/secondary	1.89e-13	2.11e-14
US electric grid	5-Methyl chrysene	model/secondary	1.40e-13	1.56e-14
LPG Production	Methyl tert-butyl ether	secondary	1.10e-13	1.23e-14
LPG Production	Phenanthrene	secondary	8.93e-14	9.98e-15
LPG Production	Styrene	secondary	8.01e-14	8.96e-15
LPG Production	Vinyl acetate	secondary	7.82e-14	8.74e-15
LPG Production	3-Methylcholanthrene	secondary	7.38e-14	8.26e-15
US electric grid	Dibenzo[a,h]anthracene	model/secondary	6.19e-14	6.92e-15
LPG Production	Zinc (+2)	secondary	4.62e-14	5.17e-15
LPG Production	Ethylene dibromide	secondary	3.16e-14	3.54e-15
LPG Production	1,1,1-Trichloroethane	secondary	2.98e-14	3.33e-15
LPG Production	2-Methylnaphthalene	secondary	2.37e-14	2.65e-15
LPG Production	Ethyl Chloride	secondary	2.11e-14	2.36e-15
LPG Production	Chlorine	secondary	2.10e-14	2.34e-15
LPG Production	Cumene	secondary	1.79e-14	2.00e-15
US electric grid	Anthracene	model/secondary	1.64e-14	1.84e-15
LPG Production	Acetophenone	secondary	1.11e-14	1.24e-15
LPG Production	Biphenyl	secondary	1.07e-14	1.19e-15
LPG Production	Acenaphthylene	secondary	8.43e-15	9.43e-16
LPG Production	Acenaphthene	secondary	7.02e-15	7.86e-16
LPG Production	Nickel cmpds	secondary	5.47e-15	6.12e-16
LPG Production	Benzo[a]anthracene	secondary	4.92e-15	5.50e-16
LPG Production	Chrysene	secondary	4.72e-15	5.27e-16
LPG Production	Lead cmpds	secondary	4.60e-15	5.14e-16
LPG Production	Indeno(1,2,3-cd)pyrene	secondary	3.66e-15	4.09e-16
LPG Production	Benzo[b,j,k]fluoranthene	secondary	2.90e-15	3.24e-16
LPG Production	Mercury compounds	secondary	2.78e-15	3.11e-16
LPG Production	Benzo[a]pyrene	secondary	2.69e-15	3.01e-16
LPG Production	Fluorene	secondary	2.60e-15	2.91e-16
LPG Production	Pyrene	secondary	2.25e-15	2.52e-16

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
LPG Production	Benzo[g,h,i]perylene	secondary	2.19e-15	2.44e-16
LPG Production	Fluoranthene	secondary	2.12e-15	2.37e-16
LPG Production	HALON-1301	secondary	2.00e-15	2.24e-16
LPG Production	Benzo[b]fluoranthene	secondary	1.96e-15	2.20e-16
LPG Production	Dibenzo[a,h]anthracene	secondary	1.40e-15	1.56e-16
LPG Production	5-Methyl chrysene	secondary	5.80e-16	6.48e-17
LPG Production	Halogenated matter (organic)	secondary	4.60e-16	5.14e-17
US electric grid	2,3,7,8-TCDF	model/secondary	3.24e-16	3.62e-17
LPG Production	Anthracene	secondary	9.78e-17	1.09e-17
LPG Production	Halogenated hydrocarbons (unspecified)	secondary	1.15e-18	1.29e-19
Natural Gas Prod.	Halogenated hydrocarbons (unspecified)	secondary	-1.95e-18	-2.18e-19
LCD incineration	Halogenated hydrocarbons (unspecified)	secondary	-2.06e-17	-2.31e-18
Fuel Oil #4 Prod.	Halogenated hydrocarbons (unspecified)	secondary	-4.72e-16	-5.28e-17
Natural Gas Prod.	Halogenated matter (organic)	secondary	-7.81e-16	-8.73e-17
Natural Gas Prod.	HALON-1301	secondary	-3.40e-15	-3.80e-16
Natural Gas Prod.	Mercury compounds	secondary	-4.73e-15	-5.29e-16
Natural Gas Prod.	Lead cmpds	secondary	-7.81e-15	-8.73e-16
Natural Gas Prod.	Nickel cmpds	secondary	-9.29e-15	-1.04e-15
LCD incineration	Halogenated matter (organic)	secondary	-1.19e-14	-1.33e-15
Natural Gas Prod.	Anthracene	secondary	-3.17e-14	-3.54e-15
LCD incineration	HALON-1301	secondary	-5.17e-14	-5.79e-15
Fuel Oil #4 Prod.	Anthracene	secondary	-5.55e-14	-6.21e-15
Natural Gas Prod.	5-Methyl chrysene	secondary	-8.45e-14	-9.45e-15
LCD incineration	Nickel cmpds	secondary	-1.42e-13	-1.58e-14
Fuel Oil #4 Prod.	Halogenated matter (organic)	secondary	-1.89e-13	-2.11e-14
LCD incineration	Dibenzo[a,h]anthracene	secondary	-2.91e-13	-3.26e-14
Fuel Oil #4 Prod.	5-Methyl chrysene	secondary	-3.50e-13	-3.91e-14
Natural Gas Prod.	Benzo[b,j,k]fluoranthene	secondary	-4.23e-13	-4.73e-14
LCD incineration	Benzo[b]fluoranthene	secondary	-4.31e-13	-4.82e-14
Natural Gas Prod.	Fluoranthene	secondary	-4.85e-13	-5.42e-14
Natural Gas Prod.	Fluorene	secondary	-5.43e-13	-6.07e-14
Fuel Oil #4 Prod.	Dibenzo[a,h]anthracene	secondary	-6.88e-13	-7.70e-14
Natural Gas Prod.	Pyrene	secondary	-8.10e-13	-9.06e-14
Fuel Oil #4 Prod.	HALON-1301	secondary	-8.22e-13	-9.19e-14
Natural Gas Prod.	Copper (+1 & +2)	secondary	-8.77e-13	-9.80e-14
Natural Gas Prod.	Aromatic hydrocarbons	secondary	-9.37e-13	-1.05e-13
Natural Gas Prod.	Dibenzo[a,h]anthracene	secondary	-9.38e-13	-1.05e-13
Fuel Oil #4 Prod.	Benzo[b]fluoranthene	secondary	-9.78e-13	-1.09e-13
Natural Gas Prod.	Benzo[a]pyrene	secondary	-1.04e-12	-1.17e-13
Natural Gas Prod.	Benzo[g,h,i]perylene	secondary	-1.06e-12	-1.18e-13
Fuel Oil #4 Prod.	Mercury compounds	secondary	-1.14e-12	-1.28e-13
Fuel Oil #4 Prod.	Benzo[g,h,i]perylene	secondary	-1.15e-12	-1.28e-13
Fuel Oil #4 Prod.	Fluoranthene	secondary	-1.24e-12	-1.39e-13
Fuel Oil #4 Prod.	Pyrene	secondary	-1.26e-12	-1.41e-13
Natural Gas Prod.	Benzo[b]fluoranthene	secondary	-1.38e-12	-1.54e-13
Natural Gas Prod.	Acenaphthene	secondary	-1.49e-12	-1.67e-13
Fuel Oil #4 Prod.	Fluorene	secondary	-1.53e-12	-1.71e-13
Natural Gas Prod.	Biphenyl	secondary	-1.55e-12	-1.74e-13
Fuel Oil #4 Prod.	Benzo[a]pyrene	secondary	-1.56e-12	-1.74e-13

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Acetophenone	secondary	-1.62e-12	-1.81e-13
Natural Gas Prod.	Indeno(1,2,3-cd)pyrene	secondary	-1.63e-12	-1.83e-13
Fuel Oil #4 Prod.	Benzo[b,j,k]fluoranthene	secondary	-1.75e-12	-1.96e-13
Natural Gas Prod.	Chrysene	secondary	-1.79e-12	-2.00e-13
Natural Gas Prod.	Benzo[a]anthracene	secondary	-1.86e-12	-2.08e-13
Fuel Oil #4 Prod.	Lead cmpds	secondary	-1.89e-12	-2.11e-13
Fuel Oil #4 Prod.	Indeno(1,2,3-cd)pyrene	secondary	-1.98e-12	-2.22e-13
Fuel Oil #4 Prod.	Nickel cmpds	secondary	-2.25e-12	-2.51e-13
Natural Gas Prod.	Acenaphthylene	secondary	-2.32e-12	-2.59e-13
LCD incineration	Anthracene	secondary	-2.41e-12	-2.70e-13
Fuel Oil #4 Prod.	Benzo[a]anthracene	secondary	-2.60e-12	-2.91e-13
Natural Gas Prod.	Cumene	secondary	-2.61e-12	-2.91e-13
Fuel Oil #4 Prod.	Chrysene	secondary	-2.61e-12	-2.92e-13
Natural Gas Prod.	Ethyl Chloride	secondary	-3.08e-12	-3.44e-13
Fuel Oil #4 Prod.	Acenaphthene	secondary	-3.83e-12	-4.28e-13
Natural Gas Prod.	1,1,1-Trichloroethane	secondary	-4.35e-12	-4.86e-13
Natural Gas Prod.	Ethylene dibromide	secondary	-4.61e-12	-5.16e-13
Natural Gas Prod.	Cadmium cmpds	secondary	-4.65e-12	-5.20e-13
Fuel Oil #4 Prod.	Acenaphthylene	secondary	-4.90e-12	-5.48e-13
LCD incineration	2-Methylnaphthalene	secondary	-5.65e-12	-6.31e-13
Fuel Oil #4 Prod.	Biphenyl	secondary	-6.43e-12	-7.19e-13
Fuel Oil #4 Prod.	Acetophenone	secondary	-6.71e-12	-7.50e-13
Fuel Oil #4 Prod.	Chlorine	secondary	-1.04e-11	-1.17e-12
Fuel Oil #4 Prod.	Cumene	secondary	-1.08e-11	-1.21e-12
Natural Gas Prod.	Vinyl acetate	secondary	-1.14e-11	-1.27e-12
Natural Gas Prod.	Styrene	secondary	-1.17e-11	-1.31e-12
Fuel Oil #4 Prod.	2-Methylnaphthalene	secondary	-1.20e-11	-1.34e-12
LCD incineration	Chlorine	secondary	-1.26e-11	-1.40e-12
Fuel Oil #4 Prod.	Ethyl Chloride	secondary	-1.27e-11	-1.42e-12
LCD incineration	Copper (+1 & +2)	secondary	-1.34e-11	-1.49e-12
LCD incineration	Aromatic hydrocarbons	secondary	-1.43e-11	-1.60e-12
LCD incineration	Zinc (+2)	secondary	-1.45e-11	-1.62e-12
Natural Gas Prod.	Methyl tert-butyl ether	secondary	-1.60e-11	-1.79e-12
LCD incineration	3-Methylcholanthrene	secondary	-1.76e-11	-1.97e-12
Natural Gas Prod.	2-Methylnaphthalene	secondary	-1.79e-11	-2.00e-12
Fuel Oil #4 Prod.	1,1,1-Trichloroethane	secondary	-1.80e-11	-2.01e-12
Fuel Oil #4 Prod.	Ethylene dibromide	secondary	-1.91e-11	-2.13e-12
Fuel Oil #4 Prod.	Zinc (+2)	secondary	-2.12e-11	-2.37e-12
LCD incineration	5-Methyl chrysene	secondary	-2.12e-11	-2.37e-12
Natural Gas Prod.	Phenanthrene	secondary	-2.33e-11	-2.61e-12
LCD incineration	Benzo[g,h,i]perylene	secondary	-2.63e-11	-2.94e-12
Natural Gas Prod.	Aluminum (elemental)	secondary	-2.81e-11	-3.15e-12
LCD incineration	Dichlorobenzene (mixed isomers)	secondary	-3.18e-11	-3.55e-12
Natural Gas Prod.	Ethylbenzene	secondary	-3.20e-11	-3.58e-12
LCD incineration	Benzo[a]pyrene	secondary	-3.69e-11	-4.13e-12
Fuel Oil #4 Prod.	3-Methylcholanthrene	secondary	-3.74e-11	-4.18e-12
Fuel Oil #4 Prod.	Vinyl acetate	secondary	-4.71e-11	-5.27e-12
Fuel Oil #4 Prod.	Styrene	secondary	-4.83e-11	-5.40e-12
LCD incineration	Pyrene	secondary	-5.06e-11	-5.66e-12
Fuel Oil #4 Prod.	Phenanthrene	secondary	-5.20e-11	-5.81e-12
Natural Gas Prod.	Chromium (III)	secondary	-5.33e-11	-5.96e-12

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	3-Methylcholanthrene	secondary	-5.59e-11	-6.25e-12
LCD incineration	Indeno(1,2,3-cd)pyrene	secondary	-5.92e-11	-6.62e-12
Natural Gas Prod.	2,4-Dinitrotoluene	secondary	-6.40e-11	-7.16e-12
LCD incineration	Fluoranthene	secondary	-6.52e-11	-7.29e-12
Fuel Oil #4 Prod.	Methyl tert-butyl ether	secondary	-6.62e-11	-7.40e-12
LCD incineration	Benzo[a]anthracene	secondary	-7.75e-11	-8.67e-12
Natural Gas Prod.	Chlorobenzene	secondary	-8.05e-11	-9.00e-12
LCD incineration	Fluorene	secondary	-8.35e-11	-9.34e-12
Natural Gas Prod.	Dichloromethane	secondary	-9.62e-11	-1.08e-11
LCD incineration	Chrysene	secondary	-9.68e-11	-1.08e-11
Natural Gas Prod.	Bromoform	secondary	-9.96e-11	-1.11e-11
Natural Gas Prod.	1,2-Dichloroethane	secondary	-1.02e-10	-1.14e-11
LCD incineration	Benzo[b,j,k]fluoranthene	secondary	-1.06e-10	-1.19e-11
Natural Gas Prod.	Barium cmpds	secondary	-1.06e-10	-1.19e-11
Natural Gas Prod.	Methyl methacrylate	secondary	-1.22e-10	-1.36e-11
Natural Gas Prod.	Silicon	secondary	-1.23e-10	-1.37e-11
Fuel Oil #4 Prod.	Ethylbenzene	secondary	-1.32e-10	-1.47e-11
Natural Gas Prod.	Tetrachloroethylene	secondary	-1.40e-10	-1.57e-11
Natural Gas Prod.	Methyl ethyl ketone	secondary	-1.43e-10	-1.60e-11
Fuel Oil #4 Prod.	o-xylene	secondary	-1.43e-10	-1.60e-11
Natural Gas Prod.	Chlorine	secondary	-1.57e-10	-1.75e-11
LCD incineration	Acenaphthene	secondary	-1.67e-10	-1.87e-11
Natural Gas Prod.	Zinc (+2)	secondary	-1.74e-10	-1.94e-11
Natural Gas Prod.	Isophorone	secondary	-1.77e-10	-1.98e-11
Natural Gas Prod.	Dimethyl sulfate	secondary	-1.84e-10	-2.06e-11
Fuel Oil #4 Prod.	Chromium (III)	secondary	-2.04e-10	-2.29e-11
Fuel Oil #4 Prod.	Copper (+1 & +2)	secondary	-2.12e-10	-2.37e-11
Fuel Oil #4 Prod.	Aromatic hydrocarbons	secondary	-2.27e-10	-2.54e-11
LCD incineration	Acenaphthylene	secondary	-2.41e-10	-2.70e-11
Fuel Oil #4 Prod.	2,4-Dinitrotoluene	secondary	-2.65e-10	-2.96e-11
Fuel Oil #4 Prod.	Chlorobenzene	secondary	-3.33e-10	-3.72e-11
Natural Gas Prod.	Di(2-ethylhexyl)phthalate	secondary	-3.85e-10	-4.31e-11
LCD incineration	Biphenyl	secondary	-3.90e-10	-4.36e-11
Fuel Oil #4 Prod.	Dichloromethane	secondary	-3.98e-10	-4.45e-11
LCD incineration	Acetophenone	secondary	-4.07e-10	-4.55e-11
Fuel Oil #4 Prod.	Bromoform	secondary	-4.12e-10	-4.61e-11
Fuel Oil #4 Prod.	1,2-Dichloroethane	secondary	-4.20e-10	-4.70e-11
Natural Gas Prod.	Cadmium	secondary	-4.65e-10	-5.20e-11
Natural Gas Prod.	Propionaldehyde	secondary	-5.02e-10	-5.61e-11
Natural Gas Prod.	Acetaldehyde	secondary	-5.02e-10	-5.61e-11
Fuel Oil #4 Prod.	Methyl methacrylate	secondary	-5.04e-10	-5.64e-11
Fuel Oil #4 Prod.	Tetrachloroethylene	secondary	-5.81e-10	-6.50e-11
Fuel Oil #4 Prod.	Methyl ethyl ketone	secondary	-5.90e-10	-6.60e-11
Natural Gas Prod.	Mercury	secondary	-6.23e-10	-6.97e-11
Natural Gas Prod.	Methyl hydrazine	secondary	-6.53e-10	-7.31e-11
LCD incineration	Cumene	secondary	-6.53e-10	-7.31e-11
LCD incineration	Aluminum (elemental)	secondary	-7.02e-10	-7.85e-11
Fuel Oil #4 Prod.	1,4-Dichlorobenzene	secondary	-7.13e-10	-7.97e-11
Fuel Oil #4 Prod.	Isophorone	secondary	-7.31e-10	-8.18e-11

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	Dimethyl sulfate	secondary	-7.63e-10	-8.53e-11
LCD incineration	Ethyl Chloride	secondary	-7.72e-10	-8.64e-11
Natural Gas Prod.	Cobalt	secondary	-8.74e-10	-9.78e-11
Natural Gas Prod.	Methyl chloride	secondary	-9.03e-10	-1.01e-10
Natural Gas Prod.	Beryllium	secondary	-9.26e-10	-1.04e-10
Natural Gas Prod.	Aluminum (+3)	secondary	-9.48e-10	-1.06e-10
Natural Gas Prod.	1,4-Dichlorobenzene	secondary	-1.07e-09	-1.19e-10
LCD incineration	1,1,1-Trichloroethane	secondary	-1.09e-09	-1.22e-10
Natural Gas Prod.	Acrolein	secondary	-1.11e-09	-1.25e-10
Fuel Oil #4 Prod.	Cadmium cmpds	secondary	-1.12e-09	-1.26e-10
LCD incineration	Ethylene dibromide	secondary	-1.16e-09	-1.29e-10
Fuel Oil #4 Prod.	Toluene	secondary	-1.35e-09	-1.50e-10
Natural Gas Prod.	o-xylene	secondary	-1.52e-09	-1.70e-10
Fuel Oil #4 Prod.	Di(2-ethylhexyl)phthalate	secondary	-1.59e-09	-1.78e-10
Natural Gas Prod.	PM-10	secondary	-1.63e-09	-1.83e-10
Fuel Oil #4 Prod.	Cadmium	secondary	-1.90e-09	-2.12e-10
Fuel Oil #4 Prod.	Mercury	secondary	-2.05e-09	-2.30e-10
Fuel Oil #4 Prod.	Propionaldehyde	secondary	-2.07e-09	-2.32e-10
Fuel Oil #4 Prod.	Acetaldehyde	secondary	-2.07e-09	-2.32e-10
Natural Gas Prod.	Chloroform	secondary	-2.09e-09	-2.34e-10
LCD incineration	Xylene (mixed isomers)	secondary	-2.22e-09	-2.48e-10
LCD incineration	Phenanthrene	secondary	-2.61e-09	-2.91e-10
Natural Gas Prod.	Benzyl chloride	secondary	-2.69e-09	-3.01e-10
Fuel Oil #4 Prod.	Methyl hydrazine	secondary	-2.70e-09	-3.02e-10
Natural Gas Prod.	Toluene	secondary	-2.86e-09	-3.20e-10
LCD incineration	Vinyl acetate	secondary	-2.86e-09	-3.20e-10
LCD incineration	Styrene	secondary	-2.93e-09	-3.28e-10
LCD incineration	Silicon	secondary	-3.07e-09	-3.43e-10
Fuel Oil #4 Prod.	Beryllium	secondary	-3.31e-09	-3.71e-10
Natural Gas Prod.	Carbon disulfide	secondary	-3.43e-09	-3.84e-10
Fuel Oil #4 Prod.	Methyl chloride	secondary	-3.73e-09	-4.18e-10
LCD incineration	Methyl tert-butyl ether	secondary	-4.01e-09	-4.49e-10
Fuel Oil #4 Prod.	Acrolein	secondary	-4.61e-09	-5.15e-10
Natural Gas Prod.	Phenol	secondary	-4.83e-09	-5.40e-10
Natural Gas Prod.	Nitrate	secondary	-4.98e-09	-5.57e-10
Fuel Oil #4 Prod.	Cobalt	secondary	-6.12e-09	-6.85e-10
LCD incineration	Chloroacetophenone	secondary	-6.74e-09	-7.54e-10
Natural Gas Prod.	Lead	secondary	-7.17e-09	-8.02e-10
LCD incineration	Ethylbenzene	secondary	-7.87e-09	-8.80e-10
Fuel Oil #4 Prod.	Chloroform	secondary	-8.65e-09	-9.67e-10
Natural Gas Prod.	Cyanide (-1)	secondary	-9.61e-09	-1.07e-09
Fuel Oil #4 Prod.	Aluminum (elemental)	secondary	-1.06e-08	-1.19e-09
Fuel Oil #4 Prod.	Benzyl chloride	secondary	-1.11e-08	-1.24e-09
LCD incineration	Chromium (III)	secondary	-1.13e-08	-1.27e-09
Natural Gas Prod.	Manganese	secondary	-1.31e-08	-1.46e-09
Fuel Oil #4 Prod.	Carbon disulfide	secondary	-1.42e-08	-1.59e-09
LCD incineration	Aluminum (+3)	secondary	-1.44e-08	-1.61e-09
LCD incineration	2,4-Dinitrotoluene	secondary	-1.61e-08	-1.80e-09
Natural Gas Prod.	Copper	secondary	-1.75e-08	-1.95e-09
Natural Gas Prod.	Bromomethane	secondary	-1.83e-08	-2.05e-09
Natural Gas Prod.	2-Chloroacetophenone	secondary	-1.85e-08	-2.07e-09

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Barium	secondary	-1.95e-08	-2.18e-09
LCD incineration	Chlorobenzene	secondary	-2.02e-08	-2.26e-09
Natural Gas Prod.	Hydrogen sulfide	secondary	-2.23e-08	-2.49e-09
LCD incineration	Dichloromethane	secondary	-2.41e-08	-2.69e-09
LCD incineration	Bromoform	secondary	-2.50e-08	-2.79e-09
LCD incineration	1,2-Dichloroethane	secondary	-2.53e-08	-2.83e-09
Fuel Oil #4 Prod.	Barium cmpds	secondary	-2.57e-08	-2.87e-09
Fuel Oil #4 Prod.	Lead	secondary	-2.94e-08	-3.29e-09
LCD incineration	Methyl methacrylate	secondary	-3.06e-08	-3.42e-09
LCD incineration	Dimethylbenzanthracene	secondary	-3.12e-08	-3.49e-09
Natural Gas Prod.	Chromium (VI)	secondary	-3.13e-08	-3.50e-09
LCD incineration	Tetrachloroethylene	secondary	-3.50e-08	-3.91e-09
LCD incineration	Methyl ethyl ketone	secondary	-3.58e-08	-4.00e-09
Fuel Oil #4 Prod.	Barium	secondary	-3.61e-08	-4.04e-09
Fuel Oil #4 Prod.	Cyanide (-1)	secondary	-3.97e-08	-4.44e-09
Natural Gas Prod.	Nickel	secondary	-4.07e-08	-4.55e-09
LCD incineration	PM-10	secondary	-4.08e-08	-4.56e-09
Natural Gas Prod.	Naphthalene	secondary	-4.31e-08	-4.82e-09
LCD incineration	Isophorone	secondary	-4.43e-08	-4.96e-09
LCD incineration	Dimethyl sulfate	secondary	-4.62e-08	-5.17e-09
Fuel Oil #4 Prod.	Silicon	secondary	-4.64e-08	-5.19e-09
LCD incineration	Toluene	secondary	-4.73e-08	-5.29e-09
Fuel Oil #4 Prod.	Manganese	secondary	-5.28e-08	-5.91e-09
Fuel Oil #4 Prod.	Naphthalene	secondary	-5.29e-08	-5.91e-09
Fuel Oil #4 Prod.	Dimethylbenzanthracene	secondary	-6.37e-08	-7.12e-09
LCD incineration	Cadmium	secondary	-6.38e-08	-7.13e-09
Fuel Oil #4 Prod.	Bromomethane	secondary	-7.56e-08	-8.46e-09
LCD incineration	Phenol	secondary	-7.60e-08	-8.50e-09
Fuel Oil #4 Prod.	2-Chloroacetophenone	secondary	-7.64e-08	-8.55e-09
LCD incineration	Mercury	secondary	-8.42e-08	-9.42e-09
Fuel Oil #4 Prod.	Copper	secondary	-8.86e-08	-9.90e-09
Natural Gas Prod.	Dimethylbenzanthracene	secondary	-9.51e-08	-1.06e-08
LCD incineration	Di(2-ethylhexyl)phthalate	secondary	-9.66e-08	-1.08e-08
Fuel Oil #4 Prod.	Nitrate	secondary	-1.04e-07	-1.17e-08
Fuel Oil #4 Prod.	Chromium (VI)	secondary	-1.20e-07	-1.34e-08
LCD incineration	Cobalt	secondary	-1.24e-07	-1.39e-08
LCD incineration	Acetaldehyde	secondary	-1.26e-07	-1.41e-08
LCD incineration	Propionaldehyde	secondary	-1.26e-07	-1.41e-08
Natural Gas Prod.	Antimony	secondary	-1.47e-07	-1.65e-08
LCD incineration	Methyl hydrazine	secondary	-1.64e-07	-1.83e-08
LCD incineration	Beryllium	secondary	-1.94e-07	-2.18e-08
LCD incineration	Methyl chloride	secondary	-2.26e-07	-2.53e-08
Fuel Oil #4 Prod.	Aluminum (+3)	secondary	-2.29e-07	-2.56e-08
LCD incineration	Copper	secondary	-2.67e-07	-2.99e-08
LCD incineration	Acrolein	secondary	-2.79e-07	-3.12e-08
Fuel Oil #4 Prod.	Antimony	secondary	-4.21e-07	-4.70e-08
LCD incineration	Hexane	secondary	-4.88e-07	-5.46e-08
LCD incineration	Hydrogen sulfide	secondary	-5.13e-07	-5.74e-08
LCD incineration	Chloroform	secondary	-5.22e-07	-5.84e-08

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Natural Gas Prod.	Hydrofluoric acid	secondary	-5.77e-07	-6.45e-08
Natural Gas Prod.	Phosphorus (yellow or white)	secondary	-5.86e-07	-6.55e-08
LCD incineration	Pentane	secondary	-6.12e-07	-6.84e-08
Fuel Oil #4 Prod.	PM-10	secondary	-6.18e-07	-6.91e-08
LCD incineration	Benzyl chloride	secondary	-6.74e-07	-7.54e-08
LCD incineration	Ethane	secondary	-7.29e-07	-8.16e-08
Fuel Oil #4 Prod.	Nickel	secondary	-7.65e-07	-8.55e-08
Natural Gas Prod.	Molybdenum	secondary	-7.65e-07	-8.56e-08
LCD incineration	Carbon disulfide	secondary	-8.60e-07	-9.62e-08
LCD incineration	Barium	secondary	-8.87e-07	-9.92e-08
Fuel Oil #4 Prod.	Hexane	secondary	-9.00e-07	-1.01e-07
Fuel Oil #4 Prod.	Phenol	secondary	-1.16e-06	-1.30e-07
LCD incineration	Nitrate	secondary	-1.17e-06	-1.30e-07
Fuel Oil #4 Prod.	Pentane	secondary	-1.30e-06	-1.45e-07
LCD incineration	Naphthalene	secondary	-1.31e-06	-1.47e-07
Natural Gas Prod.	Hexane	secondary	-1.34e-06	-1.50e-07
Fuel Oil #4 Prod.	Ethane	secondary	-1.55e-06	-1.73e-07
Natural Gas Prod.	Pentane	secondary	-1.94e-06	-2.17e-07
Natural Gas Prod.	Ethane	secondary	-2.31e-06	-2.59e-07
Fuel Oil #4 Prod.	Zinc (elemental)	secondary	-2.35e-06	-2.63e-07
Fuel Oil #4 Prod.	Hydrofluoric acid	secondary	-2.38e-06	-2.67e-07
LCD incineration	Cyanide (-1)	secondary	-2.41e-06	-2.69e-07
Natural Gas Prod.	Zinc (elemental)	secondary	-2.81e-06	-3.15e-07
LCD incineration	Manganese	secondary	-3.17e-06	-3.55e-07
Natural Gas Prod.	Nitrous oxide	secondary	-3.82e-06	-4.28e-07
Natural Gas Prod.	Selenium	secondary	-4.02e-06	-4.49e-07
Fuel Oil #4 Prod.	Molybdenum	secondary	-4.28e-06	-4.79e-07
Natural Gas Prod.	Fluorides (F-)	secondary	-4.48e-06	-5.01e-07
LCD incineration	Bromomethane	secondary	-4.59e-06	-5.13e-07
LCD incineration	Nickel	secondary	-6.29e-06	-7.04e-07
LCD incineration	Molybdenum	secondary	-6.45e-06	-7.21e-07
LCD incineration	Chromium (VI)	secondary	-6.65e-06	-7.44e-07
Fuel Oil #4 Prod.	Ammonia	secondary	-7.26e-06	-8.12e-07
Fuel Oil #4 Prod.	Hydrogen sulfide	secondary	-8.41e-06	-9.41e-07
Natural Gas Prod.	Formaldehyde	secondary	-9.17e-06	-1.03e-06
LCD incineration	Antimony	secondary	-1.40e-05	-1.56e-06
LCD incineration	Zinc (elemental)	secondary	-1.65e-05	-1.84e-06
Fuel Oil #4 Prod.	Fluorides (F-)	secondary	-1.75e-05	-1.95e-06
Fuel Oil #4 Prod.	Selenium	secondary	-1.77e-05	-1.98e-06
Natural Gas Prod.	Hydrochloric acid	secondary	-2.11e-05	-2.37e-06
Natural Gas Prod.	Vanadium	secondary	-2.30e-05	-2.58e-06
Fuel Oil #4 Prod.	Phosphorus (yellow or white)	secondary	-2.63e-05	-2.94e-06
LCD incineration	Ammonia	secondary	-3.04e-05	-3.40e-06
LCD incineration	Phosphorus (yellow or white)	secondary	-3.56e-05	-3.98e-06
Fuel Oil #4 Prod.	Nitrous oxide	secondary	-4.08e-05	-4.56e-06
Fuel Oil #4 Prod.	Hydrochloric acid	secondary	-8.74e-05	-9.77e-06
Natural Gas Prod.	Ammonia	secondary	-8.90e-05	-9.96e-06
Natural Gas Prod.	Sulfur oxides	secondary	-9.13e-05	-1.02e-05
Natural Gas Prod.	Arsenic	secondary	-1.04e-04	-1.17e-05
Natural Gas Prod.	PM	secondary	-1.37e-04	-1.53e-05
LCD incineration	Hydrofluoric acid	secondary	-1.45e-04	-1.62e-05

Table M-40. LCD LCIA Results for the Terrestrial Ecotoxicity Impact Category

Process Group	Material	LCI Data Type	Terrestrial Toxicity (tox-kg)	% of Total
Fuel Oil #4 Prod.	PM	secondary	-2.87e-04	-3.21e-05
LCD incineration	Formaldehyde	secondary	-2.89e-04	-3.24e-05
Fuel Oil #4 Prod.	Formaldehyde	secondary	-3.65e-04	-4.08e-05
Fuel Oil #4 Prod.	Arsenic	secondary	-5.00e-04	-5.59e-05
LCD incineration	Nitrous oxide	secondary	-6.75e-04	-7.55e-05
LCD incineration	Vanadium	secondary	-7.59e-04	-8.49e-05
LCD incineration	Selenium	secondary	-9.94e-04	-1.11e-04
LCD incineration	Fluorides (F-)	secondary	-1.01e-03	-1.13e-04
Fuel Oil #4 Prod.	Nitrogen oxides	secondary	-1.27e-03	-1.43e-04
Fuel Oil #4 Prod.	Benzene	secondary	-1.71e-03	-1.91e-04
Fuel Oil #4 Prod.	Sulfur oxides	secondary	-1.74e-03	-1.94e-04
Fuel Oil #4 Prod.	Methane	secondary	-1.85e-03	-2.07e-04
LCD incineration	Benzene	secondary	-2.08e-03	-2.32e-04
Fuel Oil #4 Prod.	Vanadium	secondary	-2.86e-03	-3.20e-04
LCD incineration	Hydrochloric acid	secondary	-3.08e-03	-3.44e-04
Natural Gas Prod.	Nitrogen oxides	secondary	-3.09e-03	-3.45e-04
LCD incineration	Nitrogen oxides	secondary	-9.31e-03	-1.04e-03
LCD incineration	Methane	secondary	-9.85e-03	-1.10e-03
Fuel Oil #4 Prod.	Carbon monoxide	secondary	-9.96e-03	-1.11e-03
LCD incineration	PM	secondary	-1.20e-02	-1.34e-03
LCD incineration	Carbon monoxide	secondary	-1.44e-02	-1.61e-03
Natural Gas Prod.	Methane	secondary	-1.66e-02	-1.86e-03
LCD incineration	Sulfur oxides	secondary	-1.75e-02	-1.96e-03
Natural Gas Prod.	Carbon monoxide	secondary	-2.11e-02	-2.36e-03
LCD incineration	Arsenic	secondary	-2.50e-02	-2.80e-03
Natural Gas Prod.	Benzene	secondary	-2.50e-02	-2.80e-03
Total End-of-life			**1.46e-02**	**1.63e-03**
Total All Life-cycle Stages			**8.94e+02**	**1.00e+02**

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APPENDIX N

CHAPTER 4 SUPPORTING TABLES

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Table N-1. CRT Lead Inputs by Life-cycle Stage

Life-cycle Stage	Process	Input	Quantity	Units	Type
Materials Processing	Aluminum Prod. (all virgin; EB)	Lead (Pb, ore)	6.30e-05	kg	Ancillary material
Materials Processing	Ferrite mfg. (EB)	Lead (Pb, ore)	5.70e-08	kg	Ancillary material
Materials Processing	Invar (DEAM mix)	Lead (Pb, ore)	5.84e-08	kg	Ancillary material
Materials Processing	Lead (EB)	Lead (Pb, ore)	4.96e-01	kg	Primary material
Materials Processing	Polycarbonate Production (PC; DEAM)	Lead (Pb, ore)	1.85e-06	kg	Ancillary material
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Lead (Pb, ore)	5.79e-08	kg	Ancillary material
Manufacturing	CRT tube mfg. (CDP)	Frit	6.67e-02	kg	Primary material
Manufacturing	CRT glass mfg. (CDP)	Lead	4.47e-01	kg	Primary material
Manufacturing	Frit manufacturing (CDP)	Lead	4.67e-02	kg	Primary material
Manufacturing	CRT monitor assembly (CDP)	Printed wiring board (PWB)	8.47e-01	kg	Direct to assembly
Manufacturing	PWB Mfg.	Solder (63% tin; 37% lead)	5.08e-02	kg	Primary material
Manufacturing	CRT monitor assembly (CDP)	Solder, unspecified	2.67e-02	kg	Direct to assembly
End-of-life	CRT Incineration (DEAM mix)	EOL CRT Monitor, incinerated	2.20e+01	kg	Primary material
End-of-life	CRT landfilling (CDP)	EOL CRT Monitor, landfilled	1.56e+01	kg	Primary material
End-of-life	CRT Recycling (CDP)	EOL CRT Monitor, recycled	2.42e+00	kg	Primary material

Table N-2. LCD Lead Inputs by Life-cycle Stage

Life-cycle Stage	Process	Input	Quantity	Units	Type
Materials Processing	Aluminum Prod. (all virgin; EB)	Lead (Pb, ore)	2.35e-05	kg	Ancillary material
Materials Processing	PET Resin Production (DEAM)	Lead (Pb, ore)	1.82e-07	kg	Ancillary material
Materials Processing	Polycarbonate Production (PC; DEAM)	Lead (Pb, ore)	1.03e-06	kg	Ancillary material
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Lead (Pb, ore)	2.84e-08	kg	Ancillary material
Manufacturing	LCD module mfg. (CDP)	Printed wiring board (PWB)	2.27e-02	kg	Direct to assembly
Manufacturing	LCD monitor assembly (CDP)	Printed wiring board (PWB)	3.51e-01	kg	Direct to assembly
Manufacturing	LCD monitor assembly (CDP)	Solder (60% tin, 40% lead)	3.81e-02	kg	Primary material
Manufacturing	PWB Mfg.	Solder (63% tin; 37% lead)	2.24e-02	kg	Primary material
Manufacturing	LCD module mfg. (CDP)	Solder, unspecified	7.35e-05	kg	Ancillary material
End-of-life	LCD incineration (DEAM mix)	EOL LCD Monitor, incinerated	6.50e+00	kg	Primary material
End-of-life	LCD landfilling (CDP)	EOL LCD Monitor, landfilled	3.57e+00	kg	Primary material
End-of-life	LCD recycling (CDP)	EOL LCD Monitor, recycled	9.75e-01	kg	Primary material

Table N-3. CRT Lead Outputs by Life-cycle Stage

Life-Cycle Stage	Process	Output	Quantity	Units	Type	Disposition
Materials Processing	ABS Production (DEAM)	Lead	2.12e-07	kg	Airborne	air
Materials Processing	Aluminum Prod. (all virgin; EB)	Lead	1.20e-06	kg	Airborne	air
Materials Processing	Aluminum Prod. (all virgin; EB)	Lead	1.45e-08	kg	Solid waste	landfill
Materials Processing	Aluminum Prod. (all virgin; EB)	Lead cmpds	8.72e-06	kg	Waterborne	surface water
Materials Processing	Ferrite mfg. (EB)	Lead	3.46e-05	kg	Airborne	air
Materials Processing	Ferrite mfg. (EB)	Lead	1.70e-10	kg	Solid waste	landfill
Materials Processing	Ferrite mfg. (EB)	Lead cmpds	5.19e-07	kg	Waterborne	surface water
Materials Processing	Ferrite mfg. (EB)	Lead-210 (isotope)	1.82e-01	Bq	Radioactivity	air
Materials Processing	Invar (DEAM mix)	Lead	3.62e-05	kg	Airborne	air
Materials Processing	Invar (DEAM mix)	Lead	5.49e-09	kg	Solid waste	landfill
Materials Processing	Invar (DEAM mix)	Lead cmpds	2.98e-06	kg	Waterborne	surface water
Materials Processing	Invar (DEAM mix)	Lead-210 (isotope)	1.87e-01	Bq	Radioactivity	air
Materials Processing	Lead (EB)	Lead	1.58e-03	kg	Airborne	air
Materials Processing	Lead (EB)	Lead	2.72e-09	kg	Solid waste	landfill
Materials Processing	Lead (EB)	Lead cmpds	2.75e-06	kg	Waterborne	surface water
Materials Processing	Polycarbonate Production (PC; DEAM)	Lead	4.62e-07	kg	Airborne	air
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Lead	1.10e-06	kg	Airborne	air
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Lead	1.02e-11	kg	Solid waste	landfill
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Lead cmpds	8.83e-07	kg	Waterborne	surface water
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Lead-210 (isotope)	6.54e-01	Bq	Radioactivity	air
Materials Processing	Styrene-butadiene Copolymer Prod. (DEAM mix)	Lead	2.07e-07	kg	Airborne	air
Manufacturing	CRT glass mfg. (CDP)	Broken CRT glass	1.88e-03	kg	Hazardous waste	landfill
Manufacturing	CRT glass mfg. (CDP)	cinders from CRT glass mfg (70% PbO)	8.26e-03	kg	Hazardous waste	landfill
Manufacturing	CRT glass mfg. (CDP)	CRT glass faceplate EP dust (Pb) (D008 waste)	1.03e-03	kg	Hazardous waste	landfill
Manufacturing	CRT glass mfg. (CDP)	CRT glass funnel EP dust (Pb) (D008 waste)	5.01e-03	kg	Hazardous waste	recycling/reuse

Table N-3. CRT Lead Outputs by Life-cycle Stage

Life-Cycle Stage	Process	Output	Quantity	Units	Type	Disposition
Manufacturing	CRT glass mfg. (CDP)	Hazardous sludge (Pb) (D008)	1.52e-03	kg	Hazardous waste	landfill
Manufacturing	CRT glass mfg. (CDP)	Lead	3.22e-07	kg	Airborne	air
Manufacturing	CRT glass mfg. (CDP)	Lead	4.34e-05	kg	Waterborne	surface water
Manufacturing	CRT glass mfg. (CDP)	Lead contaminated grit (D008 waste)	3.46e-05	kg	Hazardous waste	landfill
Manufacturing	CRT glass mfg. (CDP)	Lead debris (D008 waste)	2.14e-04	kg	Hazardous waste	landfill
Manufacturing	CRT glass mfg. (CDP)	sludge from CRT glass mfg (1% PbO)	8.78e-04	kg	Hazardous waste	landfill
Manufacturing	CRT glass mfg. (CDP)	Waste Batch (Ba, Pb) (D008 waste)	1.41e-03	kg	Hazardous waste	landfill
Manufacturing	CRT glass mfg. (CDP)	Waste finishing sludge (Pb) (D008 waste)	2.56e-04	kg	Hazardous waste	landfill
Manufacturing	CRT monitor assembly (CDP)	Broken CRT glass	3.82e-01	kg	Solid waste	recycling/reuse
Manufacturing	CRT monitor assembly (CDP)	Printed wiring board (PWB)	3.70e-02	kg	Solid waste	recycling/reuse
Manufacturing	CRT tube mfg. (CDP)	Broken CRT glass	6.94e-01	kg	Solid waste	recycling/reuse
Manufacturing	CRT tube mfg. (CDP)	Frit	2.99e-03	kg	Hazardous waste	landfill
Manufacturing	CRT tube mfg. (CDP)	Lead	3.01e-06	kg	Waterborne	surface water
Manufacturing	CRT tube mfg. (CDP)	Lead	1.03e-06	kg	Waterborne	treatment
Manufacturing	CRT tube mfg. (CDP)	Lead sulfate cake	2.67e-05	kg	Hazardous waste	landfill
Manufacturing	Frit manufacturing (CDP)	Lead	3.20e-10	kg	Airborne	air
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Lead	3.88e-08	kg	Airborne	air
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Lead cmpds	3.28e-12	kg	Waterborne	surface water
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Lead	4.14e-09	kg	Airborne	air
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Lead cmpds	2.66e-13	kg	Waterborne	surface water
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Lead	9.99e-08	kg	Airborne	air
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Lead cmpds	3.95e-12	kg	Waterborne	surface water
Manufacturing	Japanese Electric Grid	Lead (Pb, ore)	4.41e-07	kg	Airborne	air
Manufacturing	LPG Production (DEAM)	Lead	1.24e-05	kg	Airborne	air
Manufacturing	LPG Production (DEAM)	Lead cmpds	1.17e-09	kg	Waterborne	surface water

Table N-3. CRT Lead Outputs by Life-cycle Stage

Life-Cycle Stage	Process	Output	Quantity	Units	Type	Disposition
Manufacturing	Natural Gas Prod. (DEAM)	Lead	2.17e-08	kg	Airborne	air
Manufacturing	Natural Gas Prod. (DEAM)	Lead cmpds	2.36e-14	kg	Waterborne	surface water
Manufacturing	PWB Mfg.	Lead cmpds	1.62e-05	kg	Waterborne	treatment
Manufacturing	PWB Mfg.	PWB-Solder dross	6.70e-02	kg	Hazardous waste	recycling/reuse
Manufacturing	US electric grid	Lead	2.04e-07	kg	Airborne	air
Use	CRT monitor use (CDP)	EOL CRT Monitor, landfilled	1.01e+01	kg	Hazardous waste	treatment
Use	CRT monitor use (CDP)	EOL CRT Monitor, landfilled	2.12e+01	kg	Solid waste	treatment
Use	CRT monitor use (CDP)	EOL CRT Monitor, recycled	2.42e+00	kg	Solid waste	treatment
Use	CRT monitor use (CDP)	EOL CRT Monitor, remanufactured	6.60e-01	kg	Solid waste	recycling/reuse
Use	US electric grid	Lead	1.28e-05	kg	Airborne	air
End-of-life	CRT Incineration (DEAM mix)	Lead	1.43e-05	kg	Airborne	air
End-of-life	CRT Incineration (DEAM mix)	Lead cmpds	8.11e-10	kg	Waterborne	surface water
End-of-life	CRT landfilling (CDP)	EOL CRT Monitor, landfilled	3.91e+00	kg	Solid waste	landfill
End-of-life	CRT landfilling (CDP)	Lead cmpds	7.90e-10	kg	Waterborne	surface water
End-of-life	CRT Recycling (CDP)	Printed wiring board (PWB)	1.46e-01	kg	Hazardous waste	recycling/reuse
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Lead	-4.45e-08	kg	Airborne	air
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Lead cmpds	-2.86e-12	kg	Waterborne	surface water
End-of-life	LPG Production (DEAM)	Lead	1.07e-10	kg	Airborne	air
End-of-life	LPG Production (DEAM)	Lead cmpds	1.01e-14	kg	Waterborne	surface water
End-of-life	Natural Gas Prod. (DEAM)	Lead	-1.09e-08	kg	Airborne	air
End-of-life	Natural Gas Prod. (DEAM)	Lead cmpds	-1.18e-14	kg	Waterborne	surface water
End-of-life	US electric grid	Lead	1.28e-09	kg	Airborne	air

Table N-4. LCD Lead Outputs by Life-cycle Stage

Life-cycle Stage	Process	Output	Quantity	Units	Type	Disposition
Materials Processing	Aluminum Prod. (all virgin; EB)	Lead	4.47e-07	kg	Airborne	air
Materials Processing	Aluminum Prod. (all virgin; EB)	Lead	5.41e-09	kg	Solid waste	landfill
Materials Processing	Aluminum Prod. (all virgin; EB)	Lead cmpds	3.25e-06	kg	Waterborne	surface water
Materials Processing	Natural Gas Prod. (DEAM)	Lead	1.51e-06	kg	Airborne	air
Materials Processing	Natural Gas Prod. (DEAM)	Lead cmpds	1.65e-12	kg	Waterborne	surface water
Materials Processing	PET Resin Production (DEAM)	Lead	9.08e-08	kg	Airborne	air
Materials Processing	PMMA Sheet Prod. (DEAM)	Lead	1.92e-07	kg	Airborne	air
Materials Processing	Polycarbonate Production (PC; DEAM)	Lead	2.58e-07	kg	Airborne	air
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Lead	5.40e-07	kg	Airborne	air
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Lead	4.98e-12	kg	Solid waste	landfill
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Lead cmpds	4.33e-07	kg	Waterborne	surface water
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Lead-210 (isotope)	3.21e-01	Bq	Radioactivity	air
Materials Processing	Styrene-butadiene Copolymer Prod. (DEAM mix)	Lead	9.04e-08	kg	Airborne	air
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Lead	1.81e-09	kg	Airborne	air
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Lead cmpds	1.53e-13	kg	Waterborne	surface water
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Lead	6.38e-09	kg	Airborne	air
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Lead cmpds	4.10e-13	kg	Waterborne	surface water
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Lead	3.40e-09	kg	Airborne	air
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Lead cmpds	1.34e-13	kg	Waterborne	surface water
Manufacturing	Japanese Electric Grid	Lead (Pb, ore)	1.48e-06	kg	Airborne	air
Manufacturing	LCD backlight unit assembly (CDP)	Waste CCFL, with lead	8.17e-08	kg	Hazardous waste	treatment
Manufacturing	LCD CCFL mfg. (CDP)	Lead	8.33e-07	kg	Waterborne	treatment
Manufacturing	LCD glass mfg. (CDP)	Lead	2.01e-06	kg	Waterborne	surface water
Manufacturing	LCD glass mfg. (CDP)	Waste Batch (Ba, Pb) (D008 waste)	6.55e-05	kg	Hazardous waste	landfill

Table N-4. LCD Lead Outputs by Life-cycle Stage

Life-cycle Stage	Process	Output	Quantity	Units	Type	Disposition
Manufacturing	LCD module mfg. (CDP)	Lead	6.17e-06	kg	Waterborne	surface water
Manufacturing	LCD monitor assembly (CDP)	Printed wiring board (PWB)	7.50e-03	kg	Solid waste	landfill
Manufacturing	LPG Production (DEAM)	Lead	5.93e-07	kg	Airborne	air
Manufacturing	LPG Production (DEAM)	Lead cmpds	5.60e-11	kg	Waterborne	surface water
Manufacturing	Natural Gas Prod. (DEAM)	Lead	3.42e-08	kg	Airborne	air
Manufacturing	Natural Gas Prod. (DEAM)	Lead cmpds	3.72e-14	kg	Waterborne	surface water
Manufacturing	PWB Mfg.	Lead cmpds	7.14e-06	kg	Waterborne	treatment
Manufacturing	PWB Mfg.	PWB-Lead contaminated waste oil	5.14e-03	kg	Hazardous waste	treatment
Manufacturing	PWB Mfg.	PWB-Solder dross	2.96e-02	kg	Hazardous waste	recycling/reuse
Manufacturing	US electric grid	Lead	2.47e-08	kg	Airborne	air
Use	LCD monitor use (CDP)	EOL LCD Monitor, incinerated	9.75e-01	kg	Solid waste	treatment
Use	LCD monitor use (CDP)	EOL LCD Monitor, landfilled	3.25e-01	kg	Hazardous waste	treatment
Use	LCD monitor use (CDP)	EOL LCD Monitor, landfilled	6.82e+00	kg	Solid waste	treatment
Use	LCD monitor use (CDP)	EOL LCD Monitor, recycled	9.75e-01	kg	Solid waste	treatment
Use	LCD monitor use (CDP)	EOL LCD Monitor, remanufactured	9.75e-01	kg	Solid waste	recycling/reuse
Use	US electric grid	Lead	4.76e-06	kg	Airborne	air
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Lead	-2.90e-08	kg	Airborne	air
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Lead cmpds	-1.90e-12	kg	Waterborne	surface water
End-of-life	LCD incineration (DEAM mix)	Lead	4.80e-06	kg	Airborne	air
End-of-life	LCD incineration (DEAM mix)	Lead cmpds	2.59e-10	kg	Waterborne	surface water
End-of-life	LCD landfilling (CDP)	EOL LCD Monitor, landfilled	8.94e-01	kg	Solid waste	landfill
End-of-life	LCD landfilling (CDP)	EOL LCD Monitor, landfilled	1.64e+00	kg	Hazardous waste	landfill
End-of-life	LCD landfilling (CDP)	Lead cmpds	2.40e-10	kg	Waterborne	surface water
End-of-life	LPG Production (DEAM)	Lead	4.87e-11	kg	Airborne	air
End-of-life	LPG Production (DEAM)	Lead cmpds	4.60e-15	kg	Waterborne	surface water

Table N-4. LCD Lead Outputs by Life-cycle Stage

Life-cycle Stage	Process	Output	Quantity	Units	Type	Disposition
End-of-life	Natural Gas Prod. (DEAM)	Lead	-7.20e-09	kg	Airborne	air
End-of-life	Natural Gas Prod. (DEAM)	Lead cmpds	-7.80e-15	kg	Waterborne	surface water
End-of-life	US electric grid	Lead	9.03e-10	kg	Airborne	air

Table N-5. CRT Life-Cycle Impacts Scores from Lead-based Materials

Life-cycle Stage	Process	Input/Output	Impact Scores by Category						
			Nonrenew.	Haz. Waste	Rad	ChrTox-pub	ChrTox- occ	Aq. Tox.	Terr. Tox.
MP	ABS Production (DEAM)	Lead				4.24e-07			2.12e-07
MP	Aluminum Prod. (all virgin; EB)	Lead				2.40e-06			1.20e-06
MP	Ferrite mfg. (EB)	Lead				6.92e-05			3.46e-05
MP	Invar (DEAM mix)	Lead				7.24e-05			3.62e-05
MP	Lead (EB)	Lead				3.16e-03			1.58e-03
MP	Polycarbonate Production (PC; DEAM)	Lead				9.23e-07			4.62e-07
MP	Steel Prod., cold-rolled, semi-finished (EB)	Lead				2.20e-06			1.10e-06
MP	Styrene-butadiene Copolymer Prod. (DEAM	Lead				4.14e-07			2.07e-07
MP	Aluminum Prod. (all virgin; EB)	Lead (Pb, ore)	6.30e-05						
MP	Ferrite mfg. (EB)	Lead (Pb, ore)	5.70e-08						
MP	Invar (DEAM mix)	Lead (Pb, ore)	5.84e-08						
MP	Lead (EB)	Lead (Pb, ore)	4.96e-01						
MP	Polycarbonate Production (PC; DEAM)	Lead (Pb, ore)	1.85e-06						
MP	Steel Prod., cold-rolled, semi-finished (EB)	Lead (Pb, ore)	5.79e-08						
MP	Aluminum Prod. (all virgin; EB)	Lead cmpds				1.74e-05		1.70e-04	8.72e-06
MP	Ferrite mfg. (EB)	Lead cmpds	1.04e-06	1.00e-05	5.19e-07				
MP	Invar (DEAM mix)	Lead cmpds				5.96e-06		5.90e-05	2.98e-06

Table N-5. CRT Life-Cycle Impacts Scores from Lead-based Materials

Life-cycle Stage	Process	Input/Output	Impact Scores by Category						
			Nonrenew.	Haz. Waste	Rad	ChrTox-pub	ChrTox- occ	Aq. Tox.	Terr. Tox.
MP	Lead (EB)	Lead cmpds				5.50e-06		5.40e-05	2.75e-06
MP	Steel Prod., cold-rolled, semi-finished (EB)	Lead cmpds				1.77e-06		1.70e-05	8.83e-07
MP	Ferrite mfg. (EB)	Lead-210 (isotope)			1.82e-01				
MP	Invar (DEAM mix)	Lead-210 (isotope)			1.87e-01				
MP	Steel Prod., cold-rolled, semi-finished (EB)	Lead-210 (isotope)			6.54e-01				
Manufacturing	CRT glass mfg. (CDP)	Broken CRT glass		6.22e-07					
Manufacturing	CRT glass mfg. (CDP)	cinders from CRT glass mfg (70% PbO)		6.88e-06					
Manufacturing	CRT glass mfg. (CDP)	CRT glass faceplate EP dust (Pb) (D008 waste)		2.15e-06					
Manufacturing	CRT tube mfg. (CDP)	Frit		3.04e-06					
Manufacturing	CRT glass mfg. (CDP)	Hazardous sludge (Pb)		1.38e-06					
Manufacturing	CRT glass mfg. (CDP)	Lead	4.47e-01			8.74e-05	8.95e-01	8.70e-05	4.37e-05
Manufacturing	CRT tube mfg. (CDP)	Lead				6.03e-06		6.00e-06	3.01e-06
Manufacturing	Frit manufacturing (CDP)	Lead	4.67e-02			6.40e-10	9.33e-02		3.20e-10
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Lead				7.76e-08			3.88e-08
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Lead				8.28e-09			4.14e-09
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Lead				2.00e-07			9.99e-08
Manufacturing	LPG Production (DEAM)	Lead				2.47e-05			1.24e-05
Manufacturing	Natural Gas Prod. (DEAM)	Lead				4.33e-08			2.17e-08
Manufacturing	US electric grid	Lead				4.07e-07			2.04e-07
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Lead cmpds				6.55e-12		6.50e-11	3.27e-12
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Lead cmpds		5.32e-13	5.2E-				
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Lead cmpds				7.89e-12		7.80e-11	3.95e-12
Manufacturing	LPG Production (DEAM)	Lead cmpds				2.33e-09		2.30e-08	1.17e-09

Table N-5. CRT Life-Cycle Impacts Scores from Lead-based Materials

Life-cycle Stage	Process	Input/Output	Impact Scores by Category						
			Nonrenew.	Haz. Waste	Rad	ChrTox-pub	ChrTox- occ	Aq. Tox.	Terr. Tox.
Manufacturing	Natural Gas Prod. (DEAM)	Lead cmpds				4.72e-14		4.60e-13	2.36e-14
Manufacturing	CRT glass mfg. (CDP)	Lead contaminated grit (D008 waste)		2.99e-09					
Manufacturing	CRT glass mfg. (CDP)	Lead debris (D008 waste)		1.85e-08					
Manufacturing	CRT tube mfg. (CDP)	Lead sulfate cake		3.03e-08					
Manufacturing	CRT glass mfg. (CDP)	sludge from CRT glass mfg (1% PbO)		6.45e-07					
Manufacturing	CRT glass mfg. (CDP)	Waste Batch (Ba, Pb) (D008 waste)		1.22e-07					
Manufacturing	CRT glass mfg. (CDP)	Waste finishing sludge (Pb) (D008 waste)		2.32e-07					
Use	US electric grid	Lead				2.55e-05			1.27e-05
End-of-life	CRT Incineration (DEAM mix)	Lead		2.86e-05	1.43e-05				
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Lead				-8.90e-08			-4.40e-08
End-of-life	LPG Production (DEAM)	Lead				2.13e-10			1.07e-10
End-of-life	Natural Gas Prod. (DEAM)	Lead				-2.17e-08			-1.10e-08
End-of-life	US electric grid	Lead				2.55e-09			1.28e-09
End-of-life	CRT Incineration (DEAM mix)	Lead cmpds				1.62e-09		1.60e-08	8.10e-10
End-of-life	CRT landfilling (CDP)	Lead cmpds				1.58e-09		1.60e-08	7.89e-10
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Lead cmpds				-5.72e-12		-5.60e-11	-2.90e-12
End-of-life	LPG Production (DEAM)	Lead cmpds				2.01e-14		2.00e-13	1.01e-14
End-of-life	Natural Gas Prod. (DEAM)	Lead cmpds				-2.37e-14		-2.30e-13	-1.20e-14

MP = Materials processing.
Blank = not applicable.

Table N-6. LCD Life-Cycle Impact Scores from Lead-based Materials

Life-cycle Stage	Process	Input/Output	Impact Scores by Category						
			Nonrenew	Haz. Waste	Solid Waste	Rad	ChrTox-pub	Aq. Tox.	Terr. Tox.
MP	Aluminum Prod. (all virgin; EB)	Lead					8.94e-07		4.47e-07
MP	Natural Gas Prod. (DEAM)	Lead					3.03e-06		1.51e-06
MP	PET Resin Production (DEAM)	Lead					1.82e-07		9.08e-08
MP	PMMA Sheet Prod. (DEAM)	Lead					3.83e-07		1.92e-07
MP	Polycarbonate Production (PC; DEAM)	Lead					5.16e-07		2.58e-07
MP	Steel Prod., cold-rolled, semi-finished (EB)	Lead					1.08e-06		5.40e-07
MP	Styrene-butadiene Copolymer Prod. (DEAM mix)	Lead					1.81e-07		9.04e-08
MP	Aluminum Prod. (all virgin; EB)	Lead (Pb, ore)	2.35e-05						
MP	PET Resin Production (DEAM)	Lead (Pb, ore)	1.82e-07						
MP	Polycarbonate Production (PC; DEAM)	Lead (Pb, ore)	1.03e-06						
MP	Steel Prod., cold-rolled, semi-finished (EB)	Lead (Pb, ore)	2.84e-08						
MP	Aluminum Prod. (all virgin; EB)	Lead cmpds					6.49e-06	6.40e-05	3.25e-06
MP	Natural Gas Prod. (DEAM)	Lead cmpds					3.30e-12	3.25e-11	1.65e-12
MP	Steel Prod., cold-rolled, semi-finished (EB)	Lead cmpds					8.65e-07	8.52e-06	4.33e-07
MP	Steel Prod., cold-rolled, semi-finished (EB)	Lead-210 (isotope)				3.21e-01			
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Lead					3.62e-09		1.81e-09
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Lead					1.28e-08		6.38e-09
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Lead					6.80e-09		3.40e-09
Manufacturing	LCD glass mfg. (CDP)	Lead					4.02e-06	4.02e-06	2.01e-06
Manufacturing	LCD module mfg. (CDP)	Lead					1.23e-05	1.23e-05	6.17e-06
Manufacturing	LPG Production (DEAM)	Lead					1.19e-06		5.93e-07
Manufacturing	Natural Gas Prod. (DEAM)	Lead					6.83e-08		3.42e-08
Manufacturing	US electric grid	Lead					4.94e-08		2.47e-08
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Lead cmpds					3.06e-13	3.01e-12	1.53e-13

Table N-6. LCD Life-Cycle Impact Scores from Lead-based Materials

Life-cycle Stage	Process	Input/Output	Impact Scores by Category						
			Nonrenew	Haz. Waste	Solid Waste	Rad	ChrTox-pub	Aq. Tox.	Terr. Tox.
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Lead cmpds					8.20e-13	8.08e-12	4.10e-13
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Lead cmpds					2.69e-13	2.65e-12	1.34e-13
Manufacturing	LPG Production (DEAM)	Lead cmpds					1.12e-10	1.10e-09	5.60e-11
Manufacturing	Natural Gas Prod. (DEAM)	Lead cmpds					7.44e-14	7.33e-13	3.72e-14
Manufacturing	LCD monitor assembly (CDP)	Printed wiring board			9.38e-06				
Manufacturing	LCD glass mfg. (CDP)	Waste batch (Ba, Pb) (D008 waste)		5.67e-09					
Use	US electric grid	Lead					9.52e-06		4.76e-06
End-of Life	Fuel Oil #4 Prod. (DEAM mix)	Lead					-5.88e-08		-2.94e-08
End-of Life	LCD incineration (DEAM mix)	Lead					9.60e-06		4.80e-06
End-of Life	LPG Production (DEAM)	Lead					9.74e-11		4.87e-11
End-of Life	Natural Gas Prod. (DEAM)	Lead					-1.43e-08		-7.17e-09
End-of Life	US electric grid	Lead					1.81e-09		9.03e-10
End-of Life	Fuel Oil #4 Prod. (DEAM mix)	Lead cmpds					-3.78e-12	-3.72e-11	-1.89e-12
End-of Life	LCD incineration (DEAM mix)	Lead cmpds					5.19e-10	5.11e-09	2.59e-10
End-of Life	LCD landfilling (CDP)	Lead cmpds					4.80e-10	4.73e-09	2.40e-10
End-of Life	LPG Production (DEAM)	Lead cmpds					9.19e-15	9.06e-14	4.60e-15
End-of Life	Natural Gas Prod. (DEAM)	Lead cmpds					-1.56e-14	-1.54e-13	-7.81e-15

MP = Materials processing.
Blank = not applicable.

Table N-7. LCD Mercury Inputs by Life-cycle Stage

Life-cycle Stage	Process	Input	Quantity	Units	Type
Manufacturing	LCD CCFL mfg. (CDP)	Mercury	3.99e-06	kg	Primary material
Manufacturing	LCD backlight unit assembly (CDP)	Backlight lamp (CCFL)	1.94e-03	kg	Direct to assembly

Table N-8. CRT Mercury Outputs by Life-cycle Stage

Life-cycle Stage	Process	Output	Quantity	Units	Type	Disposition
Materials Processing	ABS Production (DEAM)	Mercury	2.12e-07	kg	Airborne	air
Materials Processing	ABS Production (DEAM)	Mercury compounds	2.12e-07	kg	Waterborne	surface water
Materials Processing	Aluminum Prod. (all virgin; EB)	Mercury	2.02e-07	kg	Airborne	air
Materials Processing	Aluminum Prod. (all virgin; EB)	Mercury	8.93e-11	kg	Solid waste	landfill
Materials Processing	Ferrite mfg. (EB)	Mercury	1.62e-07	kg	Airborne	air
Materials Processing	Ferrite mfg. (EB)	Mercury	1.11e-12	kg	Solid waste	landfill
Materials Processing	Ferrite mfg. (EB)	Mercury compounds	1.03e-10	kg	Waterborne	surface water
Materials Processing	Invar (DEAM mix)	Mercury	2.12e-07	kg	Airborne	air
Materials Processing	Invar (DEAM mix)	Mercury	3.39e-11	kg	Solid waste	landfill
Materials Processing	Invar (DEAM mix)	Mercury compounds	1.06e-10	kg	Waterborne	surface water
Materials Processing	Lead (EB)	Mercury	1.51e-06	kg	Airborne	air
Materials Processing	Lead (EB)	Mercury	1.72e-11	kg	Solid waste	landfill
Materials Processing	Lead (EB)	Mercury compounds	1.50e-09	kg	Waterborne	surface water
Materials Processing	Polycarbonate Production (PC; DEAM)	Mercury	4.62e-07	kg	Airborne	air
Materials Processing	Polycarbonate Production (PC; DEAM)	Mercury compounds	4.62e-07	kg	Waterborne	surface water
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Mercury	3.26e-08	kg	Airborne	air
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Mercury	8.26e-14	kg	Solid waste	landfill
Materials Processing	Steel Prod., cold-rolled, semi-finished (EB)	Mercury compounds	8.58e-08	kg	Waterborne	surface water
Materials Processing	Styrene-butadiene Copolymer Prod. (DEAM mix)	Mercury	2.07e-07	kg	Airborne	air
Materials Processing	Styrene-butadiene Copolymer Prod. (DEAM mix)	Mercury compounds	2.07e-07	kg	Waterborne	surface water
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Mercury	2.72e-09	kg	Airborne	air
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Mercury compounds	3.77e-15	kg	Waterborne	surface water
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Mercury	2.89e-10	kg	Airborne	air
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Mercury compounds	3.06e-16	kg	Waterborne	surface water
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Mercury	6.94e-09	kg	Airborne	air

Table N-8. CRT Mercury Outputs by Life-cycle Stage

Life-cycle Stage	Process	Output	Quantity	Units	Type	Disposition
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Mercury compounds	4.54e-15	kg	Waterborne	surface water
Manufacturing	Japanese Electric Grid	Mercury	1.18e-07	kg	Airborne	air
Manufacturing	LPG Production (DEAM)	Mercury	8.69e-07	kg	Airborne	air
Manufacturing	LPG Production (DEAM)	Mercury compounds	1.34e-12	kg	Waterborne	surface water
Manufacturing	Natural Gas Prod. (DEAM)	Mercury	1.88e-09	kg	Airborne	air
Manufacturing	Natural Gas Prod. (DEAM)	Mercury compounds	2.71e-17	kg	Waterborne	surface water
Manufacturing	US electric grid	Mercury	1.20e-07	kg	Airborne	air
Use	US electric grid	Mercury	7.51e-06	kg	Airborne	air
End-of-life	CRT Incineration (DEAM mix)	Mercury	-1.12e-07	kg	Airborne	air
End-of-life	CRT Incineration (DEAM mix)	Mercury compounds	2.15e-11	kg	Waterborne	surface water
End-of-life	CRT landfilling (CDP)	Mercury compounds	2.19e-11	kg	Waterborne	surface water
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Mercury	-3.11e-09	kg	Airborne	air
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Mercury compounds	-3.29e-15	kg	Waterborne	surface water
End-of-life	LPG Production (DEAM)	Mercury	7.50e-12	kg	Airborne	air
End-of-life	LPG Production (DEAM)	Mercury compounds	1.16e-17	kg	Waterborne	surface water
End-of-life	Natural Gas Prod. (DEAM)	Mercury	-9.44e-10	kg	Airborne	air
End-of-life	Natural Gas Prod. (DEAM)	Mercury compounds	-1.36e-17	kg	Waterborne	surface water
End-of-life	US electric grid	Mercury	7.52e-10	kg	Airborne	air

Table N-9. LCD Mercury Outputs by Life-cycle Stage

Life-Cycle Stage	Process	Output	Quantity	Units	Type	Disposition
MP	Aluminum Prod. (all virgin; EB)	Mercury	7.51e-08	kg	Airborne	air
MP	Natural Gas Prod. (DEAM)	Mercury	1.32e-07	kg	Airborne	air
MP	PET Resin Production (DEAM)	Mercury	9.08e-08	kg	Airborne	air
MP	PMMA Sheet Prod. (DEAM)	Mercury	1.92e-07	kg	Airborne	air
MP	Polycarbonate Production (PC; DEAM)	Mercury	2.58e-07	kg	Airborne	air
MP	Steel Prod., cold-rolled, semi-finished (EB)	Mercury	1.60e-08	kg	Airborne	air
MP	Styrene-butadiene Copolymer Prod. (DEAM mix)	Mercury	9.04e-08	kg	Airborne	air
MP	Aluminum Prod. (all virgin; EB)	Mercury	3.32e-11	kg	Solid waste	landfill
MP	Steel Prod., cold-rolled, semi-finished (EB)	Mercury	4.05e-14	kg	Solid waste	landfill
MP	PET Resin Production (DEAM)	Mercury	9.08e-08	kg	Waterborne	surface water
MP	Natural Gas Prod. (DEAM)	Mercury compounds	1.89e-15	kg	Waterborne	surface water
MP	PMMA Sheet Prod. (DEAM)	Mercury compounds	1.92e-07	kg	Waterborne	surface water
MP	Polycarbonate Production (PC; DEAM)	Mercury compounds	2.58e-07	kg	Waterborne	surface water
MP	Steel Prod., cold-rolled, semi-finished (EB)	Mercury compounds	4.21e-08	kg	Waterborne	surface water
MP	Styrene-butadiene Copolymer Prod. (DEAM mix)	Mercury compounds	9.04e-08	kg	Waterborne	surface water
Manufacturing	LCD CCFL mfg. (CDP)	Backlight lamp (CCFL)	1.94e-03	kg	Product	
Manufacturing	LCD backlight unit assembly (CDP)	Broken CCFL	2.69e-07	kg	Solid waste	landfill
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Mercury	1.27e-10	kg	Airborne	air
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Mercury	4.46e-10	kg	Airborne	air
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Mercury	2.36e-10	kg	Airborne	air
Manufacturing	Japanese Electric Grid	Mercury	3.97e-07	kg	Airborne	air
Manufacturing	LPG Production (DEAM)	Mercury	4.17e-08	kg	Airborne	air
Manufacturing	Natural Gas Prod. (DEAM)	Mercury	2.97e-09	kg	Airborne	air
Manufacturing	US electric grid	Mercury	1.45e-08	kg	Airborne	air
Manufacturing	LCD monitor assembly (CDP)	Mercury	2.00e-06	kg	Hazardous waste	recycling/reuse

Table N-9. LCD Mercury Outputs by Life-cycle Stage

Life-Cycle Stage	Process	Output	Quantity	Units	Type	Disposition
Manufacturing	LCD module mfg. (CDP)	Mercury	9.69e-08	kg	Waterborne	surface water
Manufacturing	LCD CCFL mfg. (CDP)	Mercury	8.33e-08	kg	Waterborne	treatment
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Mercury compounds	1.76e-16	kg	Waterborne	surface water
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Mercury compounds	4.71e-16	kg	Waterborne	surface water
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Mercury compounds	1.55e-16	kg	Waterborne	surface water
Manufacturing	LPG Production (DEAM)	Mercury compounds	6.44e-14	kg	Waterborne	surface water
Manufacturing	Natural Gas Prod. (DEAM)	Mercury compounds	4.28e-17	kg	Waterborne	surface water
Manufacturing	LCD backlight unit assembly (CDP)	Waste CCFL, with mercury	8.17e-10	kg	Hazardous waste	treatment
Manufacturing	LCD backlight unit assembly (CDP)	Waste glass, with mercury	1.05e-10	kg	Hazardous waste	landfill
Manufacturing	LCD CCFL mfg. (CDP)	Wastewater stream, from CCFL mfg.	1.67e+02	kg	Waterborne	treatment
Use	US electric grid	Mercury	2.80e-06	kg	Airborne	air
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Mercury	-2.05e-09	kg	Airborne	air
End-of-life	LCD incineration (DEAM mix)	Mercury	-8.42e-08	kg	Airborne	air
End-of-life	LPG Production (DEAM)	Mercury	3.42e-12	kg	Airborne	air
End-of-life	Natural Gas Prod. (DEAM)	Mercury	-6.23e-10	kg	Airborne	air
End-of-life	US electric grid	Mercury	5.32e-10	kg	Airborne	air
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Mercury compounds	-2.17e-15	kg	Waterborne	surface water
End-of-life	LCD incineration (DEAM mix)	Mercury compounds	8.67e-12	kg	Waterborne	surface water
End-of-life	LCD landfilling (CDP)	Mercury compounds	7.50e-12	kg	Waterborne	surface water
End-of-life	LPG Production (DEAM)	Mercury compounds	5.29e-18	kg	Waterborne	surface water
End-of-life	Natural Gas Prod. (DEAM)	Mercury compounds	-8.98e-18	kg	Waterborne	surface water

MP = Materials processing

Table N-10. CRT Life-Cycle Impact Scores from Mercury-based Materials

Life-cycle Stage	Process	Input/Output	Impact Scores by Category					
			Haz. Waste	Solid Waste	ChrTox-pub	ChrTox-occ	Aq. Tox.	Terr. Tox.
MP	ABS Production (DEAM)	Mercury			2.12e-07			2.12e-07
MP	Aluminum Prod. (all virgin; EB)	Mercury			2.02e-07			2.02e-07
MP	Ferrite mfg. (EB)	Mercury			1.62e-07			1.62e-07
MP	Invar (DEAM mix)	Mercury			2.12e-07			2.12e-07
MP	Lead (EB)	Mercury			1.51e-06			1.51e-06
MP	Polycarbonate Production (PC; DEAM)	Mercury			4.62e-07			4.62e-07
MP	Steel Prod., cold-rolled, semi-finished (EB)	Mercury			3.26e-08			3.26e-08
MP	Styrene-butadiene Copolymer Prod. (DEAM mix)	Mercury			2.07e-07			2.07e-07
MP	ABS Production (DEAM)	Mercury compounds			1.12e-04		1.97e-04	1.11e-04
MP	Ferrite mfg. (EB)	Mercury compounds			5.45e-08		9.63e-08	5.44e-08
MP	Invar (DEAM mix)	Mercury compounds			5.58e-08		9.86e-08	5.57e-08
MP	Lead (EB)	Mercury compounds			7.89e-07		1.39e-06	7.88e-07
MP	Polycarbonate Production (PC; DEAM)	Mercury compounds			2.44e-04		4.30e-04	2.43e-04
MP	Steel Prod., cold-rolled, semi-finished (EB)	Mercury compounds			4.53e-05		8.00e-05	4.52e-05
MP	Styrene-butadiene Copolymer Prod. (DEAM mix)	Mercury compounds			1.09e-04		1.93e-04	1.09e-04
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Mercury			2.72e-09			2.72e-09
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Mercury			2.89e-10			2.89e-10
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Mercury			6.94e-09			6.94e-09
Manufacturing	Japanese Electric Grid	Mercury			1.18e-07			1.18e-07
Manufacturing	LPG Production (DEAM)	Mercury			8.69e-07			8.69e-07
Manufacturing	Natural Gas Prod. (DEAM)	Mercury			1.88e-09			1.88e-09
Manufacturing	US electric grid	Mercury			1.20e-07			1.20e-07
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Mercury compounds			1.99e-12		3.51e-12	1.98e-12
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Mercury compounds			1.61e-13		2.85e-13	1.61e-13

Table N-10. CRT Life-Cycle Impact Scores from Mercury-based Materials

Life-cycle Stage	Process	Input/Output	Impact Scores by Category					
			Haz. Waste	Solid Waste	ChrTox-pub	ChrTox-occ	Aq. Tox.	Terr. Tox.
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Mercury compounds			2.39e-12		4.23e-12	2.39e-12
Manufacturing	LPG Production (DEAM)	Mercury compounds			7.08e-10		1.25e-09	7.07e-10
Manufacturing	Natural Gas Prod. (DEAM)	Mercury compounds			1.43e-14		2.53e-14	1.43e-14
Use	US electric grid	Mercury			7.51e-06			7.51e-06
End-of-life	CRT Incineration (DEAM mix)	Mercury			-1.12e-07			-1.12e-07
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Mercury			-3.11e-09			-3.11e-09
End-of-life	LPG Production (DEAM)	Mercury			7.50e-12			7.50e-12
End-of-life	Natural Gas Prod. (DEAM)	Mercury			-9.44e-10			-9.44e-10
End-of-life	US electric grid	Mercury			7.52e-10			7.52e-10
End-of-life	CRT Incineration (DEAM mix)	Mercury compounds			1.13e-08		2.00e-08	1.13e-08
End-of-life	CRT landfilling (CDP)	Mercury compounds			1.15e-08		2.04e-08	1.15e-08
End-of-life	Fuel Oil #4 Prod. (DEAM mix)	Mercury compounds			-1.74e-12		-3.06e-12	-1.73e-12
End-of-life	LPG Production (DEAM)	Mercury compounds			6.11e-15		1.08e-14	6.10e-15
End-of-life	Natural Gas Prod. (DEAM)	Mercury compounds			-7.18e-15		-1.27e-14	-7.16e-15

MP = Materials processing.
Blank = not applicable.

Table N-11. LCD Life-Cycle Impact Scores from Mercury-based Materials

Life-cycle Stage	Process	Input/Output	Impact Scores by Category					
			Haz. Waste	Solid Waste	ChrTox-pub	ChrTox- occ	Aq. Tox.	Terr. Tox.
MP	Aluminum Prod. (all virgin; EB)	Mercury			7.51e-08			7.51e-08
MP	Natural Gas Prod. (DEAM)	Mercury			1.32e-07			1.32e-07
MP	PET Resin Production (DEAM)	Mercury			1.82e-07		1.82e-07	1.82e-07
MP	PMMA Sheet Prod. (DEAM)	Mercury			1.92e-07			1.92e-07
MP	Polycarbonate Production (PC; DEAM)	Mercury			2.58e-07			2.58e-07
MP	Steel Prod., cold-rolled, semi-finished (EB)	Mercury			1.60e-08			1.60e-08
MP	Styrene-butadiene Copolymer Prod. (DEAM mix)	Mercury			9.04e-08			9.04e-08
MP	Natural Gas Prod. (DEAM)	Mercury compounds			1.00e-12		1.77e-12	9.98e-13
MP	PMMA Sheet Prod. (DEAM)	Mercury compounds			1.01e-04		1.79e-04	1.01e-04
MP	Polycarbonate Production (PC; DEAM)	Mercury compounds			1.36e-04		2.40e-04	1.36e-04
MP	Steel Prod., cold-rolled, semi-finished (EB)	Mercury compounds			2.22e-05		3.92e-05	2.22e-05
MP	Styrene-butadiene Copolymer Prod. (DEAM mix)	Mercury compounds			4.77e-05		8.42e-05	4.76e-05
Manufacturing	LCD backlight unit assembly (CDP)	Broken CCFL		1.98e-11				
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Mercury			1.27e-10			1.27e-10
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Mercury			4.46e-10			4.46e-10
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Mercury			2.36e-10			2.36e-10
Manufacturing	Japanese Electric Grid	Mercury			3.97e-07			3.97e-07
Manufacturing	LCD CCFL mfg. (CDP)	Mercury				3.99e-06		
Manufacturing	LCD module mfg. (CDP)	Mercury			9.69e-08		1.94e-07	9.69e-08
Manufacturing	LPG Production (DEAM)	Mercury			4.17e-08			4.17e-08
Manufacturing	Natural Gas Prod. (DEAM)	Mercury			2.97e-09			2.97e-09
Manufacturing	US electric grid	Mercury			1.45e-08			1.45e-08
Manufacturing	Fuel Oil #2 Prod. (DEAM)	Mercury compounds			9.27e-14		1.64e-13	9.25e-14

Table N-11. LCD Life-Cycle Impact Scores from Mercury-based Materials

Life-cycle Stage	Process	Input/Output	Impact Scores by Category					
			Haz. Waste	Solid Waste	ChrTox-pub	ChrTox- occ	Aq. Tox.	Terr. Tox.
Manufacturing	Fuel Oil #4 Prod. (DEAM mix)	Mercury compounds			2.49e-13		4.39e-13	2.48e-13
Manufacturing	Fuel Oil #6 Prod. (DEAM)	Mercury compounds			8.15e-14		1.44e-13	8.14e-14
Manufacturing	LPG Production (DEAM)	Mercury compounds			3.40e-11		6.00e-11	3.39e-11
Manufacturing	Natural Gas Prod. (DEAM)	Mercury compounds			2.26e-14		3.98e-14	2.25e-14
Manufacturing	LCD backlight unit assembly (CDP)	Waste glass, with mercury	7.73e-15					
Use	US electric grid	Mercury			2.80e-06			2.80e-06
End of Life	Fuel Oil #4 Prod. (DEAM mix)	Mercury			-2.05e-09			-2.05e-09
End of Life	LCD incineration (DEAM mix)	Mercury			-8.42e-08			-8.42e-08
End of Life	LPG Production (DEAM)	Mercury			3.42e-12			3.42e-12
End of Life	Natural Gas Prod. (DEAM)	Mercury			-6.23e-10			-6.23e-10
End of Life	US electric grid	Mercury			5.32e-10			5.32e-10
End of Life	Fuel Oil #4 Prod. (DEAM mix)	Mercury compounds			-1.15e-12		-2.02e-12	-1.14e-12
End of Life	LCD incineration (DEAM mix)	Mercury compounds			4.57e-09		8.08e-09	4.57e-09
End of Life	LCD landfilling (CDP)	Mercury compounds			3.96e-09		6.99e-09	3.95e-09
End of Life	LPG Production (DEAM)	Mercury compounds			2.79e-15		4.93e-15	2.78e-15
End of Life	Natural Gas Prod. (DEAM)	Mercury compounds			-4.74e-15		-8.37e-15	-4.73e-15

MP = Materials processing.
Blank = not applicable.

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