Disposal or Other Releases of TRI Chemicals

Disposal or other releases of chemicals into the environment occur through a range of practices. They may take place at a facility as an on-site disposal or other release to air, water, or land; or they may take place at an off-site location after a facility transfers waste that contains TRI chemicals for disposal or other release.

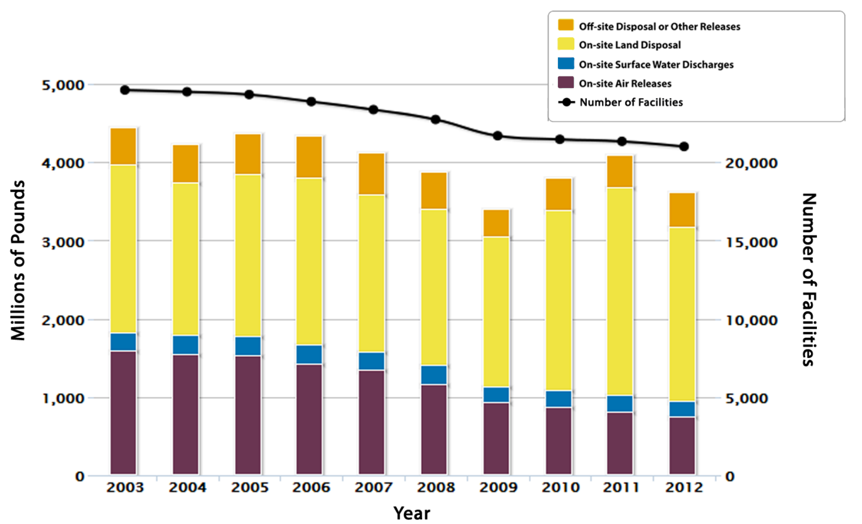
Evaluating disposal and other releases can help the public identify potential concerns and gain a better understanding of possible hazards related to TRI chemicals. It can also help identify priorities and opportunities for government to work with industry to reduce toxic chemical disposal or other releases and potential associated risks.

What is a release?

In TRI, a "release" of a chemical generally refers to a chemical that is emitted to the air, discharged to water, or placed in some type of land disposal unit.

Figure 4 shows that total disposal or other releases of TRI chemicals have generally decreased in the long-term: down 19% from 2003 to 2012. From 2011 to 2012, there was a 12% decrease in releases, mostly due to decreases in on-site land disposal by the metal mining sector. The number of facilities reporting to TRI has also declined steadily, decreasing by 15% from 2003 to 2012, and by 2% from 2011 to 2012.

Figure 4. Total Disposal or Other Releases, 2003-2012



Many factors can affect trends in total disposal or other releases, including changes in production, changes in management practices at facilities, changes in the composition of raw materials used at facilities and installation of control technologies. The long-term decreases from 2003 to 2012 in releases have been driven mainly by declining air releases, down 850 million pounds (54%) since 2003. Most of this decline was due to decreases in hazardous air pollutant (HAP) emissions, such as hydrochloric acid, at electric utilities. Reasons for the decreases include a shift from coal to other fuel sources and installation of control technologies at coal-fired power plants.

In more recent years, the large fluctuations in releases have been driven mainly by changes in on-site land disposal at metal mines. Metal mines accounted for 97% of the 696 million pound increase in total releases from 2009 to 2011, and 88% of the 483 million pound decrease in total releases from 2011 to 2012. Figure 5 shows on-site land releases over time in more detail. The fluctuations from 2009 to 2012 were mainly due to changes in waste quantities reported to TRI as “other land disposal” which generally includes toxic chemical waste disposed of in waste piles and spills or leaks. More specifically, most of the toxic chemical waste reported as other land disposal came from waste rock at metal mines.

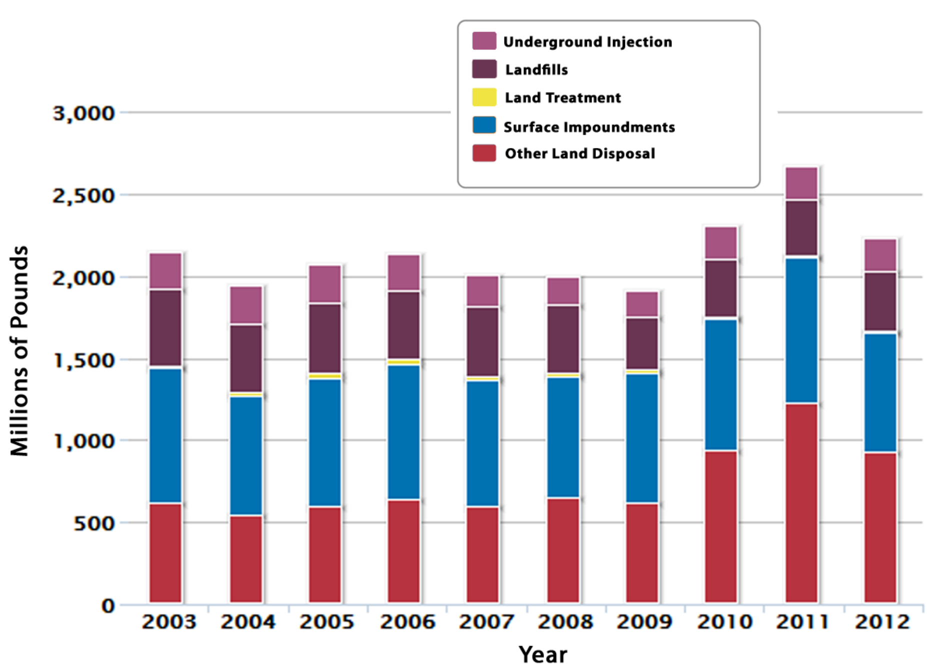
What is waste rock?

Rock removed from a mine is called “waste rock” if it does not contain economically recoverable amounts of targeted metals (e.g., copper, gold). TRI chemicals naturally present in waste rock in small concentrations are almost all reported to TRI as “other land disposal.”

Metal mining facilities typically handle large volumes of material. In this sector, even a small change in the chemical composition of the deposit being mined can lead to big changes in the amount of toxic chemicals reported nationally. In recent years mines have cited changes in production and changes in the composition of waste rock as the primary reasons for the reported variability in land disposal of TRI chemicals. Changes in waste rock composition can have an especially pronounced effect on TRI reporting because of a regulatory exemption that applies based on a chemical’s concentration regardless of the total quantity present in the rock.

Federal and state agencies require that waste rock be placed in engineered structures that contain contaminants. Federal and state land management agencies also require that waste rock and tailings piles and heap leach pads be stabilized and re-vegetated to provide for productive post-mining land use.

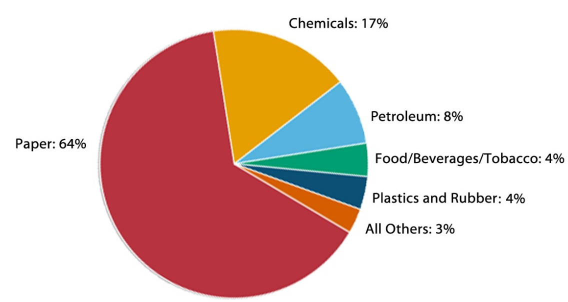
Figure 5. On-site Land Disposal, 2003-2012



Each of these land disposal categories includes a range of disposal types that vary in nature, some of which are more tightly regulated than others.

Hydrogen Sulfide Reported in 2012

Figure 6. Hydrogen Sulfide Air Releases, 2012
20.3 million pounds

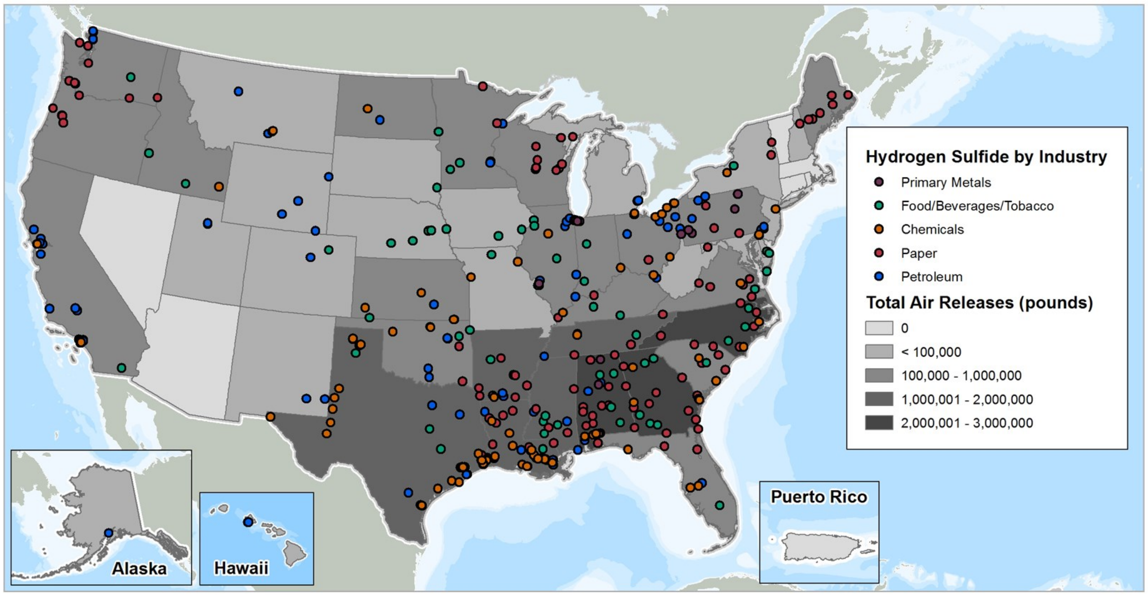


Reporting Year 2012 is the first year TRI has required facilities to submit information on hydrogen sulfide. Hydrogen sulfide is a chemical commonly produced through industrial operations, oil and natural gas extraction, and from the breakdown of organic matter. It is associated with chronic health effects in humans such as neurotoxic and upper respiratory effects, as well as adverse effects in aquatic organisms. While it was added to the TRI list of reportable toxic chemicals in a 1993 rulemaking, EPA issued an Administrative Stay in 1994 that deferred reporting while the Agency completed further evaluation of the chemical. EPA lifted the Administrative Stay on hydrogen sulfide in 2011, with reports on hydrogen sulfide due to TRI for activities in 2012.

For 2012, 484 facilities submitted TRI forms for hydrogen sulfide, with the most reporters in the petroleum (142), chemical (115), and paper (114) industries. Air releases from these three industries accounted for 89% of the 20.3 million pounds of hydrogen sulfide air releases, as shown in Figure 6. Seventeen facilities also reported newly implemented pollution prevention activities for hydrogen sulfide, including establishing a monitoring program of potential spill or leak sources and making process modifications.

The map below shows the TRI facilities by sector that reported hydrogen sulfide air releases for 2012.

Figure 7. Facilities Reporting Hydrogen Sulfide Air Emissions, by Sector



Some of the chemicals on the TRI chemical list have been designated as persistent, bioaccumulative, and toxic (PBT) chemicals. PBT chemicals are of particular concern not only because they are toxic, but also because they remain in the environment for long periods of time, and they tend to build up, or bioaccumulate, in the tissue of organisms. Here we look more closely at several PBT chemicals: lead and lead compounds; mercury and mercury compounds; and dioxin and dioxin-like compounds.

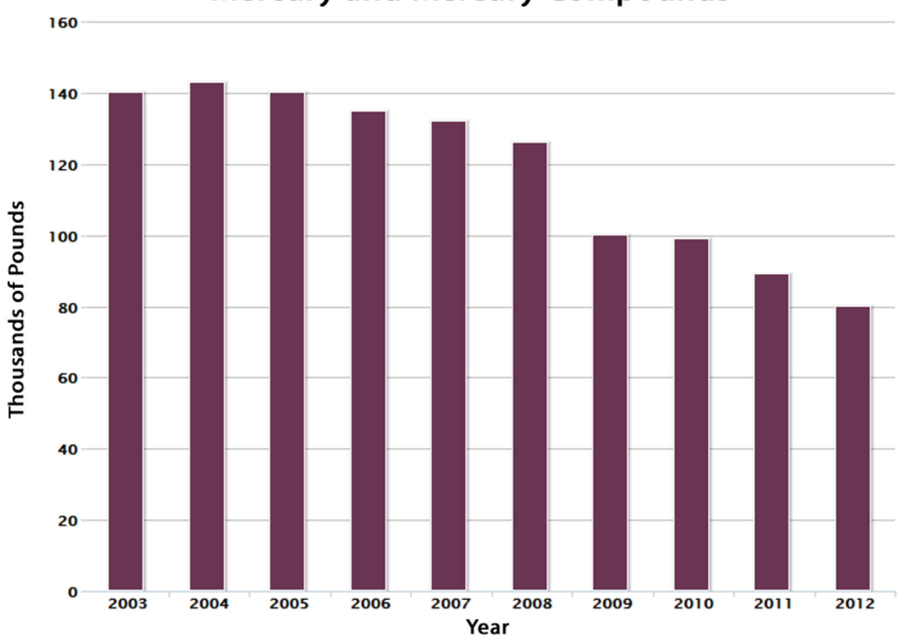
PBT Chemicals

Persistent, bioaccumulative, and toxic (PBT) chemicals have different TRI reporting requirements than other chemicals. PBT chemicals are of particular concern because they remain in the environment for long periods of time and tend to build up in the tissue of organisms.

Lead and lead compounds accounted for 98% of the total disposal or other releases of PBT chemicals in 2012 and drive PBT trends over time. Releases of lead and lead compounds rose and fell between 2003 and 2012, with a substantial increase occurring from 2009 to 2011 (102%), followed by a 22% decline in 2012; trends were driven by changes in on-site land disposal or other releases from the metal mining sector.

Mercury, another PBT chemical of concern, has traditionally been used to make products such as thermometers, switches, and some light bulbs. It is also found in many naturally occurring ores and minerals, including coal. The overall trend in total disposal or other releases of mercury and mercury compounds is also driven by metal mines, which accounted for 97% of on-site land disposal of mercury in 2012. In the United States, coal-burning power plants are the largest source of mercury emissions to the air. Since 2003, air releases of mercury and mercury compounds decreased by 42%, including a 10% decrease from 2011 to 2012, as shown in Figure 8. Electric utilities, which include coal- and oil-fired power plants, accounted for 60% of the mercury and mercury compounds air emissions reported to TRI in 2012. This sector is also driving the decline in mercury air emissions, with a 47% reduction since 2003, and a 17% reduction from 2011 to 2012.

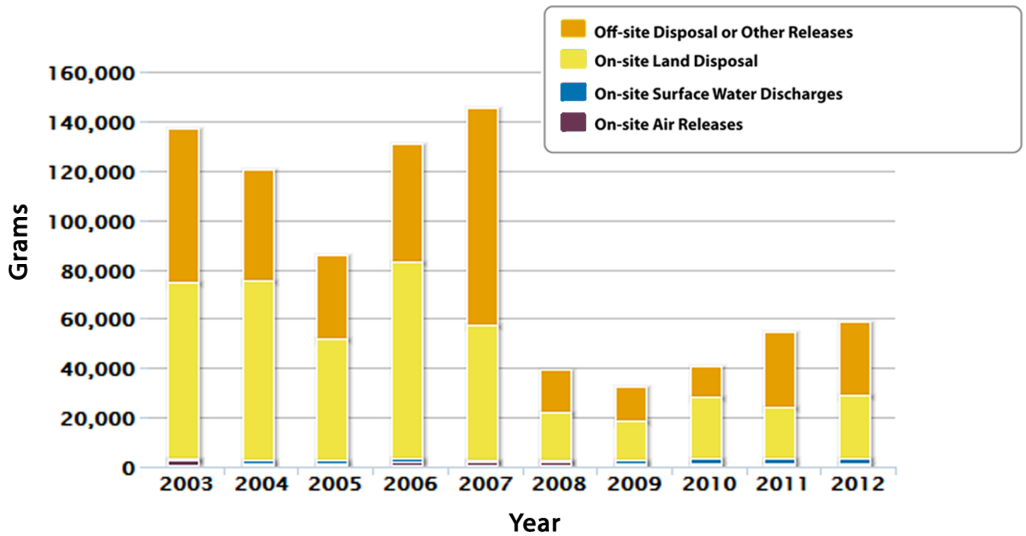
Figure 8. Air Releases, 2003-2012
Mercury and Mercury Compounds



Some reasons for the decreases include a shift from coal to other fuel sources and installation of control technologies at coal-fired power plants.

Dioxin and dioxin-like compounds (dioxins) are PBTs and characterized by EPA as probable human carcinogens. Dioxins are the unintentional byproducts of most forms of combustion and several industrial chemical processes. Figure 9 shows the amount of dioxin total disposal or other releases in grams. Releases of dioxins decreased by 57% from 2003 to 2012, but increased 8% from 2011 to 2012. This increase in 2012 was largely due to an increase in dioxins reported by one primary metals manufacturer. In 2012, most (72%) of the quantity released was disposed of in landfills on- and off-site.

Figure 9. Total Disposal or Other Releases, 2003-2012: Dioxin and Dioxin-like Compounds



TRI requires facilities to report on 17 types of dioxin and dioxin-like compounds (or congeners). These congeners have a wide range of toxicities. The mix of dioxins from one source can have a very different level of toxicity than the same total amount, but different mix, from another source. These varying toxicities can be taken into account using Toxic Equivalency Factors (TEFs), which are based on each congener's toxicity. The total grams of each congener can be multiplied by its TEF to obtain a toxicity weight. The results can then be summed for a total of grams in toxicity equivalents (grams-TEQ). Analyzing dioxins in grams-TEQ is useful when comparing disposal or other releases of dioxin from different sources, or different time periods, where the mix of congeners may vary. Since 2010, when TEQ was first included in TRI for dioxins, grams-TEQ have increased by 49% while dioxin grams released have increased by 45%. This similar increase in grams and grams-TEQ indicates that there has been little change in the overall toxicity of the mix of dioxins released over the past three years.

What is grams-TEQ?

To account for how different dioxin compounds vary in toxicity, EPA multiplies the mass reported for each compound by a compound-specific toxicity factor. The results are summed for a total of grams in toxicity equivalents (TEQ), called "grams-TEQ." Grams-TEQs allow for a better understanding of the toxicity of the releases.

Various industry sectors may dispose of or otherwise release very different mixes of dioxin congeners. Four industry sectors accounted for most of both the grams and grams-TEQ of dioxin released in 2012; however, their ranking in terms of percentage of the total is quite different for grams and grams-TEQ, as shown in Figures 10 and 11.

Figure 10. Grams
Percent of Disposal or Other Releases,
Dioxin and Dioxin-like Compounds, 2012

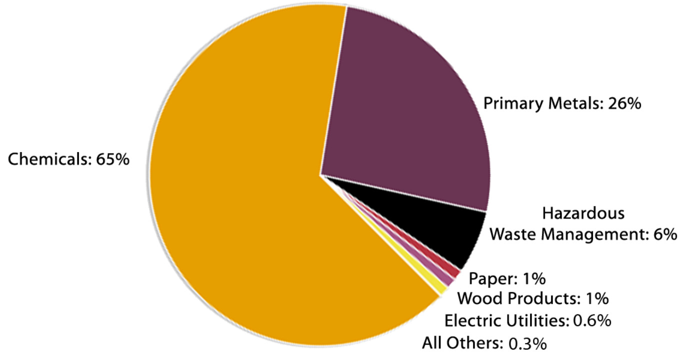
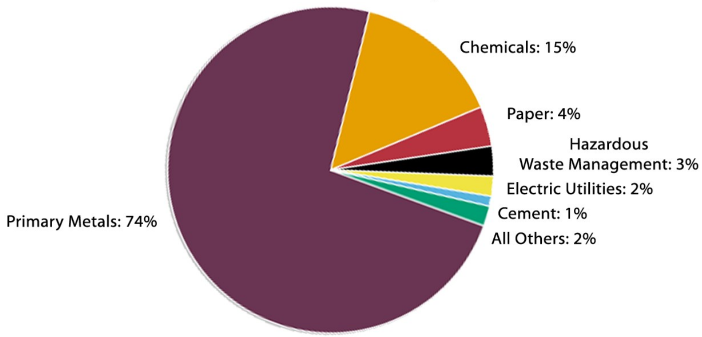


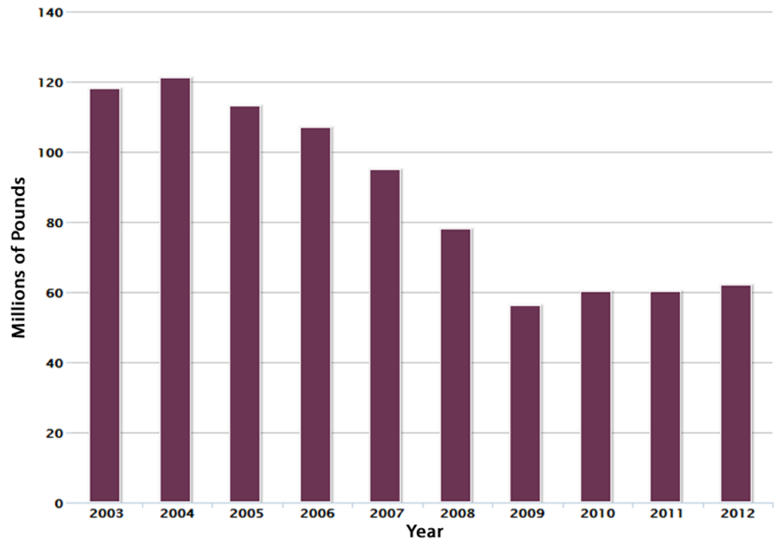
Figure 11. Grams-TEQ
Percent of Disposal or Other Releases,
Dioxin and Dioxin-like Compounds, 2012



In 2012, the chemical manufacturing industry accounted for 65% of the total grams of dioxin and dioxin-like compounds released, while the primary metals sector accounted for 26% of the total grams. However, when TEFs are applied, the primary metals sector accounted for 74% of the total grams-TEQ and the chemical manufacturing industry for 15% of the total grams-TEQ.

Among the chemicals that are reported to TRI, there are about 180 known or suspected carcinogens, which EPA sometimes refers to as Occupational Safety & Health Administration (OSHA) carcinogens. Figure 12 shows that the air releases of these carcinogens decreased by 47% between 2003 and 2012, although there was a 5% (2.7 million pounds) increase from 2011 to 2012. The long-term decreases in air releases of OSHA carcinogens were driven mainly by decreases in styrene air releases from the plastics and rubber, and transportation equipment industries.

Figure 12. Air Releases, 2003-2012
Carcinogens



Trends in pounds of disposal or other releases do not account for potential risk of chemical releases. Risk can vary depending on chemical toxicity, how chemicals are released (e.g., to the air or water), where chemicals travel, and where human populations are located.

To provide information on the potential risk of disposal or other releases, the TRI Program presents its data from a risk-related perspective using EPA's publicly-available Risk-Screening Environmental Indicators (RSEI) model. The model produces unitless "scores," which represent relative chronic human health risk and can be compared to RSEI-generated scores from other years or geographical regions.

RSEI

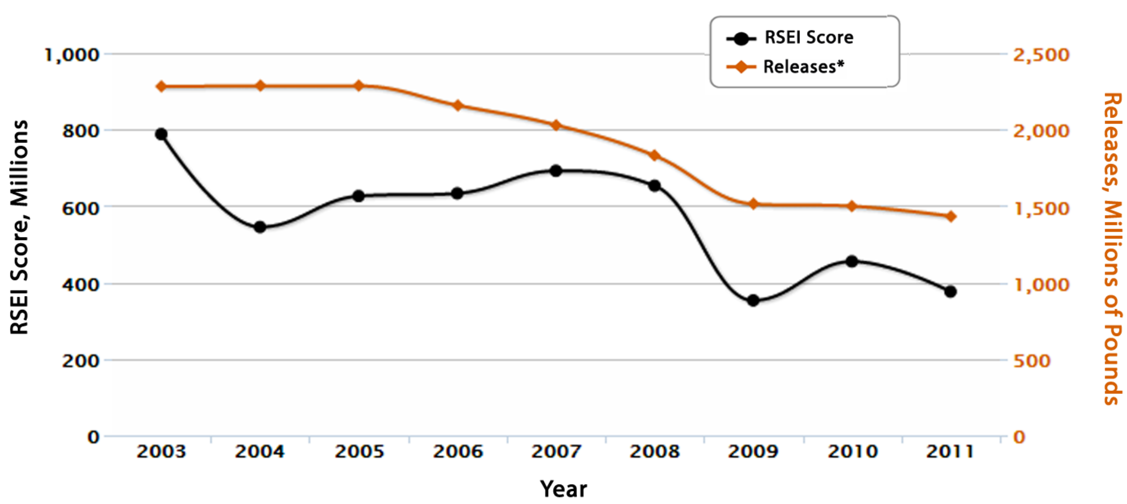
The Risk-Screening Environmental Indicators (RSEI) model considers more than just chemical quantities released, including:

- Location of releases
- Toxicity of the chemical
- Fate and transport
- Human exposure pathways
- Number of people exposed

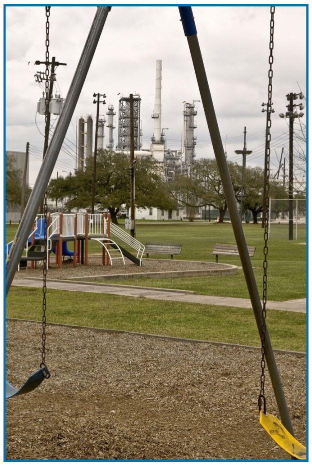
RSEI scores are calculated using on-site releases to air and water, transfers to Publicly Owned Treatment Works (POTWs) and transfers for off-site incineration as reported to TRI. Note that other release pathways, such as land disposal, are not currently modeled in RSEI. The scores are calculated based on many factors including the amount of chemical released, the location of the release, the chemical's toxicity, its fate and transport through the environment, and the route and extent of human exposure. Because modeling the exposure of TRI chemicals is time and resource intensive, RSEI data through 2011 are currently available, and updates through 2012 are scheduled to be available later in 2014.

Figure 13 shows the trend in the RSEI score from 2003 to 2011. Over this time period, the RSEI score decreased by 52%, while the corresponding pounds released over the same time period decreased by 37%. These results suggest that TRI reporters are making progress in reducing their use of higher toxicity chemicals and/or reducing releases in areas that would result in higher human exposure.

Figure 13. RSEI Score and Corresponding Releases*



*Includes only those pounds currently modeled through RSEI which are on-site releases to air and water, transfers to POTWs, and off-site transfers for incineration.



Note that RSEI is a screening-level model that uses simplifying assumptions to fill data gaps and reduce the complexity of calculations in order to quickly evaluate large amounts of data and produce a simple score. The model focuses on chronic human toxicity. It should be used for screening-level activities such as trend analyses that compare relative risk from year to year, or ranking and prioritizing chemicals or industry sectors for strategic planning. RSEI is not a formal risk assessment, which typically requires site-specific information on the toxicity of TRI chemicals and detailed population distributions to predict exposures for estimating potential health effects. Instead, RSEI is commonly used to quickly screen and highlight situations that may lead to potential chronic human health risks. More information about the model can be accessed at www.epa.gov/opptintr/rsei/. Analyses using RSEI data providing a quantitative relative estimate of risk posed by a facility can be generated in EPA's Envirofacts database using the following link: www.epa.gov/enviro/facts/topicsearch.html#toxics.

Most disposal or other release practices are subject to a variety of regulatory requirements designed to limit environmental harm. To learn more about what EPA is doing to help limit the release of harmful chemicals to the environment see EPA's laws and regulations page at www2.epa.gov/laws-regulations.