Energy Efficiency Reference for Environmental Reviewers

prepared for

Office of Federal Activities
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

prepared by

Science Applications International Corporation
7600-A Leesburg Pike
Falls Church, Virginia 22043

under

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1. INTRODUCTION

Purpose and Intent of This Reference

This reference document provides background information on the ways that the environmental review process required by the National Environmental Policy Act (NEPA) and the environmental oversight provisions of Section 309 of the Clean Air Act (CAA) can be employed to prevent pollution and save valuable natural resources through the promotion of energy efficiency. This reference is intended to promote the incorporation of the principles of energy efficiency in NEPA review and CAA oversight. However, it is the responsibility of the individual conducting review and oversight to determine how best to employ the suggestions offered in this document.

National Environmental Policy Act and the Clean Air Act

NEPA is the basic national charter for the protection of the environment. In broad and far reaching provisions it states the need for the United States to prevent environmental damage and ensure that the decisionmakers in all federal agencies consider the environmental consequences of their actions. Important issues of environmental protection and environmental quality are energy and resource use, efficiency, and conservation. NEPA implementing regulation (40 CFR 1502.16) specifically requires addressing in the discussion of the environmental consequences:

(e) Energy requirements and conservation potential of various alternatives and mitigation measures.

(f) Natural or depletable resource requirements and conservation potential of various alternatives and mitigation measures.

NEPA provides EPA with the opportunity to encourage all federal agencies to fully implement energy efficiency through its provisions and through associated laws and regulations. With virtually every significant federal action (agency legislation, regulations, and projects and programs) having the potential for energy impacts, EPA can influence the consideration of energy efficiency and conservation in most federal government actions. EPA can also provide information that can be applied by other federal agencies as they consider future actions.

In addition, EPA oversees other agencies' environmental review documents. This authority (delegated under the Clean Air Act section 309) takes the form of required review and comment by EPA of the environmental impacts of other federal agency projects subject to NEPA. EPA rates the quality of the environmental documents of other agencies and publicly reports the ratings in Federal Register notices. If EPA finds the project unsatisfactory "from the standpoint of public health or welfare or environmental quality," they refer the project to the Council on Environmental Quality. This document is part of an affirmative approach by EPA to provide assistance in incorporating energy efficiency and conservation in projects.

The Energy Policy Act of 1992

The Energy Policy Act of 1992 contains provisions for energy efficiency as it relates to buildings, utilities, appliance and equipment energy efficiency standards, industrial facilities, state and local energy conservation programs and federal agency energy management. The Act also addresses energy and the environment via improved energy efficiency, electricity generation and use, and advanced nuclear reactors among many energy and resource topics. This broad legislation concerns energy production, wise use, and conservation through law, regulation, standards, joint studies, grant funding, and technology development and transfer. Some of the activities are major federal actions and are subject to NEPA review. As such, these actions provide an opportunity to integrate the promotion of efficient energy use and development with the practice of environmental review and oversight under NEPA and the CAA.

Audiences

The primary audience for this reference is EPA staff that: (1) review legislation, regulations, and environmental assessments and environmental impact statements in meeting EPA's Clean Air Act section 309 responsibilities; and (2) participate in interagency coordination meetings, committees, and task forces on a full range of EPA's responsibilities and initiatives.

Other audiences include staff of federal agencies and private and public individuals and groups whose environmental legislation, regulations, projects, documentation, or permit applications come under EPA review, and international, state, or local governmental staff or officials and private individuals and groups interested in energy efficiency and energy conservation. All audiences should consider this document as background information, not as law, regulation, or policy, or guidelines.

Links between Environmental Quality and Energy Use

Environmental quality and energy use are closely linked. In the past, maintaining a high standard of living and economic productivity was equated to increasing energy use. Initiatives in the United States over the last 20 years, however, have demonstrated that energy efficiency and conservation can slow increasing energy demand without sacrificing productivity. Overall energy consumption per dollar of gross national product has been generally decreasing since 1970. The increased cost of energy over the last three decades has provided an incentive for energy efficiency, as are federal, state, and local air quality regulations. More stringent pollution controls over the last two decades have caused energy related air pollutant emissions to decrease while total energy use has increased.

NEPA provides the legal and institutional framework for EPA to encourage the incorporation of energy efficiency and energy conservation practices in federal agency proposed legislation or regulation and programs or actions. EPA can make their suggestions formally in their written comments under Clean Air Act section 309, but many other opportunities exist to incorporate energy efficiency and conservation much earlier in NEPA and other processes. Early planning meetings with applicants or other agencies, scoping, identification of project purpose and need, identification of reasonable alternatives, and review of study results or preliminary drafts of the EIS all provide opportunities.

The earlier in the NEPA process suggestions are made and considered, the greater the likelihood of incorporating energy efficiency and conservation in project design. This reference is provided to help the reader recognize and encourage the earliest incorporation of energy impact assessments and considerations in the NEPA process. Early in the process, when the initial investments are still low and designers are not yet wedded to a favorite plan, process, or location, evaluations of alternative approaches and technologies are usually met openly and with interest. After plans and heavy investments and commitments are made, project changes are costly and irritating. The intent of this document is to increase awareness of federal programs, information, and opportunities for energy conservation and efficiency that can be incorporated in proposed projects.

Organization of this Reference

This introductory chapter is followed by a chapter that reviews the NEPA process and describes opportunities for including energy efficiency and energy conservation in NEPA processes. Succeeding chapters outline an array of opportunities and methodologies that can be used by public agencies and private individuals to integrate efficiency and conservation into a wide range of projects and programs. These are followed by chapters that catalogue federal programs and directives that apply to energy efficiency and conservation and provide information needed to understand energy impacts, methodologies for identifying and evaluating impacts, and energy conservation opportunities to include in feasibility and design studies. The listings are not exhaustive, but show the breadth and depth of federal interest and involvement under law, regulation, policy, and practice.

2. INCORPORATING ENERGY EFFICIENCY AND CONSERVATION IN THE NEPA PROCESS

The NEPA process provides a means to introduce, familiarize, and encourage project sponsors to incorporate energy efficiency and energy conservation into their projects. The NEPA process is briefly outlined below followed by a discussion of ways to introduce energy assessments into the NEPA process.

National Environmental Policy Act

EPA's affirmative responsibility to protect the environment in the decisions it makes is governed by the law (42 USC sections 4321-4370a), regulations applied to all federal agencies (40 CFR 1500-1508); and EPA's own regulations (40 CFR Part 6). Clean Air Act (42 USC 7609) section 309 expands EPA's NEPA responsibilities to include evaluating other federal agencies projects and to officially comment and rate other agencies EISs. NEPA and its implementing regulations "requires that Federal agencies include in their decision making processes appropriate and careful consideration of all environmental effects of proposed actions, analyze potential environment effects of proposed actions and their alternatives for public understanding and scrutiny, avoid or minimize adverse effects of proposed actions, and restore and enhance environmental quality as much as possible" (40 CFR 6.100). All federal agencies must address (40 CFR 1502.16) energy and natural or depletable resources requirements and conservation potential of various alternatives and mitigating measures.

The NEPA process for any proposed project requires gathering of project, alternative, and environmental data. Once the federal agency has sufficient data, a written environmental assessment (EA) is prepared that indicates whether the potential exists for significant adverse impacts from the project and whether such impacts can be reduced to less-than-significant levels through project redesign or mitigation measures. If there is no question that significant impacts will occur, the agency may skip the EA and proceed directly to an EIS. Where significant impacts can be avoided, an agency can issue a permit or proceed with the project by issuing a Finding of No Significant Impact (FONSI). For energy and resource impacts, the question of what constitutes a significant impact may be difficult to decide.

Where environmental impacts can not be reduced to less than significant, an EIS must be prepared. The federal lead agency publishes a Federal Register Notice of Intent announcing their intention to prepare an EIS and holds "scoping" where they request suggestions on the contents of the EIS. Possible alternatives, impacts, mitigation measures, and study designs changes are often recommended. A Draft EIS is then prepared by the lead agency or a consultant to the lead agency, although the lead agency takes full responsibility for the scope and contents of the EIS.

Once the document is completed, the Draft EIS is circulated for review by the general public and other federal, state, and local agencies. Written comments on the Draft EIS and those questions and comments recorded during the public hearing(s) are collected by the lead agency and responded to by staff or the EIS consultant. Information to respond to some questions or comments may require information from an applicant or from new studies or reconsideration of some feature or mitigation measure of the project. The written responses to questions and comments, any minor project modification or new mitigation measures, and an incorporation by reference of the Draft EIS (or a copy of the Draft EIS) are collated into a Final EIS. The Final EIS is distributed to all those individuals and entities commenting on the Draft EIS.

A record of decision (ROD) is issued at the time of the permit award or project approval. It lists any mitigation measures necessary to make the recommended alternative environmentally more acceptable. Such mitigation can be made a condition of a permit or approval and the federal agency can monitor for compliance.

Influencing the NEPA Process

One way EPA fulfills its obligations under environmental laws, regulations, and polices is to specify the integration of NEPA at the earliest possible stages in the planning processes. Of greatest overall importance in early NEPA integration is the lead agency/permit or grant applicant having the opportunity in the planning, sitting, feasibility, and design stages to incorporate least damaging/most environmentally protective techniques and technology. The most cost effective means of getting the least environmentally damaging process and facilities is to have all parties familiar with the environmental constraints and opportunities, particularly energy efficiency and conservation opportunities in the earliest stages of the proposed project. CEQ NEPA guidance (40 CFR 1501.2) clearly state the importance of applying NEPA early in the process.

"Agencies shall integrate the NEPA process with other planning at the earliest possible time to insure that planning and decisions reflect environmental values, to avoid delays later in the process, and to head off potential conflicts." Each agency shall:

(a) Utilize a systematic interdisciplinary approach.

(b) Identify environmental effects and values in adequate detail so they can be compared to economic and technical analyses. Environmental documents and appropriate analyses should be circulated and be reviewed at the same time as other planning documents.

(c) Study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources.

(d) Provide for cases where actions are planned by private applicants or other non-federal entities before federal involvement so that:

(1) Policies or staff are available to advise potential applicants of studies or other information foreseeably required for later federal action.

(2) The federal agency consult early with appropriate state and local agencies and Indian Tribes and with interested private persons and organizations when its own involvement is foreseeable.

(3) The federal agency commences its NEPA process at the earliest possible time.

Opportunities for enhancing the incorporation of energy efficiency and conservation in the NEPA process can occur at a number of different points in the process:

- Preparation of NEPA and other instructional information;
- Early coordination;
- EA/FONSI;
- Scoping;
- Workshops;
- Critiques of draft products;
- Draft EIS;
- Public hearings; and
- Final EIS and Record of Decision

Preparation of NEPA and Other Instructional Information

These guidelines and other energy-related materials already available or that might be prepared provide a forum for making government agency staff and private individuals and organizations aware of the range of options available in energy efficiency and energy conservation practices. While local utility community education programs and the increasing costs of power as reflected in monthly bills have gotten the public's attention, wise use of energy and resources is important in all aspects of business, industry, manufacturing, transportation, military, power generation, and other sectors.

Energy efficiency and wise resource use need to be themes contained in all federal programs and projects. The Energy Policy Act of 1992 clearly supports such an inclusion. Since NEPA is the mechanism by which federal activities are reviewed for potential impacts, all NEPA-related instructions as well as program planning instructions need to address energy efficiency and wise resource use.

NEPA and other environmental directives require the inclusion of energy efficiency and energy conservation data and analysis. These data and analytical techniques could include life cycle analysis, long term energy and resource use analyses, comparisons of relative energy costs and savings under different alternatives--in general putting any program/project in long-term perspective in terms of energy and resource use, efficiency, and conservation.

EPA staff participate in briefings; task force formation; meetings; and requests for informal and formal comments on programs, projects, directives, initiatives, legislation, and regulations throughout government. Opportunities to make sure energy efficiency and energy conservation are considered can be as simple as preparing a fact sheet on energy conservation and efficiency that is taken to all pertinent meetings with other agencies, at all levels of government, and with private permit applicants. The fact or briefing sheet should summarize key concepts and data sources on energy efficiency and energy conservation. Suggestions on the data that should be gathered and the kind of analyses to be run can facilitate the preparation of data requests to permit applicants or federal government project proponents and the preparation of specifications or requests for proposals.

Early NEPA Coordination and the Focus on "Purpose and Need"

At the earliest stages in project/program planning, agencies or private applicants should have interagency briefings, meetings, task forces gatherings, etc. to explain the proposed project or program. These meetings are planned to familiarize agency staff with the proposed project/program and assigned staff. It cannot be emphasized too strongly that this is the appropriate early stage to make requests for data and to suggest analytical techniques. At these early stages consideration can be given and budgets developed for studies needed to evaluate energy and resource conservation questions.

Statement of Purpose and Need

One means of getting energy efficiency and conservation considered at the earliest phases in program/project planning is to stress the importance of clearly defining the purpose and need for the project or program and developing the range of alternative approaches to fulfilling the need. The purpose and need must be a clear, objective statement of the rationale for the project. It is not a one sided justification of the project. The importance of the statement of purpose and need is that it determines the alternatives to be evaluated. The possible alternatives to be considered are alternatives than can fulfil the purpose and need rather than just alternatives to a proposed project. Since the only alternatives that need be considered are those that can fulfill the purpose for the project, *the choice of the purpose and need statement is critical to a full examination of possible alternatives and the recognition of the least environmentally damaging alternative.*

Consider the different alternatives elicited by two different purpose and need statements for a project. If the purpose of the project is to build a new coal fired power plant, the alternatives could consider other locations, a different power delivery schedule, or alternative methods for controlling potential emissions. If, on the other hand, the purpose of the project is to provide

500 megawatts of power, the alternatives could include conserving enough electricity not to build the facility (demand side management), different kinds of power (e.g. wind, solar), different types of fuel (e.g. natural gas, oil, biomass), different locations, or a combination of some of the above and perhaps cogeneration. Clearly, the second purpose elicits a greater range of alternatives, some of which have less severe or different environmental consequences. As a general rule, the more extensive the range of possible alternatives, the greater the opportunity for avoiding significant impacts. Early NEPA coordination and scoping provide the greatest practical opportunities to get energy efficiency and conservation considered early in the project planning process.

Environmental Assessments/Findings of No Significant Impacts and Thresholds of Significance

For a federal agency to make a finding of no significant impact, the project to be implemented must not have the potential for a significant impact. An agency's judgement on lack of significant impact is open to review by EPA (CAA section 309) and judicial review. The trend over the last 20 years of NEPA is to mitigate all the potentially significant environmental consequences as part of the project design and to work diligently to bring forward only projects that can meet the no-significant-impact test. The difficulty is the lack of agreement on what constitutes a "significant" or "less-than-significant" impact. The advantage of preparing an EA/FONSI compared to preparing a full EIS is the simplicity of the environmental assessment and the NEPA process and the short time period. The powerful motivation in the savings of time and money (as well as environmental protection) spurs federal agencies and private permit applicants to refine projects/programs to reduce potential impacts to levels they deem less than significant. EPA needs to communicate the advantages designing projects that do not have significant impacts to other federal agencies because of the environmental and cost benefits of the EA/FONSI process over the EIS process. EPA must also emphasize the necessity to document the rationale for each determination of no significant impacts.

Threshold of Significance

The critical question on EA/FONSIs is the definition of significance. The term "significant effect" is a pivotal one under NEPA, because an EIS needs to be prepared when the probability exists for a significant impact. What is significant can be set by law, regulation, policy, or practice of an agency; it can be the collective wisdom of a recognized group (e.g. industry or trade association standards); or profession judgement of an expert or group of experts.

With the NEPA regulations in mind, it is ultimately up to the EA preparer(s) to make judgments on what constitutes a significant impact. *The threshold of significance is different for each impact and those making the judgments need to explain the rationale for the thresholds chosen.* A clear description of the choice of the threshold of significance for impact provides the reader with a basis for agreeing or disagreeing with the determination of significance based on the specific assumptions, criteria, or data.

The lack of comprehensive energy efficiency and conservation standards and the large variety of suggestions and requirements places EPA and other environmental document preparers and reviewers in the position of developing their own energy impact significance thresholds. It is critically important that thresholds set by EA/FONSI preparers clearly define assumptions on what they considered significant so they may be agreed or disagreed with based on the assumptions. EPA NEPA staff need to encourage agencies to document their thresholds of significance. EIS preparers already use air quality and water quality standards, state and local regulations and other requirements in their design criteria.

An example of a level of significance for overall energy uses used by one state department of transportation declares that the amount of energy used to build a project like a road realignment must not exceed the energy expenditure that would be expected by continued use of the road if no improvement project were built. The rationale is that if total life cycle costs are less for the improvement, then the road improvement does not have a significant adverse energy impact. While the threshold is simple to state, it requires a focused analysis to generate the data and make the comparison.

Scoping and the Development and Documenting of Alternatives

EPA staff have an opportunity for informal and formal consultation during "scoping." Scoping presents opportunities in the form of requests for written comments on a brief written description of a project or for verbal suggestions at a scoping meeting. EPA staff can request that energy conservation and energy efficiency be considered to mitigate for any potential energy or resource use impacts. The purpose and need statement defines the range of options for alternatives.

Alternatives

The alternatives identify all the alternative actions or projects that were, or are, being considered. Reasonable alternatives are explained in as much detail as available while alternatives considered and rejected early in the planning process are briefly described along with the rationale for dismissal. Dismissed alternatives are usually those that are unreasonable for technical, economic, or institutional reasons. The rationale must have sufficient data to support the conclusion not to proceed with the alternative and sufficient backup data to respond to a challenging question or comment on the Draft EIS. Agencies or private applicants typically undertake screening processes and feasibility studies to help them site the facilities and identify and refine reasonable alternatives. The screening process provides the bases for determining various alternatives that can be identified and investigated further and includes analyses of constraints and opportunities.

As part of the description of alternatives, the project sponsor screening processes and results need to be explained to provide insight into the breadth and depth of alternatives considered and rejected or pursued for further study. Explaining how the project sponsor narrowed the list of alternatives can significantly reduce questions asked after the Draft EIS is released for comment (and which need to be covered in the Final EIS) on whether conservation and demand side management were considered, were non-traditional power generating types such wind, solar, or geothermal given in-depth consideration, why were particular substation locations chosen, and many others. *A well documented explanation of the screening processes is critical in complying with the requirement for a thorough consideration of alternatives.*

The lead agency may have a preferred alternative or may wait until the Final EIS is being prepared to identify one from among several alternatives that are fully described. The message is clear in both the Council on Environmental Quality and EPA NEPA regulations that *a broad array of alternatives need to be considered and at least several reasonable alternatives need to be explored in detail and compared.* Alternatives must be chosen that sharply define issues and force comparisons of key differences. The detail on the reasonable alternatives necessary must be sufficient so that the potential impacts of the alternatives can be identified and compared. As with all of the information needed during scoping and Draft EIS preparation, there must be sufficient detail so that the environmental consequences can be evaluated and compared for efficient energy and resource use and conservation.

Major projects often have scoping reports or implementation plans in which the lead agency identifies the questions and suggestions that were raised during the scoping meetings and/or comment period. The reports also can identify how the lead agency intends to answer the questions, approach difficult issues, and analyze specific problems. EPA has an opportunity after reviewing the report to follow up with the lead agency if EPA is not satisfied with the direction the lead agency intends to take. Further discussion or explanation of comments or suggestion may gain the lead agency's concurrence, or consensus may be reached on an alternative approach.

The opportunity to ask questions and make suggestions should be governed by tests of reasonableness and practicality of the requests. The rationale for consultation directly after the issuance of the scoping report is to identify concerns that staff may have with the project and with the analysis to be undertaken in the review process to identify, qualify, and quantify the impacts before the lead agency commits their resources to developing the EIS. In the spirit of applying NEPA early in the process, EPA must raise the issues of energy efficiency and energy conservation at the beginning of the project, not after the design and EIS have been completed.

Workshops

Lead agencies frequently hold workshops, "townhall" meetings, briefings etc. to discuss a proposed project and solutions. Whether the meetings are interagency or a public meeting, EPA has an opportunity to raise questions and make suggestions on energy efficiency and conservation (among EPA's several concerns). The meetings may be directed to public information, but recently more of the meetings involve an interactive process of setting priorities, developing criteria, or refining options with participation of other agencies and the interested public, individuals, and groups. These meetings provide a forum to explore both big picture questions (e.g., can we conserve enough power through demand side management and other conservation techniques) or site specific (e.g., energy efficient lighting in a new federal building).

Critiques of Draft Environmental Documentation

Opportunities for further refinements and inclusions of energy efficiency and conservation can be sought in making sure that existing and projected energy and resource use is detailed in the Environmental Setting section and that assumptions, methods of analysis, and thresholds for significance are clearly outlined in the Environmental Consequences section.
Each impact discussed in the Environmental Consequences section has its own means of identification, qualification, and/or quantification. A goal is to quantify impacts that lend themselves to numerical calculations, modeling, and projections to show the magnitude and intensity of each impact and to allow comparison among alternatives. Other environmental elements (e.g., aesthetic values) lend themselves to more qualitative or graphic analysis.

The method(s) of comparing the energy impacts of different alternatives is critical to understanding and making reasoned choices in the decision making process. While decision making involves tradeoffs with frequently dissimilar social, economic, and environmental concerns, the difficult process and explaining the rationale for the decision in an ROD is facilitated by clear, compatible, energy impact data. Comparisons of long-term analyses are most helpful, particularly life cycle assessments, that take into account all factors and long time lines.

CEQ and EPA NEPA guidelines describe the expected general contents of the section called "Environmental Consequences." In addition to identifying, quantifying, and comparing the impacts of each alternative, 40 CFR 1502.16 specifies that discussions will include: (1) "any adverse environmental impacts which cannot be avoided should the proposal be implemented, (2) the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and (3) any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented." The last two of these requirements relate directly to energy and resource use and conservation.

Over the last 20 years a practice has developed to include these three topics (i.e., adverse impacts, short-term use vs. long-term productivity, irreversible commitment of resource) as a separate chapter(s) in the draft EIS along with perhaps a chapter called cumulative impacts, adverse effects which cannot be avoided, or residual impacts and mitigation. No matter what format is used with these topics, they often receive only cursory treatment. Such a practice is unfortunate because these long-term, larger scale issues are those that affect overall environmental quality and amenities. These concerns are directly related to energy and resource use, efficiency, and conservation. The important point is not the placement in the document, but rather the need to have the data gathered and analyses undertaken to qualify and quantify, where possible, these concerns.

An analysis of cumulative impacts reflects a broad view of environmental quality and asks the question of how impacts of the proposed project or alternatives contribute to the environmental quality in the locale. Not only are existing impacts considered, but anticipated impacts of projects approved but not constructed, projects being considered for approval, or projects being planned. This "accumulating" impacts approach to cumulative impacts can be particularly instructive when no single project is a major cause of a problem, but rather each project contributes incrementally to a growing problem. Energy and resource use are major considerations in cumulative impacts.

All of the summary topics focus on broad views and long time lines in a attempt to put project impacts in perspective. The Environmental Setting and Consequences sections present data needed to qualify and quantify the potential energy impacts and put each potential impact in perspective in terms of local, regional and perhaps state or national environmental quality. The question to be answered is: what part do the project-related impacts play in local/regional/state/national environmental quality now and in the future for each parameter.

CEQ NEPA regulations define mitigation (40 CFR 1508.20) to include:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the li: ɔf the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

This listing of mitigation measures has been interpreted as a hierarchy with "avoiding impacts" the best mitigation and "compensating" for a loss the least desirable (but preferable to loss without compensation). This hierarchy reinforces the present approach of trying to avoid or minimize potential impacts during project sitting and design. The goal is have the most environmentally sound project and alternatives to carry into the impact assessment process of NEPA. The proposed project and its alternatives, or the suite of alternatives if there is no preferred alternative, however, typically reflects choices among tradeoffs. The tradeoffs can include different sites, processes, pollution control technologies, costs, or other features.

Tradeoffs can be complex with dissimilar beneficial and detrimental impacts among the alternatives. EPA reviewers should look to see that the alternatives brought forward for analysis are: (1) all reasonable; (2) that all possible refinements and modifications for energy efficiency and resource conservation have been incorporated in the alternatives; and (3) if there are any residual impacts and consequences of mitigating that those impacts have been identified and evaluated. Mitigation measures should have minimal impacts.

The most helpful comments and suggestions at this point in the process are to clearly identify data that is missing but necessary for assessment, to specify analysis techniques or methods to help quantify the impacts, and to suggest reasonable mitigation. The tone of the comments is also important in soliciting quality responses and the interest in pursuing additional information. EPA's responses to comments are usually written and provided directly to the lead agency rather than in a public hearing.

EPA may have concerns with major issues that relate to long-term productivity and resource use and/or with more specific concerns such as specific energy use (e.g., light or air conditioning).

EPA may have concerns relative to their direct mandates on air or water quality. There may be conflicts or difficult decisions to be made or among environmental elements. A particular process may conserve energy, but produce a toxic by-product that is difficult to dispose of in a safe manner. Waste management processes trade off reducing one potential contaminant at the expense of creating another. A particular concern at the Draft EIS stage is the pursuit of sufficient data on the environmental consequences of mitigation measures. To clearly decide among alternatives, the impacts of mitigation measures must be factored into the analysis and comparison of alternatives. This is possible when life cycle assessments are conducted for each alternative and clear comparisons are made.

The holistic approach should be the focus of questions and comments to project sponsors upon review of Draft EISs. The overall question is what are all the long-term costs (environmental as well as economic) of each alternative? "Good" decisions by the decision-makers demand good quality data, careful explanations, and documented comparisons of all factors for each alternative.

Final EISs and Records of Decision

The Final EIS is distributed to all agencies and individuals that commented during the Draft EIS process. EPA has the opportunity to review the Final EIS and see if all their questions were satisfactorily answered and the concerns and issues they raised were dealt with constructively. At this late stage in the NEPA process, the opportunity for positive, constructive influence is limited. EPA has the option of determining that the project is environmentally unacceptable and referring it to CEQ for review.

3. ENERGY IMPACT ASSESSMENT PROCESSES AND METHODOLOGIES

Basic parameters

A variety of materials have energy value because of the energy that is released during various kinds of chemical or physical reactions — wood, coal, and petroleum products release energy when burned, fissionable materials release energy through radioactive decay, and water releases energy when it falls from one height to a lower one. If properly controlled, the energy released in these processes can be captured and converted into other, more useful forms.

If the energy released in one of these processes is used directly, it is termed a primary use. The combustion of natural gas or oil to heat buildings is a primary energy use, as is the burning of a fuel to produce steam required in industrial processes. The burning of fossil fuels to produce mechanical motion in vehicles or to produce steam for turning turbines to generate electricity is a secondary energy use. In general, primary energy uses are more efficient than secondary energy uses because usable energy is lost during conversion from one form of energy to another.

Energy is measured in a variety of units. The standard metric unit, the calorie is the amount of energy needed to raise the temperature of 1 gram of water 1 degree Centigrade. In the United States, the British Thermal Unit (BTU) is more commonly used. It is the amount of energy needed to raise the temperature of 1 pound of water 1 degree Fahrenheit. Other units are also used, depending on their application. They include joules, watt hours, kilogram calories, foot-pounds, or kilogram meters. Since it is important that the same units be used when comparing different forms of energy, conversion factors are provided among these common units in Table 1.

TABLE 1. CONVERSION FACTORS BETWEEN BTUS AND OTHER COMMONLY USED UNITS

1 BTU	252 calories
1 BTU	1055 joules
1 BTU	778.16 foot-pounds
1 BTU	0.252 kilogram calories
1 BTU	0.293 watt hours

Common fuels, however, are not normally measured in energy units, but by weight or volume. Nevertheless, the amount of energy released when each is burned is relatively constant, so the energy released from combustion of unit weights or volumes can be predicted. The following table (Table 2) lists several sources of energy, their units of measure, and their energy equivalent.

TABLE 2. COMMON UNITS OF MEASURE AND CONVERSIONS TO BTUs (U.S. DEPARTMENT OF COMMERCE, 1974)

Energy Source	BTU Equivalent
Butane, Liquefied	91,600 BTU/Gal
Coal, Anthracite	13,900 BTU/lb
Coal, bituminous	14,000 BTU/lb
Coal, lignite	11,000 BTU/lb
Coal, Sub-bituminous	12,600 BTU/lb
Electricity	3,412 BTU/KWh
Fuel Oil, #2	140,000 BTU/Gal
Fuel Oil, #6	152,000 BTU/Gal
Kerosene	134,000 BTU/Gal
Natural Gas	1,000 BTU/cubic foot, 100,000 BTU/therm
Propane, Liquefied	103,300 BTU/Gal

Energy applications are usually not measured in terms of energy, but in terms of power. Power is energy generation per unit time. Typical units for measuring power include watts, horsepower, or tons. Cooling capacities of air conditioning units are usually measured in tons, heating unit capacities are defined in BTUs/hour, and motor capacities are measured in horsepower or watts. The following table (Table 3) lists the common units used for various applications and their BTU/hr equivalents.

TABLE 3. UNITS OF MEASURE FOR VARIOUS APPLICATIONS (U.S. DEPARTMENT OF COMMERCE, 1974)

Application	Units of Measure	BTU Equivalent
Air Conditioning, Refrigeration	Tons	12,000 BTU/hr
Heating	BTUs	—
Motors	Horsepower (hp)	2545 BTU/hr
Boilers	Pounds of steam generated per hour or BTUs	Varies with specific characteristics of boiler
Lighting	Watts	3.412 BTU/hr

Energy Sources

The types of energy sources are important in determining the long-term availability of energy. The use of renewable energy sources such as power derived from solar energy, wind, water, and wood products saves nonrenewable sources such as fossil fuels. The stocks of fossil fuels will ultimately be consumed, requiring a switch to renewable sources if future energy demands are to be satisfied.

Renewable Energy Sources

Renewable energy sources are used for only ten percent of the U.S. annual power production. About half of the renewable energy sources are used to generate electricity while the remainder are used primarily for space and water heating.

With the exception of hydropower, renewable energy sources have been limited to relatively small-scale applications. Almost ten percent of the electricity generated in the United States in 1991 was generated by hydroelectric power plants. Other renewable energy sources such as wood, cannot be renewed at the rate required for major power generation, and technologies using solar or wind power are generally not economically competitive with nonrenewable sources of energy. Therefore, on a limited scale, renewable energy resources can be used to reduce demand for electric power.

Solar energy is used to provide space and water heating, chemical potential energy, or electricity. The direct absorption of the sun's radiation to produce heat for heating buildings or water is called an active solar or heliothermal process. The conversion of the sun's radiation into electrical energy in photovoltaic systems (solar cells) is generally termed a helioelectrical process. Energy generated by solar cells is expensive, but is of increasing interest because of environmental concerns about other forms of energy production. However, use of solar cells may entail an environmental trade-off as "solar farms" are build on large expanses of desert lands. Heliochemical processes cause chemical reactions, creating chemicals that release energy when burned. Almost all heliochemical processes are biological — the creation of useful chemicals by engineering has not yet been successful except on a very small scale.

Wind mills have been used for centuries to harness energy from the wind and generate mechanical energy to grind grains and pump water. Due to the variability of wind, however, it is generally infeasible to generate consistent, large quantities of electricity using wind turbines. Feasibility increases in areas where winds are stronger and less variable. Several areas in the U.S. have windfarms that generate electricity for commercial power systems.

Geothermal energy generation is limited to areas where there are geysers or hot springs. Steam from underground sources is used to power low pressure turbines for electricity generation. Some geothermal resource areas have power generation capacities limited to the 20-30 year life of the geothermal field.

Biomass fuels include a wide variety of materials such as wood, charcoal, peat, bagasse, biogas, and liquid fuels produced by biological processes. Wood, charcoal, peat and bagasse are usually burned to produce heat. Biogas and liquid fuels such as ethanol are potentially useful substitutes for natural gas and petroleum products, and can be used in transportation and electricity generation as well as for heat production.

Charcoal is wood that has been heated in a non-oxidizing atmosphere to convert complex organic molecules to carbon, resulting in a higher BTU value. Peat is organic material that is in the early stages of transformation to coal. Peat is generally low in sulfur, nitrogen, and ash, but must be dried before use because it has a very high water content. Bagasse is a fibrous residue from sugarcane processing that can be burned in wood-fired boilers. Biogas (methane) is generated from the anaerobic digestion of animal wastes. Biogas units provide a useful source of energy where piped gas and electricity are too expensive and has the advantage that the sludge remaining after processing can be used as a fertilizer. Ethanol is generated by the aerobic digestion of plant matter (wastes or grains) and animal wastes and waste matters including municipal solid waste. Ethanol production is not yet economically competitive with current energy sources.

In some cities, municipal solid waste is incinerated with supplemental fuels such as coal or natural gas to generate electricity, and the residual heat is for industrial or space heating. This process is called cogeneration. Since much of the municipal solid waste stream is made up of plastics (from nonrenewable sources) and fossil fuels are also required, cogeneration using municipal wastes is considered to be only partially a renewable energy source.

Nonrenewable Energy Sources

Non-renewable energy sources supply the majority of electrical energy in the U.S. and almost all of the energy used in transportation. Petroleum products are responsible for almost 50% of the power generated (natural gas provides about 25%), coal provides about 25%, and nuclear power plants generate about twenty percent of electricity in the U.S.

Although nuclear energy supplies approximately one-fifth of the U.S. energy needs, it is unlikely that this will increase because of its high cost and public concern over adverse environmental impacts associated with nuclear waste disposal.

Petroleum products and coal supply about three quarters of the U.S. energy requirements. Petroleum products and coal are used in industrial boilers and power generation stations to produce steam for manufacturing and electric generators. Domestic petroleum production has declined steadily in the last few years, primarily because cheaper crudes are available from the Middle East. As prices for foreign crudes rise, there will be greater demand for U.S. oil production. On the other hand, the U.S. has the largest coal reserves in the world, and about ninety percent of the domestic coal mined is used for electricity generation.

Methodologies/Approaches

A number of methodologies have been developed to evaluate energy use and energy efficiency in a facility, process, or building. The NEPA reviewer can use these concepts to determine whether energy use has been considered in the project planning phases. The methodologies presented below can also be used in the early stages of project planning to compare alternatives and to identify and determine whether thresholds of significance have been crossed. Thresholds of significance are discussed in Chapter 2. The use of energy conservation and energy efficiency principles should be considered in all aspects of the project alternatives that are evaluated. Some conservation and efficiency measures are described in the next section.

Life-cycle Cost Analysis

Life-cycle cost analysis (LCC) is a technique that assesses energy costs and savings potential over the total lifetime of a building or project in order to prioritize conservation measures and provide funding to those alternatives with the highest life-cycle cost savings to investment ration (SIR). Use of LCC by federal agencies was introduced by Executive Order 1203 in 1977, codified by the National Energy Policy and Conservation Act (NEPCA) in 1978, and amended by the Federal Energy Management Improvement Act (FEMIA) ten years later. LCC has been used for many years by both the public and private sector, generally focusing on alternatives related to individual facilities. Federal facility managers use LCC analyses to evaluate the costs of different acquisition, operation, maintenance, renovation, repair and disposition strategies. Typical alternatives that are evaluated in LCC analyses include buying versus leasing, renovating versus stop-gap measures, expanding versus relocating, as well as selection of construction materials and electrical and mechanical systems. Detailed information on LCC can be found in U.S. Congress (1991), and in Ruegg (1987).

The purpose of LCC analysis is to quantify a series of time-varying costs for a given alternative over an extended time horizon, and represent these costs as a single "net present value" cost. The net present value cost is the amount of money the facility owner would have to invest today, at a specified interest rate (the "discount rate") to pay all of the time-varying costs for a facility over its economic life (often assumed to be 20 years). These time varying costs, at their highest level of aggregation, usually include the following:

- Capital improvements: Capital improvements are large, infrequent investments with long economic lives. New structures and major renovations (such as may be required to improve energy efficiency) are examples of capital improvements.

- Non-recurring operations and maintenance (O&M): Non-recurring O&M costs reflect items that occur on a less frequent than annual basis that are not capital improvements. Examples include the renovation or replacement of heating ventilation and air conditioning systems, repair of highways or bridges, and other major maintenance activities.

- Recurring O&M: Recurring O&M costs reflect costs incurred on an annual to daily basis. Utility costs, routine maintenance costs, and the costs of janitorial and security services are included here.

- Energy: Energy costs include the costs for oil, gas, electricity, and other fuels. Although energy costs can be included under utilities as a recurring O&M cost, they are usually broken out because of their importance to management and their sensitivity to both market prices and the extent of a facility's use. When they are broken out, the analysis of energy conservation alternatives is simplified.

- Residual Value: Residual value is the value of the option at the end of the LCC analysis period. Residual value factors in the effects of depreciation and capital investment. Positive residual values are deducted from the sum of present value costs to obtain a single net present value cost for a given facility alternative. In this manner LCC analysis can quantify relationships that exist between cost areas. For example, certain types of capital improvements might reduce recurring O&M and energy costs while increasing the facility's residual value at the end of the analysis period.

Total Cost Assessment

Accounting procedures typically lump energy and environmental costs in an overhead account or add them to other budget line items where they cannot be disaggregated easily. As a result, facilities are often unable to identify the cost items responsible for the greatest expenditures. Using total cost assessment (TCA), facilities can customize accounting systems to gather the information necessary for an accurate identification of costs related to energy and environmental management. Detailed information on TCA can be found in U.S. EPA, 1992 (see attached bibliography).

Table 4 reveals that TCA is useful because it itemizes costs associated with specific activities or facilities. TCA was originally intended for use primarily by private sector users engaged in a production process. EPA has begun to study how TCA can be used to assess pollution prevention projects. As with the LCC analysis, the TCA study is usually focused on a particular process as it affects the bottom-line costs to the user. The objective of TCA is to identify cost items that can achieve the greatest cost savings. However, since the purpose of TCA is to develop accounting practices that internalize external (environmental) costs, environmental goals are also met by cost reductions.

Because of its focus on cost and cost effectiveness, TCA shares many of the features of LCC analysis by tracking direct costs (capital expenditures and O&M expenses/revenues). However, TCA also includes indirect costs, liability costs, and reduced costs associated with a number of intangible benefits. A summary of costs included in TCA is presented in Table 4; the quantification of these costs and benefits provides a basis for making financially advantageous decisions based on the costs of environmental controls and other activities.

TABLE 4.

Direct Costs	Damage Indirect or Hidden Costs
• Capital Expenditures - Buildings - Equipment - Utility connections - Equipment installation - Engineering • Operation and Maintenance - Raw Materials - Labor - Waste Disposal - Utilities - Value of Recovered Material	• Compliance Costs - Permitting - Reporting - Monitoring - Manifesting - Insurance - On-site Waste Management - Operation of On-site Pollution
Liability Costs	**Control Equipment Less Tangible Benefits**
• Penalties and Fines • Personal Injury and Property	• Increased Revenue From Enhanced Product Quality • Increased Revenue From Enhanced Company and Product Image • Reduced Health Maintenance Costs From Improved Employee Health • Increased Productivity From Improved Employee Relations

Life-Cycle Assessment

Life-cycle assessment (LCA) differs fundamentally from LCC and TCA because it does not concern costs or investments. Historically, life-cycle assessments have been used by both the public and private sector to identify and evaluate opportunities to reduce the environmental effects of a specific product, production process, package, material, or activity.

EPA defines LCA as a tool for examining the environmental releases and impacts of a specific product by tracking it from raw material extraction stage through production and eventual disposal. The main reason for using LCA is to evaluate proposed changes to products or processes to identify ways to reduce environmental impacts. Details on the use of LCA can be found in U.S. EPA, 1993.

LCA analyzes the entire life cycle including raw material extraction, processing, and transportation; manufacturing and distribution of products; use, reuse, and maintenance of products; recycling of products; and their final disposition. Quantities of emissions and effluents replace costs as the evaluation metric, leading to the quantification of impacts on all environmental elements at all stages of product use. Although LCA leads frequently to an "apples to oranges" comparison, it is a useful and evolving tool for the holistic quantification of impacts.

The three main components of a life-cycle assessment include:

- Inventory analysis - identifying and quantifying energy and resource use and environmental releases to air, water, and land;
- Impact analysis - characterizing and assessing the impact on the environment; and
- Improvement analysis - evaluating and implementing opportunities to reduce environmental burdens.

Of the three components, inventory analysis is the best developed, and most useful for evaluating project alternatives. Facilities use inventory analysis to quantify the energy and raw material requirements and all environmental releases during the life cycle of a product, package, process, material, or activity. As such, LCA is best viewed as a process for researching, confirming, and disclosing the quantifiable environmental relationships that exist during each phase of a product's life cycle. Personnel involved with energy conservation or pollution prevention activities should become familiar with life-cycle analysis.

The life-cycle analysis approach can be used to design or redesign projects or products to make them environmentally less damaging. With a life-cycle analysis approach, environmental design criteria are given equal footing with traditional criteria such as product quality, performance, and production price. Design criteria that are commonly considered in an LCA approach include evaluation of the use of hazardous substances, consumption of energy or water, and whether the product can be readily recycled or reused. Stating these criteria up-front helps ensure that products are environmentally compatible from raw material extraction to manufacturing through use and final disposal.

Demand-side Management

Demand-side management (DSM) consists of activities which involve actions on the demand- or customer-side of energy use, either directly caused or indirectly stimulated by the energy supplier. DSM activities are primarily oriented towards reducing electrical power consumption by consumers, however these activities can be tailored to reduce other energy uses, such as reduce gasoline consumption through the requirement for more fuel-efficient cars. Typical programs among utilities have focussed on a number of strategies discussed briefly below. These strategies are described in greater detail in Gellins and Chamberlin (1988).

- <u>Customer load control</u>: a means by which the operation of equipment is reduced during peak periods in order to decrease the range in demand for electricity from utilities. Several consumer load control strategies can be employed, including the use of time clocks or switches, current limiters, thermostats, or demand control systems. Time clocks or switches turn equipment off for periods of time to reduce the electrical load. Current limiters, fuses or circuit breakers are used to limit electricity demand and encourage improved control of power consumption. These are popular in northern Europe but is not widely used in the U.S. Some utilities have established programs to cycle air conditioning equipment on and off for short periods during peak demand hours. Demand control can also be achieved using an automatic Energy Management System (EMS). An EMS can control the timing and overall energy consumption of manufacturing equipment, lights, and heating and air conditioning equipment.

- Strategic conservation: Conservation programs are a widely implemented form of demand side management which have been successful at reducing consumer's energy consumption through reductions in the participant's energy costs. There is a broad spectrum of conservation programs that can be used to cover almost every major energy end use, appliance or device. Conservation can be attained through use of technologies to improve building heat retention (e.g. through the use of additional insulation), and by improving efficiency of appliances, lighting, air conditioners or water heaters. Conservation programs can be implemented by a utility through information programs, direct technical assistance to consumers, financial incentives, rates and demonstration programs. Further information and references on conservation programs are presented in Gellins and Chamberlin (1988).

- Energy storage: a demand-side management technique that involves the use of hardware and equipment designed to vary either the quantity or delivery characteristics of energy input while maintaining the required energy delivery schedule. Energy storage techniques are generally applied to heating and cooling of building space and water heating. This increases sales during off-peak hours and decreases demand during peak hours. Thermal storage devices do not conserve energy, however, they only shift the time of its use. These systems can pay for themselves in areas where utilities have lower rates during off-peak hours.

- Interruptible loads: demand side management programs that allow the utility to control the load provided to the consumer. The purpose of interruptible loads is to bring about a change in the maximum demand, or in the timing of individual loads in order to meed a consumer's need while minimizing peak electricity dema . A vast majority of controlled loads consist of air conditioners, water heaters, space heaters, and irrigation pumps. The utility can interrupt loads by remote signal from the utility or by timers or thermostats at a customer location.

- Rate design: All demand-side management opportunities are influenced by a utility's demand pricing structure. Historically, because of efficiencies of scale, utilities have provided discounts to major industrial consumers — costs per kilowatt hour were reduced at higher consumption levels. Demand-side management requires an alternative approach, where not only are rates for major consumers increased, but discounts or rebates are given for specific reductions in consumption, particularly during peak hours. Base or lifeline rates are the lowest rates with increased rate(s) charged for consumption above the minimum (or lifeline) rate.

Integrated Resource Planning

Integrated Resource Planning (IRP) is a planning and selection process for new energy resources that evaluates the full range of alternatives available to a public utility in order to provide adequate and reliable service to its customers at the lowest system cost. IRP is also known as Least Cost Utility Planning. The alternatives to be evaluated during IRP include new generating capacity, power purchases, energy conservation and efficiency, cogeneration and district heating and cooling applications, and renewable energy resources. System cost is defined as the direct and quantifiable net costs for an energy resource over its available life, including the cost of production, transportation, utilization, waste management, environmental compliance, and access to foreign sources of supply where applicable.

The Energy Policy Act of 1992 requires public utilities to employ IRP. The IRP process must account for necessary features of system operations, including diversity, reliability, dispatchability, and other factors of risk. In addition, the IRP process must take into account the ability to verify energy savings achieved through energy conservation and efficiency, and projected durability of such savings measured over time.

The basic elements of an Integrated Resource Plan include the following:

1. Identification and accurate comparison of all practicable energy efficiency and energy supply resource options available

2. Include a 2-year and a 5-year action plan which describes specific actions that will be taken to implement the integrated resource plan

3. Designate "least cost options" to be used for providing reliable service to customers, and explain reasons why such options are selected

4. Minimize adverse environmental effects of new resource acquisitions

5. Public participation in preparation and development of the plans

6. Load forecasting

7. Provide methods of validating predicted performance in order to determine whether objectives in the plan are being met.

Details and references on Integrated Resource Planning can be found in Edison Electric Institute, (1992).

Energy Efficiency Improvement Categories

The U.S. comprises five percent of the world's population but consumes over 30 percent of the world's energy. In comparison to other industrialized countries, the U.S. energy intensity (the amount of energy consumed per dollar of industrial output) is almost double that of West Germany, Japan, Italy, the United Kingdom, and Sweden. Because of the high environmental cost associated with energy production, improving energy efficiency is one way to reduce pollution.

Energy conservation and energy efficiency principles can be introduced in a project if NEPA reviewers are aware of some of the different energy improvement categories and techniques available. Where possible under NEPA, concepts of energy conservation and energy efficiency should be introduced in early phases of design of energy production facilities, industrial facilities, buildings or roads. Furthermore, conservation and efficiency concepts should be applied in a holistic manner to consider energy demand associated with all aspects of the project, including land-use patterns, transportation and infrastructure, water use, and waste management.

Facility Design

Energy conservation and energy efficiency principles should be considered in all phases of facility planning and design. In the case of buildings, energy can be conserved with proper attention paid to materials used; orientation, shape, and design; and choice of heating and air conditioning equipment. These factors, and the choice of industrial equipment used are also important in the design of manufacturing or industrial facilities.

Buildings provide the shelter and year-round comfort to people for almost every activity. Residential and commercial buildings consume about 36 percent of the total U.S. energy generated. Design and construction of the buildings for their end-use has a great effect on energy consumption. Energy efficient design for building is described in detail in several references, including Shaw (1989) and Markus and Morris (1980).

An energy audit is one of the first steps to perform in order to identify potential energy conservation measures. The energy audit involves inspection of the energy distribution systems and energy using devices for identification of improved energy management opportunities. Energy audits identify energy use and can provide information on potential energy savings of a planned or existing facility. Guidance on energy audits can be found in Carlson (1992) and case examples of improved energy efficiency in the federal government can be found in U.S. Congress (1991).

Since most of the energy consumed in residential and commercial buildings is for space heating and cooling, water heating, and lighting, energy conservation efforts should be concentrated in these areas. Some opportunities for energy conservation in existing buildings are outlined in Fickett et al (1990), and Lovins and Browning (1992). These include:

- Installing heat-recovery water heaters
- Adding insulation
- Weatherstripping
- Replacing incandescent lights with compact fluorescent lights
- Installing ceiling fans to reduce energy consumption for heating and cooling
- Using economizer cycles on air conditioning units when the outside temperature outside is lower than the indoor temperature.

Energy conservation through retrofitting can often result in significant energy savings. for example, Romm (1993) reports that an office that replaced its old lighting fixtures with energy efficient fixtures reduced energy consumption for lighting by 63 percent.

New buildings are designed to be more energy efficient than older designs, thus, along with new technologies in heating, cooling, and lighting have greatly reduced energy consumption. Energy efficient design can be useful in reducing energy use in the home or in commercial buildings. Energy efficient designs consider some of the following elements:

- Climate
- Siting
- Space planning
- Building envelope
- Windows and other apertures
- Structure and mass
- Electric lighting
- Thermal systems
- Process loads and domestic hot water

Careful planning during construction of buildings can greatly reduce energy consumption. For example, the Nederlandsche Middenstandsbank began planning a new office building in 1978. Planning took three years and integrated initial design, construction planning, landscaping, and energy consumption. The design relied heavily on the use of daylight, passive solar heating, heat recovery, and natural ventilation. These considerations added about $700,000 to the construction cost, but saved about $2.4 million in energy costs each year. The previous building consumed 422,801 BTUs per square foot while the new building consumes only 35,246 BTUs per square foot. In addition to energy savings, the integration of landscaping and water fountains throughout the building created an attractive work environment resulting in reduced employee absenteeism. (Browning, 1992)

Federal facilities are mandated by executive orders and regulations to undertake energy conservation activities, but state and local government facilities are not necessarily covered under federal mandates. Existing federal facilities are required to reduce energy consumption from non-renewable sources and overall energy use. Functions of these facilities vary from office buildings to vehicle maintenance to research and development, so many of the planning and conservation opportunities outlined above for commercial and industrial facilities are applicable to federal facilities. Some states and local entities have extensive and detailed energy conservation laws regulations, and ordinances.

Industrial manufacturing consumes about 36 % of the energy generated in the United States. About 70 percent of this energy is used to supply heat and power for manufacturing. Industrial motors consume more than half of the electricity generated in the U.S. Total industrial energy consumption is expected to increase, while increased energy efficiency will result in decreased energy consumption per dollar of output. The amount of energy required to produce one dollar of U.S. gross national product, energy intensity, has fallen by 28 percent since 1978. (Fickett et al., 1990). This decrease has been attributed to increased energy efficiency in production equipment and vehicles.

The major part of the energy consumed by industrial plants is used to generate heat and power for manufacturing processes that require heat for preheating, drying, welding, and forming as well as energy for equipment motors. Equipment in industrial plants tends to be oversized to accommodate peaks in production and expected future increases in production. Because these motors often do not operate at capacity, their efficiency is reduced. Retrofitting or purchasing new motors with variable speed drives allows greater efficiency at lower loads and could have a large impact on energy consumption (Fickett et al., 1990).

Energy efficiency and energy conservation benefits are obtained where new industrial plants are designed to incorporate the newest energy-efficient technologies. Existing facilities can also reduce energy consumption by modifying equipment and facilities, and through simple housekeeping and maintenance activities. Examples include:

- Inspecting and repairing steam traps;
- Eliminating leaks in combustible gas lines;
- Eliminating leaks in compressed air lines;
- Recovering boiler flue gas heat for space heating and feedwater preheating;
- Improving combustion control for dual fuel systems; and
- Replacing worn and obsolete combustion controls.

Good housekeeping and maintenance operations can greatly increase equipment life as well as maintain or improve energy efficiency levels. As equipment grows older, it can be retrofitted with new parts to make it more energy efficient, or can be replaced with an energy-efficient substitute. For example, a furnace used to preheat parts could be retrofitted with new, fuel-efficient burners, or a monitoring system could be installed to continuously adjust combustion air on a boiler to increase combustion efficiency. Fluorescent lighting fixtures can also be upgraded with energy-efficient ballasts or mirror reflectors.

Research and development of new manufacturing equipment and processes has resulted in increased energy efficiency. For example, in the coatings industry, more efficient uses of electricity for ultraviolet curing of finishes, microwave heating and drying, and induction heating of paints have resulted in energy savings. Some manufacturers are also developing painting systems that use less toxic paint and will reduce the need for energy to heat drying ovens.

Land Use and Transportation

Land use and transportation are two important aspects of facility planning and design. If a proposed project consists of office buildings or industrial facilities, land use, population densities, and transportation patterns can all impact the total amount of energy used or conserved in that project. If the proposed project consists of a road, railway, or other transportation system, design for energy efficiency and alternative modes of transportation (e.g. mass transit, bicycles) must be considered in addition to siting and access.

Transportation of people and goods uses about twenty-seven percent of energy generated in the U.S. Almost all energy consumed for transportation is in the form of petroleum products. Trucks consume by far the greatest portion of transportation fuels, and are also among the most energy inefficient modes of transportation. The heavy reliance on passenger cars for most travel in the U.S. has also proved to be costly in terms of energy consumption and environmental impacts. Vehicles that carry larger numbers of people or greater amounts of goods are generally more energy efficient than those that carry smaller numbers or amounts. Thus, buses, trains, and barges or ships can carry people and goods far more cheaply than cars and trucks, particularly over long distances.

Energy use for transportation is intimately tied to land use patterns. Less energy is used on transportation when population density is increased. The impact on existing transportation systems and issues of access must be considered in the planning phases of a project. For example, siting of a major office facility away from population centers will result in energy being used to build roads, and to transport workers to the site. A similar facility that is sited in an existing center can rely on existing transportation and mass transit infrastructure, and thereby conserve a substantial amount of energy.

Mass transit issues must be considered in the project development plans. Planning alternatives should attempt to make mass transit feasible for materials, goods, and people. Mass transit programs should utilize fuel-efficient and alternative fueled vehicles.

Road construction projects should plan for energy efficient or alternative fuel vehicles during construction as well as for efficient use by vehicles. Project alternatives should address environmental impacts from the construction of the road *and* by the emissions from vehicles traveling the finished road. Energy conservation can be achieved by appropriate design as well as by dedicating lanes for mass transit, and separate paths for bicycles and walkers.

The California Energy Commission (1993) has produced a planning guide that describes numerous methods and techniques that can be used to reduce the energy used in transportation. This guide suggests that effective land use and transportation policies can reduce automobile travel by 40% in some cases. Transportation control measures that help reduce energy use and air emissions from vehicles include: improved public transit, high occupancy vehicle and bus lanes, trip reduction ordinances, employer-based transportation management, bicycle programs with storage facilities and lanes, and flexible schedules.

Congestion management plans (CMP) are used in some heavily populated areas to minimize traffic gridlock. Within the CMP, there are opportunities to incorporate energy-saving measures. CMPs address traffic issues in five areas: 1) level of service; 2) transit standards; 3) trip reduction and travel demand; 4) land use analysis; and 5) capital improvements. (California Energy Commission, 1993). The relevant components of CMPs are presented below.

- Level of service — Establish a traffic level of service standard for a designated system of highways and roads.

- Transit standards — Standards for the frequency and routing of public transit, for the coordination of transit, and for the coordination of transit service among operators.

- Trip reduction and travel demand — Adoption of a trip reduction and travel demand ordinance and promotion of alternative modes, improved jobs-housing balance, and other strategies.

- Land use analysis — Analysis of the impacts of local land use decisions on regional transportation systems, including an estimate of costs for mitigation.

- Capital improvement program — A multi-year program to maintain or improve the traffic level of service and transit performance standards, to mitigate land use decisions, and to conform with transportation-related air quality measures.

While congestion management is a treatment for an existing problem, planning and zoning of land use can prevent congestion and greatly reduce the distances traveled and the number of trips made each day. These in turn reduce congestion and wasteful energy use. The methods listed below are examples of energy conservation opportunities that should be considered in development projects for commercial and residential areas as well as for road construction projects.

- Mix residences and worksites in each land use zone
- Place shops and services within walking distance of homes
- Place shops and services at worksites, transit, and park-and-ride lots
- Put higher density housing near public transit
- Put higher density work places near public transit
- Design for transit access and integrated circulation
- Add bikeways, bike parking, and facilities
- Add pedestrian facilities
- Incorporate trip reduction ordinances
- Create transportation management associations

- Raise car parking rate structure
- Reduce employee parking
- Encourage telecommuting and teleconferencing
- Encourage alternative work schedules
- Reduce city and county employee commute trips
- Plan traffic signal timing to maximize traffic flow
- Encourage fleet vehicle and use efficiency.

Water Use

Energy is used for pumping and treating water prior to distribution to residential, commercial, and industrial facilities. Energy is also used to treat water that has been used for industrial or sanitation purposes prior to discharge to surface waters. In addition, energy is used to heat water used in these facilities. Therefore, efficient use of water and water conservation will reduce energy use.

The use of electrical power in water distribution and treatment systems can be reduced by reducing total water use and by substituting naturally occurring water sources such as groundwater or other surface water for piped water for use in landscaping. Energy conservation benefits can also be gained by the use of energy efficient motors for pumping water.

Many areas of the U.S. have developed extensive water management programs. These programs exist in arid western states as well as in urban and coastal areas. A large portion of residential water use is for landscaping — in California it is almost half of water distributed to residential and commercial customers. California policies regarding water usage can be used as an example for other areas.

Best Management Practices (BMPs) are designed to reduce long-term water demands. These BMPs include water audits, installation of water conserving plumbing like low-volume flush toilets, low-flow shower heads and water faucets; reducing water used for landscaping; education in schools; establishing efficiency standards for water-using appliances; and providing incentives in rate structures to encourage conservation. Municipalities can adopt water efficient landscaping ordinances which mandate automatic controls on irrigation equipment, grouping plants with similar water needs, and water audits to determine water needs for areas like parks. Practices that reduce water use likewise reduces energy demands for pumping, distribution, and treatment of water. Conserving water in agriculture irrigation directly affects pumping and distribution energy costs and in some cases distribution and treatment of agricultural return waters.

Solid Waste Reduction and Recycling

Solid waste generation and disposal require energy. Energy is used in the production, packaging and transport of consumer products, and in the collection and disposal of wastes.

Therefore, reducing the amount of products and packaging used, and reducing the amount of waste generated by a facility can result in energy savings by second or third parties. For example, reduced solid waste generation decreases the number of garbage pick-ups required, reducing the amount of fuel consumed by garbage collection trucks. Any energy savings that result from waste reduction are unlikely to be accrued by the party that is producing the waste.

Several incentives can be implemented to reduce solid waste generation at a facility. Variable garbage collection rates for volume or weight of collected trash can be established by the collection agency to encourage solid waste reduction and recycling. Agencies can also establish a recycling program in conjunction with a variable garbage collection rates as an alternative to higher solid waste reduction disposal costs.

Recycling programs diminish energy consumption in the production of new products from recycled materials. For example, producing aluminum cans from recycled materials requires only ten percent of the energy required for aluminum production from raw materials. Inefficient methods of collect recyclables reduces the energy savings.

Solid waste management agencies can explore alternatives which may allow more efficient collection of trash and recyclables. These alternatives could include co-collection of trash and recyclables, minimizing recycling stops, purchasing and maintaining efficient collection vehicles, using alternatively fueled vehicles, designing efficient routes, and commingling recyclables for collection.

Incentives for waste reduction must be established by city or county governments. These incentives can include requirements for pollution prevention programs, for recycling and reuse of materials (e.g. construction and demolition debris, metals, etc.), establishment of programs to create markets for these materials, requirements for reuse and recycling activities by government, and zoning and building codes that require adequate space for recycling and access for pick-up of recyclables.

Electricity Transmission Loss Reduction

The strength of an electric current diminishes with the distance of transmission. Siting of facilities, especially those which consume significant electricity even though they are desigened for energy efficiency, close to established transmission lines can reduce energy loss through power transmission. Such siting also saves the raw materials and energy which would be otherwise used to manufacture and construct transmission lines. Siting alternatives should take such savings into consideration.

References

Browning, William. "NMB Bank Headquarters." Urban Land. June 1992: 23-25.

California Energy Commission. Energy Aware. Sacramento: California Energy Commission, 1993.

Carlson, Andrea. The NIRS Energy Audit Manual. How to Audit Campus, City and Other Buildings. Nuclear Information and Resource Service, Washington D.C. 1992.

Edison Electric Institute Rate Regulation Department. Integrated Resource Planning in the States: 1992 Sourcebook. Washington D.C.: The Institute, 1992.

Fickett, Arnold P., Clark W. Gellings, and Amory B. Lovins. "Efficient Use of Electricity." Scientific American. Sept. 1990: 65-74.

Gellings, Clark W. and John H. Chamberlin. Demand-Side Management: Concepts and Methods. Lilburn: Fairmont Press, Inc., 1988.

Lovins, Amory and William Browning. "Negawatts for Buildings. The Whys and Hows of Electric Efficiency" Urban Land July 1992: 26-29.

Lovins, Amory and William Browning. "Green Architecture: Vaulting the Barriers." Architectural Record Dec. 1992.

Markus, T.A. and E.N. Morris. Buildings, Climate and Energy. London: Pitman Publishing Limited, 1980.

Mason, John L. Energy and Transportation. Warrendale: Society of Automotive Engineers, Inc., 1990.

Pace University Center For Environmental Legal Studies. Environmental Costs of Electricity. New York: Oceana Publications, Inc., 1990.

Ruegg, Rosalie T. 1987. Life Cycle Costing Manual for Federal Energy Management Program. NBS Handbook 135. U.S. Department of Commerce, National Bureau of Standards.

Shaw, Alexander, ed. Energy Design for Architects. Lilburn: Fairmont Press, Inc., 1989.

U.S. Congress, Office of Technology Assessment. Energy efficiency in the Federal Government: Government by Example?. OTA-E-492. Washington D.C.: U.S. Government Printing Office, 1991.

U.S. Department of Commerce/National Bureau of Standards, Federal Energy Administration/ Conservation and Environment. Energy Conservation Program Guide For Industry and Commerce. Washington. D.C.: U.S. Government Printing Office, 1974.

U.S. Environmental Protection Agency, Office of Policy, Planning and Evaluation, Office of Pollution Prevention. Pollution Prevention Strategy for the Energy Sector (Draft). Washington D.C.: U.S. EPA, 1991.

U.S. Environmental Protection Agency, Total Cost Assessment: Accelerating Industrial Pollution Previention through Innovative Project Financial Analysis. (EPA/741/R-92/002). Washington D.C.: U.S. EPA, 1992.

U.S. Environmental Protection Agency, Office of Research and Development. Life-Cycle Assessment: Inventory Guidelines and Principles. Cincinnati: U.S. EPA, 1993.

Urban Land Institute. 12 Tools for Improving Mobility and Managing Congestion. Washington D.C.: Urban Land Institute, 1991.

4. FEDERAL POLICIES, DIRECTIVES, AND INITIATIVES

Beginning in the mid 1970s and taking a renewed interest in the early 1990s, the federal government has a broad range of laws, regulations, directives, policies, and initiatives to encourage, support, and in some cases coerce government, business, and citizens to conserve energy. The Energy Policy and Conservation Act of 1975 was the first major piece of legislation in which the federal government took the lead in demonstrating energy efficiency and energy conservation through provisions to reduce energy use in federal facilities. The 1975 Act and later legislation, executive orders, and other actions are described later in this chapter under the title of Federal Facilities Management.

Both EPA and Department of Energy (DOE), as well as other federal agencies, have taken on the role of encouraging savings under a number of incentive and volunteer programs with awards, grants, and cooperative programs. These are described in Energy Saving Programs (Appendix A).

Federal activities in energy conservation and energy efficiency programs are described by the Energy Policy Act of 1992 and the Pollution Prevention Act of 1990. These policies and several others are described under the section Energy Policy below.

These sections briefly characterize a number of federal laws, directives, policies, initiatives, etc. It is not intended as an exhaustive list, but rather is meant to provide general background on federal energy activities, particularly those activities EPA staff may have opportunities to bring to the attention of others in the NEPA process.

Energy Policy

Energy Policy Act of 1992 and National Energy Strategy

The National Energy Strategy (NES) was proposed to satisfy a legislative requirement under the Department of Energy Organization Act which requires the President to submit biennial reports on the national energy policy plan to Congress. The NES included seventeen demand reduction approaches and thirty-one supply side options. DOE made the decision to give higher priority to energy conservation and efficiency programs during the budgeting process. NES initiatives addressed five interlocking areas which were (CEQ 1992):

- Energy security - make the nation less prone to economic damage from sharp fluctuations in either the supply or the price of petroleum.
- Energy and economic efficiency - aim to lower energy costs to consumers, reduce energy-related emissions, maintain or enhance standards of living, and promote a strong economy.

- Energy supplies - to secure future energy supplies, develop and use renewable energy sources; increase reliance on low-emission energy sources such as natural gas; develop a new generation of safer nuclear technology; and continue development of domestic coal and oil supplies in an environmentally responsible manner.

- Environmental quality - initiatives to increase the efficiency of energy-producing and consuming technologies, reduce solid and hazardous wastes, and improve energy-related practices.

- Technology and competitiveness - fortify the nation's foundations in science and engineering research, technology development, and education; establish federal research and development priorities; strengthen research in universities, industries, and international collaboratives; accelerate technology transfer from federal laboratories in to private industry; and enhance U.S. mathematics, science, technology, and engineering education.

During 1991 and 1992, over 90 NES initiatives were introduced by the federal government, including an expanded energy efficiency and renewable energy program forming partnerships among federal agencies, industries, and states to reduce energy and water use.

The many NES initiatives and other energy related concerns were passed into law as the Energy Policy Act of 1992. Many of its provisions encourage improving energy efficiency and conservation as well as enhanced environmental protection. The breadth of the law can be seen from a brief listing of some of the topics covered:

- Energy efficiency in buildings, utilities, appliances, industry, federal facilities, and state mandated programs
- Natural gas
- Alternative fuels in federal and non-federal programs
- Availability and use of replacement fuels, alternative fuels, and alternative fueled private vehicles
- Electric motor vehicles
- Generation and transmission of electricity
- Radioactive wastes
- U.S. Enrichment Corporation
- Uranium revitalization and remedial return
- Uranium enrichment health, safety, and environmental issues
- Renewable energy
- Coal research, development demonstration, and commercial applications
- Strategic petroleum reserves
- Global climate change
- Oil pipelines
- Reduction of oil vulnerability
- Improved energy efficiency, electricity generation and use, and nuclear reactors

- Energy and economic growth
- Non-federal power and hydropower provision
- Coal, oil, and gas exploration and mining.

There are hundreds of new or revised provisions in the act that affect energy and resource development, use, and conservation. NEPA provides direct access for EPA comments on federal projects (e.g., facilities, fleet vehicles, resource development, and reserves) and secondarily in federal approvals and permits necessary for facility operation of private or public facilities (e.g., state, local government). Many of the provisions of the act, however, do not constitute major federal actions and thus do not require NEPA compliance (grant funding, changes in local law, voluntary programs, incentives, study programs, etc.).

State Regulation Utility Reform Program

Laws and regulations governing energy utilities, particularly those related to rate-paying and return to shareholders, have discouraged utilities from investing in efficiency improvements. An effort is underway to change regulations to be more conservation friendly. The EPA encourages states to include in their regulations the principles listed below (EPA 1992b).

- Eliminating the incentive to sell electricity by separating profits from sales.

- Creating an incentive to save electricity - accomplished through programs in which utilities and their stockholders can actually profit from successful investments in conservation.

- Verifying energy efficiency measures to ensure that actual energy savings are realized.

Federal Integrated Resource Planning

The Integrated Resource Planning program (IRP), formerly the Least Cost Utility Planning Program, has the responsibility to encourage utilities and regulators to use innovative regulatory and resource planning approaches to implement demand side management programs. The IRP aspires to reduce the U.S. electric energy requirements by 45,000 megawatts by the year 2010 and up to 90,000 megawatts in the long term. Thus far, IRP has concentrated principally on evaluation and implementation of Demand Side Management (DSM) programs.

There are a diverse number of methods being tried to encourage DSM programs including lost revenue/decoupling mechanisms, shareholder incentive mechanisms such as shared savings and bonus return on equity on expenditures. New areas being explored for IRP are to include compliance with Clean Air Act Amendments and transmission related issues. There is also interest for regulators to review existing utility operations, rate structures and policies to determine if IRP acts as a complement or obstacle to achieving plan goals. Data compiled for an IRP program and evaluation of a utility DSM program may provide insight into ongoing and potential energy savings anticipated in alternatives to a new source power generating facilities.

Pollution Prevention Act of 1990

On October 27, 1990, Congress passed the Pollution Prevention Act of 1990 which establishes as a new national policy:

- Pollution should be prevented at the source whenever feasible;
- Pollution that cannot be prevented should be recycled in an environmentally-safe manner whenever feasible;
- Pollution that cannot be prevented or recycled should be treated in an environmentally-safe manner whenever feasible; and
- Disposal or other releases into the environment should be employed only as a last resort and should be conducted in an environmentally-safe manner.

Pollution prevention and energy conservation can be closely linked. Pollution prevention can save all or a portion of the potential economic and environmental costs of damage and clean-up. Opportunities for pollution prevention should be viewed as opportunities for potential energy savings. NEPA preparers and reviewers should vigorously search for opportunities to refine projects and programs to maximize pollution prevention, energy efficiency, and energy conservation. One method is to conduct planning level pollution prevention/energy/resources audits on proposed project alternatives combining features of both the Energy Policy Act of 1992, Pollution Prevention Act of 1990, and other pertinent laws, regulations, and policy.

Federal Facilities Management

Energy Policy and Conservation Act

Energy Policy and Conservation Act (EPCA), enacted in 1975, was the first major piece of legislation to address energy management by the federal government. This Act directed the President to develop a comprehensive energy management plan which was to include procurement practices and a 10-year building plan. Many of the details where left for the executive branch to determine. As part of this legislation, amendments to the Motor Vehicle Information and Cost Savings Act required the federal automotive fleet meet or exceed corporate average fuel economy mileage standards.

Executive Order 11912 - Delegation of Authorities Relating to Energy Policy and Conservation

This order, signed in 1976, defined the roles of various cabinet departments with responsibilities for federal energy use as follows (US Congress 1991).

- The Administrator of the General Service Administration was appointed to carry out the amendments to the Motor Vehicle Information and Cost Savings Act to achieve a high average fuel economy for the federal fleet.

- The Administrator of the Federal Energy Administration (the Secretary of Energy) was designated for development of a 10-year energy conservation plan for federal buildings, energy conservation and rationing contingency plans, and preparation of annual reports to Congress required by EPCA.

- Finally, the Administrator of the Office of Federal Procurement Policy was required to provide guidance for applying energy conservation standards in the federal procurement process.

Executive Order 12003 - Amendment to Executive Order 11912

Issued in 1977, this order expanded the requirements of Energy Policy and Conservation Act of 1975 specifying a goal of 20 percent energy reduction per square foot in existing federal buildings. This order also required the federal fleet to surpass by 4 miles per gallon minimum statutory requirement beginning in 1980 (US Congress 1991). Some of the key provisions of Order 12003 include the following:

- The Secretary of Energy was to develop, implement, and oversee a 10-year energy conservation plan for federal buildings larger than 5,000 square feet for 1975-1985 to reduce energy consumption in existing buildings by 20 percent and new buildings by 45 percent. Also the Secretary is responsible for establishing a life-cycle-cost methodology and make a report to Congress on the plan's progress.

- The Administrator of General Services Administration ensures that vehicles purchased by executive agencies surpass the manufacturers' corporate average fuel economy standard under the Motor Vehicle Cost and Information Act, that federal vehicles surpassed the minimum statutory requirements by 2 miles per gallon in 1978 and by 4 miles per gallon in 1980, and that the federal light truck fleet also meet the minimum standards also not required under the Motor Vehicle Cost and Information Act.

Executive Order 12375 - Amendment to Order 11912

Issued in 1982, Order 12375 further amended Order 11912 to reduce the required federal passenger automobile fleet efficiency established in Order 12003. This order required only that the federal fleet meet the manufacturers' average efficiency and that light trucks meet standards set by the Secretary of Transportation (US Congress 1991).

National Energy Conservation Policy Act

Issued in 1978, National Energy Conservation Policy Act (NECPA) defined details of energy management for executive agencies, some of which were further defined in Executive Order 12003 (US Congress 1991). Other energy management steps include:

- Use of life cycle costing methodology as a basis of policy
- Energy audits of all buildings exceeding 1000 square feet
- Specified the minimum rate for retrofitting federal buildings with cost effective energy conservation measures; all buildings were to be retrofitted by 1990.

The main provisions of NECPA were called the Federal Energy Initiative.

Comprehensive Omnibus Budget Reconciliation Act

The Comprehensive Omnibus Budget Reconciliation Act (COBRA), established in 1985, amended NECPA to give federal agencies alternative sources of funding for energy efficiency investments (US Congress 1991). It suggested that agencies could seek private financing and implementation of energy efficiency projects through "shared energy savings" contracts.

Federal Energy Management Improvement Act

Enacted in 1988 as an amendment to NECPA, Federal Energy Management Improvement Act (FEMIA) modified and added several provisions to the Federal Energy Initiative (US Congress 1991). One of the provisions was a goal to reduce energy consumption per square food in federal buildings by 10 percent between 1985 and 1995. In FEMIA, Congress allowed agencies to retain a portion of cost savings for future energy conservation measures. FEMIA also created an Interagency Energy Management Task Force to survey energy use in a representative sample of federal buildings to:

- determine the maximum potential cost-effective energy savings that may be achieved, and
- make recommendations for cost-effective energy efficiency and renewable energy improvements.

Executive Order 12759 - Federal Energy Management

The Executive Order signed on April 17, 1991, mandated federal facilities to reduce energy consumption, using 1985 energy use levels as a baseline. It has the following elements:

- Reduce energy use by 20 percent per gross square foot of federal buildings by the year 2000.

- Procure energy-efficient goods and products for federal facilities.

- Directs federal agencies, operating 300 or more vehicles, to reduce fuel consumption by at least 10 percent by 1995 in comparison with fiscal year 1985.

- Requires all federal facilities to procure the maximum practicable number of alternative-fuel vehicles by the end of 1995.

Federal Agency Energy Management

Subtitle F of the Energy Policy Act of 1992 promotes conservation and efficient use of energy and water at federal facilities. In addition, this subtitle also encourages the use of renewable energy sources. Energy management requirements include energy conservation in the design and construction of new facilities, implementation of energy and water conservation measures with payback periods of less than 10 years. Agencies may exclude any federal building or group of buildings if the agency finds compliance with such requirements would be impractical. "A finding of impracticability shall be based on the energy intensiveness of activities carried out in such federal buildings or collection of federal buildings, the type and amount of energy consumed, the technical feasibility of making the desired changes, and, in the cases of the Departments of Defense and Energy, the unique character of certain facilities operated by such Departments." (FEMP Focus, 1992) Additionally, the subtitle establishes lifecycle cost methods and procedures, budget treatment for energy conservation measures, and incentives for agencies.

Federal Energy Management Program

Within the DOE, the Federal Energy Management Program (FEMP) coordinates federal energy-efficiency efforts and has several objectives as indicated below:

- encouraging better understanding of how energy is used in the federal sector

- generating energy efficiency expertise, techniques, and practices and sharing them with other agencies

- identifying key energy managers and federal decisionmakers

- promoting effective energy management practices.

The strategy that FEMP pursues is "to seek those activities that produce the maximum energy efficiency payoff with minimum expenditures." There are currently four areas of operations of FEMP:

- reporting on federal energy management efforts

- providing information, training, and technical support to federal agency personnel

- hosting interagency meetings to develop new federal initiatives (e.g., a new executive order)

- annually awarding certificates of achievement to federal facilities and personnel that have demonstrated exemplary performance.

References

Council on Environmental Quality. Environmental Quality 22nd Annual Report. Washington D.C.: U.S. Government Printing Office, 1992.

Council on Environmental Quality. Environmental Quality 23rd Annual Report. Washington D.C.: U.S. Government Printing Office, 1993.

Rocky Mountain Institute. Lean and Clean Management How Businesses Can Increase Competitiveness While Reducing Pollution. Snowmass: Rocky Mountain Institute, 1993.

Electric Power Research Institute (EPRI). Proceedings: Third National Conference on Utility Demand-Side Management Programs. DSM Strategies in Transition. EM-5452, Research Project 2050-11.

U.S. Congress, Office of Technology Assessment. Energy Efficiency in the Federal Government By Good Example?. Washington D.C.: U.S. Government Printing Office, 1991.

U.S. Environmental Protection Agency, Office of Atmospheric Programs. 1992 Accomplishments and Prospects for 1993. Volume 1: Global Change Division. Washington D.C.: U.S. EPA, 1992a.

U.S. Environmental Protection Agency. The Climate is Right for Action Voluntary Programs to Reduce Greenhouse Gas Emissions. Washington D.C.: U.S. EPA, 1992b.

U.S. Environmental Protection Agency. Green Lights Program The First Year. Washington D.C.: U.S. EPA, 1992c.

U.S. Environmental Protection Agency. Acid Rain Program Conservation and Renewable Energy. Washington D.C.: EPA430/F-92/023. U.S. EPA, 1992d.

U.S. Environmental Protection Agency. Green Lights The Second Year. Washington D.C.: U.S. EPA, 1993.

U.S. Environmental Protection Agency. Introducing... EPA Energy Star Computers. Washington D.C.: U.S.EPA.

U.S. General Accounting Office. Energy Conservation DOE's Efforts to Promote Energy Conservation and Efficiency. Washington D.C.: U.S. GAO, 1992.

The White House, Office of the Press Secretary. Pollution Prevention Executive Order - August 4, 1993. Washington D.C.: The White House, 1993.

APPENDIX A

Energy Saving Programs

Energy Conservation and Renewable Energy Reserve

Under the Clear Air Act, Title IV's primary goal is the reduction of annual SO_2 emissions by 10 tons below 1980 levels (EPA 1992d). This goal is in coordination with the Acid Rain Program whose goal is to achieve significant environmental benefits through reductions in emissions of sulfur dioxide and nitrogen oxides, the primary causes of acid rain. As an incentive to conserve energy and to use renewable energy resources (such as biomass, solar, geothermal or wind), the Energy Conservation and Renewable Energy Reserve (CRER) (58 FR 3618-3701) was established as part of the Acid Rain Program. CRER has a pool of 300,000 air emission allowances. Utilities that meet standards by implementing demand-side conservation measures or by using renewable energy resources will be awarded the allowances by the CRER. These allowances can be banked for future use as part of a compliance plan or sold.

EPA's Green Lights Program

Green Lights is a voluntary, non-regulatory program designed to reduce pollution through the use of market forces by encouraging the use of energy efficient lighting only where it is profitable and maintains or improves lighting quality. Participating organizations sign a Memorandum of Understanding with the EPA committing themselves to survey all domestic facilities, upgrade lighting wherever profitable, and complete the upgrades in five years. As of September 1993, over 1150 organizations in the U.S. had joined the program, including federal agencies; FORTUNE 500 corporations; universities; state, city, and municipal governments; electric utilities; and trade and professional associations. More than 3.8 billion square feet of facility space has been committed to Green Lights thus far, with 3,600 buildings comprising over 316 million square feet of facility space being upgraded after the second year of implementation.

In February 1993, EPA launched its Federal Green Lig.... program. Green Lights a recognized method for federal organizations to meet the requirements of the National Energy Policy Act of 1992. Subtitle F, Section 543 "Energy Management Requirements" of the Act reads:

> "An agency may participate in the Environmental Protection Agency's 'Green Lights' program for the purposes of receiving technical assistance in complying with the requirements of this section (paragraph 543.b.4)."

Participating federal organizations agree to reduce lighting energy use by 50 percent (the average achieved by our corporate partners), design all new facilities in compliance with 10 CFR Part 436, Subpart A, and all other applicable codes and regulations, and complete lighting upgrades at 90 percent of the square footage of their facilities (where appropriate) by September 30, 2000.

For federal organizations, joining Green Lights constitutes participation in the U.S. Department of Energy's Federal Relighting Initiative (federal agencies may also participate in the Federal Relighting Initiative without joining Green Lights). The provisions of the Green Lights Memorandum of Understanding are in accordance with Executive Order 12759, the National Energy Policy Act of 1992, and other applicable federal statutes and regulations.

By participating in the Green Lights program, corporate or federal organizations can take advantage of a number of resources to assist in planning, coordinating, and implementing lighting upgrades. These resources include:

- National Lighting Product Information Program *Specifier Reports* ("consumer reports" of lighting products)
- State-of-the-art software survey and analysis tools
- Financing database (updated quarterly)
- Electronic Bulletin Board Service
- General, technical, and software hotlines
- Monthly *Lighting Upgrade Workshops*
- Customer service center and hotline
- Technical publications, including:
  - Lighting *Answers*
  - Light Briefs
  - Lighting Upgrade Manual
  - Case Studies
  - Monthly Green Lights *Update*
- A pool of professional lighting auditors recognized as Green Lights *Surveyor Allies*
- Implementation support, to include:
  - Mobilization/Kick-Off Meetings
  - Implementation Planning Seminars
  - Interagency Agreement (for federal agencies)
- Public recognition in various media forums
- Account representative

(For more information contact the Green Lights Information Line at (202) 775-6650.)

EPA's "Golden Carrot" Super-Efficient Refrigerator Program

The EPA, utilities, and others cooperatively developed this program to encourage manufacturers to develop super-efficient refrigerators (U.S. EPA 1992b). Utilities have gathered 30 million dollars in rebate incentives for the manufacturer that produces a superior refrigerator. The manufacturer that produced the largest number of the most energy efficient (at least 25% more energy efficient than 1993 standards), CFC-free refrigerators the fastest and cheapest won the prize. The product will be available to consumers in 1994-1995 at a utility-subsidized price (CEQ 1992).

EPA's Energy Star Building Program

Building upon the success of the Green Lights program, EPA has developed the Energy Star Buildings Program to promote profitable energy efficiency upgrades in non-lighting systems in commercial buildings. The opportunities are large - many office buildings can reduce energy costs by 40 percent or more, using commercially available technology, with savings yielding a rate of return of 20 percent or more. EPA will provide strategic guidance, public recognition, technical briefs, analytical software, and other tools to facilitate the design and implementation of upgrades in participants' buildings. The program will encourage partners to upgrade their buildings in a straightforward, staged pattern, beginning with building tune-up measures and HVAC load reductions, and the upgrading fan systems and HVAC equipment. The goal is to adopt a hands-on approach, to enhance and accelerate the design process through using on-site data about pilot upgrade savings.

The early focus for the program will be on completing a series of Energy Showcase Buildings, where program participants have completed an accelerated and comprehensive energy efficiency upgrade. The program will later be expanded and marketed to all Green Lights partners.

EPA's Energy Star Computer Program

The EPA launched this program on June 17, 1992, to help create a market for energy-efficient desktop computers. It is estimated that computer systems consume five percent of all commercial electricity. "Research suggests that 30-40 percent of all computers are left on at night and over weekends, and that even during the day computers are active less that 20 percent of the time" (EPA 1992b). Manufacturers who agree to participate in the program will introduce personal computers that "power down," a feature formerly confined to portable computers to save battery power. The Energy Star logo will be used by manufacturers to identify machines capable of "powering down." In April 1993, the President announced that the U.S. government will purchase energy star computers where available and where the cost premium is justified by the energy savings.

Methane Recovery at Coal Mines

A variety of technologies are available to recover methane from coal mines for energy generation, but regulatory and legal barriers hinder their implementation (EPA 1992b). The EPA has been working with the U.S. coal industry to identify barriers to methane recovery. The EPA will soon launch an outreach program designed to overcome these barriers and ensure that the potential benefits of coalbed methane recovery, in terms of environmental protection, employment, and revenues, are realized.

Methane Recovery at Landfills

There are many opportunities for economic recovery and utilization of methane from landfills. The EPA is identifying and evaluating the barriers that limit the ability of landfill owners, utilities, and others from taking advantage of these opportunities. Based on this analysis. EPA will soon launch an outreach program designed to lower the barriers and encourage landfill energy recovery wherever technically and economically feasible.

The AgStar Program

The AgStar Program, launched in the summer of 1993, is a voluntary program designed to encourage dairy and swine farmers to capture the methane generated by animal waste and use it to meet on-farm energy needs. Under the program, AgStar Partners sign a Memorandum of Understanding with the EPA, committing themselves to install the most profitable animal waste methane recovery option (e.g., a waste digester or covered lagoon). The EPA provides participants with decision support software to help them choose the most profitable option based on their site-specific conditions. The USDA's Soil Conservation Service provides AgStar participants with technical specifications for each of the technologies.

The Natural Gas Star Program

The Natural Gas Star program was launched in March 1993, and currently has 26 partners from the natural gas transmission and distribution industries. Under the program, partners sign a Memorandum of Understanding with EPA, committing themselves to implement a range of technologies and programs to reduce emissions of methane from their systems. The range of options are generally profitable for the partners, although some partners have committed to go beyond the options specified in the agreement and further reduce their emissions. The EPA will soon expand the program to natural gas producers.

National Industrial Competitiveness Through Efficiency: Energy, Environment, Economics

EPA and DOE created an innovative cost-sharing grant program with states and industry to enhance industrial competitiveness through pollution prevention and energy efficiency. A total of $2.5 million will be awarded in fiscal year 1993 and three projects were awarded in 1991 and six in 1992. National Industrial Competitiveness through Efficiency: Energy, Environment, Economics (NICE^3) goal is to improve industrial energy efficiency and reduce costs and emission to the environment by soliciting projects that:

- encourage accelerated industrial development and dissemination of pollution prevention and energy conserving technologies
- demonstrate successful industrial applications in the use of techniques in conjunction with less polluting, energy-efficient technologies

- identify and implement efficiency improvements in processes, materials inputs, and waste streams

- coordinate and integrate the activities of institutions responsible for energy, the environment, and competitiveness at the federal, regional, state, and local levels

- identify and develop strategies to overcome barriers that currently inhibit waste minimization and energy efficiency techniques and practices in business and industry

- enhance industrial competitiveness through the introduction and dissemination of cost-effective waste minimization and energy efficient processes, equipment, and practices.

Noncompetitive Award of Financial Assistance - American Council for an Energy-Efficient Economy

A grant to the American Council for an Energy-Efficient Economy was awarded by the DOE (58 FR 39009-39010) for the unique combination of resources and experience which will enhance the public. The ACEEE, an educational and research organization, has been extensively involved in efforts to improve building energy efficiency. The amount awarded in the grant will be used towards facilities in which a workshop will take place for the transfer of research results for the area of industrial demand side management strategies.