ENVIRONMENTAL PLANNING AND ASSESSMENT FOR HIGHWAY VEHICLE USE OF ALCOHOL FUELS

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ABSTRACT

Argonne National Laboratory (ANL) is assisting the Office of Transportation Programs (OTP) of the U.S. Department of Energy in performing the required enviromental planning and assessment for highway vehicle alcohol fuel commercialization in accordance with the National Environmental Policy Act of 1969 (NEPA). In this presentation the process for planning and assessment is given, specific documents resulting from the process are explained.

NEPA requires an environmental impact statement (EIS) for every major federal action that may have a significant impact on the quality of the human environment. The EIS is subject to public review, according to DOE's guidelines. The environmental assessment process, as described in the DOE guidelines and as implemented by OTP will result in environmentally sound demonstration and commercialization of alcohol fuels. The term environment is defined very broadly to include the ecosystem, resource, physical environment, health, safety and socioeconomic subsystems.

Three types of environmental documents record this process: the Environmental Development Plan (EDP), the Environmental Assessment (EA) and the Environmental Impact Statement (EIS). The transportation EDP describes the energy conserving technologies; identifies and ranks environmental concerns; outlines strategies to resolve the concerns on a priority basis; and proposes a research program to implement the strategies. This is done annually for the division. In addition, environmental documentation is scheduled for each technology as it reaches different stages of development. One major document is the EA, prepared when it is not clear whether an EIS is necessary. The information to make such a decision is collected in one detailed assessment of the technology or program. An EIS may then be written if impacts are expected to be significant.

An EA is being performed for alcohol (neat and blends) fuels for highway vehicles by ANL.

INTRODUCTION

This paper describes the environmental planning and assessment process used by the Department of Energy (DOE) Office of Transportation Programs (OTP) and in particular its use in the Alternative Fuels Utilization Program, the alcohol fuels for highway vehicle project. Argonne National Laboratory has had lead laboratory responsibility for this environmental process for OTP since the inception of the process in the Energy Research and Development Administration (ERDA). (An Acronyms list appears at the end of the paper to aid the reader).

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*Significant contributions to this on-going environmental work were made by numerous specialists and by the DOE project manager, Dr. Daniel P. Maxfield.
Dr. Bernard is the section head of the Transportation Energy Systems Section, Energy and Environmental Systems Division, Argonne National Laboratory, U.S.A. Dr. Bevilaqua is a consultant to the section.

The DOE environmental impact evaluation process stems from the broad policies set forth in the National Environmental Policy Act of 1969 (NEPA) which states all agencies of the federal government shall:

(a) Utilize a systematic, interdisciplinary approach (natural and social sciences and environmental design arts) in planning and decision making impacting man's environment,

(b) Develop methods which will ensure environmental values are given appropriate consideration in decision making, along with economic and technical considerations, and

(c) Produce a detailed environmental impact statement (EIS) for major federal actions significantly affecting the quality of the human environment (from Sec. 102).

Specific NEPA guidance is provided by the Council on Environmental Quality (CEQ) in the form of guidelines and regulations. Table 1 summarizes the most recent CEQ rules and shows the strength of NEPA.

Table 1. Selected NEPA Rules
(CEQ, 43 CFR 55978 - 56007, Nov. 28, 1978)

A. Major Federal Action is

- Adoption of formal plans.
- Adoption of programs.
- Allocation of resources decisions.

B. Agencies shall

- Integrate the NEPA process early.
- Prepare Environmental Assessments at any time to assist in EIS decision
- Prepare EISs on major federal actions.
- Insure professional and scientific integrity of EIS.
- Request comments on EIS from federal, state, local agencies and public.
- Make diligent effort to include public.
- Adopt procedures to ensure decisions in accordance with NEPA.
- Prepare public record on decisions including environmental considerations.

C. The EIS shall

- Provide full and fair discussion of significant impacts.
- Inform decision makers and public of resonable alternatives (which should be rigorously explored and objectively evaluated).
- Be prepared on technology research, development or demonstration programs and shall be available before the program has reached a stage likely to determine subsequent development or restrict later alternatives.
- Be completed in time to be included in any recommendations or report considering one or more alternative means of accomplishing a goal.

Each federal agency has its own process for executing these rules. The DOE process is designed to incorporate environmental considerations into the day-to-day decisions on projects. For OTP, the major documents that are produced in connection with technology development projects or with alternative operating strategies or conservation policies which might require an EIS are the Environmental Development Plan (EDP), the Environmental Assessment (EA), and the Environmental Impact Statement (EIS) or, conversely, a Negative Determination (ND). Figure 1 sketches the relationship of these documents to OTP from NEPA to the commercialization or implementation of an OTP technology, strategy or policy.

ENVIRONMENTAL DEVELOPMENT PLANS*

EDPs were conceived and prepared as basic documents for planning and managing environmental requirements of energy technology development. Approximately 30 EDPs covering major developing energy technologies, including one for OTP have been prepared this year. [1]**

The OTP EDP is an annual cycle document that is developed in step with the Program Planning and Budget Review cycle of DOE. It covers all the programs and subprograms in OTP, providing concise descriptions of each technology, strategy or policy project that might require an EIS. (See Table 2). The major force of the EDP is the analysis of possible or expected environmental concerns that arise from each project and a determination of the efforts required while the project is still being developed to mitigate adverse effects.

The EDP process therefore provides a framework for:

a) Incorporating environmental considerations into OTP planning and decision processes at the earliest stages to assure they are given the same level of importance as technological, fiscal, and institutional concerns in decision-making.

b) Resolving environmental concerns concurrently with the development of energy strategies, policies and technologies, and

c) Providing a schedule of research to allow mitigation of adverse environmental effects through sound technological design or policy analysis.

Information contained in the EDP constitutes an inventory of the status of environmental problems and a plan for resolving these problems. Much of the ongoing DOE research and technology development is aimed at resolving the concerns identified in the EDP. It is, however, intended that the EDP be comprehensive so that no concerns escape notice.

*As currently defined and required by DOE Order 5420.1, August 10, 1978, "Environmental Development Plans."

**Number in square brackets refers to reference list at the end of the paper.

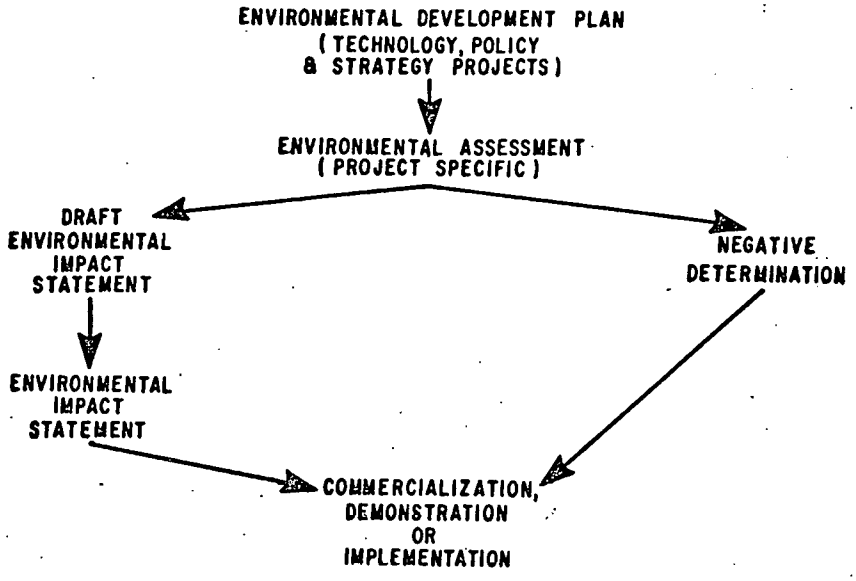

Fig. 1 The DOE NEPA Process

Table 2. OTP Technologies, Strategies and Policies Addressed in the EDP

Technology Development Program
1. Stirling Engine
2. Gas Turbine Engine
3. Turbocompound Diesel Engine
4. Gas Turbine Bus
5. Controlled Speed Accessory Drive System
6. Continuously Variable Transmission
7. Heavy Duty Diesel Truck Bottoming Cycle
8. New Hydrocarbons - Broad Cut Petroleum Fuels
9. Alcohol Fuels
10. Synthetic Fuels
11. Advanced Fuels - Hydrogen
12. Electric Vehicles
13. Hybrid Vehicles
14. Marine Diesel Bottoming Cycle
15. Coal-Oil Slurry Marine Steam Turbines
16. Pipeline Bottoming Cycle
17. Medium Speed Diesel Alternative Fuels
Strategy and Policy Program
1. Freight
2. Transport of Energy Materials
3. Intercity Passenger

Environmental Concern Identification

The first step in the EDP process is to identify and classify the environmental concerns associated with the OTP program. The classification is by environmental system and subsystem as shown in Table 3. The concern identification begins with the definition of attributes of each strategy, policy, technology or fuel that might result in an environmental impact through careful review of the technology by a multidisciplinary team. The concerns are then developed using factual information where available including the status of the understanding of the environmental effect and its control. Priorities are assigned to the concerns, primary or secondary, to identify those requiring immediate resolution.

If the concern results from issues that are characterized by lack of specific understanding to explain or estimate underlying cause/effect relationships or to adequately quantify the environmental issues, the concern is assigned primary status and exploratory research is required. If, however, the concern results from issues for which there is some understanding of the cause/effect relationship or for which the magnitude of potential impacts can be estimated, then a set of four criteria are used to determine concern status. The four criteria are: 1) the emergence of the concern impact before 1983, 2) the time required to resolve the concern via environmental assessment, research, development and demonstration, 3) the severity of the concern impact (dose-response), and 4) the size of the human population at risk. A concern is designated as primary if it meets criteria (1) or (2) and (3) or (4).

For most dose-response type impacts, the emergence date is the time of a large (several hundred vehicles) demonstration. For the others, the date is the estimated time of the implementation or commercialization. If a concern will impact a large population, or will have potentially severe effects even

Table 3. Environmental Concern Taxonomy

Environmental Systems and Subsystems	
ECOSYSTEM	HEALTH
Terrestrial	Occupational
Aquatic	Public
Human/Animal Pathways	SAFETY
RESOURCE	Occupational
Mineral	Public
Natural (Land, Water)	SOCIOECONOMIC
Capital/Labor	Social
PHYSICAL ENVIRONMENT	Economic
Air Quality	Institutional
Water Quality	
Waste Disposal	
Noise Pollution	
Aesthetic Degradation	

on a few individuals and if the time required to resolve the concern is close to or potentially longer than the time of emergence of the concern, it is designated primary. If a concern is not exploratory and does not meet the other criteria, it is designated a secondary concern.

Before an environmental research and assessment plan can be developed, the status of the understanding of any adverse environmental concerns must be identified. The lowest level of research and assessment (level 0) is concern identification with essentially no understanding of the concern. The highest level (level IV) results in concern resolution. Depending on the results of a given level, the primary concern for which understanding and resolution is sought may 1) at some time in the future be discarded because the impact was found to be negligible or 2) require further research and assessment, usually at the next level. Before a technology or fuel is commercialized or a strategy or policy implemented, level IV (problem resolution) must be accomplished for each primary concern.

Environmental Concerns and Research Requirements

Table 4 presents a summary of the primary environmental concerns and the level of understanding for each for alcohol fuels. The table also presented the type of research that is either under way or will be initiated to address the concern. This research would be used by DOE to give direction to the development program for specific technologies and projects; to determine what further environmental research is required; to assist in setting standards or designing guidelines; and to decide if the technology or project development should be discontinued. In essence the research reports provide DOE decision-makers with the status of environmental concerns and the progress towards their resolution.

The Alcohol Fuels Plan

The EDP is a plan. That plan is presented for all of OTP's activities in a series of figures similar to Fig. 2, the research and assessment plan for alternative fuels. The figure shows relevant technology development decision points and schedules EAs, EISs, and reports called Environmental Readiness Documents (ERD), the last of which are internal to DOE and used by the Assistant Secretary for the Environment to determine the environmental status of a technology. The lower portion of the figure is the research plan.

Of interest are the alcohol (blends and neat) milestones at the top of Fig. 2, the EA and EIS for alcohols scheduled in the middle of the figure, and the individual research activities scheduled in the bottom portion of the figure. Concerning the latter, the EDP states that the DOE Office of the Assistant Secretary for the Environment (ASEV) will complete an environmental effects assessment for spillage, for UBF, aromatics and aldehydes in vehicle exhaust emissions, for control of dermal absorption and interaction effects, and for evaporative emissions by October 1, 1982. Annual progress reports may define further necessary transportation system specific health effects research which would be scheduled in subsequent EDPs. Candidate control strategies will be evaluated by October 1, 1981. Since the shipping, distribution and use of alcohol as a vehicle fuel presents many safety concerns, identified in the EDP, research items are planned. A near-term report on

Table 4. Alcohol Fuels Concern/Research Relationship Map

Summary Primary Concern	Level of Understanding (see note)	Standard, Guideline or Limit: Existing or Due Date	Environmental Research Required
Ecosystem			
Since alcohol blends may come into widespread use in the 1980's, alcohol shipping accidents may have localized adverse aquatic impacts.	II In general, short chain alcohols are toxic to aquatic organisms.	Shipping guidelines, due 1983.	Effects study. Control and alternatives study.
Physical Environment			
The impact of the evaporative and exhaust emissions on air quality from any combination of alternative fuels and heat engines is of concern.	I or II depending on pollutant.	New exhaust emission goals, evaporative emissions goals for use as transport fuel, due 1983 for alcohol gasoline blends.	Engine emission tests. Effects study, possibly transport and fate studies depending on R&D results.
Health			
Aldehydes and unburned fuel in exhaust emissions, dermal absorption. Interaction effects.	II Quite toxic. resolution may be difficult.	As above, under physical environment.	
Aromatics in exhaust emissions.	II Known carcinogen.	Exhuast emission goals due 1983.	Effects study.
Safety			
Flammability and explosiveness.	III Wide flammability range relative to gasoline; invisible flame.	---	Control technology, alternative design.

Note: Level of Understanding:
0 = Concern identified but no understanding of impacts or severity.
I = Initial understanding but not relevant to transportation system or environmental systems.
II = Qualitative understanding of impacts on environmental systems but not transportation system components.
III = Full understanding of the effects on all systems/subsystems.
IV = Sufficient design, control technique, modification or alternative available.

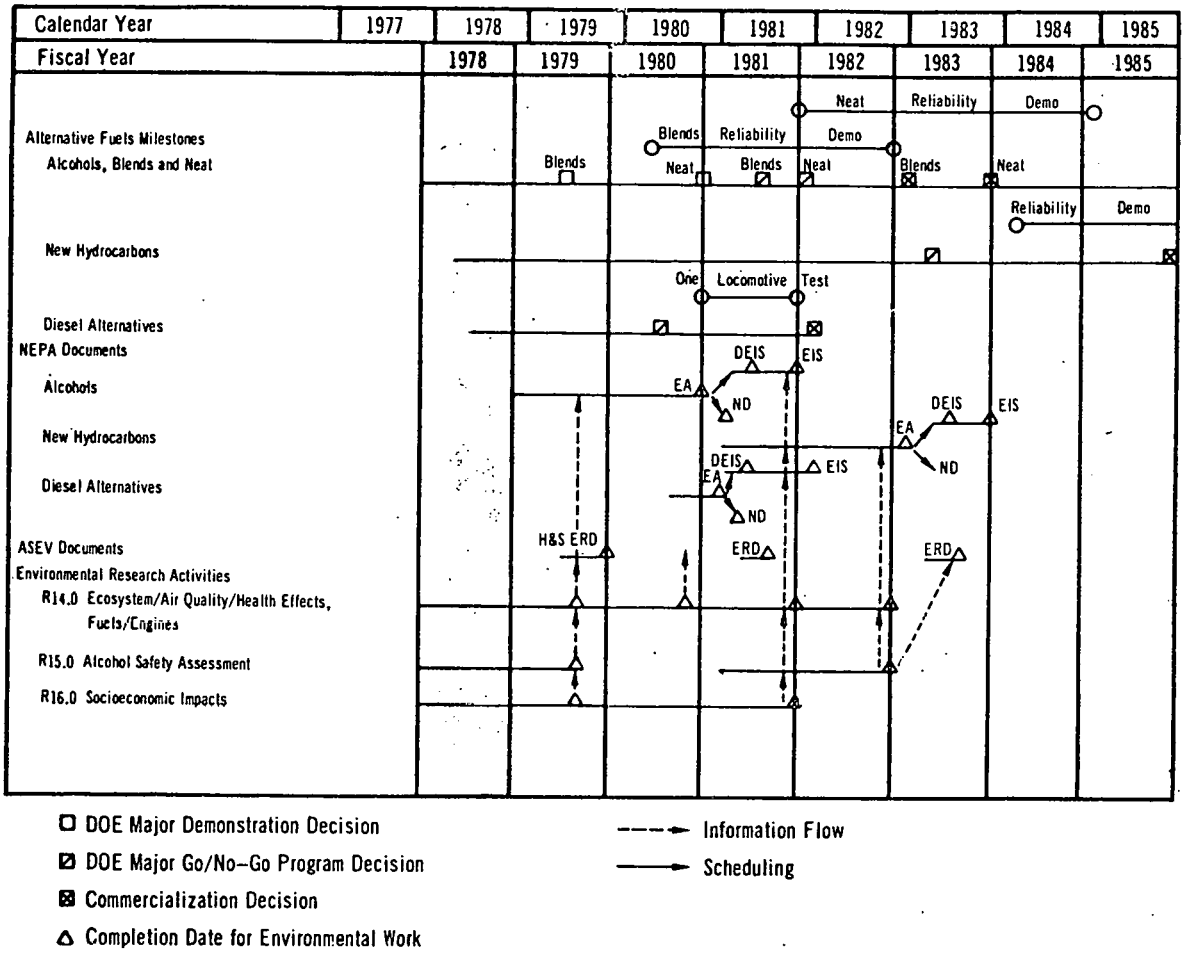

Fig. 2 Alternative Fuels Environmental Research and Assessment Plan (Source: Ref. [1], Fig. 4.5)

the state-of-the-art is scheduled to be completed by ASEV late in 1979 and a full assessment of effects and control is scheduled to assist the 1983 commercialization decision. In the area of socioeconomic impacts the EDP assigns OTP the main responsibility to assess the impacts for vehicle systems, specifically to assess the institutional and labor barriers and the economic and social impacts of commercialization. Reports are due in August 1979 and October 1981.

Environmental Assessment for DOE Alcohol Fuels Program for Small Highway Vehicles

Another product of the EDP is the scheduling of an EA for each technology before it reaches a level of usage or of development that could result in significant environmental impacts. The EA (see reference 2 for an example) is a decision document collecting all the analyses of the project or technology and the possible impacts. It is an input to the decision to write an EIS, per NEPA requirements, or to make a negative determination. If it is clear that an EIS will be required, the EA is dispensed with and the analysis is documented directly in the EIS. For the current OTP projects, EAs are scheduled first, because it is not clear what level of commercialization or implementation is most likely to occur while still at early stages of R&D. The impact of various levels can be assessed in the EA.

As Fig. 2 shows, and EA is underway for alcohol fuels for automobiles and small trucks. It is oriented toward evaluating the utilization of blends to the year 2000. The supply side for the fuels will not be investigated except at an overview level. This is not to say that the impacts of fuel production are negligable, but that the assessment of those impacts are not the topic of this EA.

Table 5 lists the tasks and subtasks of the assessment. Tasks 1 through 3 are expected to be completed this year and the remainder of the assessment by October 1, 1980.

NEPA requires the consideration of alternative federal actions. Task 1 defines those alternatives. Scenarios will be constructed for each alternative alcohol program. NEPA requires that the do nothing (no program) alternative be assessed. The scenario at the other extreme would be the total U.S. small vehicle fleet by 2000 be burning a 10% alcohol/gasoline blend. Intermediate scenarios define various methods and rates of penetration such as major rural penetrations before blends become available in large urban areas. At the time of this writing it is not clear if a scenario containing substantial neat utilization will be developed and assessed.

These scenarios are quite detailed. They combine the vehicle characteristics of task II and give vmt of each type of vehicle for each assessment year. They also define the federal government program supporting the assumed markets penetration rates while taking into account potential state, city and private alcohol fuel activities.

The assessment tasks II through VIII are based on the taxonomy of Table 3 but are defined specifically to address the expected alcohol issues as raised by the EDP. The assessment is meant to be comprehensive and the depth of the investigation for each subtask is uniform. Often sufficient information exists and a subtask is simply to put that information into a form consistent with the assessment structure. For other subtasks significant research is often necessary to increase the existing information to a level consistent with the assessment.

Environmental Impact Statements

An EIS is a NEPA-required document for major federal actions that will have a significant impact on the human environment. DOE's method of determining which actions are major and how significant the impacts may be includes the EDP/EA process described above and the judgment of the DOE Assistant Secretary for Environment. If an EIS is necessary, then the project will undergo additional public scrutiny, possibly via public hearings, and thorough examination of the draft EIS. It is possible that the project or technology or the rate of introduction of the technology could be modified as a result of the EIS. Final implementation of the project can proceed only if the EIS is acceptable.

Summary and Conclusions

This paper has reviewed the DOE environmental evaluation process designed to implement NEPA policies and guidance. In particular it has focused on that process as it is being used for DOE's alcohol fuels project within the Office

Table 5. Alcohol Fuels Environmental Assessment Tasks and Subtasks

I. ALCOHOL FUEL PROGRAM ALTERNATIVES
- Task 1.1 Alternative Alcohol Fuel Utilization Scenarios
- Task 1.2 Public and Private Sector Roles

II. TECHNOLOGY CHARACTERIZATION
- Task 2.1 Blend and Neat Alcohol Fuel Composition
- Task 2.2 Personal and Commercial Vehicle Engine Performance Characterization
- Task 2.3 Characterization of Materials Extraction, Processing and Distribution of Alcohol Fuels

III. NATURAL RESOURCE ASSESSMENT
- Task 3.1 Net Energy Analysis
- Task 3.2 Raw Material Requirements and Availability
- Task 3.3 Unavoidable Adverse Impacts and Offsetting Conditions

IV. ECOSYSTEM ASSESSMENT
- Task 4.1 Aquatic Systems Impact Assessment
- Task 4.2 Terrestrial Systems Impact Assessment
- Task 4.3 Unavoidable Adverse Impacts and Offsetting Conditions

V. PHYSICAL ENVIRONMENT
- Task 5.1 Air Quality Impact Assessment
- Task 5.2 Water Quality Impact Assessment
- Task 5.3 Waste Disposal Impact Assessment
- Task 5.4 Noise Analysis
- Task 5.5 Aesthetic Degradation
- Task 5.6 Land Use
- Task 5.7 Unavoidable Adverse Impacts and Offsetting Conditions

VI. HEALTH ASSESSMENT
- Task 6.1 Occupational and Public Health Impact Analysis
- Task 6.2 Unavoidable Adverse Impacts and Offsetting Conditions

VII. SAFETY ASSESSMENT
- Task 7.1 Occupational and Public Safety Impact Analysis
- Task 7.2 Unavoidable Adverse Impacts and Offsetting Conditions

VIII. SOCIOECONOMIC ASSESSMENT
- Task 8.1 Employment Patterns, Sills and Distribution Impact Analysis
- Task 8.2 Public Institutional Impact Analysis
- Task 8.3 Factor Prices Assessment
- Task 8.4 User Cost Impact Analysis
- Task 8.5 Capital Requirements and Return on Investment
- Task 8.6 Balance of Payments Impact Analysis
- Task 8.7 Mobility and Area Development Impact Analysis
- Task 8.8 Transportation Sector Infrastructure Impact Analysis
- Task 8.9 Unavoidable Adverse Impacts and Offsetting Conditions

IX. RECOMMENDATIONS RELATIVE TO AN EIS
- Task 9.1 Impact on the Quality of the Human Environment

of Transportation Programs. Thus far, the process is effective in addressing environmental concerns early in the development of a technology, strategy or policy and in projecting the research and assessment requirements necessary to resolve those concerns. There are, of course, some difficulties in carrying out this process; further, the real success of DOE's method for NEPA implementation will not be known until environmentally and technologically sound vehicles are available as a result of the RD&D efforts, or useful policies are implemented. Assessment efforts completed to date for the electric vehicle program have uncovered some possible impacts requiring further study to understand them and to mitigate them.

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ACRONYMS

ANL	Argonne National Laboratory
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EA	Environmental Assessment
EDP	Environmental Development Plan
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Administration
ERDA	Energy Research and Development Administration (predecessor to DOE)
ERD	Environmental Readiness Document
FY	Fiscal Year
NEPA	National Environmental Policy Act of 1969
NTIS	National Technical Information Service
OTP	Office of Transportation Programs, Assistant Secretary for Conservation and Solar Applications, DOE
RD&D	Research, Development, and Demonstration
UBF	Unburned Fuel
vmt	Vehicle Miles of Travel