Chapter 23

ENERGY

MDT ENVIRONMENTAL MANUAL

October 2010

Table of Contents

Chapter 23
ENERGY

23.1 OVERVIEW

The *Council on Environmental Quality Regulations* (40 CFR 1500 through 1508) for implementing the *National Environmental Policy Act* (42 USC 4321, et seq.) require an environmental impact statement (EIS) to include discussion of the Energy requirements and conservation potential of various alternatives and mitigation measures. This includes energy that would be consumed in project construction and for producing the materials used in construction, energy consumed in the operation of vehicles that would use the completed project and energy that would be used in maintaining the completed project.

One purpose of an energy analysis is to identify project alternatives that have the greatest potential for fuel conservation. The analysis can also encourage the planning, design, construction and operation of highways in a manner that promotes energy conservation. The analysis can assist in determining if a project will economically benefit the public, and it can be used in project staging decisions and detour considerations (e.g., fuel use by the public during construction).

The dominant energy source for the transportation sector is petroleum. Nearly two thirds of the petroleum consumed in the United States is in this sector. Highway travel accounts for nearly three-fourths of total transportation energy used, with about 80% from automobiles, light trucks and motorcycles, and about 20% from heavy trucks and buses.

Fuel consumption is a function of traffic characteristics similar to those affecting emissions. Primary characteristics include traffic flow, driver behavior, highway geometrics, vehicle fleet and climate. Modeling by the Oak Ridge National Laboratory suggests that of all the travel-related factors affecting fuel economy, average vehicle speed explains most of the variability in fuel consumption and is a good predictor of fuel economy for most urban trips. Fuel efficiency under steady flow, cruise-type driving conditions peak at speeds of 35 mph to 45 mph (55 km/h to 70 km/h) and then rapidly declines at higher speeds. At lower speeds, engine friction, tires and accessories (e.g., power steering, air-conditioning), as well as repeated braking and acceleration, reduce fuel efficiency.

This Chapter provides guidance and procedures for comparing and documenting the potential energy effects of project alternatives and associated energy conservation measures for projects involving preparation of an EIS.

23.2 LAWS, REGULATIONS AND GUIDANCE

23.2.1 23 USC 139 "Efficient Environmental Reviews for Project Decision-Making"

For projects involving preparation of an EIS and for environmental assessments being prepared in accordance with the FHWA "SAFETEA-LU Environmental Review Process Final Guidance," this Part of the *United States Code* (USC) requires that, at appropriate times during the study process, the lead agency or agencies for the project collaborate with agencies serving as participating agencies to determine the methodologies to be used and the level of detail required for assessing impacts, including energy effects. See Chapters 11 "Preparing Environmental Documentation," 13 "Environmental Assessment/FONSI" and 14 "Environmental Impact Statement/ROD" for further guidance on this requirement.

23.2.2 FHWA Technical Advisory T 6640.8A

The Technical Advisory, dated October 30, 1987, includes the following guidance for addressing the energy effects of proposed projects.

Except for large-scale projects, a detailed energy analysis including computations of BTU requirements, etc., is not required. For most projects, the draft EIS should discuss, in general terms, the construction and operational energy requirements and conservation potential of various alternatives under consideration. The discussion should be reasonable and supportable. It might recognize that the energy requirements of various construction alternatives are similar and are generally greater than the energy requirements of the no-build alternative. Additionally, the discussion could point out that the post-construction, operational energy requirements of the facility should be less with the build alternative as opposed to the no-build alternative. In this situation, one might conclude that the savings in operational energy requirements would more than offset construction energy requirements and thus, in the long term, result in a net savings in energy usage.

For large-scale projects with potentially substantial energy impacts, the draft EIS should discuss the major direct and/or indirect energy impacts and conservation potential of each alternative. Direct energy impacts refer to the energy consumed by vehicles using the facility. Indirect impacts include construction energy and such items as the effects of any changes in automobile usage. The alternative's relationship and consistency with a State and/or regional energy plan, if one exists, should also be indicated.

The final EIS should identify any energy conservation measures that will be implemented as a part of the preferred alternative. Measures to conserve energy include the use of high-occupancy vehicle incentives and measures to improve traffic flow.

23.2.3 *Energy Requirements for Transportation Systems*, FHWA, June 1980

This 1980 publication, reprinted by the Federal Highway Administration, Office of Environmental Policy, contains background information and discussion on methodologies for conducting energy studies for transportation systems, projects and operational improvements.

23.3 PROCEDURES

A detailed energy analysis, including numerical computation of fuel use (BTU) is required only for major projects that involve preparation of an EIS and that have potentially significant energy impacts.

23.3.1 Information Gathering

The Preliminary Field Review (PFR) is the initial step in the analysis of the energy effects of a proposed project. The Design Team (DT) notifies and invites appropriate MDT personnel, including the Project Development Engineer (PDE) within the MDT Environmental Services Bureau (ESB), to the field review. The PDE reviews the list of ESB attendees and includes others as necessary to ensure appropriate ESB personnel are in attendance. The PDE participates in the PFR to make a preliminary evaluation of available information on the project scope and the energy implications of the project alternatives (e.g., potential for increasing fuel efficiency by providing more travel lanes, channelized intersections, a wider roadway to improve traffic flow). Following the field review, the DT prepares a PFR Report summarizing the issues discussed during the PFR, including energy issues. The DT distributes the final PFR Report for review and comment. Within ESB, the PDE serves as the document champion to collect and coordinate comments from the other Sections. The PDE compiles the comments into a PFR review memorandum for signature by the Environmental Services Bureau Chief.

For projects subject to the requirements of 23 USC 139 "Efficient Environmental Reviews for Project Decision-Making," the PDE, in cooperation with FHWA, collaborates with participating agencies in determining the appropriate methodologies to be used and the level of detail required in the analysis of energy impacts of project alternatives. As project development proceeds, the PDE coordinates with the DT to gather and document information on existing conditions (the no-build alternative) and aspects of the project alternatives that have potential energy implications. Those aspects include the following:

- current and projected traffic volumes, average speeds, level of service, vehicle mix and crash history for the existing facility;
- length and highway geometrics (e.g., horizontal and vertical alignment, number and width of travel lanes, shoulder widths) of the existing and proposed facilities;
- construction materials for the existing and proposed facilities;
- projected traffic volumes, average speeds, level of service and expected posted speed limit;
- anticipated vehicle mix (e.g., percentage of automobiles, light trucks, motorcycles, heavy trucks, buses);
- anticipated amount of earthwork and land disturbance; and
- proposed energy usage mitigation measures (e.g., inclusion of High Occupancy Vehicle (HOV) lanes, channelization and/or designated turn lanes to improve traffic flow; designing build alternatives to maximize use of on-site materials, reduce haul distances

and minimize amount of area to be disturbed; phasing or sequencing construction to reduce traffic delays and length of detours).

The PDE consults with State and local officials to determine if there is a regional energy plan for the project area and, if so, obtains a copy of the plan.

23.3.2 Analysis and Findings

In accordance with Technical Advisory T 6640.8A, except for large-scale projects, a detailed energy analysis including computations of BTU requirements, etc., is not required. For most projects, the analysis should address, in general terms, the construction and operational energy requirements and conservation potential of alternatives under consideration.

23.3.2.1 Considerations

In conducting the analysis of energy effects of project alternatives, the PDE considers questions such as the following:

- Will the new roadway be longer or shorter than the existing facility and in comparison with other build alternatives, and what are the implications for effects on fuel consumption?
- Will HOV lanes or other measures (e.g., channelized intersections) be installed to promote efficient use of the roadway?
- Will the design, projected travel speeds and level of service of the new roadway cause vehicles to travel at speeds of maximum efficiency or at speeds higher or lower than the maximum efficiency?
- Are crashes on the existing facility a major cause of delays resulting in inefficient fuel use that the proposed project would correct?
- Are there significant differences in the construction energy requirements for alternatives under consideration (e.g., more earthwork/land disturbance, more construction materials needed)?
- What energy conservation measures will be employed during construction?
- Will the new roadway and the materials used in its construction require less maintenance?

23.3.2.2 Alternatives Analysis

As part of the analysis of energy effects, the PDE evaluates both the no-build alternative and the build alternatives under study. For analysis of the no-build alternative, the PDE compares the information on operating characteristics, length, geometrics, construction material and safety for the existing facility with the comparable information for the build alternatives. This comparison is to identify differences in energy usage between the alternatives (e.g., improved level of service/smoother traffic flow for the build alternatives, resulting in improved fuel efficiency; shorter travel distance for build alternatives, resulting in potential for reduced fuel consumption).

The PDE documents, in general terms, the results of the comparison. For each item involving an energy usage difference, the documentation addresses the relative energy advantages/ disadvantages of the no-build and build alternatives in terms of operational energy usage and energy used for construction/maintenance, as applicable. For example, the build alternatives require a commitment of energy for construction but that commitment would be offset by improvements in operating fuel efficiency and reduction in fuel used for highway maintenance, compared to the no-build alternative.

For the build alternatives under study, the PDE compares the various items of information obtained regarding each alternative's design, anticipated performance characteristics, earthwork/land disturbance and energy usage mitigation measures. The PDE identifies and documents, in general terms, substantive differences in potential energy usage associated with any of these aspects for each alternative under study. This may include evaluating substantive differences in travel distance or horizontal alignment resulting in implications for operational energy usage differences between alternatives or substantive differences in the amount of earthwork, land disturbance or materials needed for construction resulting in substantial differences in construction energy usage between alternatives.

If all of the build alternatives have essentially equivalent potential energy effects, the PDE documents that determination and its basis (e.g., all of the build alternatives involve essentially similar designs, anticipated performance characteristics, earthwork/land disturbance and energy mitigation measures and, therefore, should have equivalent potential energy effects in comparison to the no-build alternative).

For aspects that the PDE determines involve substantive differences in potential energy usage effects for the build alternatives, the PDE documents, in general terms, the relative energy advantages/disadvantages of the alternatives involved. This documentation presents the results in terms of operational energy usage and energy used for construction/maintenance, as applicable. For example, all build alternatives have essentially similar operational characteristics; however, Alternative A is significantly longer than other build alternatives, thus, implying greater operational and maintenance fuel consumption for that alternative. Alternative A also involves more earthwork/land disturbance and more construction materials than other build alternatives, thus, implying greater construction-related fuel consumption.

The PDE ensures the results of the analysis of energy effects, including proposed mitigation measures, are appropriately reflected in the project environmental document (see Chapters 11 "Preparing Environmental Documentation," 14 "Environmental Impact Statement/ROD" and, as applicable, 13 "Environmental Assessment/FONSI") and included in the project file.

23.3.3 Mitigation and Commitments

The PDE and DT ensure the project plans and contract documents accurately reflect mitigation measures that are to be implemented for the project. To the extent possible, the PDE and DT should prepare the contract documents using the *MDT Standard Specifications* to minimize the need for special provisions.

The District Environmental Engineering Specialist monitors project construction to ensure that all mitigation measures are implemented in accordance with the approved project plans.