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The views expressed in this paper are ours and are not necessarily those of EIA. The paper has not received formal clearance and is provided solely to facilitate discussion of the technical issues it addresses.

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Issues for Developing State Energy Emergency Conservation Plans

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The key components of the process of developing a state-level energy emergency conservation plan and concomitant issues critical to responding effectively to future fuel-supply emergencies are described. In the event of a declared energy emergency, every state will be expected to consume a certain percentage of fuel below some predetermined base-period volume. The primary concern of the states then is to propose actions to meet the targets during a specified time frame and to achieve objectives such as minimizing market disruptions in geographic subareas and price monitoring. Also of prime concern to the states is maintaining the mobility of the traveling population. Equally important are the equitable distribution of the hardship that results from any shortfall, the ease of implementation of plans in advance of a major fuel-supply interruption, and the reliance on voluntary rather than mandatory conservation by the public. Efforts by the states should assist the public response by emphasizing alternative mobility options and encouraging consumers to find and use those alternatives in their own self-interest.

Since the 1973-1974 oil embargo, both the U.S. Department of Transportation and the U.S. Department of Energy have been increasingly active in transportation energy conservation and contingency planning at the federal, state, and local levels. A clear understanding of the guidelines that have been established and promoted by these agencies during the past years is essential to successful plan development and implementation. Although the effort has accelerated since 1979, the development of adequate plans for energy emergencies has been of great concern only at the local and state levels. In general, these plans can be characterized as a compendium of options that have been inadequately evaluated with respect to their probable effectiveness, their impact on various market segments, and their feasibility of implementation. Furthermore, they are generally not well coordinated with recent federal directives and guidelines on energy contingencies. In an effort to avoid such problems in its own work, the New York State Department of Transportation (NYSDOT) recently contracted with System Design Concepts, Inc., to conduct a fairly extensive study of transportation energy contingency planning. This paper discusses the key components of a planning process and issues critical to an effective response during future energy shortfalls.

BACKGROUND OF TRANSPORTATION ENERGY EMERGENCY PLANNING

U.S. Department of Transportation

The Federal Highway Administration (FHWA) and the Urban Mass Transportation Administration (UMTA) have been promoting a wide range of transportation energy conservation and contingency planning, research, demonstration projects, workshops, and conferences (1). These activities have been conducted pursuant to national transportation legislation, the Emergency Highway Energy Conservation Act of 1974, which provides for such programs as ridesharing, the 55-mile/h speed limit, and park-and-ride development as well as financial assistance for transit authorities and transportation system management. In early 1979, FHWA and UMTA issued a joint directive that requested that all regional administrators "actively promote energy contingency planning among the states and metropolitan planning organizations and strongly recommend inclusion of contingency plan development in each MPO's Unified Planning Work Program" (2). As a follow-up, the U.S. Department of Transportation (DOT) issued a document listing the kinds of actions some local entities had taken in preparing to deal with energy shortages (3). A three-part report was prepared for DOT to be used as a guide by the many actors involved in the planning and implementation of transit, paratransit, and ridesharing initiatives (4).

FHWA issued a directive encouraging the preparation of energy contingency plans by state and substate agencies as a preparatory response to an energy emergency (5). Each state highway agency is encouraged to work cooperatively with state energy officials in preparing the transportation element of statewide, substate, and metropolitan-area energy conservation plans and emergency energy conservation plans.

U.S. Department of Energy

In November 1979, Congress passed the Emergency Energy Conservation Act (EECA), which directed the establishment of a federal gas rationing plan and a standby federal emergency energy conservation plan. States are required to prepare and submit a state emergency conservation plan (SECP) within 45 days of the establishment of a mandatory energy conservation target by the President. If a state does not submit a plan, or if the plan does not meet federal criteria, a federal backup, or "standby", plan consisting of mandatory measures may be imposed on the state (6). So far, only voluntary gasoline-reduction targets have been issued.

The requirements for state plans under the legislation are fairly broad. A plan must demonstrate the capability of meeting the target, equity, and consistency with state and federal law and must include appropriate public participation. State plans may contain measures suggested by the federal plan, coupled with other proven measures or measures uniquely appropriate to the state or local area.

If the President projects that fuel supplies may be reduced, possibly due to federal policy decisions, political events, international petroleum agreements, or diversion of supplies to the Strategic Petroleum Reserve, he can make the current state voluntary fuel-reduction targets mandatory at any time. Once the mandatory target was established (assumed to be in the range of 7-8 percent), the state would begin to implement its emergency conservation plan. The target would probably not have to be reached for at least 3-5 months. However, monthly monitoring of movement toward compliance is expected from the U.S. Department of Energy (DOE). If the state plan was not meeting the specified target, the federal government could mandate other measures. For the first half of 1980, most states were meeting their targets.

In order to assist state energy and transportation officials to develop policies and programs for SECPs, DOE distributed information on state-level actions and the range of options available, including the context for conducting state-level planning (7). DOE also published an Energy Emergency Handbook (8), designed as a reference document for use by those with responsibilities for energy emergency management at the state and local levels. A conference on contingency planning in the transportation sector was sponsored by DOE and UMTA for the purpose of providing a forum for examining issues related to transportation energy contingency planning and to provide a basis for more coherent and effective public and private planning (9).

Local Efforts and State-Level Roles and Responsibilities

Prior to the requirements of the EECA, transit authorities and metropolitan planning organizations (MPOs) took the most initiatives and had the primary responsibility for transportation contingency planning in most states (10-12). Although states control many of the key powers that govern short-term actions such as pricing, restrictions on fuel purchase, rationing, and fuel set-aside, few state transportation or energy agencies have developed programs for exercising these powers in support of local or statewide objectives. As a result of EECA, however, local efforts are now being paralleled by statewide planning efforts. The current emphasis has been to encourage state government to assume more responsibility in conservation and contingency planning and to pay particular attention to the present targets established by DOE as a guide (13).

Depending on the state, it is either the state energy office or the state transportation office that has prepared or is preparing these plans. In most states, however, the energy office has the primary lead but is working closely with the transportation department. Some of the important responsibilities that must be clarified at this level are the following:

1. Definition of fuel savings and/or mobility maintenance objectives for conservation and contingency planning (for example, how, where, and to what extent different areas of a state should comply in meeting a mandatory demand-reduction target),
2. The analytic framework for assessing the potential for statewide and local-area actions,
3. Criteria for plan content, and
4. The role of the statewide plan in relation to local-area plans in terms of an ongoing planning process, plan implementation, emergency management, and funding.

A key issue facing state-level planners is the integration of existing fuel-supply-related powers and actions, controlled by state energy offices, with actions to reduce demand and maintain mobility, which are largely the responsibility of transportation agencies and operators at the local level.

Several organizations have followed the progress of EECA plan development, including the National Conference of State Legislatures, the National Governors Association, the U.S. Congress, and, more recently, the Planning Research Unit of NYSDOT. Our survey found that more than half the states have plans in draft form. Yet, on review, it should be noted that there has been a lack of evaluation of the energy savings attributable to the plan, the economic impacts of the actions, and the lost mobility implied by the shortage. These plans are oriented to reducing gasoline lines and preventing panic at the pump. The third, equally important, goal--maintaining the mobility of the traveling population--is often ignored. Particularly disturbing in many plans is the lack of awareness of the expected effectiveness of government-imposed actions in relation to the effects of changes in the driving habits of individuals without government intervention and improvements in fleet fuel efficiency.

ANALYTIC ELEMENTS OF STATE EECA PLANNING PROCESS

To assist in the plan development process, we suggest here a number of practical considerations that should be incorporated into such plans and suggest a systematic approach for evaluating possible strategies.

The exact format of any statewide EECA planning process depends on the objectives, roles, and responsibilities of the agencies and actors involved (14). However, certain analytic procedures should be followed in order to (a) systematically evaluate all actions and strategies contained in the statewide plan as to their probable effectiveness, interrelations, and impacts on various affected groups and geographic areas and (b) ensure their consistency with existing conservation behavior and local contingency plans. This planning process comprises five analytic elements, which are described below.

Transportation Inventory

The development of emergency transportation energy plans must consider the specifics of a state's transportation systems, the demographic and travel characteristics of its residents, and their willingness and ability to further conserve transportation energy or cope with temporary fuel shortages. An energy planning data base is required that will provide consistent levels of information and emphasis on

1. Transportation modes (automobile, bus, truck, rail, and air),
2. Transportation sectors (local and intercity),
3. Types and time of travel (work, nonwork, weekday, and weekend),
4. Geographic areas (urban, suburban, and rural) and subareas (agricultural and recreational), and
5. Past and current patterns of public response.

This data base forms an essential control mechanism for measuring the impacts and effectiveness of potential actions on a statewide and disaggregate basis.

Scenarios

State plans should define and consider likely future conservation and contingency scenarios in order to anticipate statewide impacts, measure projected public response, and determine appropriate public and private actions. These scenarios should be specified in terms of the following characteristics at the statewide level (it should be recognized that significant variations will occur at the local level):

1. Price of fuel,
2. Type and level of fuel shortfall,
3. Public perception,
4. Geographic distribution,
5. Lead time and immediate history, and
6. Type of fuel allocation.

If scenarios defined by the state were used as the basis for local energy planning and development, a strong element of consistency would be added to the overall planning process. Currently, most local areas use independent, often arbitrary assumptions about the future, especially regarding the level of fuel shortage or travel demand. In addition, inconsistent scenarios can result in a breakdown in emergency management of a crisis situation by different levels of government if the scenarios are used as a basis for "triggering" predetermined response actions. Parallel analyses can be developed for urban-level plans.

Impacts of Scenarios

States should have a clear understanding of the public response, travel demand, and economic consequences of future scenarios--assuming no government action--in order to determine when, where, and to what extent different types of government or private-sector actions may be appropriate. Some of the most important impacts of scenarios for purposes of emergency energy planning are

1. Energy savings due to efficiency improvements (i.e., fleet turnover and speed reduction);
2. Reduction in travel [in vehicle miles of travel (VMT)] for local, intercity, work, nonwork, weekday, and weekend travel;
3. Reduction in travel (VMT) due to diversion from automobile to other modes (local transit, commuter rail, and intercity bus, rail, and air) and increases in demand for these modes; and
4. Economic impacts of scenarios, including expenditures for gasoline and revenue losses to government and travel-related industries.

By examining the impacts in item 2 above, it is possible to determine the level of unmet travel needs associated with various types of travel for different scenarios. Disaggregation of these data by socioeconomic and demographic characteristics, combined with public response survey data, will provide a profile of who suffers most during fuel shortfalls. These unmet travel needs act as a barometer for identifying conservation behavior and selecting possible actions to reinforce that behavior while maintaining mobility and reducing negative economic impacts.

Candidate Actions

Existing state and local contingency plans contain a wide range of actions and strategies (15,16). Thus, a sufficient base of possible actions is readily available from which candidate actions suited to the unmet travel needs of and impacts on each state and local area for different scenarios can be drawn.

In order to initiate the sorting process necessary to evaluate and select those actions that are most appropriate for each state, selection criteria for the candidate actions must be defined. The following criteria should serve as a guide:

1. Geographic variation--Because of the differences between urban and rural areas of the state with respect to price and fuel shortfall levels, existing transit services, socioeconomic characteristics, existing actions already planned and/or implemented, the appropriateness of some actions is likely to vary significantly.
2. Feasibility--The feasibility criterion covers a range of possible considerations, including (a) time required to implement or remove an action; (b) anticipated acceptance by and/or compliance with the action by consumers, business and industry, and government; and (c) implementation constraints and opportunities, including financial, political, institutional, legal, technical, operational, and environmental, as well as the degree of flexibility required for optimum implementation of an action.

3. Government involvement--Consideration must be given to the degree to which the success of an action depends on direct government participation in planning, implementation, or enforcement as opposed to actions that the public or various groups can take themselves, with minimum government intervention or assistance, to save energy and maintain mobility. This criterion would include the administrative costs of government involvement.
4. Fuel savings--In considering the estimated transportation fuel savings for different types of fuels directly attributable to an action, it must be recognized that some actions will have greater fuel-saving potential when combined with other actions.
5. Mobility effects--The mobility-effects criterion considers the direct and indirect effect that an action may have on maintaining mobility (work, personal business, and social-recreational travel) and essential transportation services (public, commercial, police, fire, public health, and social service transportation).
6. Equity--Actions taken should not pose an unreasonably disproportionate share of the burden of restricted energy use on any region or any specific type of industry, business, commercial enterprise, or group of consumers.
7. Cost-effectiveness--The cost-effectiveness of an action should be high in terms of (a) the primary objectives of the scenario, (b) the relative importance of the action in terms of other alternative actions, (c) the relative importance of the action to other scenarios and objectives over the long and short term, and (d) the importance of the action to the success of interrelated strategies and actions.

Impact of Actions

The effectiveness of candidate actions in meeting the unmet travel needs, negative impacts, and objectives associated with each scenario should be determined. Evaluation of the probable effectiveness of actions has been relatively weak in most existing contingency plans and nonexistent in others. Some useful assessment techniques have been compiled, but no comprehensive "cookbook" of proven methodologies is currently available for use by contingency planners (17,18).

Reliance on VMT control totals established as part of the contingency-planning data base and scenario framework can greatly assist the evaluation process. These control totals can be used to help define specific market segments relevant to individual actions or combinations of actions and thus determine an upper bound on the potential for each action. The VMT control totals are categorized as follows:

1. Area--Statewide, urban (standard metropolitan statistical area), and rural;
2. Sector--Local and intercity;
3. Type--Work and nonwork; and
4. Period--Weekday and weekend.

Market segments for actions include the following:

1. Major--Consumers, private industry, and government; and
2. Submarkets--Employees by employer size, shoppers, business travelers, vacationers, recreation travelers, and gasoline purchasers.

PRINCIPLES FOR PLAN CONTENT

The following basic points serve as guiding principles that should be considered before a decision is made on a package of actions or strategies to be considered in a state emergency conservation plan.

Focus on Markets and Substate Areas

The plan should focus on easily identifiable segments of society whose transportation fuel needs can be identified and for which the savings potential from major actions can be assessed. The following markets or segments are necessarily quite broad so that no single group is unfairly burdened: (a) consumers, (b) business and industry, (c) freight and goods movement, (d) recreation and vacation travelers, and (e) government.

The overwhelming negative reaction to the proposed, and subsequently dismissed, weekend boating ban in the federal standby plan can attest to the need for careful assessment of energy savings potential. Broad packages of actions should be developed for each market and region that are internally consistent, are tailored to regional demographics and transportation options, and stress conservation while maintaining mobility.

Incentive-Based Program

The plan should emphasize actions that help each market or region to deal with shortages by expanding alternative mobility options, providing information, or providing assistance, either technical, managerial, or financial. Coercive actions should be stressed only as a last resort in the event of a very clear, immediate, and massive need. When coerced, people will respond only to the minimum extent necessary, violations will be extensive, and enforcement will be difficult and burdensome, if possible at all. When the crisis passes, behavior will revert to precrisis patterns; thus, attainment of ongoing conservation goals over the long run will be hindered.

Emergency Versus Conservation

The plan should clearly distinguish between actions appropriate for true emergencies that require immediate actions and less immediate conservation efforts. The state may have to develop two different emergency response approaches for two different situations: (a) meeting supply shortages or perturbations, a situation that requires measures to alleviate market disruptions as evidenced by long queues at retail service stations, and (b) meeting a conservation target, voluntary or mandatory, in the absence of a clear supply shortage externally imposed on the state, a situation that requires measures to help people cope with less fuel.

In the first case, the public's willingness to conserve is greater since its perception of the reality of the "crisis" is sharper. In the second case, consumers are likely to be skeptical, generally unwilling to act on their own, and more resentful of coercive actions.

Clear Lines of Government Responsibility

The plan should integrate and build on the various planning efforts and established responsibilities of public and private groups in transportation. Key groups that should be included, both in the planning process and in plan implementation, are federal, state, and local governments; transportation providers; fuel suppliers; business; and other interested parties. Otherwise, in the event of a future energy emergency, a situation may occur in which part of a local plan may conflict with the state plan.

Generally, the state plan is far more likely to be activated before either federal rationing, for which a 20 percent shortfall and congressional approval are required, or local contingency plans, for which an emergency declared by the Governor would probably be required. At this point, the implementation of many elements of a state plan will require the cooperation of local officials, probably MPOs.

MPOs in urbanized areas can be particularly valuable in employer-oriented plan development. In many areas, these organizations are already working with employers and transit operators to institute carpooling, vanpooling, transit promotion, and flex-time programs. They can also assist companies in preparing ridesharing and other conservation and contingency plans by providing instruction and methods for data collection and analysis, impact identification, and implementation mechanics and can assist conservation plan actions generally by coordinating and promoting conservation and mobility actions and serving as a regional clearinghouse and multiagency "spokesperson".

Existing Communication Channels

Where communication with the public (or with various markets) is necessary, maximum use should be made of already existing contact systems--MPOs, for example--or reregistration notices from the state department of motor vehicles, which can be augmented (at very low cost) with additional material on motorists' driving habits and fuel-efficient cars as well as carpooling and use of transit. Existing industry and business groups (e.g., chambers of commerce), organizations of public officials (e.g., county executive associations), transportation providers (e.g., bus and taxi companies), consumer and public interest groups (e.g., the League of Women Voters), and others can provide input and act as secondary promotion resources.

Equity

Equity is a high priority for energy planning. The EECA of 1979 states that, "taken as a whole, the plan should be designed so as not to impose an unreasonably disproportionate share of the burden of restrictions of energy use on any specific class of industry, business, or commercial enterprise or any individual segment thereof." Understandably, the boating interests voiced concern over the proposed restrictions on recreational watercraft presented in the federal standby plan.

Phased and Measured Implementation

The plan should be structured so that elements can be added or subtracted incrementally, or increased or decreased in intensity, according to the level of the emergency and the progress made toward conservation and mobility objectives. Actions that prevent panic, encourage conservation, and are incentive based should come first; only in extreme crises (15-20 percent energy shortfall) should stringent actions be considered. At shortfalls greater than 20 percent, federal rationing systems should be included in the plan's action packages.

Boundaries

The plan should consider what adjacent states and countries (Canada and Mexico) are doing in terms of each scenario and action, especially for those actions that affect intercity vacation travel and fuel availability (e.g., speed-limit enforcement and odd-even gasoline rationing). Interstate coordination, including Canada, is required to mitigate negative impacts on the tourist industry.

SUMMARY AND CONCLUSIONS

It is universally recognized that transportation energy conservation is an essential component of an effective state policy for energy emergencies. The statistics of conservation potential are generally well known and agreed to. Transportation energy must be conserved continually as well as in an emergency, and potential state-level actions to initiate this conservation should be prudently prepared.

Recent federal directives have greatly accelerated the process of emergency plan preparation at all levels of government, by private industry, and by transportation providers. This paper suggests a number of practical considerations that should be incorporated into such plans to improve their effectiveness and relevance.

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Analysis of Long-Term Transportation Energy Use

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The structure of ENTRANS, a DYNAMO-based simulation model of the interactions between energy supply and transportation-related energy use, and some of its policy analysis applications are described. ENTRANS includes representation of the characteristics of transportation supply (public transit, highways, and automobiles) and households' travel-related decisions (car type, travel mode, trip length, and frequency). The model is capable of analyzing a wide range of policies designed to change automobile fuel use. The results of several detailed policy analyses are described. These results indicate that automobile fuel-efficiency standards can be both effective and cost efficient and that fixed additions to the gasoline tax can have substantial short-term, but little long-term, impact on fuel use. Overall, the model is a useful step in the development of a comprehensive tool for the analysis of transportation energy policy. Ongoing development will make ENTRANS more useful for specialized applications.

This paper describes the structure and applications of a model for forecasting transportation energy use at the national level. Development of the model started in September 1978 and over the course of the effort, U.S. gasoline prices doubled and use of gasoline for automobiles became a significant national concern. The original purpose of this research was to develop a better understanding of the long-term effects of transportation energy policy on gasoline use through an explicit representation of all of the important interactions among travel demand, transportation supply, and energy supply. The events of the past two years have both increased the importance of obtaining better understanding in this area and (to an even greater extent) increased the relevance of the research to the current debate on national energy policy. Attempts to reduce U.S. dependence on foreign energy sources have inevitably involved analysis of policies including gasoline pricing and taxation, automobile energy efficiency regulations, and increased support of public transit systems. The long-term effects of such policies are, however, not fully understood.

The model developed in this research effort--Energy Use in Transportation (ENTRANS)--represents a large subset of the factors that have an impact on the effectiveness of alternative policies. The model has been implemented in a way that allows easy access by policy analysts with diverse levels of computer experience. It has already been used in a range of policy analysis tasks and is continually being updated with recent data and improved structural elements. The model version whose results are described here, ENTRANS 4/15, was developed recently for the Solar Energy Research Institute.

WHY ANOTHER TRANSPORTATION ENERGY MODEL?

When this project was originally proposed, in November 1977, a number of completed transportation energy use models were already available. Although a few of these were actively being used for policy analysis, the difference in forecasts among the models was generally quite large. For example, Figure 1 shows the range in estimates of automobile fuel use from a sample of relatively current models (1). One could argue that this range in estimates represents a plausible (and even optimistically small) level of uncertainty about uncontrollable future events. However, our review of the existing models indicated that the differences in model forecasts were explainable not so much by uncertainty in the parameter estimates as by differences in model structure and, in particular, by differences in the factors and interactions that were included in the models. Generally, those models had been "first-generation" efforts. In addition, they had been built to address relatively limited ranges of policy issues. Our approach was to build on these efforts by piecing together a more structurally complete model set and, in addition, to draw more heavily on some of the recent work in transportation demand modeling.

A more structurally complete model is not necessarily a better model. In constructing our model, we wanted, in addition, one that would be easy to use and would be capable of representing, in a realistic way, the effects of a wide range of policies.

MODEL STRUCTURE AND COMPONENTS

The remainder of this paper summarizes the development and applications of ENTRANS. Substantially greater detail on both model structure and applications can be found elsewhere (2-5).

The basic components and relations included in this modeling effort are shown in Figure 2. Energy supply is described by the price and availability of crude oil. These quantities are determined in an externally linked energy supply model, NEP2000 (6). Energy consumption is divided into two end-use categories: transportation and all other uses. Transportation energy use is further split into passenger travel and freight transportation. ENTRANS represents, in detail, only those mechanisms that influence passenger travel. Other uses of crude oil are determined exogenously to the model.