Simulation for Estimating the Impact of Supply Restriction Policies on Gasoline Consumption

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A simulation model is developed to measure the impacts of several supply restriction policies on gasoline consumption during energy shortfalls. The model, which uses FORTRAN programming language and the next-critical-event approach, takes a microscopic view of travel in a typical urban area in Virginia. The model is built to assess the impacts of the following supply restriction policies: odd-even rationing, weekend closure of stations, upper and lower limits on fuel purchase, and elimination of one day's driving per week. The primary entities in the model are households, automobiles, and service stations. During the simulation period, a real-life situation is simulated in which automobile drivers make work, shopping, recreation, and other trips determined from specified distribution functions. Each trip has its own characteristics, such as trip purpose, length, average speed, and the time at which it is made. During the course of the day, drivers visit gasoline stations when the fuel in their vehicles is low, wait in lines when stations are busy, and park their vehicles at home when gasoline is unavailable. The results of this simulation reveal that only elimination of one day's driving per week has some notable effect on fuel consumption when the level of a gasoline shortage is low (around 5 percent). However, when the shortage level is up to about 15 percent, none of the policies tested has an important effect on the reduction of fuel consumption. The most significant impact on travel behavior and fuel consumption stems from the shortage itself.

Since 1950, transportation has accounted for a relatively constant share of the total petroleum demand (about 52-55 percent) and total energy demand (about 25-26 percent) (1). Whereas the percentage share of transportation stays constant, transportation energy demand has grown considerably in absolute terms over the past 30 years. Between 1950 and 1977, petroleum demand for transportation increased 190 percent; between 1970 and 1977, it increased 25 percent (1). In 1979, 18.6 million bbl/day were consumed in the United States, of which 7.9 million bbl were imported (2). Excluding a dramatic technological breakthrough, it appears that this dependence on petroleum by the transportation sector will continue into the 1980s (3). The United States has experienced severe shortages of gasoline in the past, and a recurrence of these conditions seems inevitable due to our continuing dependency on foreign petroleum supplies. For these reasons, it is necessary for state and local governments to evaluate potential contingency measures beforehand.

Within the framework of contingency planning, numerous alternatives are available (rationing programs, promotion of ridesharing and transit, adjustment of peak-hour demand, etc.). This paper only addresses the impacts of the following supply restriction policies on fuel consumption: (a) elimination of one day's driving per week, (b) weekend closure of stations, (c) odd-even rationing, and (d) upper and lower limits on fuel purchase.

A computer simulation model is developed to estimate travel behaviors in response to shortage situations and consequent rationing policies. Numerous models have been developed for this purpose. These models fall into the basic categories of aggregate (4,5) and disaggregate (6,7). The disaggregate models permit a broader range of travel and policy options than the aggregate approach. However, both modeling techniques have important limitations. All of the models to date are demand based and lack a component for limiting the supply of gasoline.

The model developed for this analysis adds a supply component to the estimation of consumption. This addition makes the model more realistic for simulating shortfalls.

Under free-market conditions, the price of gasoline will increase during supply shortfalls. However, since the model was built before the deregulation of gasoline prices, the price of gasoline is assumed to be fixed in the model during supply shortfalls. This fixed price, which is below the equilibrium price, makes demand higher than supply. Queues are therefore formed in gasoline stations. The model incorporates the feedback between queue length and demand to reflect the dynamic interrelations present in the real world.

The modeling technique adopted for this analysis represents a departure from the conventional econometric modeling approach. A stochastic simulation model was developed for this study because of some of its inherent advantages over the econometric approach. The true validity of the econometric model lies in its ability to transfer historical relations into the future. Econometric models cannot adequately deal with new technology for different futures from the historic past. Very few data exist concerning the way drivers reacted to either the 1973-1974 or the subsequent gasoline crisis. However, in order to predict the effects of different supply restrictions on fuel consumption, one cannot effectively project past trends into the future (as in the econometric model) simply because sufficient data on past trends do not exist. In addition, Louviere and others (8), in their recent work comparing econometric with stochastic simulation models, found that the stochastic model is equal to the conventional model in terms of predictive ability. Furthermore, the parameter estimates of the stochastic model were found to be temporally and spatially stable and consistent with the estimates of the econometric model.

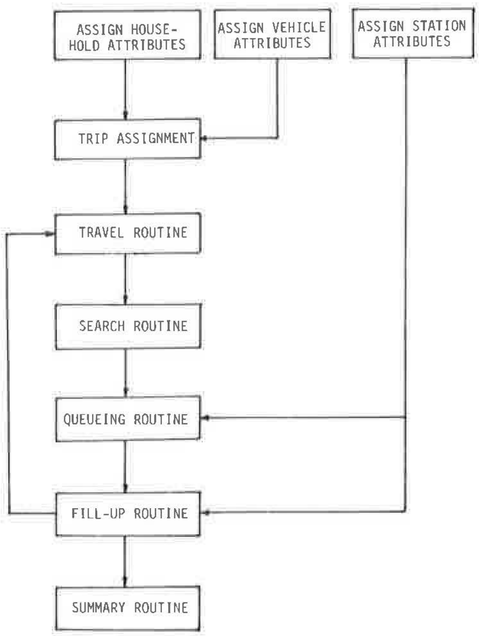
METHODOLOGY

The model simulates the travel activities of passenger vehicles for a typical urban area in Virginia. Statistics for the model are based on data from the City of Richmond, which exhibits characteristics (population density, area size, automobile fleet, etc.) typical of urban areas in Virginia. According to the passenger vehicle-to-station ratio, 2500 passenger vehicles and three service stations are created for the hypothetical urban area. They exhibit operating and capacity characteristics similar to those of their real-life counterparts.

Model Formulation

The model, shown in Figure 1, consists of nine major components: household attributes, vehicle attributes, station attributes, trip assignments, travel routine, search routine, queuing routine, fill-up routine, and summary routine. First, the attributes of the household, vehicles, and service stations are initialized. Actual travel activities are then simulated in the travel routine according to their assigned trips, household attributes, and vehicle attributes. As soon as the level of gasoline in a vehicle reaches the point where fuel is needed, a service station is searched. The queuing routine is then activated, the fill-up routine is called, and

Figure 1. Major components of model.



the vehicle is filled with a certain amount of gasoline. It then leaves the station and reenters the travel routine. Gasoline in the service station is reduced by the fill-up amount. If the level of gasoline in a service station is below a certain point, a distributor is asked to refill the station.

The model uses the next-event approach to update activities in the system. The simulated "clock" is advanced by the amount necessary to cause the most imminent event to take place in a day and continues until the end of the simulation period. The basic concept underlying the next-event approach is that there is no need to view the system at points in time other than those at which critical events occurred. The critical events defined in the model are start of a trip, end of a trip, search for a service station, enter a service station, leave a service station, call to refill a service station, end of a day, and end of the simulation period.

After the base model is formulated, it is calibrated to replicate the actual unconstrained condition of travel and fuel consumption in Virginia. Supply constraints and restriction policies are then imposed on the model to examine their effects on travel and fuel consumption.

Assignment of Household Attributes

Three attributes are assigned to each household in the model: household income, vehicle ownership, and household size. Since, according to the 1977 Nationwide Personal Transportation Study (NPTS), the average number of vehicles per household is 1.52, approximately 1645 households are generated in the model to own the 2500 vehicles. These attributes are assigned to households by certain probability distributions through the Monte Carlo approach. Unlike most other previously developed models in which the attributes of vehicle ownership, household income, and household size are just assigned randomly to each household through their marginal probability distributions, this model makes use of their joint probability distributions to assign these attributes. The joint probability distributions are calculated from Federal Highway Administration 1977 NPTS Public Use Tape.

Assignment of Vehicle Attributes

Six attributes are assigned to each vehicle in the model: license plate number, size, tank capacity, average fuel consumption rate, an initial amount of gasoline, and a regular refilling point.

Assignment of Station Attributes

Six attributes are assigned to each service station: station hours, station capacity, number of pumps in the station, average service time, an initial amount of fuel, and the day and amount of replenishment. The initial amount of fuel is randomly assigned between one-fifth and the full capacity of the tank. All other attributes are obtained through a random sampling of three service stations in the Richmond area.

Trip Assignment

Vehicles in the model are assigned to perform four types of trips: work, shopping, recreation, and other. Work trips include travel for earning a living. Shopping trips in the model represent travel for purchasing commodities. Recreation trips include travel for social and recreational purposes. Other trips in the model stand for the remaining trip purposes, such as civic, educational, religious, and personal business. The percentage of vehicle trips and average trip length by trip type are first assigned to each vehicle by its household income and then modified by its vehicle ownership, household size, and day of the week the trip is made. These percentages are then used as probability distributions to assign trips to each vehicle by using the Monte Carlo technique. Trip starting time is also assigned to each trip according to the distribution of daily traffic and its purpose (9). An idle period is assigned to each trip at its destination according to its purpose. These idle periods are assumed to be uniformly distributed in the ranges given below:

Trip Type	Idle Period (h)
Work	6-9
Shopping	1-4
Recreation	2-8
Other	1-3

The work trips are performed mostly on the weekdays. For weekend travel, shopping and recreation trips are the dominant ones. However, the average vehicle miles of travel (VMT) for recreation trips is much more than that for shopping trips during weekend days (10).

In the event of gasoline shortages, it is likely that people will cut their trips according to the discretionary level of each trip. Work trips in the model are regarded as nondiscretionary, unlike recreation trips, which are considered the most discretionary. Shopping trips are considered important, but their lengths are reduced according to gasoline shortage levels (11). The discretionary level of other trips in the model is assumed to be between that of work and shopping trips.

Travel Routine

Once all relevant attributes are assigned to the vehicles, the travel routine is performed. The model is simulated by the next-event approach. By comparing the starting time of all trips, the earliest one is selected and the simulated "clock" is moved forward in time to that point. The selected vehicle is then assigned a trip length according to its household attributes and trip purpose. The average travel speed is assumed to be a function of trip length and the level of fuel supply constraints. The longer the trip length, the higher is the average travel speed expected. Speeds will be lowered slightly during gasoline shortages in an effort to conserve energy (12). The fuel consumed on the trip is calculated from vehicle characteristics and travel speed. The travel time is also computed from trip length and average speed. The recorded time of the vehicle is then advanced by the time it spent on the trip. Once a vehicle arrives at its destination, an idle period is assigned to it according to its trip purpose. The simulation model searches again through the time of occurrence of each event, selects the next-earliest one, moves forward in time to that point, and updates the status of the system, and so on. This process continues until the clock is advanced to a value greater than 24, and the simulation process starts all over for the next day.

Search Routine

When the fuel in a vehicle is below its refilling point, the driver under normal conditions searches for a service station with the shortest waiting line. When a vehicle arrives at a service station, the driver must decide whether it is worth the time to wait in the queue or to seek another station. This decision is based on two factors: the level of gasoline shortfalls and the length of the queue. A driver will be more inclined to join a long queue when he or she realizes that queues at competing stations are likely to be long because of a limited-supply condition. On the other hand, a driver will be more inclined to seek shorter queues during the period of energy abundance.

Queuing Routine

Once the vehicle enters a service station, a queuing system is activated. The service facility in this model is specified as a multiserver system with infinite storage capacity. The service time is assumed to be exponentially distributed. The queuing discipline is in a first-come-first-served order.

Fill-Up Routine

As soon as the clock moves forward to the time that a vehicle is going to be served, the fill-up routine is entered. At this point, the status of the system has the following changes:

1. The amount of fuel in the vehicle is increased by the quantity with which the vehicle is filled.
2. The number of vehicles in that service line is reduced by one.
3. The amount of fuel in the station is subtracted by the quantity with which the vehicle is filled.
4. The time attached to the vehicle is advanced by the time consumed at fill-up.

If the level of gasoline in a service station drops below its refilling point and the next day is not a scheduled refilling day, a special request for replenishment is sent to the distributor. When the amount of gasoline in the station is depleted, the station is closed.

The refueled vehicle returns to the travel routine and continues its travel activities.

Summary Routine

Some of the variables in the model are summarized at the end of each day and at the end of the simulation period. The most pertinent ones are

1. Amount of gasoline consumed during the simulation period,
2. Amount of gasoline consumed annually by automobiles in Virginia,
3. Total VMT for automobiles in the model during the simulation period,
4. Annual VMT for automobiles in Virginia,
5. Total VMT for automobiles in each household income category, and
6. Total VMT for automobiles in each household vehicle ownership category.

Model Calibration and Validation

Several experimental runs are first executed for the base model. The outputs show that the model is functioning in the manner intended. The base model is then calibrated by comparing the following model outputs with the Virginia data: annual VMT, annual vehicle gasoline consumption, and annual VMT per vehicle (13). The percentages of VMT by work trip, shopping trip, recreation trip, and other trip are compared with the nationwide data (9).

Adjustments of various trip lengths and fuel consumption rates are made to reduce the differences between the model outputs and the actual data until they are acceptable. Various random number seeds are used to run the model to make a sensitivity analysis of the system. Both the means and standard deviations of the outputs are found acceptable.

In order to validate the base model, some of the results generated by the model are compared with nationwide data (9). The table below illustrates the model output for distribution of VMT by household income and vehicle ownership (income in 1977 dollars):

Item	VMT (%)	Households (%)
Household income		
<$5000	15	21
$5000 to $9999	21	22
$10 000 to $14 999	23	21
$15 000 to $24 999	26	24
≥$25 000	15	12
Vehicles owned by household		
1	24	41
2	43	40
≥3	33	19

It appears that these results are quite consistent with the actual travel pattern in the United States.

Introducing Gasoline Shortages into the Base Model

The base model is formulated under the condition of ample supplies of gasoline. For the purpose of reflecting the degree of hardship in obtaining gasoline, an indicator called HARD is introduced into the model. The value of HARD, which is a nonnegative real number, is determined by two factors.

The first factor is the percentage of a vehicle being rejected by service stations (PREJ). When a vehicle needs to be refilled but cannot get gasoline from service stations, it is defined as being rejected by service stations. This can occur when (a) a station is closed because its fuel is depleted and (b) the vehicle is not allowed to be refilled due to certain restriction policies. Thus, the value of PREJ contributed by condition a can somewhat reflect the level of gasoline supply shortages and that contributed by condition b can disclose the hardship in obtaining gasoline imposed by restriction policies. The value of HARD is assumed to increase proportionally with the value of PREJ.

The second factor is the average queue length at service stations (QUEUE). As the waiting lines get longer, the hardship of refill increases. The value of HARD is assumed to be increased by the amount of QUEUE/6.

The value of HARD varies between 0 and 6. The previous factors can be regarded as a kind of inconvenience cost that, as jointly represented by HARD, will have certain impacts on travel demand. On the other hand, changes in travel demand affect fuel consumption and, consequently, the value of HARD. For example, increases in queue lengths will raise the value of HARD and thus reduce the demand for travel and consequently decrease the fuel consumption. This results in less frequent visits to gasoline stations and hence reduces queue length, lowers the value of HARD, and so on. In this way, the model incorporates some feedback between these factors and travel demand.

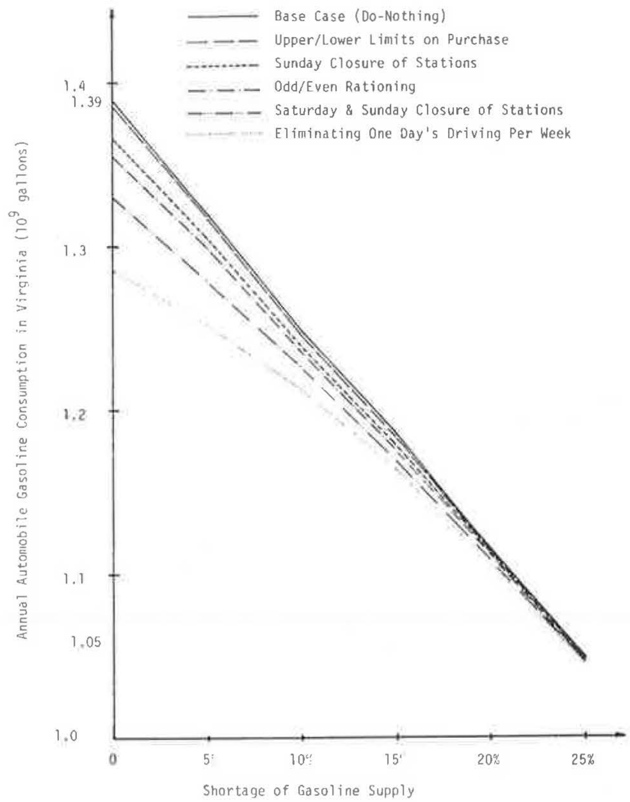
The following behaviors in the model are assumed to be influenced by HARD:

1. Trip assignment--It is assumed that, when the difficulty of obtaining fuel increases, trips will be cut according to their discretionary level. In the event of a 20 percent shortfall, discretionary travel can be cut by as much as 25 percent (12). The specific type of discretionary trip that best lends itself to being reduced is the recreation trip. In response to a 20 percent shortfall, New York State survey respondents generally agreed that they will vacation closer to home, change modes for vacation, and be more likely to cancel vacation trips altogether (12). The frequency of shopping trips is reduced only slightly, but trip lengths are decreased during shortage conditions. The frequency of other trips is reduced by a small amount, but trip lengths remain unchanged. Work trips, on the other hand, are reduced only slightly by diverting some trips to other modes (i.e., transit, carpool, etc.).
2. Trip chaining--It is assumed that trip chaining will be increased during gasoline shortfalls. Instead of separate round trips to work, to shop, and to visit, travel activities can be scheduled to permit visiting many destinations on a single trip. In the model, trip chaining is made by eliminating one trip and increasing the length of another by a certain amount.
3. Refilling point and fuel purchase--It is assumed that, when the difficulty of obtaining fuel increases, automobile users will increase the frequency with which they refill. This in turn will result in more frequent visits to gasoline stations and hence longer wait lines. An even higher value of HARD will result in this case, which will further worsen the situation. It is also assumed that drivers will be more inclined to refill more fuel during any one stop at service stations.

SCENARIOS AND RESULTS

The model is developed to measure the impacts of several supply restriction policies on gasoline consumption during energy shortfalls. These policies are first evaluated under a normal (no-shortage) condition. The fuel consumption of the base case (do-nothing) scenario is used as a reference point for evaluating the results of other scenarios. Shortages up to 25 percent of normal supply are then simulated in the model.

Figure 2. Automobile gasoline consumption versus supply shortage under various restriction policies.



Base Case Scenario

In the base case, no restriction policies are adopted. As can be seen in Figure 2, fuel consumption declined proportionately with reduced supply. The fuel consumption under the no-shortage condition (1.39 billion gal, the result of the calibrated base model) is the actual automobile fuel consumption in Virginia for 1979 (13). The slightly fluctuating results under various levels of supply shortage are caused by the randomness of the random numbers generated in the model.

Upper and Lower Limits on Fuel Purchase

The upper limit on fuel purchase restrains the maximum quantity of gasoline with which a vehicle can be refilled. The purpose is to prevent chaos among gasoline buyers within a short period of time. However, on the other hand, it causes more frequent visits to gasoline stations. The lower limit requires the purchase of gasoline to be at least a specified amount. It tries to prevent frequent refillings and thus reduces gasoline queues. These two restriction policies are in fact two different ones. However, since some gasoline stations used both of them at the same time during the past energy crisis, the two policies are used together in the model as one single policy.

The upper and lower limits on fuel purchase are assumed to be 10 and 6 gal, respectively, in this scenario. The result of this scenario indicates that the reduction in fuel consumption is almost negligible, as shown in Figure 2. The primary impact of this policy is on gasoline queues; there is little impact on fuel consumption.

Odd-Even Rationing

The policy of odd-even rationing excludes vehicles with unmatched odd-even plate numbers from being refilled at the gasoline station during even-odd days. Although this policy reduces gasoline queues at stations, the inconvenience of refilling it imposes on automobile users will cause a reduction in travel. The fuel consumed under this condition (1.355 billion gal) is only about 2.5 percent less than that in the base case. The ineffectiveness of this policy in reducing fuel consumption is due to the fact that most of the vehicles are usually refilled every four to five days under normal conditions. Thus, this policy does not disrupt their refilling actions to a significant extent. Moreover, most automobile users can adjust their refilling days to get along with this policy. However, those who do need to obtain gasoline daily will be affected by this policy.

Weekend Closure of Service Stations

Under the policy that assumes closure of all service stations on weekends, two scenarios are examined: (a) closing all stations on Sundays only and (b) closing them on both Saturdays and Sundays.

For the scenario of Sunday closure, most consumers can adjust their refilling days away from Sunday except those who need to travel long distance on that day. This scenario results in a 1.7 percent reduction in fuel consumption from the normal condition.

For the scenario of both Saturday and Sunday closure, the reduction of fuel consumption is about 2.5 times that of the previous scenario (about 4.3 percent below the normal condition).

Elimination of One Day's Driving

The scenario that eliminates one day's driving prohibits vehicles from operating on one weekday per week. The day of prohibition is assigned according to the vehicle's license plate number, as follows:

Last Digit of Plate Number	No-Driving Day
1 and 6	Monday
2 and 7	Tuesday
3 and 8	Wednesday
4 and 9	Thursday
5 and 0	Friday

The elimination process is executed at the very beginning of the travel routine once this scenario is initiated. In the event that travel is prohibited for a vehicle on a given day, other vehicles in the household, if any, with proper plate numbers are first searched out as substitutes. Trips that are supposed to be taken on the prohibited day, except work trips, are scheduled for trip chaining on the following day. The reduction of fuel consumption under this policy is about 7.5 percent below the normal condition, as shown in Figure 2.

As with most of the other policies, when the level of fuel supply shortages increases, fuel consumption under this policy tends to be closer to that of the do-nothing case. Under a 15 percent shortage, the fuel consumption for this policy is only 1.86 percent lower than that of the do-nothing case, since at higher shortage levels the excess travel demand has already been curtailed and the remaining travel demand is hard to suppress.

CONCLUSIONS AND DISCUSSION

Since the model was originally developed for the Virginia Division of Motor Vehicles (DMV) to estimate the impact of several restriction policies on the collection of state gasoline tax revenues, reduction of gasoline consumption was used as a criterion for evaluating these policies. Therefore, in terms of reducing fuel consumption, these policies were ranked in descending order as follows:

1. Elimination of one day's driving per week,
2. Saturday and Sunday closure of stations,
3. Odd-even rationing,
4. Sunday closure of stations,
5. Upper and lower limits on fuel purchase, and
6. Do nothing.

The results of the model show that only the elimination of one day's driving per week has some notable impact on fuel consumption, if the level of shortfalls is low. When the shortfall level is increased to around 15 percent, all policies have little or no significant impact on the reduction of fuel consumption. The most important impact on travel and fuel consumption comes from the shortage itself.

The reduction of fuel consumption should not be the only criterion for evaluating alternative restriction policies. Those policies that reduce fuel consumption the most, on the other hand, may impose the most hardship in obtaining gasoline on the automobile users. Thus, these policies are also ranked, as in the table below, by the HARD value (for all levels of gasoline shortage) to reflect the hardship in obtaining gasoline that each policy imposes on automobile users:

Rank	Restriction Policy	Comparative Avg HARD Value
1	Saturday and Sunday closure of stations	3.05
2	Odd-even rationing	2.71
3	Sunday closure of stations	2.49
4	Upper and lower limits on fuel purchase	2.20
5	Do nothing	2.15
6	Elimination of one day's driving per week	2.07

The average HARD value is used only as a reference for comparative purposes. However, the inconvenience costs should include not only the hardship in obtaining gasoline but also the disruption in travel caused by the restriction policies and by the unavailability of fuel.

The model is currently being revised to include two major refinements: the fluctuation of the price of gasoline under decontrol status for various shortage conditions and a comprehensive determination of inconvenience costs for travelers under alternative policies.

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REFERENCES

1. Reducing U.S. Oil Vulnerability: Energy Policy for the 1980's. Office of Assistant Secretary for Policy and Evaluation, U.S. Department of Transportation, Nov. 1980.
2. Profile of the 80's. Office of Assistant Secretary for Policy and International Affairs, U.S. Department of Transportation, Feb. 1980.

3. Considerations in Transportation Energy Contingency Planning. TRB, Special Rept. 191, 1980.
4. Y. Sheffi and V. Prins. Dual Price System for Management of Gasoline Lines. TRB, Transportation Research Record 801, 1981, pp. 60-67.
5. Development of an Aggregate Model of Urbanized Area Travel Behavior: Final Report. U.S. Department of Transportation, Jan. 1979.
6. J. Horowitz. Modeling Travel Responses to Alternative Gasoline Allocation Plans. Presented at 60th Annual Meeting, TRB, 1981.
7. M. Ben-Akiva and T. Atherton. Transferability and Updating of Disaggregate Travel Demand Models. Presented at 60th Annual Meeting, TRB, 1981.
8. J.J. Louviere and others. Laboratory-Simulation Versus Revealed-Preference Methods for Estimating Travel Demand Models. TRB, Transportation Research Record 794, 1981, pp. 42-51.
9. 1977 Nationwide Personal Transportation Study: Report 3. FHWA, Dec. 1980.
10. R. Gorman. Household Characteristics and the Determinants of Travel Behavior. Presented at 60th Annual Meeting, TRB, 1981.
11. A. Politano. Exploring Social and Economic Effects of Measures to Reduce Motor Fuel Consumption. Presented at 60th Annual Meeting, TRB, 1981.
12. D. Hartgen and A. Neveu. The 1979 Energy Crisis: Who Conserved How Much? New York State Department of Transportation, Albany, Preliminary Res. Rept. 173, April 1980.
13. A.G. Hobeika and others. Impacts of Transportation Supply and Gasoline Shortages on Virginia Gas Tax Revenues: Volume II. Virginia Division of Motor Vehicles, Richmond, Aug. 1980.

Assessment of State Emergency Energy Conservation Planning

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Since the enactment of a federal law providing a framework for a coordinated national response to energy supply interruptions, there have been many developments that have tended to hinder this objective. The current oil glut and stabilizing prices, the lack of sufficient planning funds, and the redirection of federal regulatory policy are some of the factors that are affecting the progress of transportation emergency energy conservation planning. A survey was conducted by the New York State Department of Transportation to determine the status of state emergency conservation plans as required by the Emergency Energy Conservation Act of 1979 and to assess each state's plan development process with particular emphasis on the format of the plan, the extent of local plan coordination, impact assessments of specific measures, and measurement of specific implementation details. The results of this survey suggest several shortcomings of emergency conservation planning as conducted by state transportation and energy agencies throughout the country: lack of money for plan development and implementation, inadequate cost estimates of the plan, lack of good coordination with local plans, lack of evaluations regarding energy savings, and no assessment of economic impacts.

The possibility of energy supply interruptions has been a constant threat to oil-importing nations over the past few years. The past two "crises" (1973-1974 and summer 1979) evoke memories of long lines at gasoline stations, reduced travel mobility, and general frustration.

Prompted by these events, Congress in November 1979 enacted the Emergency Energy Conservation Act (EECA). One of its many purposes was to encourage the development of statewide plans to deal with energy shortages prior to their occurrence. The philosophy behind the EECA was to have in place state plans that could respond to a shortage in a rational, coherent manner--that is, to help maintain essential mobility, reduce gasoline lines, and prevent panic buying at service stations.

Several organizations, including the National Conference of State Legislatures, the National Governors' Association, and the U.S. Congress (1,2), have followed the progress of EECA plan development. These surveys primarily reviewed statewide efforts rather than evaluating the extensiveness of the planning effort. In October 1980, the New York State Department of Transportation (NYSDOT) sent a questionnaire to all state energy offices and transportation departments throughout the country, not only to inquire about the status of these plans but also to learn what actions other states are including in their plans, to assess their planning processes, and to record their experiences so that energy planning in New York State may have the benefit of other work.

Although the responsibility for developing EECA plans has fallen on state energy offices, many state transportation departments have been actively involved in energy conservation, contingency, and long-range planning. Since we were interested in the extent of transportation department involvement in the EECA plan development process, the same survey was therefore distributed to all state transportation departments as well as energy offices. Responses to the survey numbered 27 from energy offices and 22 from transportation departments. Of these, 9 responses were received that were not entirely usable. Even though both types of responses were received from only 11 states, the transportation department responses provide insight into EECA planning for those states in which the energy offices did not respond.

STATUS AND DEVELOPMENT

The development of transportation plans for gasoline and diesel emergencies has been initiated in part by federal directives. The Federal Highway Administration and Urban Mass Transportation Administration encourage the preparation of energy contingency plans by the state transportation departments and the local metropolitan planning organizations (MPOs), and encourage each state highway agency to work cooperatively with state energy officials in preparing the transportation elements of emergency