Compact Van

The new-model compact van is expected to be larger than the current Volkswagen van sold in this country but smaller than the current domestic products. The sales-weighted average test weight is estimated at 3200 lb, between 600 and 1000 lb lighter than current domestic six-cylinder vans. The available engines and transmissions will probably include the same types as the small pickup-utility vehicles.

CONCLUSIONS

Between now and 1985, automobiles and light trucks will become lighter, have components that incorporate more advanced technology, and will be more fuel efficient.

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Framework for Analyzing the 1979 Summer Fuel Crisis: The New York State Experience

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Past experience has demonstrated the need for coordinated statewide and local plans for responding to energy emergencies. At these levels, however, the characteristics, implications, and impacts of such emergencies are complex. Shortage levels, travel responses by the public, transportation resources, and other factors exhibit wide geographic variations during an emergency. Reliable data concerning these variables are scarce and uncoordinated for energy emergency planning purposes. No framework exists for analyzing the past experience of individual states and local areas in order to plan for appropriate responses to possible future energy emergencies of various durations and intensities. Ongoing efforts by New York State to develop such an approach are described. Available data sources are examined, and a framework is presented for integrating data with base-case control totals to develop a model of travel behavior during the 1979 summer fuel crisis as the basis for future emergency scenarios. It is shown how this framework can be used to measure the effectiveness of individual actions within the context of the total possible responses by the public and government to replace the mobility that is lost during energy emergencies.

During the summer of 1979, New York State experienced a period of rapidly increasing fuel prices coupled with severe supply shortfalls. Although residents in all areas of the state shared in a fuel price increase of approximately 21 percent between May and August, those in the downstate New York City metropolitan area faced a supply shortfall that was significantly greater than the one encountered by those in other areas of the state. The combination of fuel price increases and different shortfall levels had adverse consequences that ranged from minor inconveniences to serious mobility and economic losses. Beyond public-order measures (such as "odd-even" and minimum-purchase rules), government did little to minimize the disruptive impacts of the situation. The events of 1979, coupled with the experience of the Arab oil embargo of 1973, demonstrate convincingly the need for all levels of government (federal, state, and local) to develop in advance a coordinated response in the event that a comparable or worse situation should arise in the future.

This paper presents a framework through which New York State can prepare an organized response to future energy emergencies. The approach consisted initially of a detailed analysis of the effects of the 1979 crisis on travel behavior in different areas of the state based on available data. These disaggregated data were then related to an overall framework of statewide and local-area travel behavior under nonemergency (base-case) conditions. The framework served as a device for (a) measuring the impacts of the 1979 crisis and other crisis scenarios of greater or lesser magnitude and (b) measuring the effectiveness of various actions to replace lost mobility and alleviate the disruptive consequences of energy emergencies. The effectiveness of individual actions and improvements in fleet fuel efficiency can then be used to estimate the total possible response by government and the public to maintain mobility during different levels of gasoline shortage.

Mobility is defined as the ability of a person to travel for different purposes by whatever mode and circumstance (i.e., cost or time) he or she would choose. Mobility is calculated in terms of person miles of travel that could be maintained by public and government actions as people shift to more use of carpools and transit. Shortage is defined as the percentage reduction in gasoline available compared with what would be required immediately to maintain personal mobility by normal modes of travel.

SUMMER CRISIS OF 1979

The initial task was to assemble all relevant evidence about how households in New York State adjusted to the fuel shortage in the summer of 1979. Responses to the crisis included (a) purchasing more fuel-efficient automobiles, (b) driving more slowly, (c) reducing the number of trips taken and/or their length, (d) trip chaining (travel to several destinations before returning home), (e) substituting transit or automobile passenger trips (ridesharing) for driver-only automobile trips, and (f) shifting the location of a residence to reduce work-trip distances.

Available data concerning the selected response patterns consisted of monthly data on the use of gasoline for highway travel, traffic-count information, ridership figures for public transportation, trends in summer vacation travel, and survey responses regarding the adjustment strategies adopted.

Although the available data were not comprehensive, they were appropriate for identifying both the range and the magnitude of consumer adjustments during an energy emergency. When related to a framework of base-case travel conditions in New York State (described later in this paper), these and other data sources can provide an effective framework for analyzing potential responses to a statewide energy emergency.

Gasoline Sales

For the purpose of tax collection, New York State keeps a record on monthly wholesale gasoline sales. By examining the sales figures during the 1979 summer crisis, it is possible to develop an overall measure of the level of a shortage. Gasoline sales in New York State for June, July, and August 1979 were down 12, 11, and 9 percent, respectively, from the corresponding monthly totals in 1978, and the percentage decline for the entire three-month period in comparison with 1978 was 10.5 percent. Changes in fuel use during the shortage are attributable primarily to two factors: (a) changes in the average fuel efficiency of the fleet and (b) travel reductions (either canceled trips, trips of shorter distances, or the substitution of transit trips for automobile trips). Direct evidence of travel reductions in each part of New York State was available from traffic counts, figures for transit ridership, trends in vacation travel, and survey response data.

Traffic Counts

The availability and comprehensiveness of traffic-count data covering the 1979 summer fuel crisis vary significantly among the geographic areas within New York State. Traffic counts in all areas of the state are available for the 29 permanent counting stations maintained by the New York State Department of Transportation (NYSDOT). Traffic-count information differentiated by weekend versus weekday as well as by time of day is available only for the New York City metropolitan area. Despite the small number of permanent count stations, traffic-count data are instrumental in defining both the overall magnitude of the impacts as well as their distinct geographic variations.

The data reviewed showed that the most dramatic declines in traffic occurred in the New York City metropolitan area, ranging from 11 percent in the city to approximately 18 percent in the suburbs. The percentage declines in the New York City area were exceeded at some count stations located on Interstate highways or other major highway links that primarily attract intercity travelers. Depending on the area, declines from 16 to 24 percent were recorded. Traffic-count stations in urban areas outside of New York City as well as in small urban or rural communities generally recorded only 1-3 percent reductions in traffic during the crisis.

The above traffic-count information is based on 24-h traffic volumes added together and averaged for a month but not differentiated by time of day or day of the week. As noted, some information for New York City does make such distinctions. Where available (primarily for the facilities of the Port Authority of New York and New Jersey), the data show that the sharpest decline in traffic during the crisis occurred at night and on the weekends and that relatively more modest declines occurred during the weekday morning and evening peaks.

Transit Ridership

Although some of the observed decline in local traffic can be attributed to trips not made, some was caused by the substitution of public transportation for the private automobile. Most systems experienced increases in ridership, which ranged from a high of approximately 20 percent for the New York suburban buses and Albany-Schenectady transit to 6 percent for Buffalo transit.

Although transit data are available for all operators throughout the state, they do not differentiate the increase in transit ridership either by time of day or day of the week. As a result, it is necessary to assume that the overall figures are representative of changes in specific types of transit trips--e.g., work trips and shopping trips. On the basis of such an assumption, the portion of observed travel reduction attributable to increases in transit ridership can be estimated. Thus, even though the available transit data lack desirable detail, they are capable of being related to base-case travel conditions within New York State.

Trends in Vacation Travel

Changes in vacation travel accounted for a greater share of the observed travel reductions during the 1979 crisis than they did during the 1973 situation, since the 1979 crisis occurred during the peak vacation season. Data are available on both park attendance and resort occupancy to show the magnitude of the impact on vacation travel during 1979.

Aggregate figures show that overall statewide park attendance was down by 4.2 percent in 1979 from 1978 and attendance at selected attractions throughout the state was down 22 percent during the comparable period. These data are limited in usefulness, since they cannot be readily translated into estimates of travel reduction.

Some of the resort-occupancy data, differentiated by vacation area, show that while statewide occupancy decreased by 2 percent in 1979 compared with 1978, occupancy increased at facilities near major metropolitan areas but fell off in the most remote areas. For example, occupancy at resorts on Long Island increased by 4.4 percent in 1979 over 1978 whereas in the Adirondacks it decreased by 9 percent. In contrast to statewide figures on park attendance, the disaggregate resort-occupancy information, which shows the tendency to substitute shorter- for longer-distance trips, can be used in conjunction with traffic-count data to account for the portion of travel reduction attributable to changes in vacation travel. Once this is accomplished, the data can be related to base-case travel conditions within the state.

Survey Response Data

The final evidence regarding travel adjustments during the crisis is provided by a survey of households in New York State taken in October 1979 (1). The objective of the survey was to determine what types of actions households selected during 1979 to cope with the situation. The data are particularly useful because they can be summarized not only on a statewide basis but also for specific geographic regions. Such disaggregation demonstrates clearly the varying nature of the crisis as well as the adjustments selected.

The results showed a clear ordering of response preference during the crisis in which shopping actions and minor changes in driving habits and car maintenance dominated. In fact, approximately 47 percent of the households polled said that they initiated trip chaining for shopping, and 42 percent said that they reduced their driving speeds in response to the crisis. Vacation-related changes were second in priority as adjustment strategies: Approximately 17 percent of the households took their vacation closer to home, 16 percent took public transportation for their trips, and 16 percent canceled vacation plans. Other strategies adopted by a slightly smaller share of the households were purchases of new fuel-efficient cars and work-travel adjustments. Strategies such as relocation of either home or job, elimination of recreation vehicles, or walking to work were substantially less popular.

The survey information has some significant limitations. For example, it cannot be translated directly into specific travel reductions, since it does not give an indication of how many shopping trips households eliminated or how much travel was involved. The information cannot stand on its own but must be used in connection with the other data sources on travel reduction. The survey information is valuable in that it demonstrates household preferences in selecting the type of trip activity to reduce during a crisis. Thus, it can be used to interpret observed reductions in travel and allocate these reductions to specific trip purposes as well as geographic areas.

Another weakness of the information is that it does not separate changes that would have occurred anyway from the ones directly attributable to the crisis. Thus, although 15 percent of the households said that they bought new fuel-efficient cars, it is probable that most of the households would have purchased the vehicles anyway as part of the general trend in car purchasing established before the crisis.

Summary

The combination of available data sources documenting the impact of the 1979 crisis does not answer all the questions about the magnitude of the travel reduction or the extent to which particular types of trips or geographic areas were affected. Data gaps exist because of incomplete documentation of travel behavior during the crisis. Nevertheless, the data that are available provide the basis for demonstrating the manner in which base-case travel conditions in New York State were altered by the crisis. The focus of the next section of this paper is to show how the base-case travel condition framework was developed to demonstrate how all the data regarding travel changes during the crisis (summarized in this section) were related to that framework in order to develop a model of the 1979 crisis and future energy emergency scenarios.

OVERALL FRAMEWORK FOR ASSESSING ENERGY EMERGENCIES

Available data on observed travel-behavior changes from the sources outlined in the previous section were integrated to the extent possible to ensure consistency and were related to an overall framework of base-case travel conditions in New York State. The framework consists of information concerning the amount of fuel consumed and vehicle miles traveled in the various geographic areas within the state for various trip purposes, both on weekdays and on the weekend, for local and intercity travel.

By applying the percentage declines in travel observed during 1979 to the range of base-case conditions, a statewide model of the 1979 summer crisis was derived. Furthermore, the effects on base-case travel conditions of other situations more or less severe than the one in 1979 were modeled in a similar fashion. The 1979 crisis model and its variations (scenarios) provide a quantitative basis for measuring the impacts of different energy emergencies on New York State. In particular, they provide an overall approach for measuring the effectiveness of public and government actions to replace the mobility that is lost during energy emergencies (as described later in this paper).

Base-Case Control Totals

The base-case travel framework consists of vehicle miles of travel (VMT) control totals that reflect the relative distribution of travel within New York State. An annual statewide automobile VMT estimate of 64.3 billion prepared by NYSDOT was allocated among local areas [the New York City metropolitan area, eight upstate standard metropolitan statistical areas (SMSAs), and small urban or rural areas] based on previous estimates of differences in VMT within these geographic areas (2). For each area, the VMT total was further distributed between local and intercity travel, among various trip purposes, and between weekday and weekend travel.

The estimate of total intercity VMT travel in New York State was based on data contained in the National Travel Survey (3) on the number and average length of long-distance trips (i.e., trips in excess of 200 miles round trip) in New York State. The estimate for total intercity VMT was 6.71 billion.

The distribution of local automobile VMT by trip purpose and weekday-weekend travel was accomplished by reference to the Nationwide Personal Transportation Study results by city size (4). The local areas of the state were grouped on the basis of size--i.e., large SMSAs with more than 3 million people, smaller SMSAs in various size categories, unincorporated areas, etc.--and the distribution of VMT from the survey results appropriate to their size category was applied. This distribution provides reasonable, statewide trip-purpose estimates that can be adjusted or updated by local-area planners based on more recent or discrete data sources.

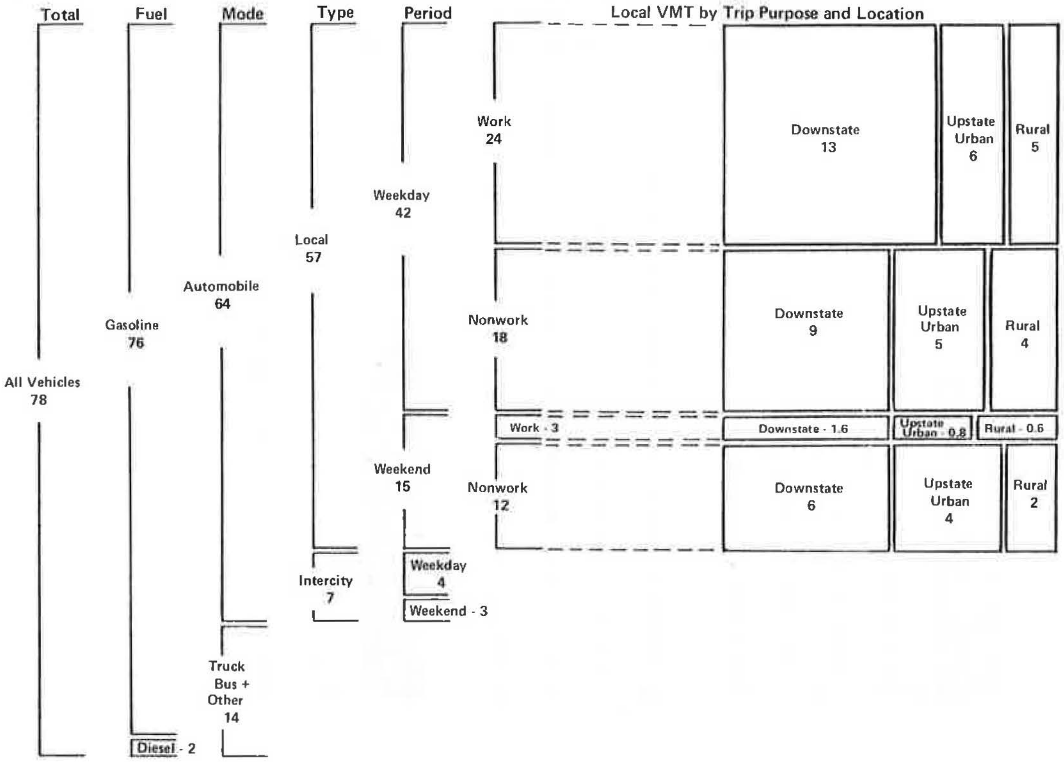
Figure 1 shows the distribution of travel in New York State that resulted from the process described above. These data provide a base-case travel framework, including automobile VMT control totals for each area of the state. The framework highlights the following key travel relations, which are important in assessing the changes that occur during energy emergencies:

1. Gasoline-powered automobiles and trucks will be the key types of vehicles affected by future energy emergencies, since they account for 97 percent of vehicle travel in New York State in 1979.
2. Local automobile travel constitutes approximately 90 percent of total automobile VMT; the remainder is categorized as intercity travel.
3. Approximately 75 percent of local automobile travel occurs on weekdays. Work-related trips account for more than half of local weekday automobile travel.
4. In contrast to local travel, a higher proportion of intercity travel occurs on the weekend. Both intercity travel and total weekend travel are oriented to activities other than work.
5. In all categories of local travel (i.e., weekday work, weekday nonwork, weekend work, and weekend nonwork), a majority (51 percent) of the VMT occurs within the downstate areas; the remainder is split between upstate urban areas (29 percent) and rural areas (20 percent).

Energy Emergency Model

The combination of all available data regarding public response to the 1979 shortage was used to develop an energy emergency model of New York State

Figure 1. Distribution of vehicle travel in New York State in 1979 (billions of VMT).



(i.e., temporary three-month gasoline shortage of 11 percent accompanied by price increases of about 20 percent). The situation assumes no active government intervention beyond "public-order" types of action such as odd-even purchases, minimum purchases, and special allocations from the state set-aside supply. The further assumption made is that the entire 11 percent shortfall is accounted for by VMT reductions resulting from trips not made, trips of shorter distances, or trips made on public transportation. The VMT reduction factor caused by the purchase of more fuel-efficient vehicles can be treated separately from travel reductions (as shown in the following section of this paper).

By using the available data, the percentage declines in VMT over the base-case conditions were calculated and used to distribute the statewide shortage among the various planning categories by trip purpose and by weekday versus weekend travel. These percentage declines in travel are shown in Figure 2. Although the estimates were based on the three-month experience during 1979, the data are presented on an annual VMT basis.

A more detailed review of reductions in weekday work-trip VMT, including the impact of transit and nontransit actions for different areas of the state, was conducted. It showed, for example, that weekday work-trip VMT in New York City declined by 9 percent, 5 percent of which was attributable to the observed increase in transit ridership. Although no specific data were available, the savings in nontransit work-trip VMT were attributed to ridesharing (carpooling), assuming people continued to make the trip and that other alternatives such as walking or temporary relocation were not widely adopted. Thus, the total decline in weekday work-trip VMT was 1.9 billion, of which 75 percent, or 1.4 billion, was attributed to carpooling.

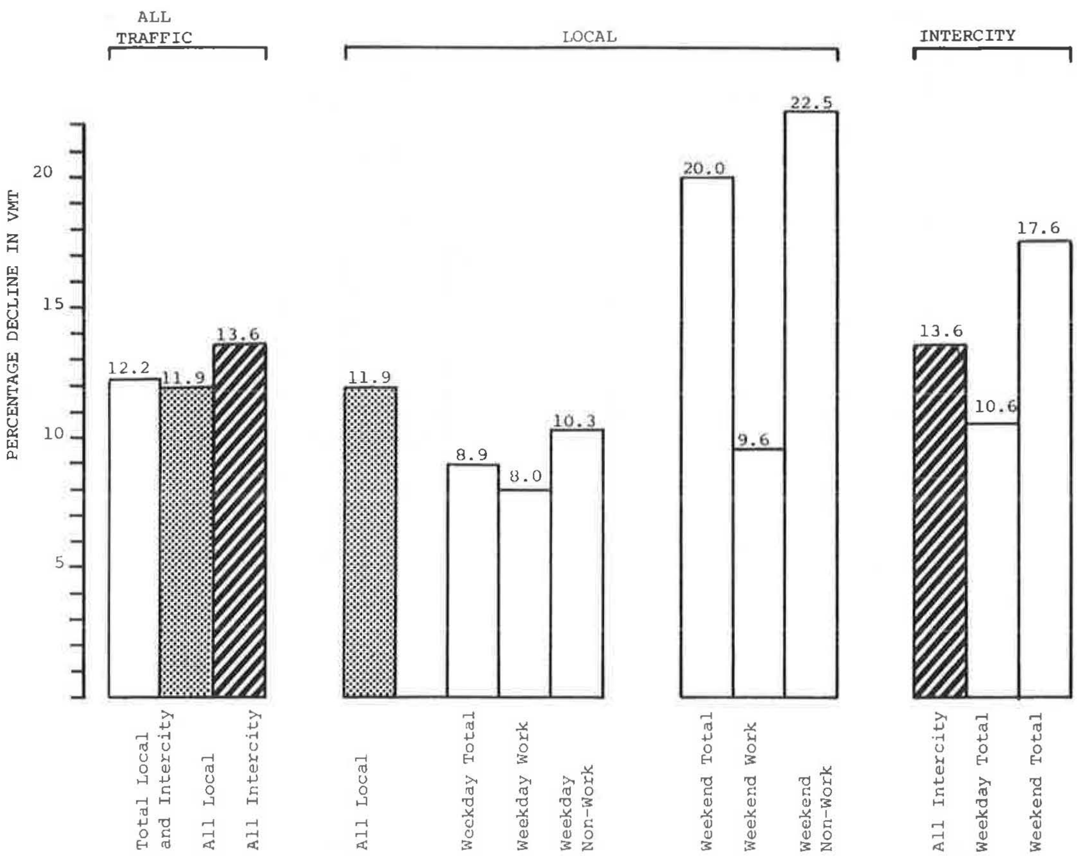
In New York City, 56 percent of work-trip savings was attributable to transit and 44 percent to carpooling. In contrast, the comparable figures for Long Island were 17 and 83 percent, respectively. The same dominance of carpooling held true for both the upstate SMSAs and the small urban and rural areas. Carpooling in these areas accounted for 89 and 99 percent, respectively, of the savings.

Scenarios

The model of travel reductions resulting from public responses to a real 11 percent shortage in New York State served as the basis for two additional energy emergency scenarios of 8 and 20 percent shortages. The underlying assumptions for these additional scenarios are as follows: (a) If the current gasoline allocation system remains unchanged, the distribution of fuel shortages in the future is likely to be similar to the pattern that occurred in 1979 (5), and (b) the public is likely to rely on past experience as long as shortage levels do not exceed those encountered in 1979 but will probably begin to modify behavior as shortages increase in size and duration beyond those levels.

The first type of scenario addresses the situation in which it appears to the President that a fuel shortage is imminent but is not yet apparent in the fuel supply system. In such a situation, the President may establish mandatory emergency conservation targets for each of the states pursuant to the Emergency Energy Conservation Act of 1979. It is felt by the federal government that, if enough fuel can be conserved by meeting these targets, a lesser shortage will occur in the future than if conservation efforts were not applied before the shortage occurred at the gasoline pumps. The reduction target would be established, a state would have 45 days to submit a plan, and the U.S. Department of Energy would monitor a state's efforts to comply with the target over the next 12 months. Failure to prepare a state plan or meet the target

Figure 2. Percentage decline in automobile VMT in New York State during 1979 summer fuel shortage.



means that federal travel-restriction measures could be imposed on a state.

The second type of scenario envisions a more serious, longer-term shortfall that could occur as the result of a very severe curtailment of oil imports (e.g., a blockade of the Persian Gulf or destruction of the oil fields) or that could evolve as a result of a worsening of the conditions during a temporary 11 percent shortage. Under this scenario, the shortages and price increases would be severe and would be sustained on a national basis, making decisive and effective federal actions necessary. Public perception would be characterized by a high level of belief in the urgency of the problem accompanied by widespread demand for direct government intervention to ensure that gasoline is distributed fairly. The level of shortage was set at 20 percent for this scenario. A shortfall of 20 percent in all fuels is the "trigger point" identified for a federal rationing program.

For purposes of discussion in the remainder of this paper, the three scenarios can be briefly described as follows:

Scenario	Condition
A	Mandatory target of 8 percent reduction in gasoline use
B	Temporary 11 percent gasoline shortage
C	Long-term crisis with 20 percent gasoline shortage

Forecasts of Travel Reductions

Forecasts were developed of the VMT reductions by area, trip purpose, and time of the week that would occur because of responses to each scenario. The statewide results are shown in Figure 3. For purposes of comparison, the VMT reductions for all three scenarios are on an annual basis. Similar forecasts were developed for each local area of the state by scenario.

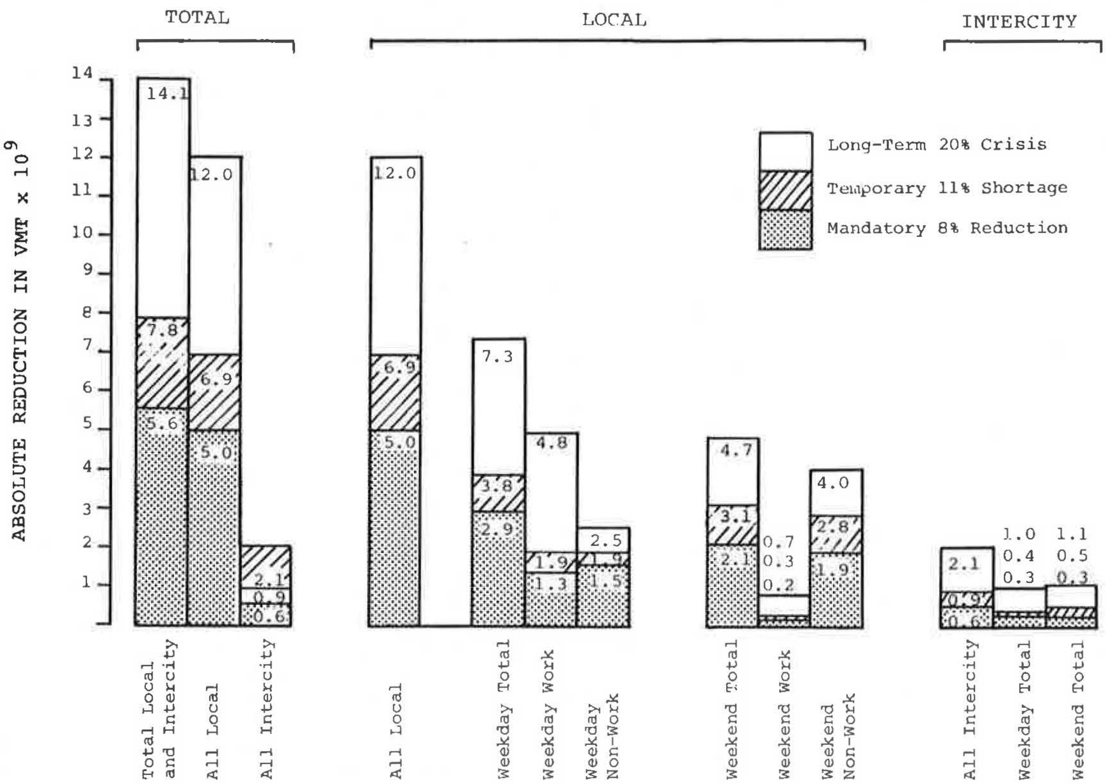
The bar graphs in Figure 3 demonstrate that the magnitude of VMT reductions under scenario C are significantly greater than are the reductions under either of the other two scenarios. Local travel rather than intercity travel accounts for the greater part of the VMT reduction under all scenarios.

There are also distinct differences among the three scenarios in terms of the relative reductions in VMT predicted by type of trip and day of the week. In scenario C, weekday travel (particularly weekday work travel) accounts for proportionately more of the total VMT reduction than it does under both other scenarios. Weekday work travel would account for 34 percent of the total statewide VMT reduction under scenario C but only 24 percent of the total under scenarios A and B. This will occur because people will concentrate on cutting their discretionary (nonwork) travel during temporary or minor shortages but will seek more fundamental changes in their means of work travel under longer-term shortfalls. By doing so, they can preserve more of their discretionary travel.

Summary

Available data from past energy emergencies and base-case VMT control totals can be used to develop a model of the type, magnitude, and distribution of statewide and local-area travel changes in response to a temporary 11 percent gasoline shortage. The

Figure 3. Immediate reduction in automobile VMT in New York State under three scenarios.



model can be varied to reflect different emergency scenarios in terms of severity, duration, fuel price, public policy, and other characteristics as well as likely public responses to these scenarios. Importantly, the model and scenarios provide a comprehensive basis for determining the mobility loss and other impacts suffered by the citizens, economy, and local areas of New York State during energy emergencies.

RELATIVE EFFECTIVENESS OF DIFFERENT RESPONSES IN MAINTAINING MOBILITY

New York State residents and businesses will face enormously different levels of adversity and hardship during future energy shortages, depending on whether the most appropriate actions, less appropriate actions, or no actions at all are taken. The data sources and framework described earlier in this paper provide a mechanism for analyzing the effectiveness of specific actions as well as the relative contributions that different types of overall responses can make in alleviating the negative consequences of energy emergencies.

This section demonstrates how the overall framework can be used to estimate the effectiveness of public responses, government actions, and fleet fuel-efficiency improvements in replacing the mobility that is lost during an energy emergency. Specifically, it focuses on the effectiveness of government action (or inaction) in replacing lost mobility in New York State and the role of government actions as part of an overall response to the three energy emergency scenarios previously described.

Public Response

When a fuel shortage occurs, all of the traveling that people would like to do cannot be done by the means they would normally use. By switching to public transit, carpooling, and organizing trips better, people can maintain mobility while cutting down on vehicle travel. These actions constitute the public response to an energy emergency and will occur even if no government actions are taken.

The estimate of diversion from automobile to transit and carpooling for the work trip during the 1979 summer crisis was used, along with survey data on actions the public might take at greater fuel-shortage and price levels, to estimate public response under different scenarios in comparison with the base case.

Government Actions

During a fuel shortage, additional actions can be taken by government agencies in cooperation with the private sector to help maintain mobility by helping people to use existing services and by providing new or expanded services. Based on a preliminary screening of more than 90 possible actions and the advice of a 40-member Energy Contingency Planning Advisory Group, 27 actions were considered in New York State (6). The actions are grouped below according to the different travel-purpose categories, or "markets", defined in the emergency planning framework described earlier in this paper, where they could be expected to have a significant effect:

1. Work travel--Employer-based carpooling, vanpooling, and subscription bus; mandatory vehicle occupancy; high-occupancy-vehicle lanes; staggered hours; standees on buses; spare transit vehicles; stockpiling of buses; route rationalization; park-and-ride lots; taxis; school buses; parking charges; and bicycle to work;
2. Nonwork travel--Carpool coordinator program, transit to state parks, transit to other recreational sites, and trip planning;

3. Intercity travel--"One-tank" campaign, transit to vacation areas, speed enforcement (55 miles/h), speed-limit reduction (50 miles/h), and intercity bus commuter stops; and
4. Other--Public information, data and management monitoring, and goods movement.

Other actions by governments to maintain order, reduce negative economic impacts, and distribute negative impacts equitably--such as odd-even or minimum-purchase plans, station hours, coupon rationing, a vehicle-sticker plan, tax rebate rationing, and the state set-aside program--were analyzed but are not discussed in this paper.

Not all actions are appropriate for each scenario. Moreover, of the actions that might be possible under any particular scenario, some are more appropriate than others in terms of their effectiveness, costs, required implementation time, and other factors. Finally, some actions may be appropriate but require considerable advance planning and negotiation during one scenario in order to be effective during another scenario. These factors necessitated a further distribution of the 27 actions by scenario.

An analysis of each action was conducted to determine the potential VMT savings for each scenario. Finally, these savings were stated as a percentage of the decline in VMT projected to occur in each travel category and area of the state for each scenario. Together, the total savings of these actions can be shown as the percentage reduction in gasoline use for each scenario that can be achieved without a reduction in mobility.

Improvements in Fleet Fuel Efficiency

During both emergency and nonemergency periods, people buy more fuel-efficient cars and retire older cars, and this results in improvements in average automobile fuel efficiency and mobility. However, the ability to purchase more fuel-efficient vehicles in response to an emergency is limited to the income consumers have available and the ability of manufacturers to alter the fleets thay have for sale. Both factors inhibit this response during short-term (three-month) emergencies.

However, the general trend of automobile purchasing patterns reflects an increasing emphasis on more fuel-efficient vehicles. These trends allow us to project the average fuel efficiency of a state's fleet of vehicles over time. In New York State, such trends show an average improvement in fuel efficiency of 4.6 percent/year between 1979 and 1985 and 3.6 percent/year between 1985 and 1990 (7). During the three-month period in the summer of 1979, improvements in automobile fleet fuel efficiency could have resulted in a fuel savings of 1.15 percent over the fuel consumed in the comparable three-month period in 1978.

Based on these findings, short-term (90-day) and long-term (one-year) fleet fuel-efficiency improvements were included in the calculation of the mobility that is replaced under different emergency scenarios.

Effectiveness of Responses

Figures 4-6 show the effect of public response, government actions, and fleet fuel-efficiency improvements over time on achieving the total reduction in gasoline assumed under each scenario without a reduction in mobility. The amount of mobility that must be lost under each scenario is also presented. The impacts of each response after 90 days and after one year are shown. It was assumed that the public's responses and the appropriate actions by governments and private employers could reach their full potential for replacing lost mobility within 90 days. The effects predicted are those that will occur if all appropriate responses are made.

These figures demonstrate that, in the short term (90 days), a coordinated consumer and government response can replace up to 57 percent of the mobility lost due to the shortage. Over the long term (one year), the mobility added by fleet fuel-efficiency improvements can increase this amount to about 80 percent. The role that government actions can play in maintaining mobility during an emergency is significant but less than what the public will do on its own and substantially less than the effect of fleet fuel efficiency over time. The government actions that are predicted to achieve the best results in replacing lost mobility are those that open up more of the travel opportunities that New York residents demonstrated they desired during the 1979 energy shortage.

Figure 4 assumes a federally mandated target of 8 percent reduction in gasoline use and shows a prediction of the portion of that target that can be met by each type of appropriate response without reducing mobility. Even though there is no shortage of fuel at the pumps, it is predicted that public and private employers and state and local agencies can take significant actions to maintain mobility while meeting the 8 percent target reduction. The appropriate response will enable New York to meet most of the target (6.4 percent) without adverse impacts on mobility. It is predicted that the public will make up all of the remainder of the 8 percent target (5 percent after 90 days and 1.6 percent after one year) by reducing mobility voluntarily. However, this depends largely on the public's perception of the emergency.

Figure 5 indicates that, during a 90-day period, the portion of an 11 percent shortfall that might be met by all appropriate responses would be 5.9 percent before a reduction in mobility was necessary. However, there is always a shortfall in fuel availability of at least 5.1 percent, and probably greater, that will be met by reductions in mobility during the first 90 days. If the contingency lasts longer than 90 days, continued fleet fuel-efficiency improvements result in substantial additional amounts of mobility being replaced. After a year, all appropriate responses can achieve most of the necessary reduction in gasoline use (9.3 out of 11 percent) without reducing mobility.

If the patterns of shortages observed in 1979 prevail, however, the loss of mobility that does occur after either 90 days or one year will not be distributed equally but will be concentrated in downstate urban and suburban areas. Thus, other actions should be taken at the state and local levels to equalize the remaining burden of the mobility loss as well as to maintain public order.

Figure 6 shows the relative impacts of appropriate statewide responses of each type in a crisis situation (20 percent or greater gasoline shortage). Under this scenario, the public is expected to make much more significant responses in order to maintain mobility so as to achieve a 6.4 percent reduction in gasoline use without reducing mobility. Actions taken by government and private firms to replace lost mobility can account for an additional 3.8 percent of the necessary reduction in gasoline use without reducing mobility. Improvements in automobile fleet fuel efficiency are predicted to be the same as in the contingency, since the public will not have any additional money available to accelerate the purchase of new automobiles.

After 90 days, all appropriate responses to replace mobility will have reduced gasoline use by

11.4 percent before any necessary reduction in mobility. After one year, 14.8 percent out of the 20 percent reduction will have been accomplished without reducing mobility. Thus, only a 5.2 percent reduction in mobility is necessary after one year compared with the 20 percent reduction that would occur if a shortage happened immediately.

At a crisis level of 20 percent shortfall, even if all appropriate responses are taken, and after a year has passed, the amount of reduced mobility that cannot be recovered by appropriate actions will be significantly greater than at the lesser shortage levels (5.2 versus 1.7 or 1.6 percent).

CONCLUSIONS

This paper demonstrates that, despite inadequate data, a useful quantitative framework can be developed at the state level for assessing the impacts of, and developing coordinated responses to, future energy emergencies. The framework consists of documentation of current travel patterns combined with available information on past shortages in order to develop future emergency scenarios for statewide and local-area analysis.

Analysis of statewide energy emergency scenarios can identify what adverse economic and social impacts are likely to occur in different regions and which residents are likely to lose the most mobil-

Figure 4. Impacts of all appropriate responses to mandatory target of 8 percent reduction in gasoline use: results after 90 days and one year.

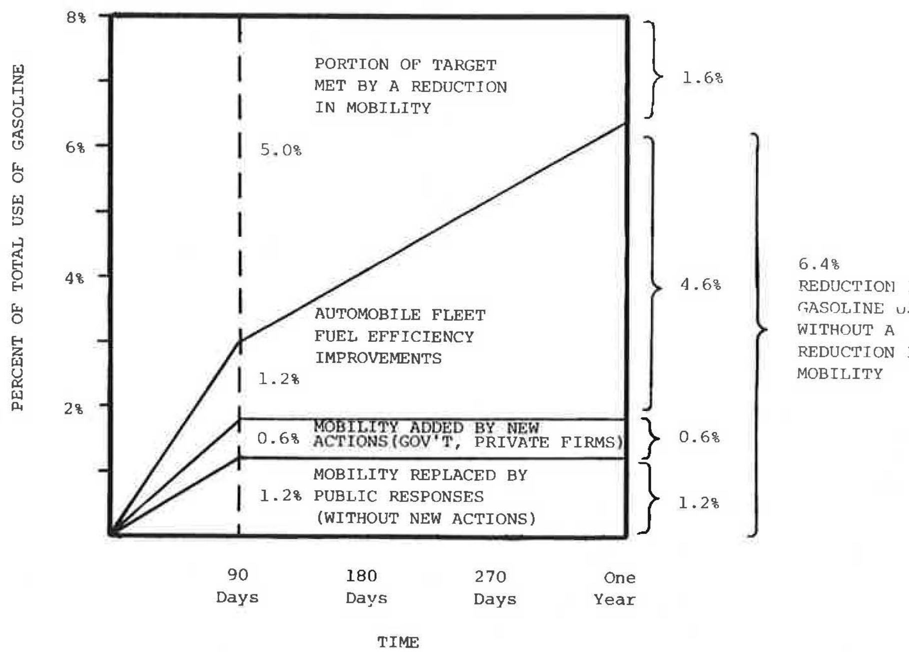


Figure 5. Impacts of all appropriate responses to 11 percent gasoline shortage: results after 90 days and one year.

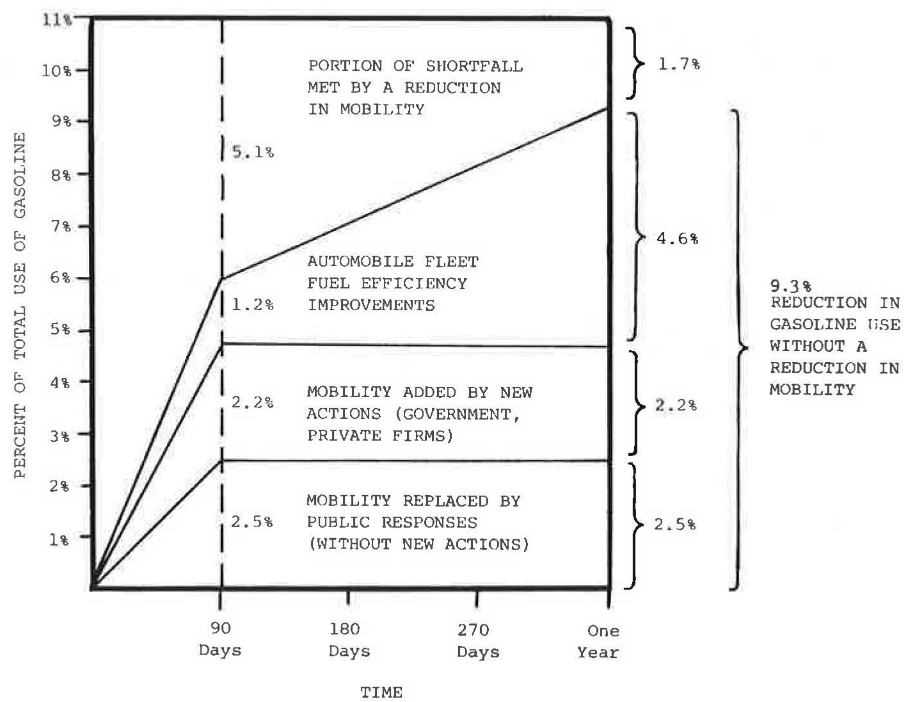
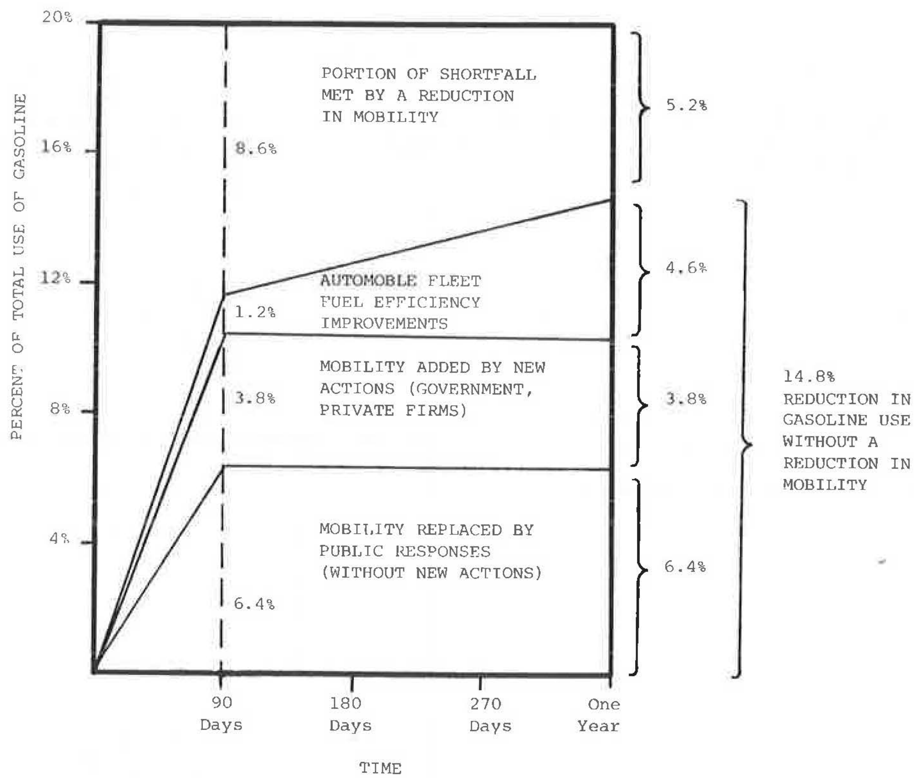


Figure 6. Impacts of all appropriate responses to 20 percent gasoline shortage: results after 90 days and one year.



ity. The framework facilitates evaluation of actions to minimize the adverse impacts of future shortages and can be used to identify how much individuals, business, and government can do together to preserve the mobility that would otherwise be lost.

If government does nothing, the public will make changes in their travel patterns to maintain a significant amount of mobility. If government, in cooperation with business and individuals, takes actions that open up more of the travel opportunities that New York residents demonstrated they desired during the 1979 energy shortage, then about half the mobility lost due to an energy emergency can be replaced within 90 days. The continuing additional impact of fleet fuel-efficiency improvements can help to replace a maximum of 80 percent of the lost mobility over the long term.

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