and a 26.7 percent reduction in fuel consumption, when compared to a tractor semitrailer combination under the lower weight and size limits that still exist in some states.

CONCLUSION

Trucks are essential to the national economy and cannot survive for long with existing low-allocation fuel levels. Two-thirds of the communities in the United States have no alternative to truck transportation.

A modest updating of vehicle size and weight laws could significantly reduce the diesel fuel requirements of the trucking industry. These vehicle dimensions have for some time been endorsed by the American Association of State Highway and Transportation Officials. In addition, the National Cooperative Highway Research Program, in a recently completed study on truck size and weight, noted that

> Nonuniformity in state laws relating to motor vehicle sizes and weights is costing the American public from \$1.6-\$2.8 billion annually. Although these additional costs most directly affect the trucking industry, transportation costs are ultimately reflected in the marketplace and in the cost of living.

It is essential that a uniform minimum 80 000-lb gross vehicle weight limit and 65-ft length limit be implemented nationwide. The sooner this is done, the sooner fuel saving as a result of such action will occur.

No matter how or what type of fuel a carrier buys, problems with most contingency plans will most likely be experienced. The only way, it seems, for a carrier to get supplies is to demonstrate repeatedly what happens when trucks do not roll. For example, it is likely that

1. Factories will close because the inbound raw materials cannot be moved;
2. Factories will close because produced goods cannot leave the shipping dock;
3. Consumers will be inconvenienced more if they cannot get gasoline, food, or clothing; and
4. A significant number of motor carrier employees will be without jobs.

Urban Goods Movement: Management Solutions to an Energy Problem

Cathryn Goddard

Urban goods movement, or local freight transportation, may appear unglamorous or perhaps unimportant, compared to stirring issues such as those prompted by an energy crisis. The movement of goods and services to and from urban areas, however, represents fully 5 percent of the gross national product of this country. Most of us are familiar with long-haul freight transportation, which accounts for 47 percent, or \$103 billion, of all freight. But, in 1978, local freight transportation expenditures accounted for the majority of the freight bill (53 percent), or \$116 billion.

Urban goods movement represents a part of our distribution system that can respond effectively in the short run during emergency situations such as those experienced during the 1973-1974 oil embargo. Part of this responsiveness during a crisis is also an indication of the cost saving that can take place under normal circumstances with more effective planning (1).

IDENTIFYING THE PROBLEM

Some key statistics will put our discussion in perspective. Initially, we will examine a few energy-related issues and then look at urban goods movement.

Energy Context

When I served as the director of the Office of International Energy Research at the U.S Department of the Treasury, I was one of the principal authors of the Secretary's Report to the President on the National Security Implications of Oil Imports (2). The Treasury Department has the responsibility to report on these national security implications because they stem from the impact of oil imports on the balance of payments.

Statistics prepared for this investigation highlight the nature and gravity of the oil import problem the United States is facing. Our analysis essentially compared the volume and value of oil imports for the three years (1959, 1975, and 1978) during which previous investigations had taken place.

If we look at the volume of oil imported in millions of barrels per day, excluding the strategic petroleum reserve, we observe a dramatic increase from 1.8 million bbl/day in 1959 to 6.5 million bbl/day in 1975, reaching 8.7 million bbl/day in 1978. Imported oil as a percentage of domestic production also increased significantly in the same time frame: 18 percent in 1959, 39 percent in 1975, and 45 percent in 1978. Similarly, the share of imported oil in total domestic energy demand increased dramatically in the same direction. From 9 percent in 1959, it rose to 19 percent in 1975 and reached 23 percent in 1978.

The vulnerability of the source from which the petroleum originates represents a key element for determining the effect of oil imports on national security. In 1959, OPEC did not exist, but, if we compile a total of oil imports from OPEC-member countries in that year, the share of OPEC imports over total oil imports was 70 percent. It rose to 78 percent in 1975 and to 83 percent in 1978. (This share has declined somewhat in 1979 because of increased production from the North Sea and Mexico.) Perhaps of more concern than OPEC itself, the Middle East has traditionally been considered a source of vulnerability for our imported oil supplies. Imports from the Middle East represented 21 percent of total imports in 1959, 27 percent in 1975, and 34 percent in 1978.

The value of U.S. oil imports has increased even more dramatically than the volume. The price per barrel in 1959 was only about \$2.26, which, of course, was considered exorbitant at the time. The price rose to \$11.45 in 1975 and to \$13.28 in 1978. Current market prices vary from \$26.00 to \$32.00 for contract crude and even higher for spot-market purchases. Price times quantity will give you the oil import bill, which increased markedly from \$1.5 billion in 1959 to \$27 billion in 1975 and reached \$42 billion in 1978.

Although the investigation itself was presented in 1979 and relied on 1978 statistics, the numbers for 1979 oil imports are in. In that year, we imported 8.8 million bbl/day at a cost of \$60 billion. That \$60 billion figure can be personalized by recognizing that it represents about \$275/person in the United States.

Urban Goods Movement

Let us now turn to urban goods movement to present some key statistics for 1978. The orders of magnitude involved in urban goods are quite staggering—3.6 million vehicles, 48 billion miles, 36 billion stops, and 9.9 billion gal of fuel.

Local freight transportation is a $116 billion business and, typically, is only a part of some other industry (3). For example, most of the companies handling local freight are not in the transportation business. They tend to be involved in selling a service or distributing a product. From the bakery truck that delivers doughnuts to the giant class 8 vehicle that transports food from warehouse to grocery store, these vehicles and services are the subset of another industry. Department stores, for example, tend to own their own facilities for delivery. In fact, for-hire transportation represents less than 10 percent of urban goods movement.

In the 1960s, shopping malls were being developed within the cities to attempt to reattract business into urban areas. One of the first thoughts that came to mind was to prevent all trucks from coming into new malls. It quickly became apparent, however, that those trucks were essential to commercial handling of the numerous goods and services that we purchase in the marketplace. Urban goods movement, in fact, is the critical final link in our multiproduct, multioutlet economy. Without the elaborate distribution network that has evolved, we would not have the variety of choice in a central location offered by our urban areas.

Urban goods movement is inherently fuel intensive. By definition, circulation in a city involves more stop-and-go driving. This initial relative inefficiency is then reinforced by the inevitable idling involved in the delivery of services and products. These apparent inefficiencies in fuel should be compared to far greater inefficiencies that would be involved were we all required to go to one central grocery store or one central service station. The inefficiency would still exist but would be shifted to the passenger movement side of the equation.

BETTER MANAGEMENT: PART OF THE SOLUTION

In more than 400 actual situations with client fleets ranging from 5 to 200 vehicles, it was found (1) that better management of urban goods fleets contributes at the same time to better management of energy resources. Three areas of improvement are considered here—different systems, different fuels, and a different approach.

Different Systems

Different systems for urban goods movement can maintain the same selection of goods while looking to a new means of transportation. For example, we can consider Buck Rogers types of future scenarios with pneumatic tubes, pipelines, or conveyor belts.

Consolidated deliveries can also make an important contribution. For example, the soft-drink distributor could also deliver candy bars during the same run. Rising fuel prices have, to some extent, encouraged this practice, which certainly took place during the oil embargo of 1973-1974. Significant marketing implications, however, result from consolidated deliveries. In general, the person making the delivery is an extension of the sales force of the parent firm. The soft-drink delivery person may not wind up selling as many candy bars if deliveries are made for both on the same run.

Another alternative is, of course, to provide less selection with the same means of transportation. Fewer specific brands could mean less need for separate bottle-beverage trucks. Fewer but larger stores could also reduce the demand for movement of urban goods. As we mentioned earlier, however, the lower number of stores could increase the vehicle miles traveled by consumers who drive to those stores.

Different Fuels

Yet another approach is to use a different fuel. Diesel, propane, gasohol, and electricity are among the many options for local freight transportation. With respect to electricity, DOE today has selected fleets performing routine services in urban areas as the showpieces for commercial application of electric vehicles. In this particular instance of a low-payload, predictable route, the electric vehicle may already be commercially feasible, even with the use of today's technology.

Different Approach

A more important near-term solution, and a more promising one even in the long run, is to rely on a different management approach. Although urban goods movement is typically managed as a step-child, it was found that there are significant cost-saving motives that justify the application of more-sophisticated management techniques. These techniques, including our proprietary Computer Assisted Route Development (CARD) system, can make significant improvements in the efficiency of movement of urban goods. Resequencing can lead to fewer miles and, therefore, less fuel consumption.

In a more elaborate case, comprehensive analysis can address not only route engineering as illustrated, but also every facet of local delivery operations, including at-depot activities, at-stop activities, stem- and on-route driving techniques, delivery management, and company delivery policies. While all of these areas are important, the greatest opportunities for fuel savings are in the last two areas.

CONCLUSION

Urban goods movement is a pivotal weight in our precisely balanced economy. During the 1973-1974 oil embargo, we saw that great accommodation could indeed take place to prevent the disruption of the supply of goods and services to urban areas.

The new systems envisioned, however, are not short-run solutions. For example, although alternate fuels will play a role in our energy future, they will not do so immediately. One possible exception, but a rather limited one, is gasohol.

Rising fuel costs provide the economic motivation for applying better management techniques to the movement of urban goods. As the price of oil rises, the dollars to be saved through better management more than justify the costs of developing and applying these techniques. The same logic is even more pervasive during a period of emergency, where the premium for uninterrupted supplies of services and products provides an economic incentive for the carrier to rely on better management techniques.

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Policy Implications of Urban Traveler Response to Recent Gasoline Shortages

Robert L. Peskin

The purpose of this paper is to identify promising urban transportation-planning policy actions to reduce gasoline consumption; it is based on observations of travel behavior during recent periods of gasoline shortage and increases in price. Such policy guidance is important because it is becoming increasingly apparent that the U.S. public is not always altering its travel patterns in ways that planners have predicted. With the broad range of alternative actions recently proposed—some with huge national impacts (such as the rationing of gasoline)—and with the many levels of local, regional, state, and federal government agencies likely to be involved, planners need to develop a coordinated set of actions. These actions must be designed to provide the greatest degree of energy saving possible and, at the same time, be consistent with the travel behavior and preferences of urban travelers.

Considerable discussion has taken place in recent years about ways in which energy consumption, particularly gasoline consumed by automobiles, can be reduced for urban travel. An important and useful distinction between two fundamental concepts, energy contingency planning and energy conservation, was recently noted by Daniel Roos (1) as follows:

> Energy contingency planning [is] "stand-by" or quick-response actions designed to solve immediate energy problems after they occur. This typically involves preparing for sudden increases in transit ridership and enforcement of regulations designed to minimize energy consumption.
> Energy conservation [is] continuous and longer-term actions designed to make reduced energy consumption a permanent characteristic of the urban transportation system. It should be noted that an adequate degree of conservation would make most contingency planning unnecessary.

With these concepts in mind, this paper will review the major findings of prior studies of gasoline shortages, especially those studies of travel behavior during the 1973-1974 gasoline shortage. The discussion will note the important consistent findings between these studies and more recent studies conducted during the 1979 shortages. Based on this review, policy implications for urban transportation planning will be identified for the following time frames:

1. Short-range planning includes both immediate actions, as well as those that could be implemented within three to five years, and is primarily oriented to energy contingency planning.
2. Long-range planning involves actions designed around a concerted conservation effort and planning for more efficient travel.

It should be noted that this paper is concerned with urban travel. The impacts of energy shortages on intercity (vacation) travel, although important from a national energy policy perspective, are not reviewed except to the extent that travelers trade off between urban and intercity travel.

FINDINGS OF PRIOR RESEARCH

In this section, some travel-behavior surveys conducted during and after the 1973-1974 gasoline shortage are reviewed. This review attempts to identify those findings that are of some importance in urban transportation policy decision making. The discussion highlights those findings that recur in different survey techniques and seem to be consistent over time, as shown by more recent research findings. Those actions that relate specifically to potential energy contingency planning and to conservation are identified. For example, the Planning Research Unit of the New York State Department of Transportation has prepared many reviews as part of its continuing research on travel response to energy shortages (2,3). Liff (4) has also reviewed attitudinal approaches to exploring changes in travel behavior. This paper concentrates on the implications of such findings rather than on the techniques used to obtain them. The major travel-behavior findings considered are (a) response to changes in gasoline availability as opposed to increases in price, (b) effect of household income, (c) reluctance to alter work trips, (d) trip chaining, (e) vehicle speed reduction, (f) reluctance to use of public transportation, and (g) automobile occupancy changes.

Response to Changes in Gasoline Availability as Opposed to Increases in Price

Peskin and others (5) in a home-interview survey of Chicago's North Shore residents, observed that respondents were basing travel decisions more on the availability of gasoline than on price. This was confirmed by Skinner (6) in travel diaries recorded by families of Federal Highway Administration employees and by Sacco and Hajj (7) in their household survey in the Dutch Forks, South Carolina, area. This finding has fundamental implications for gasoline-rationing and gasoline tax proposals now being discussed by the U.S. Department of Energy. Further, it identifies an important flaw or omission in analytical tools used in urban transportation planning. To date, no modeling chain has considered the availability of gasoline as an impediment to travel.

Effect of Household Income

Becker and others (8), in a survey of Portland, Oregon, residents, used a disaggregate analysis to identify market segments that responded differentially to the gasoline shortage. They noted that, while higher-income high-automobile-ownership households were more likely to change to more energy-efficient travel behavior in response to a shortage, lower-income households that already changed were more likely to remain changed after the shortage ended. This sensitivity of behavior with respect to income was also observed by Stearns (9), based on a nationwide survey, and partially by Peskin and others (5) to the extent that the upper-middle-income households behaved like those in the other surveys.

It is quite apparent that these findings will be important in considering a gasoline tax as a means to reduce consumption. The fundamental problem, however, is that there has been no opportunity to observe the effects of price increases in the absence of changes in availability. Corsi and Harvey (10) attempted to explore hypothetical price increases by asking Milwaukee area respondents to identify price thresholds at which energy-conserving behavior would occur. Lee (11) explored pricing issues by using California traffic volume data and attempted to include the availability issue by considering the true price, which included a cost of the wait time to purchase gasoline. Both of these studies see pricing as the action necessary to achieve conservation goals. However, they do not address social equity concerns—an extremely important issue to resolve if gasoline tax increases are implemented.