

Consumer Trade-Offs Between Mobility Maintenance and Gasoline Savings

JOANNA M. BRUNSO and DAVID T. HARTGEN

ABSTRACT

Gasoline use in New York State has steadily declined since 1978. However, travel has steadily increased since 1968, set back only twice by the oil crises of 1973 and 1978. Two analyses were performed to examine this phenomenon: First, aggregate trends in travel, fuel use, price, and efficiency were used to determine the general nature of consumer trade-offs between fuel use and travel. Second, three statewide surveys of consumer response (performed in 1979, 1980, and 1982) were examined for their impact on travel. The trade-offs were clarified by relating conservation impacts to changes in energy use and method of travel. The study found that shifts to fuel-efficient automobiles have helped consumers save significant amounts of money formerly spent on gasoline. However, it was found that consumers were reinvesting some of these savings in additional travel. Consumers claimed to take actions to limit nonwork travel, but when actual trip rates, trip distances, and incidence factors were applied to the survey responses, it became apparent that the major conservation strategies were work and car related. The authors inferred from the data that after an initial reduction in travel in response to gasoline shortages in 1979, consumers appeared to have invested some of the savings made possible by more fuel-efficient automobiles in additional nonwork travel in order to regain the household travel patterns that were most satisfying to them.

Gasoline is a key fuel in transportation energy use and is particularly crucial because it is essential to general public mobility. Since the oil shortages of 1973-1974 and 1979, significant efforts have been made in transportation planning to conserve energy.

To a large extent, plans and programs have focused on work travel as the primary target of consumer response to shortages. But work travel represents only 32 to 40 percent of all travel (1-3), leaving most travel unaffected by conservation plans. The purpose of this study is to examine the ways consumers have responded to energy restrictions and price increases, and the changes in consumer focus that have occurred in the wake of the 1979 energy crisis. This assessment is made through two analyses. First, state-level trends in travel, fuel use, price, and car efficiency are used to determine consumer trade-offs. Second, three statewide surveys of consumer responses (performed in 1979, 1980, and 1982) are examined for their impact on work, nonwork, and other actions. The conservation impacts are then related to changes in gasoline use (energy conserved) and changes in vehicle miles of travel (VMT). By examining the trends of all these factors since 1978, the year of highest gasoline consumption, it should be possible to understand the trade-offs consumers are making to cope with changes in energy price and supply.

BACKGROUND

A number of studies exist on consumer response to the 1973 to 1974 and 1979 energy crises (4-19). Most studies focused on consumer response to price rises and shortages. These studies determined that it was a shortage of fuel rather than an increase in price that initially compelled consumers to conserve. In both cases, consumers emphasized small nonwork ac-

tions in terms of frequency of response, but less frequent major actions accounted for most of the energy saved. The introduction of more fuel-efficient automobiles in the late 1970s stimulated car purchasing behavior during the 1979 crisis. One study found that vehicle fleet turnover was the largest single energy-saving action. This in turn allowed household travel to return to precrisis patterns. Subsequent studies also showed that consumers eventually returned to "normal" travel patterns.

RECENT TRENDS IN TRAVEL AND ENERGY USE

Figures 1a through 1d show the recent New York State (NYS) trends in annual vehicle miles of travel, gasoline use, gasoline pump price, and on-the-road average automobile efficiency. National data are similar (20-21). NYS travel has increased steadily since 1968, set back only twice by the oil crises of 1973 and 1979. Gasoline use has declined steadily since 1978. At the time of the shortages, gasoline prices climbed rapidly. By 1978 domestic automobile manufacturers began to make fuel-efficient automobiles increasingly more available. As more of these automobiles entered the used automobile market and the "gas guzzlers" of the past were retired, on-the-road automobile efficiency increased steadily.

The thesis of this paper is that a complex interaction among travel, gasoline usage, gasoline price, and car efficiency is responsible for these trends. As the fuel efficiency of the average automobile rises, less gasoline is needed to travel a given distance. If the rise in efficiency outpaces the rise in gasoline demand, pressure on demand will drop, and gasoline prices will go down. Because fewer dollars are being spent on gasoline for current travel patterns, household funds can now be reinvested in

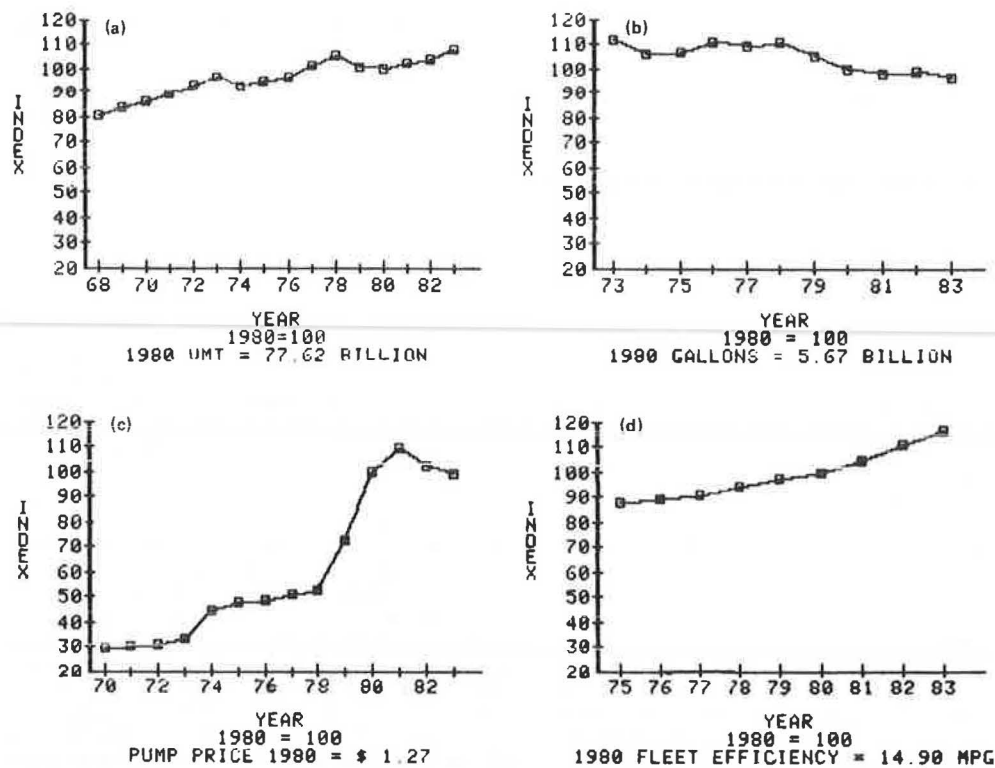


FIGURE 1 Recent trends in travel and energy use: (a) vehicle miles of travel, (b) annual highway gasoline usage, (c) nominal pump price, and (d) on-road automobile fuel efficiency.

other goods and services (including new automobiles) or be used to travel still more miles. In essence, households can reinvest gasoline savings in travel that might have been foregone under tighter financial circumstances.

Table 1 and Figure 2 show recent trends in NYS gasoline use and VMT. In the 1979 energy crisis, gasoline consumption dropped about 340 million gal from 1978, while travel dropped 3.68 billion VMT from 1978. Statistics for 1980 showed continued drops. But since 1980, travel has slowly increased from its low point of 77.62 billion VMT, and 1983 numbers show that travel totaled 83.78 billion VMT, or 6.16 billion VMT above the 1980 low. However, gasoline consumption has continued to fall. (Gasoline in NYS is used about 98 percent of the time for private or personal travel.) Although the VMT changes might partly be due to background population growth or demographic shifts, the VMT changes between 1980 and 1983 (+7.9 percent) are more than 10 times as fast as population changes in the same time period.

Additional travel above the 1980 low point may be thought of as additional mobility needs expressed

through actions. The gasoline necessary for additional travel may be thought of as gasoline that could have been saved, had travel remained at 1980 levels. However, consumers appear to have chosen to purchase more gasoline, in exchange for increased mobility, rather than to save gasoline.

Figure 2 shows how much gasoline would be needed to power the increased mobility. For instance, in 1983 about 350 million gal of gasoline would have been required to power the additional 6.16 billion VMT. The 350 million gal of reinvested gasoline came partly from increases in fuel efficiencies (.20 = 6.16/17.38 - 6.16/16.45) and partly from gasoline that was "not saved" (.35 - .20). The authors interpret the 350 million gal as conservable gasoline that was spent to allow growth in mobility. Compared with the savings already achieved between 1978 and 1983 (820 million gal) the amount of reinvested gasoline is considerable and is growing as a percentage of savable gasoline.

In the authors' view, consumers are using improvements in vehicle efficiency, combined with selected additional gasoline use, to travel more. A

TABLE 1 Gasoline Reinvested in Travel, New York, 1978 to 1983

Basic Data			Change from 1978		Rebound After 1979		Source of Reinvested Gasoline		
Year	Gasoline (gal millions)	Travel (VMT billions)	Gasoline (gal millions)	Travel (VMT billions)	Travel Change from 1980	Reinvested Gasoline to Support ΔT^b	Fuel Efficiency	Gasoline Not Sold	Percent Reinvested as Percent of Total Savable
1978	6.29	81.50	14.00						
1979	5.95	77.82	14.50	-3.68					
1980	5.67	77.62	14.90	-3.88					
1981	5.57	79.13	15.60	-2.37	+1.51	-10	-10	.00	12
1982	5.62	80.48	16.45	-1.02	+2.86	-17	-05	-12	20
1983	5.47	83.78	17.38	+2.28	+6.16	-35	-20	-15	30

^aAvg automobile efficiency.

^bColumn 8 = Column 7/Column 4.

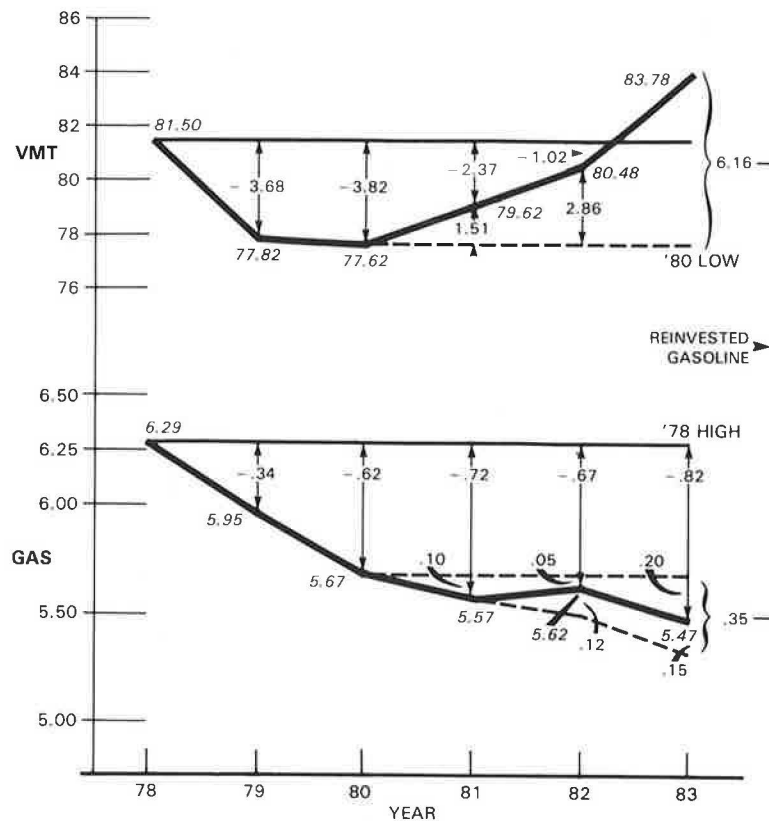


FIGURE 2 Trends in travel and gasoline use in New York State.

considerable and growing portion of the gasoline potentially savable (30 percent in 1983) is being re-invested in more travel by way of greater fuel efficiency and other factors.

CONSERVATION TRADE-OFFS

To better understand conservation trade-offs, the New York State Department of Transportation (NYSDOT) conducted a series of telephone surveys that investigated many actions consumers took to conserve gasoline. The first of these surveys was taken in October of 1979, shortly after the 1979 oil crisis. This was followed in October of 1980, and again in January of 1983 (1982 data). The surveys were of the simple-random-sample type and were representative of the number and gender of the population within the various counties of the state. Details of these studies are available in other documents (14,22-25).

Initial and Subsequent Responses to the 1979 Crisis

Results of the percent responses to these surveys are summarized in Table 2. The 1979 data indicate that "small-frequent" options, such as trip chaining, driving slower, and increased maintenance, were most frequently mentioned by consumers. Reducing vacation travel was also an important response, given the timing of the shortage (summer 1979). Mode switching behavior was not frequently mentioned. During the 1979 crisis, a surprisingly large percentage of consumers also mentioned "buy fuel-efficient cars" as an action to conserve fuel. Although the authors recognize that the lack of a clear baseline (i.e., 1978 behavior) clouds these data, they nevertheless

believe that the data show the overall pattern of 1979 responses.

The responses to the 1980 survey generally paralleled the previous survey. The percentage of affirmative responses was highest in the nonwork actions category, and was greater in 1980 than in 1979. But mode shifting (transit to work and carpool to work) declined slightly in frequency. Upstate New York residents placed more emphasis on shopping actions; persons aged 65, households without automobiles, and low-income households adopted fewer actions than others.

NYSDOT repeated the survey in early 1983. Data were collected in the same fashion as in earlier surveys. The 1983 survey shows that conservation behavior was far more prevalent in 1983 than in 1980 or 1979, only 2 years earlier. Of 17 items compared in Table 2, all but 1 ("drive slower") were up in frequency of response, and the increase was substantial.

It appears that by 1983 a conservation attitude had permeated a much broader spectrum of society. The items most frequently mentioned and increasing most rapidly were "combining shopping and other trips," "shopping closer to home," and "shopping on the way home from work." Included among the top-ranked actions were three actions that were not included in the previous surveys: "sharing rides to nonwork activities," "choosing social and recreational trips closer to home," and "walking and bicycling to nonwork activities."

Energy Savings from Conservation Actions

An estimate of the gallons of gasoline saved by each household can be calculated from these data by applying trip rates developed either from these or

TABLE 2 Actions to Conserve Gasoline Taken in 1982

Rank Order	1979 (N=1,520)	1980 (N=1,560)	1982 (N=1,503)	Δ1982- 1980	Area				Household Income (\$000s)		
					NYC (N=585)	LI (N=95)	West/ Rock (N=223)	Upstate (N=600)	<10 (N=309)	10-25 (N=565)	>25 (N=496)
1. Combine shopping and other trips	47	54	76	+22	71	76	76	80	66	82	78
2. Shop closer to home	41	47	65	+18	68	66	57	64	71	70	58
3. Share rides to nonwork activities	—	—	59	—	53	60	67	63	51	63	60
4. Make fewer shopping trips	35	53	54	+1	48	53	46	61	59	58	47
5. Choose social and recreational activities closer to home	—	—	52	—	52	54	44	51	54	58	46
6. Walk or bicycle to nonwork activities	—	—	51	—	58	49	45	45	45	53	52
7. Shop on way home from work	24	30	50	+20	52	43	48	51	27	58	58
8. Use a train, bus, or airplane for vacation	16	21	45	+24	56	42	52	33	37	43	52
9. Drive slower	42	43	35	-10	28	36	29	41	26	38	38
10. Have car tuned more often	37	26	29	+3	29	11	26	34	17	34	33
11. Take bus or subway to work	15	14	28	+14	50	9	20	10	22	30	29
12. Take bus or subway more often for nonwork activities	15	15	25	+10	43	16	20	11	29	29	19
13. Buy fuel-efficient car	15	17	25	+8	19	31	25	30	14	26	33
14. Vacation closer to home	17	19	22	+3	21	21	15	26	16	28	21
15. Cancel a vacation trip	16	12	18	+6	18	18	12	18	20	19	15
16. Walk or bicycle to work	8	11	16	+5	18	7	17	16	10	20	17
17. Carpool to work	14	13	14	+1	10	7	16	18	8	16	16
18. Job closer to home	5	4	11	+7	10	15	15	11	6	16	11
19. Sell car (do not replace)	8	5	7	+2	7	7	4	6	5	7	2
20. Move closer to work	2	3	7	+4	8	6	5	7	6	9	7

Note: Values given in table are percentage of respondents mentioning these actions. Dashes indicate data not available.

other surveys, along with assumptions concerning the opportunity to curtail energy use.

There are two methods of undertaking this computation: the simplified method used by Neveu et al. (4) and a more detailed method used for the 1983 data only (25). Both methods yield similar results.

For both methods, the savings in fuel is calculated as follows:

$$S_{ij} = (Z)(L_a R_a - L_b R_b)(1/\text{mpg})(I) \quad (1)$$

where

S_{ij} = weekly savings for action j for household i ,

L = trip length before (b) and after (a) the change in behavior,

R = trip rate (per week) before and after change in behavior,

mpg = miles per gallon of average automobile,

Z = 1 if action taken, 0 if action not taken, and

I = incidence factor (the percentage of conservation opportunities that are actually taken advantage of).

Weekly savings for each household can then be determined by summing the 18 actions proposed or each action can be analyzed separately or in relation to the other actions:

$$S_i = \sum_{j=1}^{18} S_{ij} \quad (2)$$

The total weekly savings for NYS can be computed by expanding the survey by the number of households in the state. Thus,

$$\text{NYS weekly savings} = \sum_{i=1}^N (S_i) (6.4 \text{ million households}/N) \quad (3)$$

where N is the number of respondents in each survey.

The simplified method uses a single estimate of trip length and rates for each action j and one overall incidence factor for all actions. The inci-

dence factor is determined by comparing the estimated total savings from Equation 3 with the actual savings shown in Table 3. The computation in Equation 3 yields a total savings of 2,141 million gal for 1982 compared to 1978. However, Table 3 shows that the actual 1982 savings in gasoline is only 665.8 million gal, or about 31 percent of the total possible. The reason for this difference is that not every opportunity for savings actually results in conserved gasoline. In other words, the incidence factor is about 0.31. Similar factors for 1979 and 1980 are 26 percent and 46 percent, respectively.

Table 4 shows the NYS energy savings from each action for each year. If these savings are summed over all of the actions, the total number of gallons saved in the average week of the year indicated is computed for NYS. This number can then be divided by the number of households to arrive at the average savings per household per week. The data in Table 4 show that since 1979 the greatest fuel savings has been achieved through automobile-related actions, but that this proportion is declining. The major proportion of these savings has been attributed to the purchase of more fuel-efficient automobiles. During 1979, 44 percent of all savings were due to automobile-related actions; by 1982 this proportion had declined to 34 percent. As the automobile fleet ages, the gas guzzlers of the past are being phased out; by 1980 (and even more so in 1982) consumers also sought more fuel-efficient used automobiles.

Nonwork savings are attributable to shopping-related and vacation actions. Together, these have varied little as a proportion of savings, rising from 30 percent in 1979 to 34 percent in 1980 and 1982.

Each of the shopping actions saves a small amount of fuel. From a gallon-saved point of view, shopping on the way home from work and shopping closer to home appear to be most effective. However, the data in Table 4 show that shopping actions, although mentioned by an increasing percentage of the respondents as the years progress, accounted for a decreasing amount of energy saved in terms of absolute gallons and percentage of total fuel sold.

TABLE 3 New York State Gasoline Savings Since 1978

Year	No. of Households in NYS (x 10 ⁶)	Fuel Sold per Year (gal x 10 ³)	Gallons per Household per Week	Δ Gallons from Previous Year	Δ Gallons Change per Household per Week	Δ Gallons from 1978	Δ Gallons per Household per Week from 1978
1978	—	6,286,240	19.05	—	—	—	—
1979	6.345	5,949,975	18.03	-336,265	-1.02	-336,265	-1.02
1980	6.449	5,668,563	16.90	-281,412	-.84	-617,677	-1.84
1981	6.449	5,569,749	16.61	-98,814	-.29	-716,591	-2.14
1982	6.523	5,620,407	16.42	+50,658	+.15	-665,833	-1.96
1983	6.563	5,467,682	16.02	-152,725	-.45	-818,558	-2.40

TABLE 4 New York State Weekly Savings per Week

Action	Energy Savings by Actions Already Taken					
	1979		1980		1982	
	Gal (x10 ⁶)	Percent	Gal (x10 ⁶)	Percent	Gal (x10 ⁶)	Percent
Work-related						
Bus/subway	0.84	13	1.30	11	2.3	18
Carpool	0.52	8	1.07	9	1.1	8
Walk/bike	0.13	2	0.24	2	0.2	2
Subtotal	1.49	23	2.61	22	3.6	28
Shopping-related						
Shop closer to home	0.32	5	0.48	4	0.6	5
Combine shop/other	0.13	2	0.35	3	0.3	2
Shop less often	0.19	3	0.48	4	0.3	2
Bus/subway to nonwork	0.19	3	0.24	2	0.2	2
Shop on way home from work	0.26	4	0.47	4	0.6	5
Subtotal	1.09	17	2.02	17	2.0	16
Car-related						
Tune-up	0.38	6	0.47	4	0.4	3
Drive slower	0.13	2	0.24	2	0.1	1
Buy a more fuel-efficient car	1.29	20	2.85	24	2.8	22
Sell a car (do not replace)	1.03	16	1.19	10	1.1	8
Subtotal	2.83	44	4.75	40	4.4	34
Vacation						
Cancel a vacation trip	0.26	4	0.35	3	0.3	3
Change mode for vacation	0.52	8	1.30	11	1.8	14
Vacation closer to home	0.06	1	0.24	2	0.2	1
Eliminate RV or boat	—	—	0.12	1	—	—
Subtotal	0.84	13	2.01	17	2.3	18
Moves						
Move closer to work	0.06	1	0.24	2	0.2	2
Job closer to home	0.19	3	0.24	2	0.3	3
Subtotal	0.25	4	0.48	4	0.6	5
Total weekly savings	7.2	100 ^a	11.88	100	12.8	100
Total annual savings			617.7		665.8	
Weekly savings per household	1.02		1.84		1.96	

^aColumns may not add to zero due to rounding errors.

Figure 3 is essentially a blow-up of the lower portion of Figure 2, with more detail on the nature of these savings. The drop in gasoline sales since 1978 is apportioned to the various categories of actions, so that the area between the gasoline use curve and the x-axis is divided into the indicated conservation actions. Points A, B, and C represent the trend using the simplified method. Points D, E, F, and G represent the trends using the more detailed method.

As can be observed, over the years the proportion of conserved gasoline attributed to work has increased, while automobile, vacation, and nonwork conservation has decreased. By inference, automobile-related savings appear to have peaked in 1981. Because the three additional conservation actions (sharing rides for nonwork travel, walking or bicycling to nonwork activities, and choosing social and recreational activities closer to home, all under point G in Figure 3) were not surveyed in all three

years, it is reasonable to assume that a significant amount of the nonwork-related gasoline conserved would have been attributed to these actions in previous surveys. It is also clear that had these actions not been included in the 1982 survey, conservation of gasoline attributed to nonwork other than vacation would have shown a more significant decrease.

POLICY IMPLICATIONS AND CONCLUSIONS

The responses in each of the three surveys have shown that NYS consumers are saving considerable amounts of gasoline compared with 1978. A significant number of respondents mentioned trip planning, nonwork activities occurring closer to home, and other nonwork actions as gasoline savers, but when gallons conserved were estimated, more gallons were conserved through automobile and work actions than any other

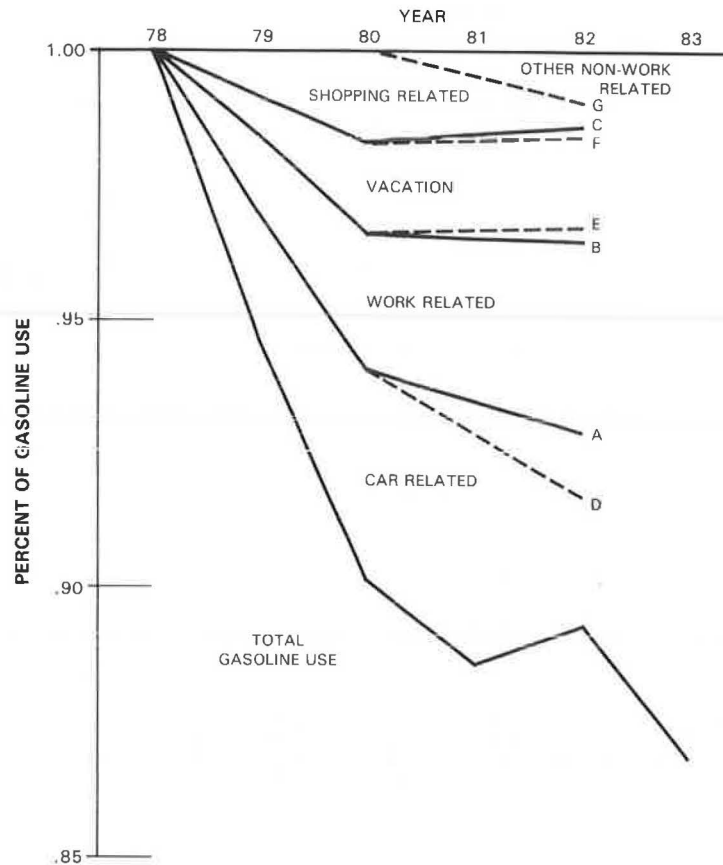


FIGURE 3 Allocation of gasoline conserved by types of conservation actions.

group. Furthermore, when incidence and trip rates determined by the survey were applied in the computations, savings through automobile actions were a bit smaller and gallons saved commuting to work were a bit larger.

The following conclusions may be drawn:

- Shifts to more fuel-efficient automobiles have helped consumers save significant amounts of gasoline. However, as the fleet ages and older automobiles are retired from service, the benefits of fuel-efficient automobile purchases may decrease. With annual VMT rising, cars will have to become even more efficient or other strategies will have to be found to maintain conservation levels.

- Consumers are abandoning a "drive slower" attitude. They appear to believe that driving slower is not worth the effort or loss of time involved.

- Consumers have chosen automobile- and work-related actions as strategies to reduce gasoline cost and consumption.

- Consumers have made less of an effort to conserve gasoline in nonwork travel. There may be many reasons for this, including habit, consumer wants, and a feeling that it is just not worth the effort. However, the large percentage of respondents who replied affirmatively to actions involving shopping, sharing rides to nonwork activities, and walking and bicycling suggests that consumers do think about not using gasoline, whether for energy conservation or cost containment. Although it is not entirely clear why these strategies are not used (as shown in the trip tables), it may be that undertaking one or two of these actions a month may satisfy the respondent's perception of conservation although actually contributing little to total conservation.

- Consumers appear to be reinvesting some of the potential savings in increased travel. In 1983, 30 percent of the savable energy was reinvested.

Within little more than a decade, consumers have experienced two oil supply shortages and a subsequent sharp increase in prices. Trade-offs have gradually been made in travel behavior to return to precrisis patterns. As long as more fuel-efficient automobiles are purchased, less fuel-efficient automobiles are retired from service, and some work-related conservation actions are practiced, NYS consumers will likely continue to make trade-offs. Some gasoline prices will rise rapidly (given the free market approach and absence of controls advocated by the current federal administration) and continue to rise until demand is curtailed. Consumers who have recently purchased more fuel-efficient cars will not immediately purchase newer automobiles. The demand for newer automobiles may well come from lower-income groups who have not yet purchased newer vehicles.

The study suggests that consumers know how to conserve gasoline very well. When asked whether they had taken any of the conservation actions, consumers replied that they had conserved by trip combining, shopping closer and more efficiently, sharing rides with neighbors and friends, and bicycling or walking to social and recreational sites. Furthermore, the percentage responding yes to these actions increased each year. However, when actual trip rates, incidence rates, and trip distances were applied to these responses, it became apparent that the major conservation strategies were work and car related. Shopping actions contributed little to conservation. Most nonwork conservation was contributed by vacation-related actions, particularly in 1982, but it is not

clear whether this was caused by the recession rather than conservation.

The study also related trade-offs in gasoline use and the expansion in travel to the pattern of conservation activities. The expansion of the economy was accompanied by an expansion of automobile sales, both new and used. Because many of the pre-1978 gas guzzlers have not yet been retired from service, and because even more recent trades may involve improvements in fuel efficiency, the overall fleet efficiency will probably continue to increase. This will continue to allow consumers the option of conserving gasoline or driving more.

The findings suggest that a complex goal-oriented household decision structure is guiding family travel behavior. The patterns of the behavior (initial "shock" savings and subsequent new car purchasing, followed by a rebound of selected travel patterns) are clear; the causes can only be speculated on. A constant real or relative travel budget may be guiding the process, but current data cannot answer this. What is clear is that households are flexible and resourceful in saving gasoline in a crisis, and are equally adept at regaining mobility in the wake of a crisis.

ACKNOWLEDGMENT

This study was supported by a grant from the Urban Mass Transportation Administration as part of a larger study of energy use reductions in nonwork travel. The authors wish to thank Janet Jaracz for the preparation of the manuscript.

REFERENCES

1. M.E. Roskin. Purposes of Vehicle Trips and Travel. Report 3,1977 Nationwide Personal Transportation Study. FHWA, U.S. Department of Transportation, Dec. 1980.
2. N.S. Erlbaum et al. Automotive Energy Forecasts: Impacts of Carpooling, Trip Chaining, and Auto Ownership. Preliminary Research Report 134. Planning Division, New York State Department of Transportation, Albany, Dec. 1977.
3. J.M. Brunso and D.T. Hartgen. An Update on Household-Reported Trip Generation Rates. Transportation Analysis Report 30. Planning Division, New York State Department of Transportation, Albany, Aug. 1983.
4. O. Schueftan and R. Ellis. Federal and Local Responses to the 1979 Fuel Shortage. Report DOT-P-30-81-06. U.S. Department of Transportation, Feb. 1981.
5. Considerations in Transportation Energy Contingency Planning. TRB Special Report 191. TRB, National Research Council, Washington, D.C., 1980.
6. R.L. Peskin et al. The Immediate Impact of Gasoline Shortages on Urban Travel Behavior. Northwestern University, Evanston, Ill.; U.S. Department of Transportation, April 1975.
7. L.E. Skinner. The Effect of Energy Constraints on Travel Patterns: Gasoline Purchase Study. U.S. Department of Transportation, July 1975.
8. J.F. Saaco and H.M. Hajj. Impact of the Energy Shortages on Travel Patterns and Attitudes. In Transportation Research Record 561, TRB, National Research Council, Washington, D.C., 1976, pp. 1-11.
9. T.M. Corsey and M.E. Harvey. Travel Behavior Under Increases in Gasoline Price. Traffic Quarterly, Vol. 31, 1977, pp. 605-624.
10. B.W. Becker et al. Behavior of Car Owners During the Gasoline Shortage. Traffic Quarterly, Vol. 30, No. 3, July 1976.
11. C. Keck et al. Changes in Individual Travel Behavior During the Energy Crisis 1973-74. Preliminary Research Report 67. Planning Division, New York State Department of Transportation, Albany, Aug. 1974.
12. Transportation Energy Opinion Survey. Comprehensive Planning Organization of the San Diego Region, San Diego, Calif., Sept. 1979.
13. R.B. Trent and C.R. Pollard. Individual Responses to Rising Gasoline Prices: A Panel Approach. Presented at 61st Annual Meeting of the Transportation Research Board, Washington, D.C., 1982.
14. D.T. Hartgen and A.J. Neveu. The 1979 Energy Crisis: Who Conserved How Much? In TRB Special Report 191: Considerations in Transportation Energy Contingency Planning, TRB, National Research Council, Washington, D.C., 1980.
15. J.D. Dilitz. Reported Household Gasoline Purchasing Experience: June 1979. Transportation, Vol. 11, No. 3, Sept. 1982.
16. E.E. Iverson et al. Response of Washington State Residents to Higher Transportation Costs and Energy Shortages. Washington State Department of Transportation, Olympia, Aug. 1981.
17. C.E. Dare. Transportation Energy Contingency Plans for Rural Areas and Small Communities. Transportation Institute, University of Missouri at Rolla, Dec. 1981.
18. E.C. Sullivan and K.C. Picha. The Impact of Gasoline Shortages and Price Increases on Recreational Travel. Institute of Transportation Studies Working Paper UCB-ITS-WP-80-15. University of California, Berkeley, Oct. 1980 (revised Dec. 1980).
19. T. Hamstra and P. Motoyoshi. Changes in Recreational Travel in Washington State. Report WARD-49-1. Washington State Department of Transportation, Olympia, Nov. 1982.
20. Traffic Volume Trends. FHWA, U.S. Department of Transportation, various issues.
21. Monthly Motor Gasoline Reported by States. FHWA, U.S. Department of Transportation, various issues.
22. A.J. Neveu. The Sensitivity of Work and Non-Work Travel to Energy Shortages or Price Rises. Preliminary Research Report 201. New York State Department of Transportation, Albany, July 1981.
23. D.T. Hartgen, J.M. Brunso, and A.J. Neveu. Initial and Subsequent Consumer Response to Gasoline Shortages. Transportation Analysis Report 40. Planning Division, New York State Department of Transportation, Albany, Oct. 1983.
24. J.M. Brunso, D.T. Hartgen, and S.L. Kupferman. Equity Impacts of Gasoline Shortages and Price Rises. Transportation Analysis Report 20. New York State Department of Transportation, Albany, Aug. 1982.
25. J.M. Brunso and D.T. Hartgen. Energy Use in Non-Work Travel. Data Services Bureau, New York State Department of Transportation, Albany, 1984.

The views expressed in this paper are those of the authors, including any errors of fact or omission.

Publication of this paper sponsored by Committee on Energy Conservation and Transportation Demand.