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The 1979 Energy Crisis: Who Conserved How Much?

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During the 1973-1974 oil embargo and again in 1979, U.S. foreign supplies of petroleum were greatly reduced. Transportation, almost totally dependent on petroleum (1), and New York State, whose dependence on foreign oil is much greater than that of the United States (2), were particularly hard hit. During both periods, prices rose about 35 percent and shortfalls of 11-13 percent were experienced (3). People encountered unpleasant experiences of Sunday station closings, long queues at stations, concern about availability, and odd-even and minimum-purchase restrictions. However, during these two shortfall periods, partial relaxation of supplies, coupled with certain government actions and strong positive consumer response, alleviated the crisis in three or four months. But the U.S. embassy takeover in Iran and the Russian invasion of Afghanistan have once again spurred price increases and raised the specter of shortages.

A large number of analyses have been prepared on energy impacts of transportation actions, but until recently most have focused on conservation actions (4-7). More recent attention has turned to the analysis of actions from a contingency viewpoint—that is, studies of transit system capacity (8-12) and ridesharing (10). County, city, and state-level analyses have only recently been prepared (13-16). These efforts are generally intended to address the issues raised by state or federal legislatures, satisfy DOT requests for energy contingency planning, or provide information and overview to planners (17-18). The Emergency Energy Conservation Act of 1979 provides further impetus for the preparation of such plans. Through the Standby Federal Emergency Energy Conservation Plan (proposed interim final rules, February 1980), the federal government, after setting targets for conservation, can impose plans on states whose own plans or efforts to conserve are not satisfactory. A number of states, notably California (19), have begun such work, and some draft guidelines have been prepared by the Massachusetts Institute of Technology (20).

We are particularly concerned, however, that few, if any, of these studies integrate the role of the consumer into the planning and energy contingency efforts. All the studies we have reviewed are prescriptive in nature, purporting to show what actions, if taken by government, can induce the requisite conservation response from the public. Yet numerous reviews of consumer response during the 1973-1974 and 1979 crises (21-23) show that, in spite of government efforts, consumers did the saving on their own by cutting discretionary travel where possible and by taking numerous personal actions to conserve. Although rationing at shortfalls of more than 20 percent (24) may force conservation, state and federal plans developed for less severe shortfalls (8-20 percent) must consider voluntary as well as coerced public response. The purpose of this paper is to determine in actual savings what the nature of public response has been so far and is likely to be in the future.

THE 1979 CRISIS

Both the 1973-1974 and the 1979 crises were precipitated by major international events. In 1979, the Iranian revolution of December 1978 subsequently led to the cutoff of Iranian oil production. When production did resume, it was at significantly lower levels. Government directives concerning the buildup of heating fuel supplies for the 1980 season exacerbated a precarious balance, resulting in a severe (7-10 percent) shortfall in California in May 1979. Pressure subsequently mounted in New York during that same month, resulting in the imposition of an odd-even gasoline purchase plan in New York City in June 1979 and the tapping of future set-asides. In the meantime, the crisis eased in California. These actions, coupled with significant conservation by the public, gradually loosened the squeeze; odd-even was removed in New York City in September 1979 with prices in the $0.97/gal range, an increase of $0.27 in 10 months. The takeover of the U.S. embassy in Iran on November 4, 1979, and the Russian invasion of Afghanistan have spurred prices again; the February 1980 U.S. average price of regular gasoline was $1.15/gal for unleaded, with premium at $0.05-$0.15 higher (prices in New York were about $0.05-$0.15 above the U.S. average). Many analysts predict that gasoline will cost $1.50/gal by the end of 1980.

As a result of these events, traffic and gasoline consumption in New York State since then declined. Traffic was down 4.5 percent in New York, while gasoline consumption dipped 5.3 percent. Total gasoline saving in New York was 280 million gal for the first three quarters, 328 million gal for the year.

CONSUMER SAVINGS

To determine precisely how these savings were achieved, the New York State Department of Transportation (NYSDOT) engaged in a two-part analysis of energy actions. The first part—determining what actions the public took—was obtained from responses to a public opinion poll conducted by Crossley Surveys on behalf of NYSDOT (22). The second part—quantifying the savings from each action—was accomplished by applying reported trip length, trip rate, and energy use data to the Crossley responses. Each of these efforts is discussed below in light of three scenarios: (a) actions between January and October 1979, (b) actions at $1.50/gal for gasoline, and (c) actions at a 20 percent shortfall.

Actions Taken by the Public

Consumer actions taken in 1979 were generally similar to those taken during the 1973-1974 crisis, but several important differences were noted. Table 1 indicates results of the Crossley poll, which was based on a representative sample of 1520 New York households and conducted in October 1979. The poll responses thus cover the period of January through mid-October 1979. Respondents were

Table 1. Results of Crossley poll of New York State residents showing percentages who took energy-saving actions during January-October 1979.

Action	Area				Age			Sex		Cars per Household			Household Size			Household Income ($000s)		
	New York City	Long Island	Westchester and Rockland Counties	Upstate	18-34	35-64	>65	Male	Female	0	1	>2	1-2	3-4	>5	<10	10-25	>25
Combined shopping with other trips	30	55	43	62	50	48	31	40	53	13	51	57	42	49	54	36	49	52
Drove slower	36	47	45	46	43	43	31	46	38	12	48	49	39	43	48	33	41	49
Shopped closer to home	31	45	46	49	43	41	36	37	45	20	45	46	38	43	44	38	43	41
Tuned car	24	46	41	47	39	40	19	39	36	4	41	47	30	40	49	22	37	46
Shopped less often	24	43	27	45	36	37	26	30	40	11	38	42	29	38	44	30	35	40
Shopped on way home from work	21	24	22	30	32	25	4	24	26	11	25	31	20	29	31	14	27	33
Vacationed closer to home	11	12	16	25	21	16	9	19	15	7	17	22	13	20	21	14	18	19
Used train, bus, or plane for vacation	18	15	14	14	21	14	7	16	16	13	15	18	17	16	12	12	15	23
Canceled vacation trip	14	13	8	19	19	15	7	14	17	6	20	15	14	17	18	11	18	14
Bought a more fuel-efficient car	9	18	5	22	20	14	9	16	15	5	14	21	13	17	19	10	17	17
Used bus or subway for non-work travel	26	8	13	7	19	13	10	16	14	20	19	9	16	14	15	17	18	13
Carpooled to work	9	16	16	18	19	13	2	17	12	7	13	18	10	17	16	8	17	16
Took bus or subway to work	22	5	10	5	17	9	4	14	10	13	16	8	11	12	13	11	14	12
Eliminated recreational vehicle or boat	4	14	1	15	13	7	6	10	9	2	10	12	7	11	12	8	8	12
Sold a car	4	14	0	12	11	7	3	9	8	7	6	11	6	11	11	8	8	9
Walked or bicycled to work	6	9	3	11	13	6	1	8	9	10	8	8	7	9	11	9	9	8
Take job closer to home	3	6	5	7	9	3	1	5	6	4	5	7	3	6	7	6	6	4
Moved closer to work	2	1	0	4	4	2	0	2	3	1	3	3	2	3	2	2	3	3

asked to indicate what actions they had taken since January to cope with the crisis. The data show that consumers have emphasized small and frequent actions, such as driving slower, getting cars tuned, and combining and reducing discretionary and shopping travel. But certain major actions have also been taken by a significant share of most groups. These include vacation-related actions (since the crisis peaked during the summer months), fuel-efficient car purchasing, carpooling, and use of transit for work and nonwork trips. Few consumers mentioned taking drastic actions, such as changing jobs or residences and selling a car. Relatively few were willing to eliminate the use of a recreational vehicle or boat. Most important, responses vary significantly for different geographic and demographic groups.

To evaluate how response patterns would change in the future, the Crossley poll also included questions on intended response if gasoline prices were to rise to $1.50/gal. Table 2 shows how New Yorkers would react. While the overall profile of response is similar to that for actions taken already, certain major actions would increase in incidence, supplanting minor actions. In particular, the incidence of driving slower and car tune-up would decline sharply as purchases of fuel-efficient cars rapidly accelerate. Thus, in a seeming contradiction, it may be difficult to hold down speeds if gasoline prices continue to increase.

The Crossley poll also elicited response on a major shortage scenario. Table 3 shows how the Crossley respondents indicated they would respond to a somewhat more severe shortfall of 20 percent. Responses are generally similar, in rank order, to actions already taken in 1979. However, more emphasis would be placed on major actions such as vacationing closer to home and changing travel modes for vacation, purchasing fuel-efficient cars, using transit for nonwork travel, and selling a car. Certain other actions (driving slower, car tune-up, and shopping-related actions) would decline in incidence as their places were taken by major actions. Overall, these responses are similar to those under the $1.50/gal gasoline-purchase scenario. In addition, a 20 percent shortfall would also increase vacation trip cancellations, undoubtedly because of fears of not being able to get fuel while on the road. As with the previous scenarios, major differences in response are apparent by geographic and demographic groupings.

The limitations of the above data are readily apparent. While the data show the relative frequency of response to various actions, they do not show how much energy was actually saved by each action. Because some actions are expensive as well as effective (e.g., fuel-efficient car purchasing), they may only be taken infrequently. Nevertheless, they still have a major effect on consumers. In exchange, other actions may be taken very frequently (e.g., driving slower) but not save much energy on a per-time basis. We must thus adjust the above responses to account for the savings potential of each action. [Further detailed statistics applicable to this study of New York's energy saving and actions may be obtained from the authors.]

Energy Saving

In order to better understand the conservation potential inherent in the public's response to various energy-constrained futures, it is necessary to explicitly quantify an action's energy saving. In this analysis, the quantification of the savings of all 18 actions used in the Crossley poll was accomplished by using typical state trip lengths and trip rates by purpose and an assumed statewide car average fuel efficiency (CAFE) of 15 miles/gal. Different approaches were used for each action, but generally the methods are based on the following equations:

$$S_{ij} = (\phi)(L_B - L_A)(R_B - R_A)(CLH)(1/15) \quad (1)$$

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

where

S_{ij} = savings for action j for household i;
ϕ = 1 if action j were taken, 0 otherwise;
L = trip length, before and after change in behavior;
R = trip rate;

Table 2. Percentages who would take energy-saving actions if gasoline cost $1.50/gal.

Action	Area				Age			Sex		Cars per Household			Household Size			Household Income ($000s)		
	New York City	Long Island	Westchester and Rockland Counties	Upstate	18-34	35-64	>65	Male	Female	0	1	>2	1-2	3-4	>5	<10	10-25	>25
Combined shopping with other trips	28	50	43	62	50	45	29	43	47	12	49	55	41	49	49	32	49	48
Drove slower	20	31	25	31	31	26	13	26	27	10	30	30	23	26	35	22	26	30
Shopped closer to home	27	41	53	48	42	39	28	36	42	13	42	47	35	42	43	31	40	43
Tuned car	14	43	19	38	34	27	13	27	28	3	27	39	21	32	36	20	29	34
Shopped less often	25	48	39	48	40	39	25	33	42	11	40	49	33	39	49	29	38	42
Shopped on way home from work	16	25	46	28	31	23	4	24	24	10	24	29	20	26	30	11	27	28
Vacationed closer to home	13	20	33	30	26	22	11	22	22	8	20	29	18	24	27	16	24	24
Used train, bus, or plane for vacation	21	21	31	26	29	21	17	23	25	14	24	27	25	24	20	20	24	30
Canceled vacation trip	10	20	16	22	18	16	14	14	19	6	19	18	14	17	21	14	19	15
Bought a more fuel-efficient car	10	28	23	24	25	18	3	19	19	5	19	24	14	21	27	14	20	22
Used bus or subway for non-work travel	26	11	18	11	21	16	11	18	17	16	22	13	18	17	16	20	20	16
Carpooled to work	9	15	24	23	25	13	1	18	15	6	15	22	13	19	18	11	18	19
Took bus or subway to work	16	7	23	7	18	8	6	12	12	12	14	9	12	11	11	8	15	12
Eliminated recreational vehicle or boat	3	9	7	14	13	6	4	9	8	2	8	12	6	10	11	8	8	10
Sold a car	10	15	5	12	14	10	5	11	11	5	13	12	9	12	16	11	12	11
Walked or bicycled to work	5	7	11	14	14	7	2	9	10	6	10	9	8	9	14	10	10	9
Take job closer to home	3	6	8	6	8	3	2	4	5	3	4	6	4	5	6	6	5	4
Moved closer to work	1	2	2	4	4	2	0	2	3	2	2	3	1	2	4	3	2	3

Table 3. Percentages who would take energy-saving actions if a 20 percent gasoline shortfall occurred.

Action	Area				Age			Sex		Cars per Household			Household Size			Household Income ($000s)		
	New York City	Long Island	Westchester and Rockland Counties	Upstate	18-34	35-64	>65	Male	Female	0	1	>2	1-2	3-4	>5	<10	10-25	>25
Combined shopping with other trips	23	52	42	59	48	43	26	40	46	11	44	55	36	48	49	33	45	46
Drove slower	20	30	23	30	30	25	13	26	25	9	29	29	22	25	36	22	26	30
Shopped closer to home	23	29	48	47	40	36	24	34	38	11	39	44	33	38	41	30	37	38
Tuned car	13	34	19	34	31	23	11	24	26	3	24	35	19	29	30	19	27	28
Shopped less often	21	47	45	47	39	38	22	32	40	11	36	47	30	39	45	27	37	40
Shopped on way home from work	14	25	31	27	28	21	2	21	22	8	21	28	17	24	28	12	24	23
Vacationed closer to home	12	22	36	28	27	20	13	22	41	8	22	28	18	24	26	17	23	23
Used train, bus, or plane for vacation	22	21	37	26	30	22	17	24	25	13	25	29	25	26	21	22	23	32
Canceled vacation trip	13	25	41	22	23	20	14	19	22	6	23	24	18	20	25	16	23	20
Bought a more fuel-efficient car	10	26	28	22	22	19	5	18	18	5	19	24	13	21	27	15	19	21
Used bus or subway for nonwork travel	27	11	25	11	23	16	11	21	16	16	22	16	20	17	18	20	21	18
Carpooled to work	9	18	30	22	25	14	1	18	16	6	15	23	13	20	18	10	18	20
Took bus or subway to work	15	7	20	8	17	8	4	13	11	9	14	10	11	12	12	8	14	12
Eliminated recreational vehicle or boat	4	9	8	13	13	6	4	9	8	1	9	11	7	9	11	6	8	4
Sold a car	11	15	4	11	14	11	4	11	11	6	13	11	9	12	15	12	11	10
Walked or bicycled to work	5	7	7	13	14	5	2	8	9	6	9	9	8	8	12	11	10	7
Take job closer to home	2	4	6	6	7	3	1	3	5	3	4	5	3	5	5	6	5	3
Moved closer to work	1	2	0	4	4	2	0	2	3	2	2	3	2	3	3	4	3	2

CLH = factor for car left at home;
1/15 = miles per gallon for average car; and
S_i = household i's savings.

The following table shows the average amount of gasoline that a household would save per week by taking various actions:

Action	Average Household Saving per Week (gal)
Work related	
Bus, subway to work	4.18
Carpool to work	2.22
Walk, bicycle to work	0.93

Action	Average Household Saving per Week (gal)
Shopping	
Shop closer to home	0.43
Combine shopping with other trips	0.20
Shop less often	0.30
Bus, subway for nonwork trips	0.74
Shop on way home from work	0.58
Car	
Tune up	0.65
Drive slower	0.19
Buy a more fuel-efficient car	5.23
Sell a car but do not replace	8.02
Vacation	
Cancel trip	0.87
Change travel mode	1.91
Vacation closer to home	0.33
Eliminate recreational vehicle, boat	0.18
Move	
Live closer to work	1.54
Take job closer to home	2.04

(The average for New York State is 12.8 gal/week/car.) The actual derivations for different actions may be found in the Appendix.

By using these energy-savings values, the actual, or implied, number of gallons saved by each respondent who adopted these actions was computed and examined by various demographic breakdown for each of the three scenarios. Computation of total state savings for the 39-week period, Jan.-Sept. 1979, is obtained by expanding the data: total state savings $= \sum_{i=1}^{1520}$ (savings$_i$)(39 weeks)(0.30 incidence rate) (6.3 M households/1520).

Total Savings

Table 4 summarizes the total energy saved by New Yorkers based on various actions taken during the first 39 weeks of 1979. Overall, state residents conserved an estimated 289.5 million gal of gasoline. This represents a per-household saving of 46 gal. Of this saving, 44 percent was due to car-related actions, primarily the purchasing or selling of a car. Work and nonwork savings are approximately equal, with vacation-related savings close behind. Savings through the use of transit accounted for 16 percent and carpooling conserved 8 percent of the total.

When New Yorkers were queried about their future actions, the savings picture changes. If the price of gasoline increases to $1.50/gal, New Yorkers would increase their saving to 320.9 million gal of fuel. However, the breakdown of this saving shifts. Vehicle-purchasing action assumes greater importance as well as certain vacation-related actions (primarily modal changes). These upward trends come at the expense of work and nonwork actions, especially in the use of transit for the work trip, in driving slower, and in car tune-ups.

If a 20 percent reduction in the supply of gasoline were to occur, a similar pattern is forecast. Work and nonwork savings decline as vacation and car-purchasing savings increase.

Savings by Region

Significant differences were evident when the energy savings by region in New York were examined. During 1979, upstate residents accounted for 45 percent of the total savings; New York City residents, 35 percent; and Long Island residents, 16 percent. However, Long Island households had the highest average savings (56.4 gal), with upstate New York households a close second (51.3 gal). New York City households averaged the lowest saving (10.2 gal).

Downstate (New York City, Long Island, and Westchester and Rockland Counties) residents concentrated their savings in work-related actions, with transit accounting for 31 percent of New York City's savings. Upstate residents emphasized car-related actions for more than half of their total savings. Transit was responsible for only 4 percent of the gasoline saved in upstate New York. From these data, it can be concluded that transit is an effective energy saver if the service is already available. In areas such as New York City, with its extensive transit system, transit-related savings will be very high. However, in other areas with poorer service, transit will not be as effective, and policymakers should concentrate their efforts on other, more productive actions.

When looking at the two different futures (i.e., gasoline at $1.50/gal and a 20 percent shortfall), the savings picture is

Table 4. Overall transportation energy savings by New Yorkers during 1979 and under two scenarios.

Action	January-October 1979 Gallons (000 000s)	%	At $1.50/gal Gallons (000 000s)	%	At 20 Percent Shortfall Gallons (000 000s)	%
Work related						
Bus or subway to work	37.0	13	30.3	9	28.9	9
Carpool to work	22.9	8	24.5	8	26.4	8
Walk or bicycle to work	5.5	2	6.1	2	5.3	2
Shopping						
Shop closer to home	13.1	5	12.3	4	11.4	4
Combine shopping with other trips	6.9	2	6.7	2	6.3	2
Shop less often	7.7	3	8.4	3	8.0	3
Use bus or subway for nonwork trips	8.2	3	9.3	3	9.9	3
Shop on way home from work	10.6	4	10.0	3	9.0	3
Car						
Tune up	17.6	6	13.1	4	11.7	4
Drive slower	5.9	2	3.8	1	3.6	1
Buy a more fuel-efficient car	57.8	20	71.3	22	69.3	22
Sell a car (do not replace)	47.3	16	62.2	19	61.4	19
Vacation						
Cancel a vacation trip	10.3	4	11.0	3	13.4	4
Change mode for vacation	22.5	8	33.4	10	34.5	11
Vacation closer to home	4.1	1	5.3	2	5.2	2
Eliminate recreational vehicle or boat	1.2	–	1.1	–	1.1	–
Moves						
Move closer to work	3.4	1	3.1	1	3.6	1
Take job closer to home	7.5	3	9.0	3	6.6	2
Total saving	289.5	100[a]	320.9	100[a]	315.6	100[a]

[a]Percentage does not add to 100 due to rounding.

altered somewhat. Although the relative savings by region remain stable (even though New York City conserves less fuel), the emphasis within each region is changed. The importance of work-related actions in New York City declines primarily because of a reduction in the savings attributable to transit. Car-purchasing actions assume greater importance in all areas but upstate New York (where it is already high), and vacation-related savings increase everywhere. The relative importance of driving slower and tune-up declines.

Savings by Age

The elderly (over 65) population does not account for much of the total energy savings, either relatively or absolutely. This is not surprising because they travel less than the rest of the population. They place greater emphasis on shopping travel and less on work travel. However, all age groups give roughly equal emphasis to car purchasing, with a surprisingly high percentage of elderly (25 percent) taking these actions. On a per-household basis, young families conserved the most (57.1 gal).

Under a future of gasoline at $1.50/gal, all age groups increase their savings, but the proportion of savings in each age group remains constant. The middle-age group (35-64 years) puts increased focus on car- and vacation-related actions at the expense of work and shopping travel. The elderly population increases its savings from vacation actions (modal changes) and decreases its focus on shopping-related savings slightly. But 48 percent of the group shifted to car selling. Price squeezes would clearly affect car ownership patterns of the elderly more than any other group.

Potential fuel savings under a future of reduced energy supplies (20 percent less) are similar. The elderly would have a slightly lower energy savings (18.4 gal) than in 1979 (19.8 gal).

Savings by Sex

The energy savings in all areas are just about equal between men and women. In 1979, men concentrated their savings on work travel, and women placed more emphasis on shopping travel. Both sexes had their greatest savings in car-related actions—men, 43-45 percent, and women, 47-48 percent.

The pattern of savings is similar for each of the two futures. In each future, savings from car-related actions increase, males decrease their work-travel savings, and women decrease their shopping-travel savings. Both groups place more of their savings emphasis on vacation travel.

Savings by Car Ownership

As was expected, households with more than two cars were responsible for half of the gasoline conserved by New York State residents in 1979. Zero-car households accounted for less than 10 percent of the total savings. They placed more emphasis on transit actions (22 percent versus 9 percent for two-car households) and on vacation actions, especially modal change for the vacation trip. Car-related savings (accounting for more than 35 percent of the savings in all groups) was surprisingly similar across the groups.

Again, the two futures provide similar pictures. The importance of car-related action increased in households with zero or one car, and decreased in the two-car households. Vacation-related savings increase across the board at the expense of work and shopping-travel savings. The relative savings of each group remain constant, although zero-car households actually conserve less fuel (19 gal) under the two futures than they did in 1979 (24.1).

Savings by Household Size

Energy savings are spread across the various household sizes. Each group is responsible for a significant portion of the overall reduction in energy use, although one- or two-person households save less on a per-capita basis. Car-related savings are almost half of each group's total savings, with one- and two-person households saving a slightly smaller portion. Additionally, these households also have a larger portion of their savings in vacation-related actions. Overall, in 1979, the energy savings are about equally distributed among each household group.

In the two energy futures, car-related savings are still the greatest; vacation-related savings increase, and work and shopping-related savings decrease. Again, the savings are spread equitably across household groups.

Savings by Household Income

In the first nine months of 1979, the lower-income households accounted for only 11 percent of the total gasoline saved in New York State and saved relatively less per capita. Since this group is generally one with few travel options, this result is not surprising. Those that are more able to conserve, the middle- and upper-income groups, are the ones that bear the brunt of the savings, both relatively and absolutely. Car-related savings again are the largest—more than 40 percent of the total savings in each group. The lower-income group places more emphasis on car and shopping actions and less on work travel than the other two income levels.

The results under the two energy futures are again similar to each other. Work-related savings, especially for transit to work, decline in all groups. Vacation- and car-related savings increase across the board. The lower-income group again accounts for only 10-12 percent of the total conservation effort.

CONCLUSIONS AND IMPLICATIONS

Table 5 provides a summary of the energy savings in New York State during 1979 based on six demographic characteristics. Perhaps the primary observation from this analysis is the extensiveness and internal rationality of consumer actions to conserve transportation energy. New York residents did respond significantly to the 1979 energy crisis and saved more than 6 percent of the total gasoline used in the first three quarters of 1979 through a variety of actions that cut across all facets of travel.

Second, contrary to government pressure and exhortations, consumer saving is not accounted for primarily by carpooling, transit, slower driving, or by cuts in discretionary travel. While certain actions were mentioned with great frequency (e.g., rearranging shopping travel), they do not save much energy either cumulatively or individually. Most conservation occurred through car-related actions, particularly fuel-efficient car purchasing and car selling. In this way, many consumers are saving energy while maintaining mobility.

Third, the data suggest that consumers do not view conservation actions separately but as elements of sets that are selected for maximum benefit and minimum pain. Thus, actions taken early on to conserve marginal amounts of fuel (e.g., shopping travel actions, driving slower, and tuning cars) are likely to be replaced by major actions as prices rise or shortages deepen. As consumers switch to major actions—a trend clearly discernible in our data—government efforts to enforce or encourage unpopular or lower-level actions (such as ridesharing, use of transit, driving slower, and tuning cars) are likely to become more difficult. In fact, our data suggest that upward trends in transit use, driving slower, ridesharing, and, possibly, tune-ups have probably peaked and are likely to turn downward in the future without strong government pressure.

Fourth, we are struck by the observation that consumer actions were generally independent of government directives. In fact, viewed against the wide range of survey responses and their particular focus, government suggestions and efforts to encourage conservation have been narrow and ineffective. Clearly, there is a lot more going on out there than we are readily able to assess.

Table 5. Percentage of energy saved by New York State residents, January-October 1979, based on six demographic characteristics.

Action	Percentage of Total Saving																	
	Area				Age			Sex		Cars per Household			Household Size			Household Income (000s)		
	New York City	Long Island	Westchester and Rockland Counties	Upstate	18-34	35-64	>65	Male	Female	0	1	>2	1-2	3-4	>5	<10	10-25	>25
Work related																		
Bus or subway to work	25[a]	11	17[a]	3[b]	2[b]	13	11	16	9	15	19	8[b]	13	12	14	11	14	14
Carpool to work	6	9	16[a]	8	8	9	1[b]	10	5	6	7	9	8	9	7	4	9	10
Walk or bicycle to work	2/33	2/22	/33	2/13	12[a]/22	2/24	/12	2/28	2/16	2/23	1/27	2/19	2/23	1/22	3/24	2/17	1/24	2/26
Shop related																		
Shop closer to home	4	4	9[a]	5	4	5	9[a]	4	6	4	5	4	5	4	4	6	4	4
Combine shopping with other trips	2	2	3	3	2	3	4	2	3	1	3	2	3	2	2	2	2	2
Shop less often	2	3	3	3	2	3	5	2	3	2	3	3	3	3	3	3	2	3
Bus or subway for nonwork trips	6	1	4	1	3	3	5	3	3	7	4	1	3	2	3	4	3	2
Shop on way home from work	4/18	3/13	5/24	4/16	4/15	4/18	1/24	3/14	4/19	3/17	4/19	4/14	3/17	4/15	4/16	3/18	4/15	4/15
Car related																		
Tune up	5	6	11[a]	7	5	7	7	6	7	1[b]	7	7	6	6	7	5	6	6
Drive slower	2	2	3	2	2	2	3	2	2	1	2	2	2	2	2	2	2	2
Buy a more fuel-efficient car	14	20	10[b]	26	20	19	25	19	21	12	18	23	20	20	21	19	21	18
Sell a car (do not replace)	10[b]/31	22[a]/50	–[c]/24	21[a]/56	18/45	15/43	13/48	16/43	17/47	24[a]/38	12/39	18/50	13/41	18/46	18/48	23[a]/49	15/44	15/41
Vacation related																		
Cancel a vacation trip	4	2	3	4	4	4	3	3	4	3	5	3	4	4	3	4	4	3
Change mode for vacation	10	6	11	6	8	7	7	7	9	12[a]	7	7	10	7	5	8	7	9
Vacation closer to home	1	1	3[a]	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
Eliminate recreational vehicle or boat	/15	/9	/17	1/13	/13	/12	1/12	/11	/14	/16	/13	/11	/15	/12	/9	1/15	/12	/13
Moves																		
Move closer to work	1	2		1	1	1		2	1	1	1	1	2	1		1	1	1
Take job closer to home	3/4	3/5		2/3	3/4	2/3	4/4	3/5	2/3	5[a]/6	2/3	3/4	3/5	3/4	1/1	1/2	3/4	2/3

Note: Blank cells represent less than 1 percent.
[a]Higher than average. [b]Lower than average. [c]Less than 1 percent, but lower than average.

From this analysis, the following conclusions can be drawn.

1. Consumer behavior under energy constraints is not well understood. Clearly, though, behavioral response depends on (a) options available, (b) economic position, (c) prior investments and options, and (d) crisis severity. What is known is that numerous options are taken jointly by different groups. Therefore, the role of government at all levels should be to expand options and make them available to more people rather than to constrain and coerce behavior.
2. Narrow governmental focus solely on transit and ridesharing is unproductive because it encourages actions that in total save little energy and constrain mobility. A better strategy would be to develop and encourage packages of actions for different market segments, based on the savings behavior of different groups.
3. Because replacement behavior by consumers may have impacts on other dimensions (e.g., declines in driving slower affect safety), governments should be particularly aware of possible negative impacts and losses in energy savings. Programs to prevent such deterioration should be developed as part of energy conservation and contingency planning.
4. Relative savings effort (e.g., savings per household) should not be viewed too rigorously. Although such statistics may indicate a softness of response in certain markets and overachievement in others, a more reasonable conclusion is that the economic circumstances of respondents, combined with options available to them, slows or accelerates relative savings. Government should focus on the differences in action profiles rather than on the differences in relative savings.

In summary, our major finding is that consumers are responding to energy constraints and will continue to do so in the future. The nature of these responses varies by area and group. Generally, consumers will choose sets of actions

that are available, are in their own best interests, minimize mobility loss, build on prior actions, and are economically workable for them. If government operates to help consumers by expanding, publicizing, and economizing the use of options, conservation can occur with minimum mobility loss and without coercion.

APPENDIX—Derivation of Weekly Energy Savings

In order to develop estimates of the energy savings that resulted from the public's response to the gasoline shortages during the summer of 1979, some estimates of the weekly energy-saving potential of each of the 18 actions taken during this time period must be derived. In this project, these estimates were developed by using typical New York State trip lengths and trip rates (24) and an assumed average statewide CAFE of 15 miles/gal. To account for the car left home for some actions, the estimated savings are reduced by 40 percent (24). This section documents the formulations used to estimate the weekly energy saved by each action contained in the Crossley survey. Independent checks are provided where available.

1. Take Bus or Subway to Work

Savings = work-trip length x 2 x 1/CAFE x 5 days/week x car-left-home factor = work-trip length x 2 x 1/15 x 5 x 0.6 = work-trip length x 0.400 gal/week.

As an independent check, Erlbaum (26) shows that the increase in transit ridership on state transit systems during the first three quarters of 1979 accounts for about 25.9 million gal of gasoline saving, or about 9 percent of this total gasoline saving of 280 million gal. Adding the expanded estimates from Table 4 provides an estimate of 45.2 million gal from the Crossley poll. (Work-trip length for each household is taken from the Crossley study.)

2. Carpool to Work

Assume (a) a circuity factor of 10 percent and (b) drive 2 days/week.

Savings = $[(\text{work-trip length} \times 2 \times 5 \text{ days/week})_B - (\text{work-trip length} \times 2 \times \text{circuity} \times 2 \text{ days/week})_A] \times 1/\text{CAFE} \times \text{car-left-home factor} = \text{work-trip length} \times [(2 \times 5) - (2 \times 1.1 \times 2)] \times 1/15 \times 0.6 = \text{work-trip length} \times 0.224$ gal/week.

An independent check can also be made. Brunso (27) showed that the effect of the 1979 energy crisis was to increase the percentage of people carpooling by 3.5 percentage points among state workers in Albany. Further, the average gasoline saving per carpooler was found to be 283 gal/year. If this saving holds for all workers, then a rough estimate of total savings is as follows: energy saved = (283 gal/year)(0.75 year)(0.035)(4.1 M workers upstate) = 30.4 million gal. This is reasonably close to the Crossley estimate of 22.9 million gal (Table 4).

3. Walk or Bicycle to Work

Assume either mode applicable for six months.

Savings = work-trip length x 2 x 5 days/week x 1/CAFE x 1/2 year x car-left-home factor = work-trip length x 2 x 5 x 1/15 x 1/2 x 0.6 = work-trip length x 0.200 gal/week.

4. Shop Closer to Home

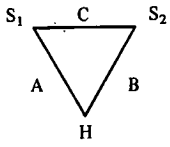
Assume (a) a potential saving of 30 percent and (b) opportunity to shop 5 days/week.

Savings = shopping-trip length x 2 x 5 days/week x shopping-trip rate/day x 1/CAFE x potential savings = 2.75 x 2 x 5 x 0.77 x 1/15 x 0.3 = 0.424 gal/week.

5. Combine Shopping with Other Trips

Assume the following:

(a) one opportunity/week
(b) before-trip pattern: H→S_1→H→S_2→H
(c) after-trip pattern: H→S_1→S_2→H



Savings = [(2A + 2B) - (A + B + C)] x 1/CAFE x times/week = [(2 x 2.75 + 2 x 2.75) - (2.75 + 2.75 + 2.45)] x 1/15 x 1 = 0.203 gal/week.

6. Shop Less Often

Assume a 20 percent lower shopping-trip rate.

Savings = shopping-trip rate x 0.2 x shopping-trip length x 2 x 1/CAFE x 5 days/week = 0.77 x 0.2 x 2.75 x 2 x 1/15 x 5 = 0.282 gal/week.

7. Use Bus or Subway for Nonwork Travel

Assume an opportunity for nonwork travel 2 times/week.

Savings = shopping-trip length x 2 x 1/CAFE x 2 times/week = 2.75 x 2 x 1/15 x 2 = 0.733 gal/week.

8. Shop on Way Home from Work

Assume the following:

(a) before-trip pattern: H→W→H→S→H
(b) after-trip pattern: H→W→S→H
(c) opportunity 2 times/week.

Savings = (before-trip length) - (after-trip length) x 1/CAFE x 2 times/week = [(5.1 + 5.1 + 2.75 + 2.75) - (5.1 + 3.70 + 2.65)] x 1/15 x 2 = 0.567 gal/week.

9. Tune Car

Assume (a) a saving of 5 percent and (b) an annual VMT/car of 10 000 miles.

Savings = 0.05 x VMT/week x 1/CAFE = 0.05 x 10 000/52 x 1/15 = 0.641 gal/week.

10. Drive Slower

Assume (a) a saving of 1.5 percent and (b) an annual VMT/car of 10 000 miles.

Savings = 0.015 x VMT/week x 1/CAFE = 0.015 x 10 000/52 x 1/15 = 0.192 gal/week.

11. Buy a More Fuel-Efficient Car

Assume (a) a saving of 40 percent and (b) an annual VMT/car of 10 000 miles.

Savings = 0.4 x VMT/week x 1/CAFE = 0.4 x 10 000/52 x 1/15 = 5.128 gal/week.

12. Sell a Car (Do Not Replace)

Assume (a) a saving of 60 percent and (b) an annual VMT/car of 10 000 miles.

Savings = 0.6 x VMT/week x 1/CAFE = 0.6 x 10 000/52 x 1/15 = 7.692 gal/week.

As a check, Erlbaum (28) estimated the 1979 saving due to fleet turnover as 140 million gal on an annual basis, or 105 million gal for 9 months. This is close to the Crossley estimate of 105.1 million gal for selling a car and buying a more fuel-efficient car (Table 4).

13. Cancel a Vacation Trip

Assume that the average vacation trip is 717 miles.

Savings = vacation-trip length x 1/CAFE x 1/52 weeks = 717 x 1/15 x 1/52 = 0.919 gal/week.

14. Change Mode for Vacation

Assume a 1500-mile trip.

Savings = vacation-trip length x 1/CAFE x 1/52 weeks = 1500 x 1/15 x 1/52 = 1.923 gal/week.

15. Vacation Closer to Home

Assume 250 miles saved.

Savings = vacation miles saved x 1/CAFE x 1/52 weeks = 250 x 1/15 x 1/52 = 0.321 gal/week.

16. Eliminate Recreational Vehicle or Boat

Assume that the average household uses 9.36 gal/year for recreational vehicle or boat.

Savings = 9.36 x 1/52 = 0.180 gal/week.

17. Move Closer to Work

Assume a work-trip cut of 50 percent.

Savings = work-trip length x 2 x savings x 1/CAFE x 5 days/week = work-trip length x 2 x 0.5 x 1/15 x 5 = work-trip length x 0.333 gal/week.

18. Move Job Closer to Home

Assume a work-trip cut of 50 percent.

Savings = work-trip length x 0.333 gal/week.

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