Trends in New York State Automobile Ownership Patterns 1973-1977

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Data on all motor vehicles that have a gross vehicle weight of up to 2722 kg (6000 lb) registered to persons in New York State were analyzed with respect to age and sex of the owner. The study found that the increase in the vehicle fleet in New York State from 1973 to 1977 can be attributed solely to women. Increases in women's ownership are moderated somewhat by differential population growth by age cohort. The main determinants for the men's level of ownership appear to be economic conditions expressed in employment. As to the type of automobile owned, men generally register much heavier automobiles than do women, and the men's vehicles show somewhat larger increases in average gross vehicle weight. Disaggregated by age, men and women show similar patterns in the gross vehicle weight increase, which is probably a reflection of economic conditions. Vehicles registered to young men and women show an extremely high increase in gross vehicle weight, those registered to middle-aged persons show a very low increase, and those registered to older persons show a moderate but steady increase. At the very least, an ongoing statewide fuel-efficiency monitoring program for new automobiles is called for.

New York State has considerable reason to be concerned about energy use in its transportation sector. In 1974, New York State imported 84 000 000 m^3 (530 000 000 bbl) of petroleum. Approximately half of the energy generated from such petroleum imports is used in transportation, where current technology offers little possibility for energy substitution (1). More important, through payments made for petroleum and petroleum products, New York State loses substantial economic resources to other states and overseas (2, 3). The federal government has reacted with a mandatory corporate-average-fuel-economy (CAFE) standard (Public Law 94-163) for new automobiles through 1985. Such federal programs, however, are generally ill-prepared to cope with the effects of regional maldistribution: We could, for instance, find that the CAFE standards are attained on the federal level but still see large state-to-state variations.

In addition, the availability of crude oil as a natural resource or the lack of such, climatic differences, economic development, and a host of other regionally differing factors warrant the development of state or regional energy policy to supplement or even substitute for federal policy. This paper presents results of an ongoing effort of the New York State Department of Transportation to assess the background, trends, and effect of policy alternatives on energy usage in New York's transportation sector. Other reports are available (4-6) and more will be coming forth in the future. This paper is based on an earlier report (7) and represents a refinement of some of the earlier findings. Detailed backup information to the analysis in this paper is only included where necessary; the interested reader is referred to the earlier report (7) for a full presentation of all available background data.

DATA AND METHOD

For a given state, total gasoline consumption is determined by automobile ownership and automobile usage patterns. On the individual level, an automobile's efficiency is determined by a variety of factors, the most important of which is vehicle weight (8). Thus, policies that aim, directly or indirectly, to reduce vehicle weight have a particularly high potential to reduce automotive fuel consumption. The federal program to increase new automobile efficiency to 11.7 km/L (27.5 miles/gal) by 1985 initially relies heavily on weight reduction as one means to achieve its goals (9).

The current study focuses on a segment of the New York State vehicle fleet defined as follows: all passenger and commercial vehicles of up to 2722 kg (6000 lb) gross vehicle weight (GVW) registered to private owners. Commercial vehicles were included because a van or a pickup truck owned for business purposes is frequently used for personal transportation as well. For this research, New York State's Department of Motor Vehicles cross-matched its vehicle license and drivers' license files to permit analysis of these vehicles by weight and the owner or registrant's age, sex, and county of residence. The period covered by these data is January 1973-June 30, 1977.

The following analysis deals with all of these variables except county. The same argument that was used to justify statewide analysis within the federal frame could be used for the inclusion of county data within a statewide analysis, but time constraints did not allow us to do so. Work to include this differentiation is in the planning stage.

So far, analysis of vehicle efficiency and consumer behavior toward fuel-efficient vehicles deals almost exclusively with new automobiles and, at best, takes the existing fleet as a given (10-13). Almost half of the New York State fleet is at least five years old (see Table below) (14), so we are ill advised to disregard the effect of old automobiles on the state's fleet's efficiency.

Automobile Age (years)	Percentage of Fleet
New	13
1	11
2	11
3	11
4	10
5	9
6	9
7	8
8	6
9	5
10	3
11	2
12+	2

A number of shortcomings of the data need to be pointed out:

1. Multiple automobile ownership is inherent in the data. Nationwide, the percentage of multiple automobile-owning households was 42 percent of all automobile-owning households in 1974 (15).
2. The cross-tabulations are by age and sex of the registrant. The registrant, however, does not have to be the primary user. In New York State sharply different insurance premiums based on the sex and age of the registrant provide incentives to register automobiles in the names of women or older persons.
3. The summary tabulation of automobiles without respect to automobile age makes it almost impossible

to separate effects of differential longevity of automobiles, changes in the automobile age distribution, and changes in vehicle size (measured by weight) from one another.

TRENDS IN DEMOGRAPHICS AND THE VEHICLE FLEET IN NEW YORK STATE

Size of the Fleet

Overall, the fleet has increased by 183 923 vehicles, from 7 759 378 in December 1973 to 7 943 301 vehicles in December 1976 (Figure 1). Female registrants account for all of this increase. Male registrants show a net loss over this period, in spite of a slight recovery in the male-registered fleet after the loss in 1974. This development initially contrasts with population trends. However, if we disaggregate automobile owner and population trends by age and sex (Figure 2), women show an across-the-board increase in vehicle registrations, moderated somewhat by population growth, which is not uniform for all age groups. For men, the analysis is slightly more complex. Men up to age 45 show a loss in registrations, which is moderated by the growth of that male population age cohort, and men older than 45 show a gain in registrations, which is moderated by the reduction in the size of that age cohort.

This crossover requires additional variables for a full explanation. Economic conditions, as described by employment, for instance, provide part of such an explanation: Young and middle-aged men have fared worse with respect to employment than did their share in the population (Figure 2). Young and middle-aged women, on the other hand, show gains in employment far ahead of the increases in the respective population size; thus a greater need is generated for personalized transportation and the economic resources to acquire additional vehicles are provided (Figure 2). The larger work force of women is supported by a substantial increase in labor-force participation, which reflects changed child-bearing habits as well as the emergence of nontraditional households, which showed a substantially larger growth than did traditional households. If we look at young and middle-aged men and women together, we cannot exclude the possibility of shifts in registrations from men to women under the differential insurance rates in New York State. From the foregoing analysis, we should expect to see an increasing number of vehicles registered

Figure 1. Fleet size, New York State fleet 1973-1977.

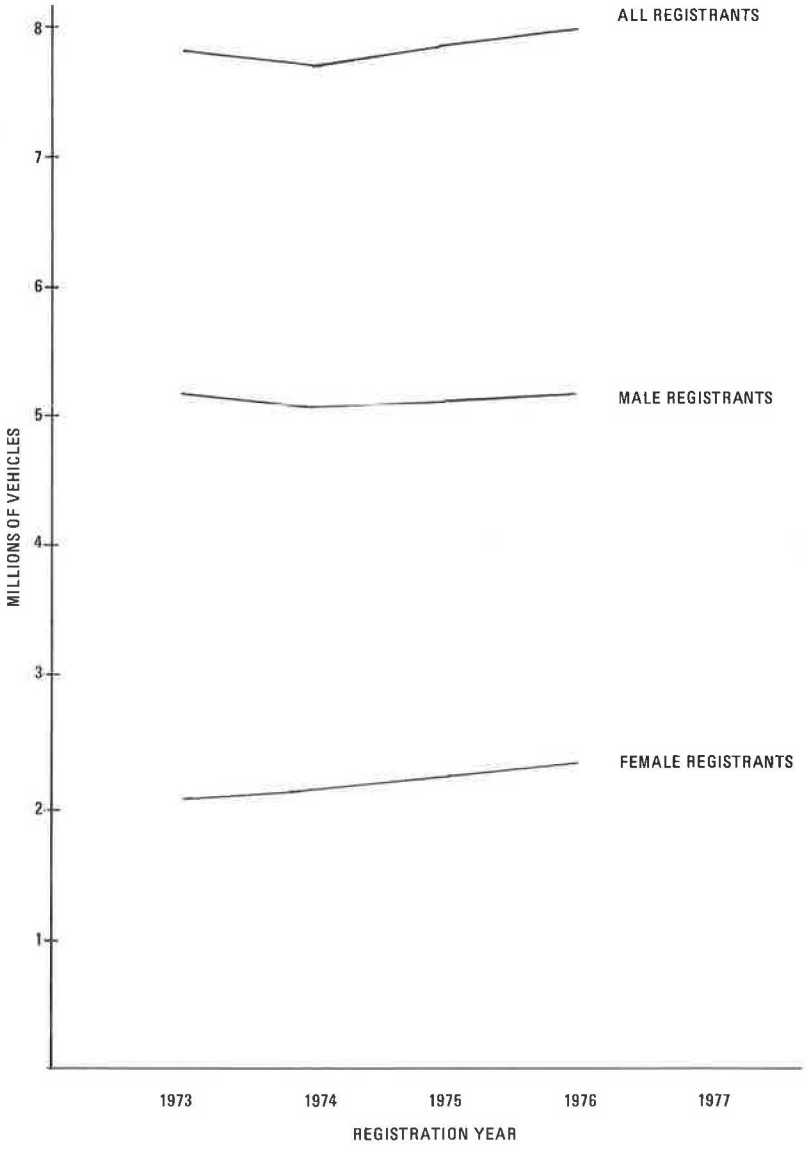


Figure 2. Changes in fleet size, population and employment, by sex in early 1970s.

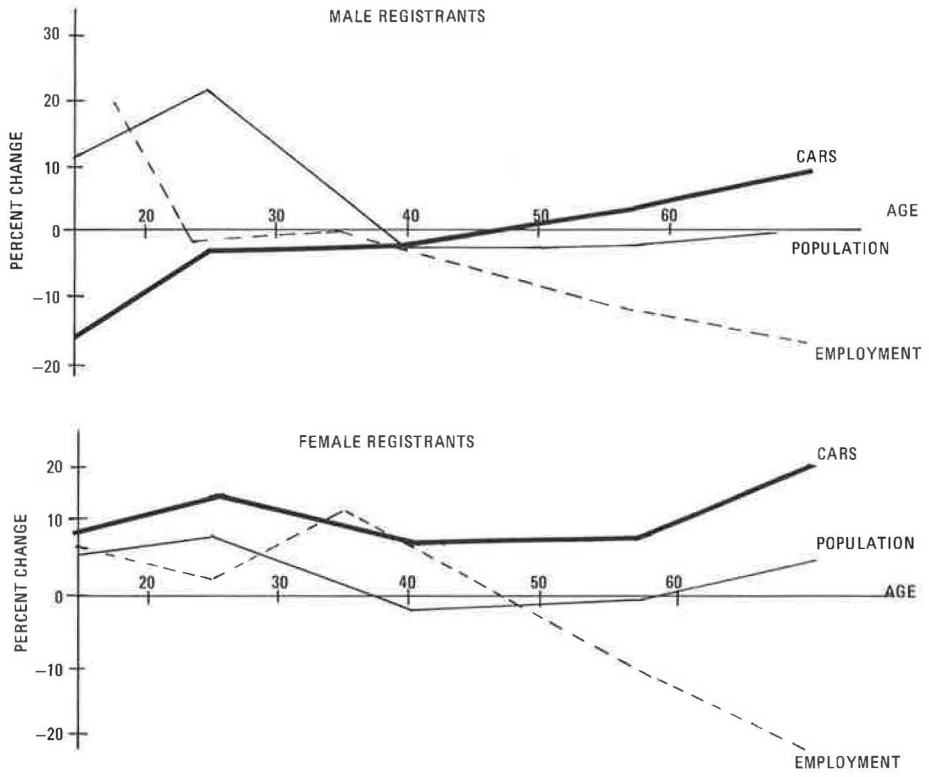


Table 1. Selected automobiles: trends in weight, 1972-1977.

	GVW (kg)						
Automobile[a]	1972	1973	1974	1975	1976	1977	Δ 1974-1977
Impala	1782	1877	1907	1913	NA	1617	-290
Monte Carlo	1590	1684	1781	1781	1772	1747	-34
Cutlass	1551	1717	1780	1691	1674	1641	-139
Nova	1355	1390	1448	1500	1461	1440	-8
Vega	979	1007	1075	1095	1108	-[b]	
Pinto	934	959	1076	1132	1111	1049	-27
Corolla	805	821[c]	823	986[d]	1010	914	+91

Note: 1 kg = 2.2 lb.
[a] Basic model. [b] Discontinued. [c] Estimate from similar model. [d] Change in model designation.

to women of all age groups, as well as to older men; however, an increase in registrations for young and middle-aged men should only occur if the employment of these persons improves.

Trends in Vehicle Weight

In spite of a petroleum supply crisis in 1973-1974 and increased marketing of smaller and scaled-down automobiles, average GVW of the New York State fleet increased steadily between 1973 and 1977 (1 kg = 2.2 lb).

Year	Average GVW (kg)	Change
1973	1581	
1974	1589	+8
1975	1596	+7
1976	1608	+12
1977	1616	+8

There are three effects reflected in the GVW figures: changes in the age distribution, differential longevity by automobile size (larger automobiles tend to last longer than do small automobiles), and the average GVW of each model year as it enters the fleet. Separation of the effects of these three sources of variation from one another would be important, but the only effect we can account for with some certainty is due to changes in the age distribution. We have some knowledge of the development of GVW by model type (Table 1) but are unable to properly account for the effect of differential longevity without extensive analysis.

The basic method for the extraction of the model year effect from the fleetwide average GVW is as follows: The average, fleetwide GVW in any given calendar year can be written as the weighted average of the average GVW by model year of all model years on the road in that calendar year; the weights used are the percentages, which reflect the composition of the fleet in the given calendar year in terms of vehicles of all model years on the road in in that calendar year.

For 1975, for instance:

$$1596 \text{ kg} = 0.823\ GVW_{73-} + 0.108\ GVW_{74} + 0.069\ GVW_{75} \quad (1)$$

where 1596 kg (3518 lb) is the fleetwide New York State average GVW for 1975; GVW_{73-} is the average New York State GVW of automobiles of vintage 1973 and earlier; GVW_{74} and GVW_{75} are the contributions of model years 1974 and 1975, respectively, to the fleetwide 1975 average GVW; and 0.823, 0.108, and 0.069 are the percentages of the vehicles of those vintages in the 1975 New York State fleet.

By using the fleetwide average New York State GVW from the table above and known age distributions, we obtain the following system of linear equations:

$$\begin{bmatrix} 1581 \\ 1584 \\ 1596 \\ 1608 \\ 1616 \end{bmatrix} = \begin{bmatrix} 1.0 & 0 & 0 & 0 & 0 \\ 0.8987 & 0.1013 & 0 & 0 & 0 \\ 0.823 & 0.108 & 0.069 & 0 & 0 \\ 0.718 & 0.1013 & 0.0857 & 0.095 & 0 \\ 0.646 & 0.10 & 0.081 & 0.101 & 0.072 \end{bmatrix} \times \begin{bmatrix} GVW_{73} \\ GVW_{74} \\ GVW_{75} \\ GVW_{76} \\ GVW_{77} \end{bmatrix} \quad (2)$$

The solution of this system of equations yields 1581 kg (3485 lb) for GVW_{73} and the following values for the remaining variables (1 kg = 2.2 lb):

Year (XX)	GVW_{XX} (kg)	ΔGVW
1974	1666	
1975	1664	-2
1976	1701	+37
1977	1691	-10

The trends in these numbers (as reflected by the changes from year to year in the last column) is reason for concern. Even if we were to allow that the effect of differential longevity could influence the trend as well as the level of the solution, we find that this trend does not really reflect the development observed in GVW by model (Table 1).

This pattern, obviously, does not have to mean that New Yorkers buy larger automobiles; an alternative explanation for the increase is that they load their automobiles with heavy options. Irrespective of the reasons, we observe a less than desirable change in fleet efficiency.

That our concern should not only be about new automobiles but also about used automobiles as well is evidenced by the table below, which shows much more massive shifts in registration than new automobiles alone could produce (1 kg = 2.2 lb).

Weight Class (kg)	Model Year 1973-1974	1974-1975	1975-1976
<1134	+4 922	+36 496	-11 651
1135-1588	-75 872	-14 032	-15 078
1589-1814	-82 854	-43 813	+26 037
1815-2268	+52 229	+81 801	+95 204
>2269	+41 214	+42 331	+46 989
Total	-60 361	+102 783	+141 501

In consideration of the problems experienced when the new automobiles were introduced into the fleet during 1974-1976, we should expect some of these moves to be due to differential longevity. Due to different usage patterns (12), large automobiles have the potential to remain in the fleet longer, a situation that may be aggravated as replacement decisions are deferred. This deferral of replacement is reflected in new automobile registrations in New York State. (This table excludes vehicles registered commercially to private persons.)

Year	New Privately Owned Registrations
1970	777 726
1971	792 173
1972	819 090
1973	874 280
1974	670 349
1975	618 753
1976	699 393
1977	713 964

Table 2. Average GVW: male and female owners.

	Male		Female	
Year	Average	GVW (kg) Δ	Average	GVW (kg) Δ
1973	1608		1507	
1974	1618	+10	1515	+8
1975	1630	+12	1520	+5
1976	1641	+11	1530	+10
1977	1650	+9	1536	+6
1973-1977		+42		+29

Note: 1 kg = 2.2 lb.

The drop between 1973 and 1974 is dramatic, and the level of the late 1960s has not been reached again. Even cursory inspection reveals that this pattern is not reflected to the same extent in fleet size; additional evidence of increasing pressure on the used-automobile market stems from the price index of used automobiles (increase of 83 percent since 1967 and a dramatic increase in the rate of growth around 1974 versus an increase of 41 percent for new-automobile prices during the same period) (13).

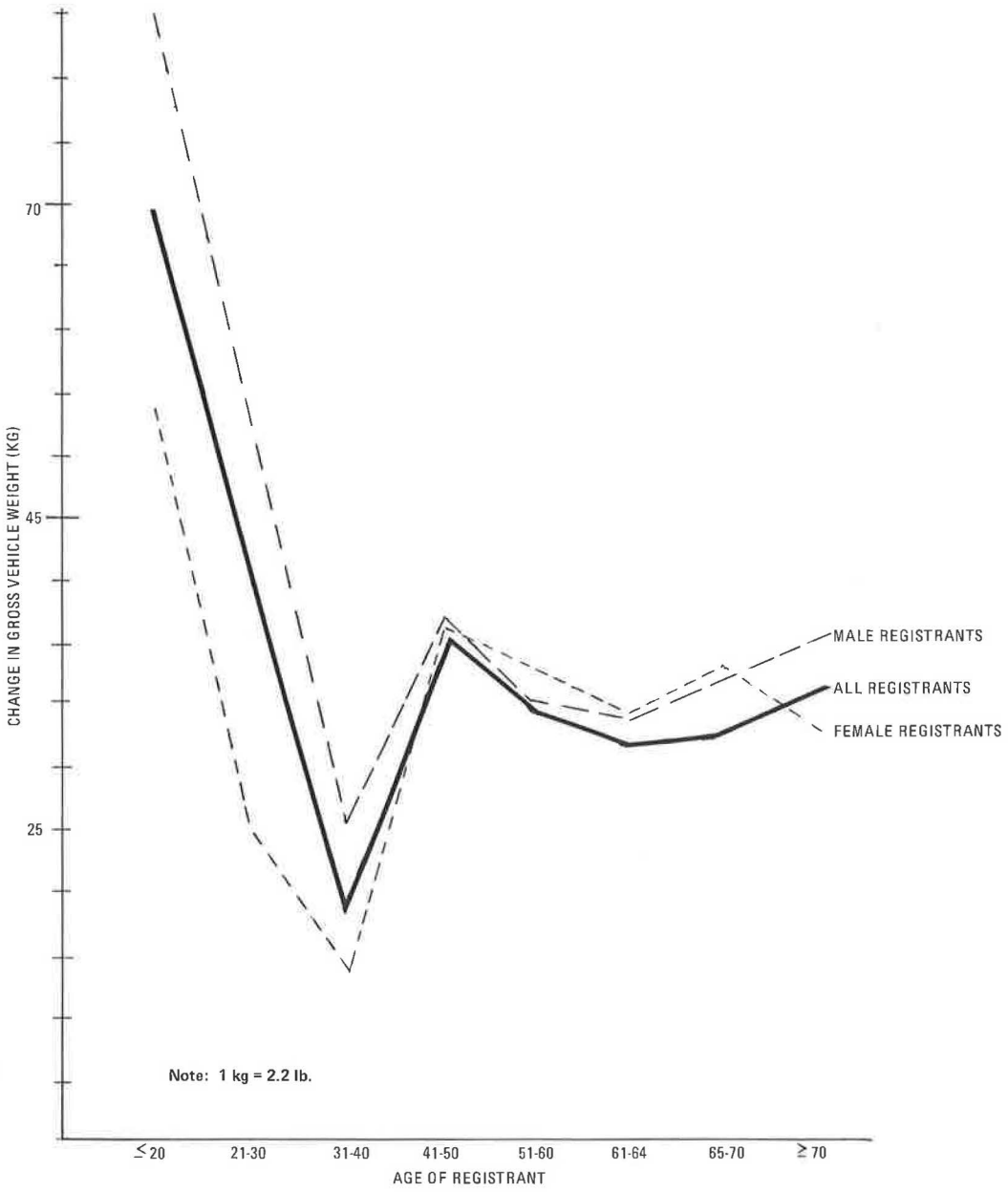
Despite reservations about the quality of the data, the trends of average GVW disaggregated by the sex and age of the registrant are examined. Only fleetwide trends can be examined since we do not know the fleet-age distributions disaggregated for these fleet segments.

Disaggregation by sex shows that women, in general, register much lighter automobiles than do men and that the increase in weight of automobiles owned by women was less than that of the automobiles owned by men (Table 2).

This finding is in line with the view that women are more energy conscious than men (16), but other economic factors probably contribute more to the explanation of this finding. It is also quite possible that a substantial share of automobiles registered to women belong to multiautomobile households. At least for new automobiles, it has been demonstrated that a second automobile tends to be smaller than the first automobile in multiautomobile households (12). Since the automobile insurance rates in New York State favor women over men (heavily so in the younger age groups), we would expect many second automobiles to be registered in the names of women rather than men.

Finally, in a comparison of average GVW increases by sex and age of the registrant, we find virtually the same pattern for men and women (Figure 3). Age, obviously, is a very important discriminator. Not surprisingly, there appear to be three distinctly different age groups that correspond rather well to the three groups identified in the examination of vehicle registrations. This points to a common cause in these patterns, which we believe to be largely economic. The level of discretionary income tends to be very low at a young age, to be higher but largely tied up for the establishment of a household for middle-aged persons, and to rise dramatically in the last few years of employment when dependents have left the household and most major purchases (e.g., a house) no longer constitute a severe drain on earnings. This leads us to hypothesize that increases in automobile prices have forced young people into the clunker segment of the used-automobile market, which is generally heavier in GVW than the somewhat broader segment previously accessible to them. Middle-aged people, due to the severe strain on their resources by other household-related expenses, have probably found it hard to frequently trade automobiles and thus have escaped the market pressures that would force them into relatively cheaper but heavier automobiles. In addition,

Figure 3. Change in average New York State GVW, 1972-1977, by sex.



since these persons are likely to acquire relatively new automobiles as a bounce-back effect from the previously owned rather old automobiles, they do not need to follow a steady, frequent pattern of trading. We hypothesize that such a pattern lies behind the steady increase in GVW found for older persons who own automobiles.

OUTLOOK

In the 1976 and 1977 model years, the strong trend to increase the weight of models came to a halt (Table 1). The start of a substantial scaling-down program is expected to continue over the next few years (17). Specifically, the U.S. Department of Transportation (DOT) expects that scaling down alone will be sufficient to achieve 1981 CAFE standards but that substantial changes in engineering, design, and materials will be required to meet the standards thereafter (9). Manufacturers, who have over the past years introduced a variety of new subcompact models (Chevette, Fiesta, Omni-Horizon) priced to meet the Japanese competition (and generally below comparable prices for European automobiles) are likely to meet or exceed the 1978 CAFE standard of 7.7 km/L (18 miles/gal). In New York State, the CAFE figure for the first nine months of the 1978 model year was an estimated 8.9 km/L (19.0 miles/gal). However, since three of the four American automobile manufacturers (Ford, Chrysler, and American Motors) have admitted that they lose money on each of the small automobiles they sell and the fourth manufacturer (General Motors) has declined to make public statements, we should not expect American manufacturers to push sales of these very efficient vehicles more than necessary to meet CAFE standards.

There is some short-term relief on petroleum imports due to larger domestic production in Alaska, substitution of other sources, and conservation efforts (14), but demand for petroleum products in the transportation sector continues to increase. This does not have to mean that conservation goals in transportation are not met; considering the composition of the vehicle fleet with respect to average fuel efficiency by model year (18) and

age distribution, an increase in demand for petroleum products has to be expected for several more years to come.

CONCLUSIONS

Among all the trends observed in this study, two are reasons for concern from an energy conservation point of view: the continued increase in vehicle registrations, which is possibly linked to an increase in multi-automobile households, and the lack of a strong decrease in average GVW in the 1977 model year. This latter trend is particularly disturbing since it can have a variety of meanings. These include a temporary bounce-back effect after the difficult years of 1974-1976, a last chance to own a big automobile rush, and outright consumer rejection of smaller vehicles. In the light of these possibilities, the 1978 model year takes on particular importance in the analysis of this trend. This model year showed not only very substantial scaling down in size but also a number of new, smaller models in the American market. Thus, in the light of the wide range of policy implications represented by the above consumer attitudes, it is virtually mandatory that New York State institute on ongoing new-automobile fuel-efficiency monitoring program. In view of the pervasive influence of older automobiles on the fleet efficiency, an extension of this monitoring program to older automobiles might be indicated as well. Depending on the trends observed under this program, one or several of the policy programs described in another paper (7) should be considered for implementation.

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