3. Vehicle Miles Traveled

This chapter presents information on household vehicle usage, as measured by the number of vehicle miles traveled (VMT). VMT is one of the two most important components used in estimating household vehicle fuel consumption. (The other, fuel efficiency, is discussed in Chapter 4). In addition, this chapter examines differences in driving behavior based on the characteristics of the household and the type of vehicle driven. Trends in household driving patterns are also examined using additional information from the Department of Transportation's Nationwide Personal Transportation Survey (NPTS).

Household VMT is a measure of the demand for personal transportation. Demand for transportation may be viewed from either an economic or a social perspective. From the economic point-of-view, the use of a household vehicle represents the consumption of one consumer good to secure other goods or services: household members drive to work, to shop, for recreation, or to socialize. The social perspective takes into account the makeup of the household and the motivation for each vehicle trip.

Total and Average Vehicle Miles Traveled

In 1991, household vehicles traveled a total of just over 1.6 trillion miles, up by 91 billion miles (6.0 percent) since 1988 (Table 5). This represents an annual increase of only 2.0 percent, which is substantially slower than in the early 1980's (between 1983 and 1988, annual growth averaged about 4.5 percent). The total increase since 1983 (32 percent) corresponds to an average annual increase of 3.5 percent per year.

Table 5. Annual Percent Change in Vehicles and Vehicle Miles Traveled, 1983, 1985, 1988, 1991

	Survey Year				Survey-to-Survey Annual Percent Change			Overall
	1983	1985	1988	1991	1983 to 1985	1985 to 1988	1988 to 1991	1983 to 1991
Number of Households (million)	84.4	87.3	91.6	94.6	1.7	1.6	1.1	1.4
Number of Households with Vehicles (million)	72.2	77.7	81.3	84.6	3.7	1.5	1.3	2.0
Real Disposable Personal Income (billion $1987)	2894	3162	3404	3535	4.5	2.5	1.0	2.4
Number of Household Vehicles (million)	129.3	137.3	147.5	151.2	3.0	2.4	0.8	2.0
Vehicles Miles Traveled (billion)	1215	1353	1511	1602	5.5	3.8	2.0	3.5
Vehicle Miles Traveled per Household with Vehicles (Thousand)	16.8	17.4	18.6	18.9	1.7	2.2	0.6	1.5

Vehicle Miles Traveled per Vehicle (Thousand)	9.4	9.9	10.2	10.6	2.4	1.3	1.3	1.5

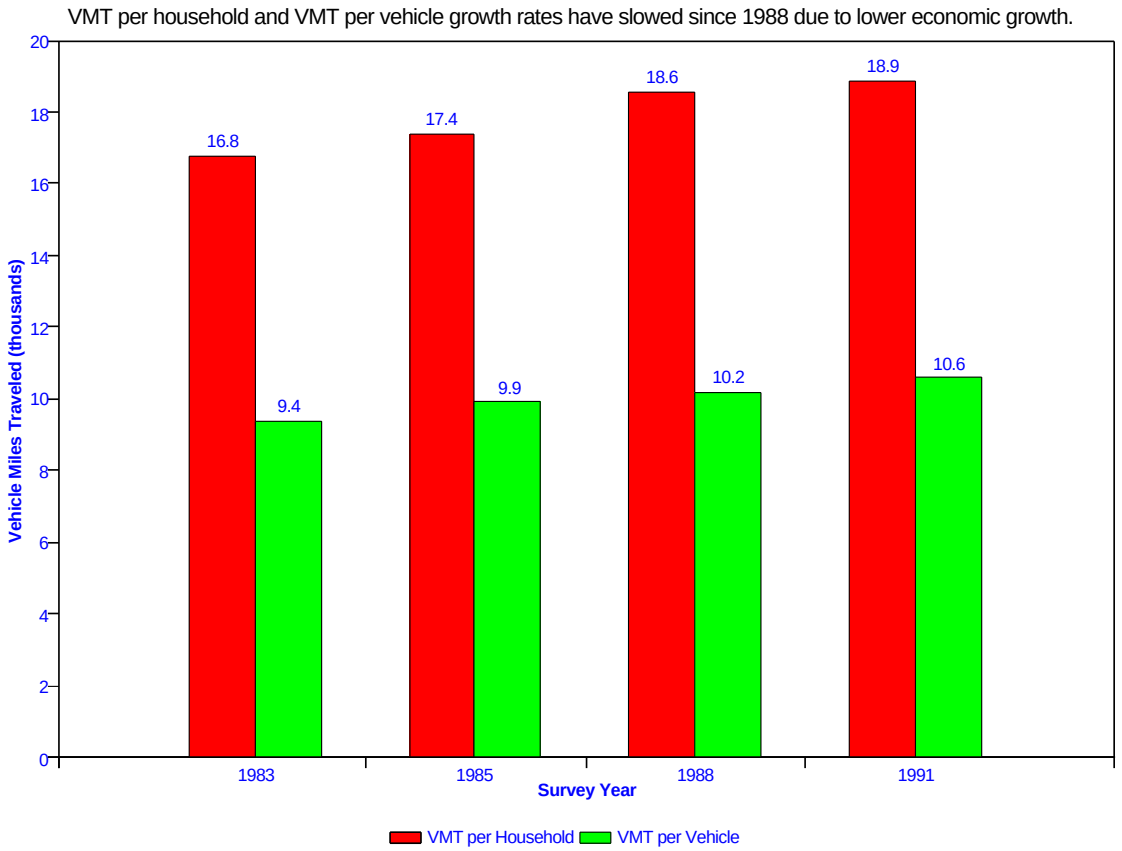
Sources: Energy Information Administration, Office of Energy Markets and End Use, 1983, 1985, 1988, and 1991 Residential Transportation Energy Consumption Surveys; U.S. Bureau of Economic Analysis, *Survey of Current Business Population*, March 1992.

The relatively slower growth since 1988 can be traced to both the downturn in the economy and underlying longer-term social changes that have affected households and their members. The growth in household vehicle miles traveled typically averages about 1 percentage point above the growth in real disposable personal income (personal income adjusted for inflation). The 3.5 percent overall annual growth in VMT between 1983 and 1991 compares to 2.4 percent growth in disposable personal income over the same time period. The 2.0 percent growth in VMT between 1988 and 1991 compares to a 1.0 percent growth rate for personal income (Table 5).

In 1991, there were more than 150 million household vehicles in nearly 85 million U.S. households (about 90 percent of all households). U.S. households with vehicles drove, on average, about 10,600 miles per vehicle and 18,900 miles per household (Figure 6). Two key factors affecting how much individual households drive are the number of drivers and the presence of children in the household. The following sections examine the effect of these and other factors (such as the number of drivers and household income) on household VMT.

Figure 6. Household and Vehicle Miles Traveled by Survey Year

Source: Energy Information Administration, Office of Energy Markets and End Use, 1991 Residential Transportation Energy Consumption Survey.



Measurement of Vehicle Miles Traveled (VMT)

The annual VMT for each vehicle in the RTECS was either (1) calculated using two odometer readings or (2) imputed using a regression estimate. For each vehicle in the sample, the RTECS collects a beginning-of-year and an end-of-year odometer reading. VMT equals the difference between the two readings, adjusted to reflect a 365-day year. For vehicles that were in the household less than a full year, the mileage was adjusted to reflect the amount of time the household was in possession of the vehicle. For vehicles that were missing one or both odometer readings, a regression estimate was used to estimate the annual mileage. For a vehicle that was not used by the household for the full year, the regression estimate was adjusted downward to reflect the amount of time the vehicle was in the household. The total VMT, representing the number of miles traveled nationally for all residential vehicles, is equal to the weighted sum of the individual VMT for each vehicle. (See Appendix B, "Estimation Methodologies," and Appendix C, "Quality of the Data," for further discussion about the annual VMT.)

The Effect of Household Composition

Average household driving varies extensively depending on the makeup of the household:

- Households with children drove 22,800 miles on average, compared with 16,500 miles in households with no children.

- Households with 16- or 17-year-old children drove more than any other major group (28,000 miles), about 7,000-8,000 miles more than households with younger children.

- In households without children, VMT ranged from 10,600 miles in single adult households to 19,700 miles in households with two or more adults.

- In single-driver households without children, VMT ranged from a low of 7,300 miles for drivers at least 60 years old to 14,200 miles for drivers under 35 years old.

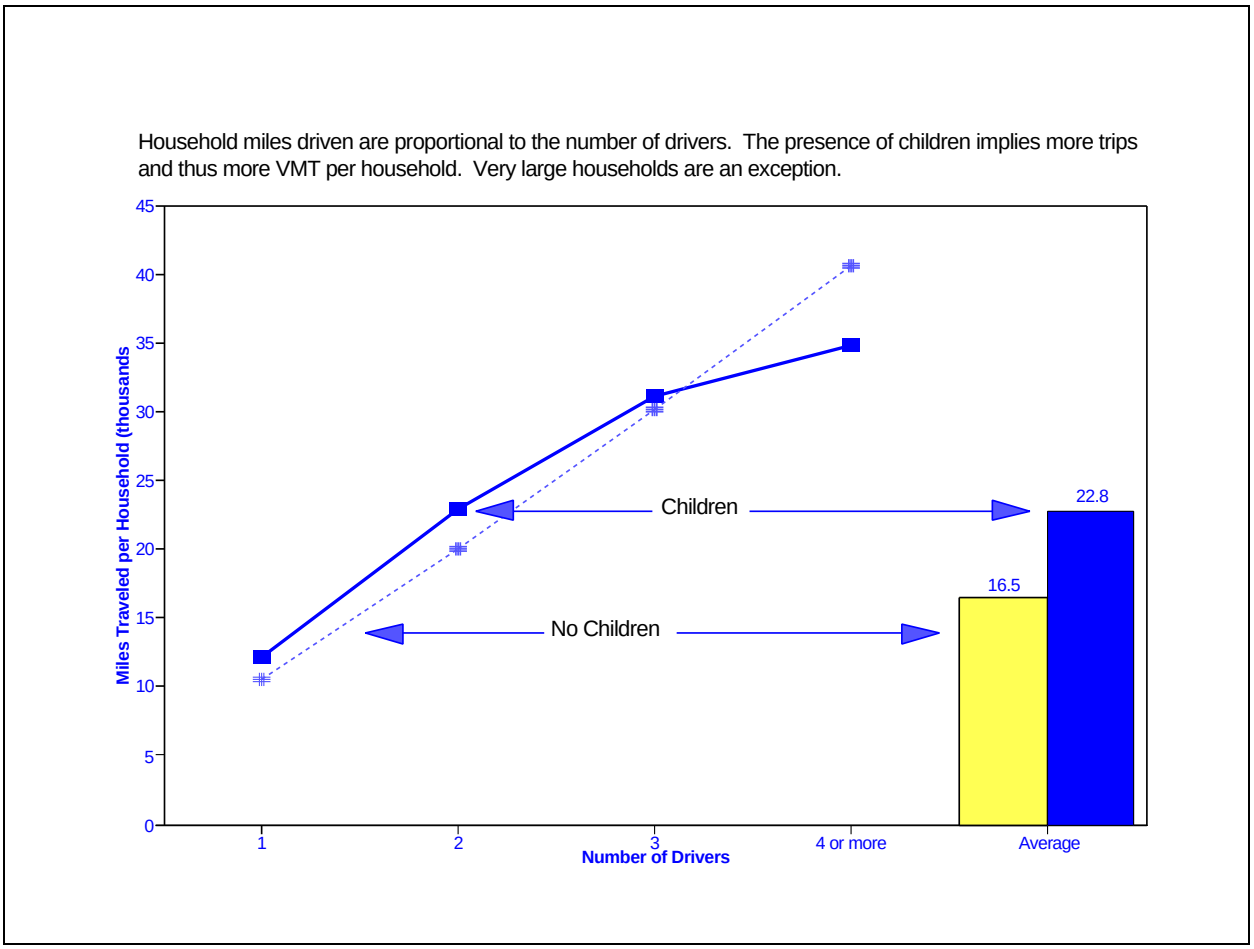
- Excluding households with 16- or 17-year old children, the remaining households with children still averaged 21,700 miles, about 5,000 miles more than households without children; the difference being the presence of adults over 60 years of age[2]. If they are excluded, then households with young children drive less than households with at least two adults and no children. In other words, the households that do the most driving are those with two adults, no children and a head of household younger than 60 years of age.

[2]Households in which the head of household was at least 60 years old. All household ages refer to the head of household, as stated in the RECS.

The Effect of the Number of Drivers

In 1991, VMT averaged 10,000 miles per driver in households with no children, and 1,000 to 2,000 miles higher in households with children, depending on the age of the children (Figure 7). These averages apply to households with up to three drivers. In households with four or more drivers, the presence of children (regardless of their age) implied fewer miles per driver. There are two likely explanations. One is that these households included one or more younger or older adult drivers, who tend to drive less than average. A second, and related consequence of the first, is that the number of vehicles does not keep pace with the number of drivers. The data also indicates that it is equally likely that households with three drivers have two or three vehicles; and those with four drivers are only slightly less likely to have three rather than four vehicles. Thus VMT cannot keep pace with drivers in larger households with more than three drivers.

Figure 7. Average Household Vehicle Miles Traveled and the Number of Drivers



Source: Energy Information Administration, Office of Energy Markets and End Use, 1991 Residential Transportation Energy Consumption Survey.

The Effect of Household Income

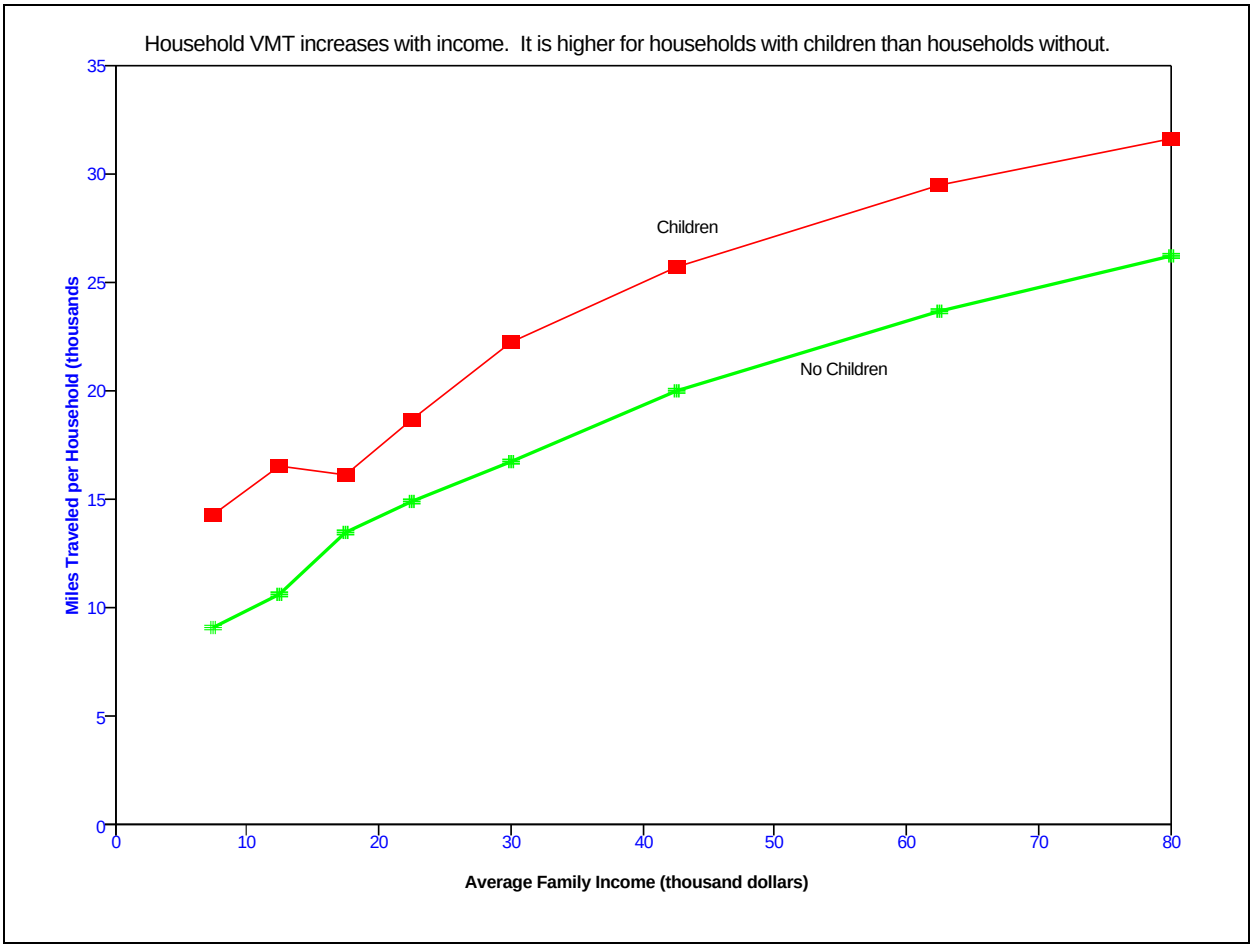
VMT per household increases with household income (Figure 8).

- For every additional $10,000 of income, vehicle miles traveled increased by approximately 3,000 miles. Within each income category, the presence of children added 3,000 to 5,000 miles per household.

- Households with annual incomes of $35,000 or more drove about twice as many miles per household as those earning less than $15,000.

Household income is more likely to increase with household size, so also is the number of drivers. Thus it is plausible that income and drivers are correlated. For example, more drivers would imply more household members in the work place and consequently a higher household income.

Figure 8. Average Household Vehicle Miles Traveled and Income



Source: Energy Information Administration, Office of Energy Markets and End Use, 1991 Residential Transportation Energy Consumption Survey.

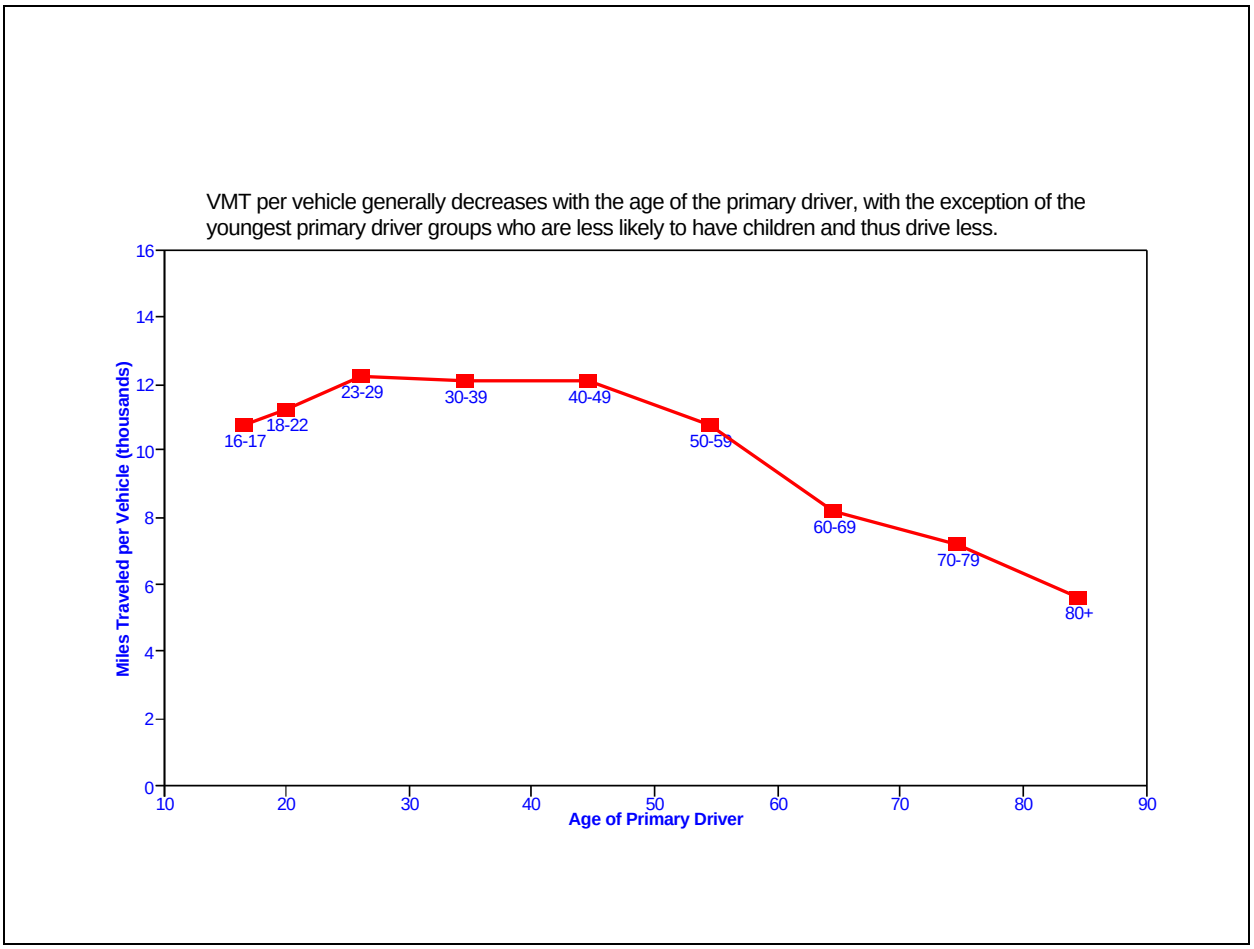
The Effect of Driver Age

VMT per vehicle is also related to the age of the driver in the household (Figure 9).

- VMT per vehicle increases with age of the primary driver into the 30's, averages more than 12,000 miles per year through the 40's, then declines. The youngest primary drivers probably drive less because they are less likely to have children (which adds to driving distances in other age categories), and are also less likely to have to go to work.

- Primary drivers in their 80's drive the least (an average of less than 6,000 miles).

Figure 9. Average Vehicle Miles Traveled per Vehicle and Age of Primary Driver



Source: Energy Information Administration, Office of Energy Markets and End Use, 1991 Residential Transportation Energy Consumption Survey.

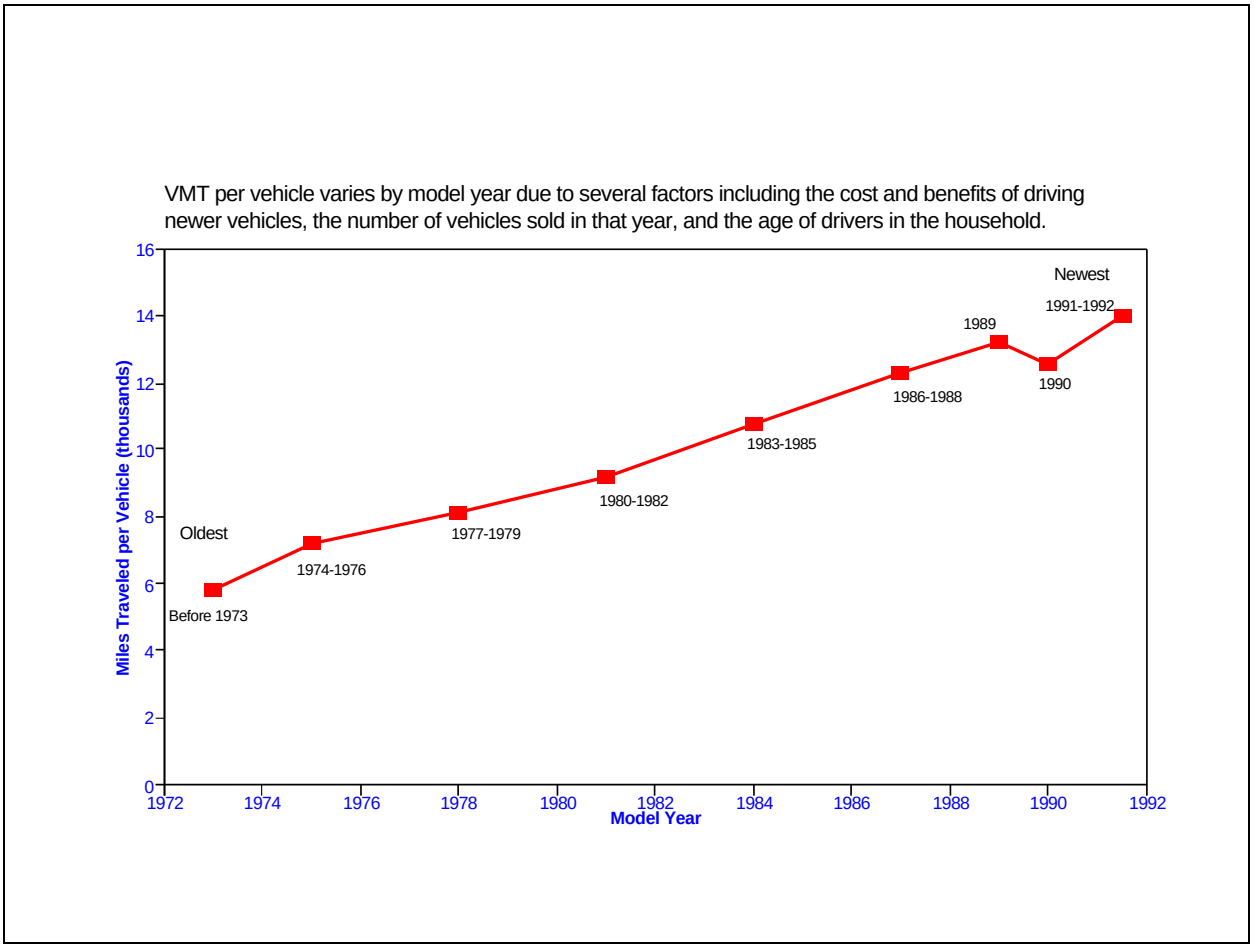
The Effect of Vehicle Age

The number of miles driven in a vehicle appears to be inversely proportional to the age of the vehicle (Figure 10). The newest vehicles in the survey (model years 1991 and 1992) were driven twice the number of miles per vehicle as the oldest vehicles (the pre-1977 models). This is not surprising, as new vehicles are typically cheaper to run, more comfortable, and more reliable than older vehicles.

Approximately 85 percent of the oldest vehicles (pre-1977 model year) were in households with more than one vehicle. In such a household, an older vehicle typically is not the household's primary vehicle, and is therefore driven less than the primary (probably newer) vehicle.

Another factor may be that older households tend to hold on to their vehicles longer and older households drive less than younger households. Thus older vehicles are in part associated with the age of the primary household member.

Figure 10. Average Vehicle Miles Traveled and Vehicle Age



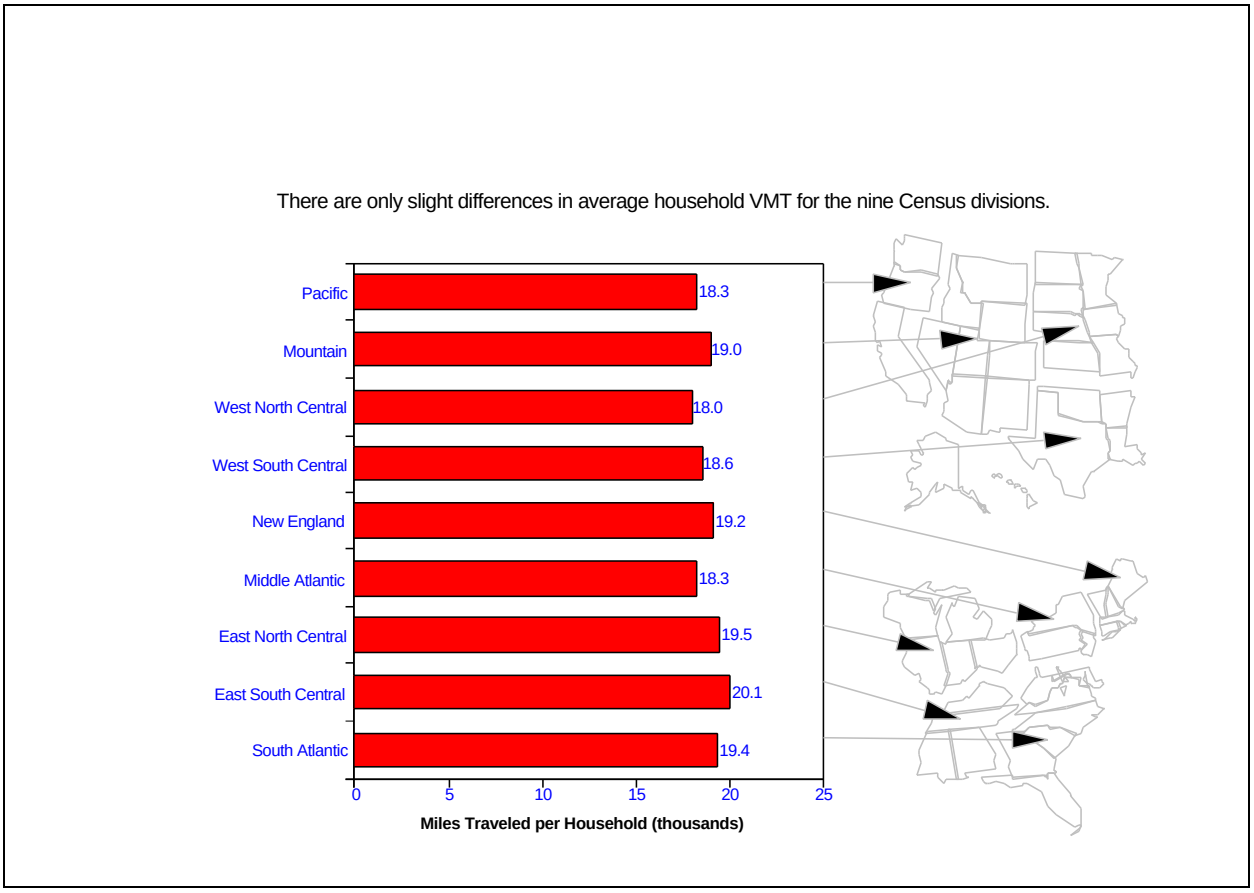
Source: Energy Information Administration, Office of Energy Markets and End Use, 1991 Residential Transportation Energy Consumption Survey.

The Effect of Region

Regional differences in VMT are of particular interest when considering gasoline tax issues. The debate over the proposed increase in the gasoline tax in the fiscal year 1994 budget suggested that households in the South and West Regions (where cities are fewer and more widely separated) drive further distances than in other regions. Although the 1991 RTECS identified some differences among regions, none of the variation was statistically significant. Figure 11 shows the average per household VMT by Census region. Of greater interest is the wide variation within each region, as indicated by the standard errors associated with the RTECS data. On average, metropolitan households drive about 900 miles more each year than nonmetropolitan (generally rural) households (20,400 miles per household compared with 19,500 miles in rural areas). As would be expected, central city households drive the least on average (only 15,900 miles).

Rural refers to all nonmetropolitan areas in the United States, for example, those not in a Metropolitan Statistical Area, and it is not meant to imply farm or ranch types exclusively. However, there are limited data in the survey from respondents that could be classified as "farm operations," those that were more than one acre in size and had $1,000 or more in sales in the year. Because of the wide variation in this limited number of cases, their average household VMT of 29,000 is not statistically different from the smaller average of 19,500 for all rural households. It is likely, however, that these farm operations have a higher annual VMT than nonfarm households at the national level.

Figure 11. Average Household Vehicle Miles Traveled and Census Regions



Source: Energy Information Administration, Office of Energy Markets and End Use, 1991 Residential Transportation Energy Consumption Survey.

The Effect of Vehicle Type

Minivans were driven more on average than any other type of household vehicle in 1991 (12,700 miles), followed by sport-utility vehicles (11,800 miles), passenger cars (10,400 miles), large vans (9,800 miles), and pickup trucks (9,400 miles).

Vehicle preferences reflect the household's stage of life (singles with no children, households with young children, households with teenagers or older parents, etc.). For example, households with children own 76 percent of the minivans and 58 percent of the sport-utility vehicles (the two highest mileage categories). The presence of children not only influences the preference for minivans and sport-utility vehicles but is also associated with higher VMT (as discussed above).

Another reason for the relatively greater use of minivans and sport-utility vehicles is their relative newness in the vehicle fleet. These alternatives to the more traditional station wagon or family sedan have only been on the market since the last half of the 1980's. They, therefore, have not had enough time to penetrate uniformly into older households, and they are still too new to be relegated from their status of primary household vehicle. If these vehicles were distributed more uniformly by age across the vehicle population, their usage would more likely resemble usage patterns for other types of vehicles.

Insights from the Nationwide Personal Transportation Survey (NPTS)

Changes in demand for transportation by households, as detailed above, reflect the substantial changes in economic and social factors over the past decade. The U.S. Department of Transportation's Nationwide Personal Transportation Survey (NPTS)[3] provides some insights into these changes, which are not directly addressed in the RTECS itself. In particular, the NPTS provides insights on the household demographics and economic changes responsible for increases in the number of household trips and VMT.

In contrast to the RTECS' focus on vehicles, the NPTS focuses on all types of trips--who makes trips in household vehicles and why they chose household vehicles over other modes of transportation such as walking, biking or mass transit. Despite the differences in what is measured by the NPTS and the RTECS, the coverage is similar enough in the aggregate to justify using NPTS findings about travel behavior to explain the driving trends identified in the RTECS. For instance, the NPTS estimates personal miles traveled (PMT) by any mode and examines the role of personal vehicles in capturing an increasing fraction of PMT. The total VMT of 1,613 billion miles[4] measured by the NPT's in 1990 is very similar to the 1,602 billion miles reported in the 1991 RTECS. The findings reported below are based on the results of the 1983 and 1990 NPTS.

Growth in Personal Miles Traveled

Personal miles traveled increased by about 19 percent between 1983 and 1990. The NPTS attributes this increase to three factors: population growth (4.3 percent), more trips per capita (7 percent), and longer trips on average (6.9 percent).

[3]*Travel Behavior Issues in the 90's: Nationwide Personal Transportation Survey*, U.S. Department of Transportation, Federal Highway Administration, July 1992.

[4]Includes travel-day and travel-period trips as explained in the box that follows on the NPTS.

- Although **population growth** is the smallest component explaining these changes, substantial regional shifts in population can account for rapid growth in some areas - in particular the South and West Regions.

- The number of **trips per capita** represents the number of trips an average person undertakes for any reason, by any mode of transportation. Women led the trend in the increasing number of trips per capita, largely due to an increase in personal business trips. This trend is consistent with the increasing representation of women in the work force since 1983.

- The **average trip length** increased because of the increasing emphasis on travel to work. In particular, the progressive shift of the population from urban centers to more suburban areas (and also out of the city) increased the average length of the trip to work.

The Nationwide Personal Transportation Survey (NPTS)

The Department of Transportation's NPTS used a random-digit-dialing telephone survey to interview approximately 22,000 households about their driving patterns and estimated mileage. This information supplements the RTECS information on vehicle consumption, mileage (both vehicle and personal), and expenditures collected via two-stage personal interviews with over 3,000 households. RTECS data from respondents' odometer readings (more than 6,000 vehicles) are used to estimate the mileage traveled by the vehicle-owning households nationwide.

In many respects, the two surveys complement each other and allow a better understanding of trends in personal-travel behavior and energy consumption.

- NPTS. The NPTS collects three types of information: (1) a "personal travel day" measure which includes all trips for any reason over a 24-hour period, (2) a "travel period" measure which includes long trips of over 75 miles one-way made in a 14-day period, and (3) a "commercial" travel measure which includes travel by household members who drive as an essential part of their work. Surveys are made throughout the year to account for seasonal variations. The NPTS covers all travel by any mode of transportation including walking, bicycling, and motorcycles.

- RTECS. The RTECS measures VMT using odometer readings taken at the beginning and end of the year. This method captures all travel by household members in all vehicles that they either own or use substantially.

- Data Comparisons. The vehicle miles recorded for the RTECS include the vehicle mileage portions of the "personal travel day" and the "travel period" measures reported in the NPTS, and some of the "commercial" mileage. RTECS considers "commercial" travel as personal travel if the household has access to that vehicle for personal use for more than a month of the year. RTECS, however, does not include travel by walking, bicycling, and motorcycling, which are included in the NPTS.

Another trend noted in the NPTS is the substantial increase in the percentage of the population who drive, particularly among women. Personal miles driven by women increased by 49 percent between 1983 and 1990 (91 percent for women in the 16-to-19-year-old range). Personal miles driven by men also increased, but by a more modest 18 percent, mainly in the 16-to-34-year-old range. Men continue to account for approximately 70 percent of the total personal miles driven.

Growth in Vehicle Miles Traveled

Vehicle miles traveled are a result of: (1) the number of vehicle trips and (2) the average vehicle-trip length. The increasing number of vehicle trips and vehicle miles of travel, as measured in the NPTS was much higher than would be expected on the basis of the growth in personal trips and personal miles of travel. In addition to making more frequent and longer trips, an increasing number of household members appear to be switching to using personal vehicles for their trips and cutting back in their use of alternatives such as public transportation.

Although increasing trip length and frequency are the dominant forces behind the increase in VMT, other factors also contribute to this trend. These include a decline in vehicle occupancy; a decline in use of public transportation and walking as alternatives to vehicle travel; and increasing travel distances for commuting to work, for work-related trips, and for trips to school and church (Figure 12). The following is based on the 1983 and 1990 NPTS.

- The NPTS estimated that travel in **personally operated vehicles** increased from 82 percent of all travel in 1983 to 87 percent in 1990. This 5-percentage-point increase was accounted for by the increased number of trips; the decline in the use of public transit and walking; and a net decline in those working at home (due to a shift from rural to urban employment).

- **Average vehicle occupancy**, a measure of the number of persons in a vehicle per vehicle trip, declined from 1.7 in 1983 to 1.6 in 1990. One factor contributing to this decline is the increase in working singles (male and female) with vehicles. The decline in average vehicle occupancy means that 6 percent more trips were required for the same set of riders to achieve the same person miles traveled[5].

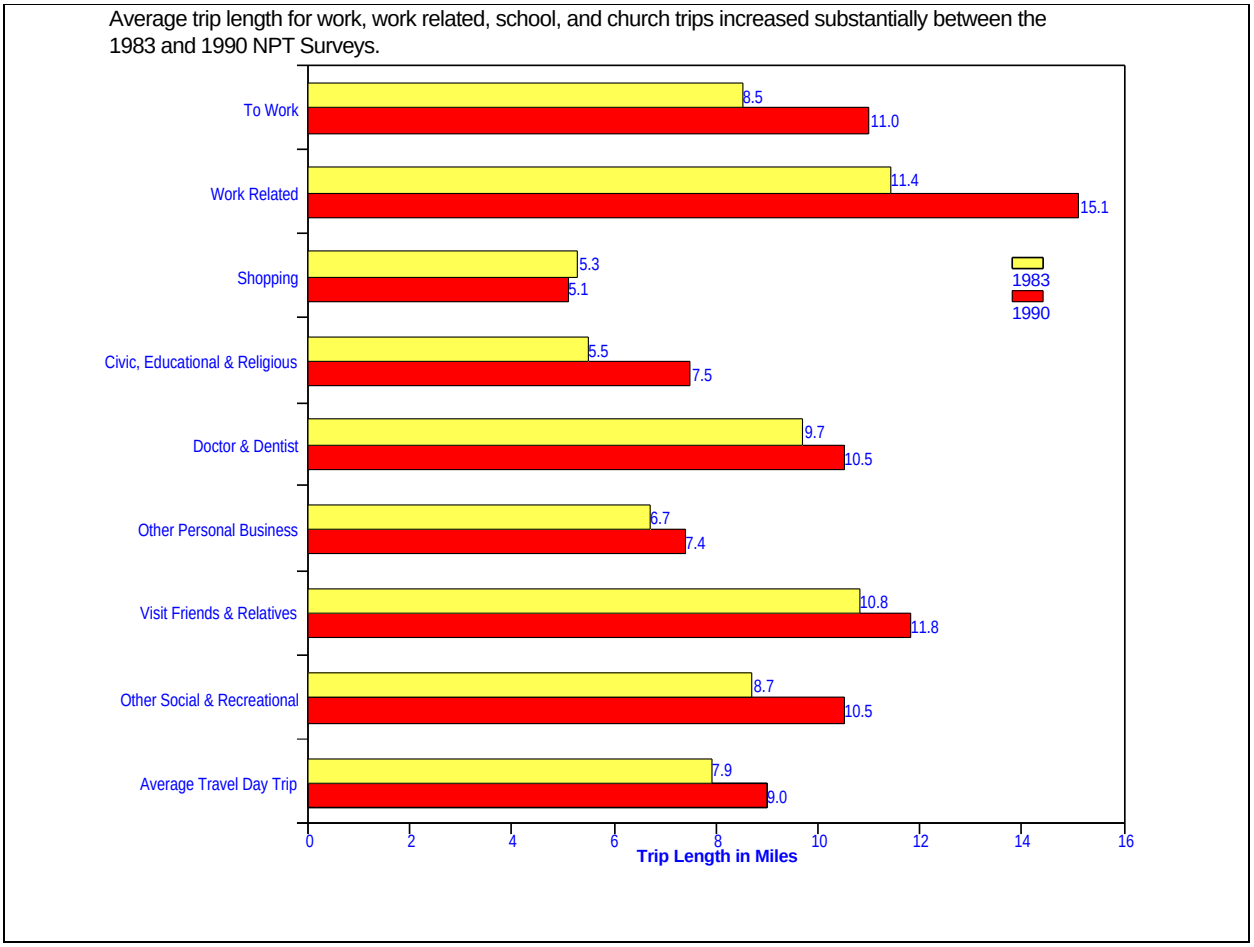
- **Average vehicle-trip length** grew by 13.9 percent from 1983 to 1990. The family and personal business grouping of trips for shopping, to doctors and dentists, and other family and personal business had the largest increase in share of VMT. Social and recreational trips appeared to have declined as a fraction of VMT.

- **Personal trip length** grew by 9 percent. The average trip length for work and work-related business, and school and church increased the most. Their fraction of VMT hardly changed over the 1983 to 1990 interval.

Household VMT, as recorded in RTECS, have grown for reasons more diverse than the simple compounding of the growth of households and number of vehicles. These reasons include increases in the locational changes of households and work, aging of the population, number of women holding driving licenses, and increases in vehicle ownership. The aging of the population has led to more people in the 25- to 45-year old group, the years of peak driving. Increase in female labor-force participation have led to more women holding driving licenses and more driving for work, family, and personal business purposes. The locational changes of households and work have led to longer trip lengths for work and work-related purposes. It could be argued that more and smaller households have also led to fewer occupants in the average vehicle and more resulting trips. More recent Census-based data suggest that some of these social and demographic measures may have slowed, perhaps to be overtaken by others.

[5]100 average trips of 1 mile with 1.7 persons per vehicle is equivalent to 170 person miles. If the vehicle occupancy falls to 1.6, then 170/1.6 trips are required for the same person miles: a 6-percent increase.

Figure 12. Trends in Vehicle-Trip Length, 1983 and 1990



Sources: Department of Transportation, *1983 and 1990 Nationwide Personal Transportation Surveys*.