

ENERGY INFORMATION ADMINISTRATION (EIA)

DOE/EIA-0464(2005)

NOVEMBER 2005

HOUSEHOLD VEHICLES ENERGY USE: LATEST DATA & TRENDS

BASED ON AUGMENTATIONS OF THE JANUARY
2004 RELEASE OF THE 2001 NATIONAL
HOUSEHOLD TRAVEL SURVEY CONDUCTED BY
THE U.S. DEPARTMENT OF TRANSPORTATION
AND OTHER RELEVANT EIA DATA

ENERGY INFORMATION ADMINISTRATION
OFFICE OF ENERGY MARKETS AND END USE
U.S. DEPARTMENT OF ENERGY
WASHINGTON, DC 20585



THIS PUBLICATION IS AVAILABLE ON THE WEB AT:
WWW.EIA.DOE.GOV/EMEU/RTECS/NHTS_SURVEY/2001/INDEX.HTML

The Energy Information Administration, the independent statistical and analytical administration within the U.S. Department of Energy, prepared this report. The information contained herein should not be construed as advocating or reflecting any policy position of the U.S. Department of Energy or any other organization.

ENERGY INFORMATION ADMINISTRATION

CONTACTS AND ACKNOWLEDGEMENTS

This report was prepared by the Energy Information Administration (EIA) under the general direction of Margot Anderson, Director of the Office of the Energy Markets and End Use (202.586.2589). Dwight K. French, Director of the Energy Consumption Division (ECD) (202.586.1126) and Mark A. Schipper, Program Manager (202.586.1136), directed this project. Specific technical information may be obtained from Derrick S. Pinckney (202.586.5744), Survey Statistician for transportation programs.

EIA expresses its gratitude for the data support received from the National Highway Traffic Safety Administration's Corporate Average Fuel Economy (CAFE) program for critical data components of this project, without such assistance and participation none of this effort would have been possible.

Contacts for detailed technical questions on energy consumption and consumer topics may be found on <http://www.eia.doe.gov/contacts/multifc.htm>. For information on the National Household Travel Survey and its sampling and estimation methods, please contact Susan Liss of the Federal Highway Administration on 202.366.5060 or Patricia Hu, Director of the Center for Transportation Analysis of Oak Ridge National Laboratory of Center for Transportation Analysis, Oak Ridge National Laboratory, on 865.946.1349.

This report, Household Vehicles Energy Use: Latest Data & Trends, provides details on the nation's energy use for household passenger travel. A primary purpose of this report is to release the latest consumer-based data on household vehicles and expenditures, derived from the U.S. Department of Transportation's 2001 National Household Travel Survey (NHTS) and independent estimates of vehicle miles per gallon and fuel prices at that time.

This report also draws on data programs made available to the EIA from other Federal agencies, EIA's past Residential Transportation Energy Consumption Surveys (RTECS) and other EIA data sources and projections to assess household transport energy use from 1983 to the present time and into the near future. The data and analysis in this report center on several important intensities of use of household energy use for travel: number and type of vehicles per household; annual miles per household and per vehicle; gallons of fuel consumed and type of fuel used; prices paid for fuel and total expenditures; and fuel economy.

Only light-duty vehicles and recreational vehicles are included in this report. EIA has excluded motorcycles, mopeds, large trucks, and buses in an effort to maintain consistency with its past residential transportation series, which was discontinued after 1994.

CONTENTS

CONTACTS AND ACKNOWLEDGEMENTS.....	II
TABLE TITLES	V
DETAILED TABLE TITLES [U.S. EQUIVALENTS].....	V
DETAILED TABLE TITLE [INTERNATIONAL SYSTEM OF UNITS (SI)].....	VI
FIGURES.....	VI
EXECUTIVE SUMMARY	1
INTRODUCTION.....	1
HIGHLIGHTS	2
DECOMPOSING ENERGY USE	7
ENERGY OVERVIEW.....	9
INTRODUCTION.....	10
<i>Data Sources</i>	10
ORGANIZATION OF REPORT	12
ENERGY PROFILE	13
<i>Top-Down View</i>	13
<i>Bottom-Up View of Personal Transportation</i>	14
Costs Rise for U.S. Households.....	14
Prices Expected to Move Higher	14
<i>Demand Analysis Techniques</i>	15
PREDICTORS OF ENERGY NEEDS.....	16
<i>Structure</i>	18
Households with Vehicles.....	18
Number of Vehicles	19
Types of Vehicles	21
<i>Activity</i>	23
Vehicle-Miles Traveled	23
One-Way Trips Per Year and Average One-Way Trip Distances	24
<i>Energy Intensity</i>	26
Energy Performance: Gallons per Vehicle-Mile Traveled.....	26
DECOMPOSING ENERGY NEEDS	34
<i>Measuring an Effect</i>	36
<i>Summary of Decomposition 4942</i>	37
<i>Summary of Decomposition 4941</i>	38
<i>Energy Savings</i>	42
<i>Comparing Effects Over Time and Into The Future</i>	42
DATA FOR DECOMPOSITION 4941.....	44

REFERENCES	49
ABBREVIATIONS	50
APPENDIX A: DETAILED TABLES	51
APPENDIX B: ESTIMATION METHODOLOGIES	125
INTRODUCTION.....	126
<i>Disclaimer</i>	126
<i>Data Sources</i>	127
<i>Procedures and Definitions</i>	128
VEHICLE MILES TRAVELED	131
<i>In-Possession Vehicle-Miles Traveled</i>	132
VEHICLE FUEL ECONOMY	133
<i>The EPA Composite MPG</i>	135
<i>Fuel Economy Shortfall</i>	135
<i>The On-Road MPG</i>	137
<i>Shortfall Adjustment Based on Discount Factors</i>	137
<i>The In-Use MPG</i>	139
ANNUAL VEHICLE FUEL CONSUMPTION.....	141
ANNUAL VEHICLE FUEL EXPENDITURES AND PRICE.....	144
<i>Vehicle Fuel Expenditures</i>	144
<i>Type of Fuel Used</i>	145
<i>Gasoline Prices</i>	146
<i>Diesel Fuel Prices</i>	148
<i>Other Fuel Type Prices</i>	149
APPENDIX C: QUALITY OF THE DATA.....	151
INTRODUCTION.....	152
<i>Nonsampling Error</i>	152
<i>Unit Nonresponse</i>	153
<i>Imputation Procedures for Supplemental Data</i>	153
<i>Cold-Deck Procedure</i>	154
QUALITY OF SPECIFIC SUPPLEMENTAL DATA ITEMS	158
<i>Cold-Deck Procedure: Sensitivity Analysis</i>	158
<i>Vehicle Fuel Price and Expenditures</i>	159
<i>Gasoline Equivalent Gallon</i>	159
<i>GREET Model</i>	159
<i>Transportation Energy Data Book: Edition 22 — 2002</i>	160
APPENDIX D: DESCRIPTION OF DATA	163
STRUCTURE OF THE DATA FILES.....	164
<i>Basic Structure</i>	164
RELATIONSHIP AMONG U.S. DOT AND EIA PUBLIC-USE DATA FILES.....	164
UNDERSTANDING THE DATA FILES.....	165
CODEBOOK FOR EIA AUGMENTATIONS	166
APPENDIX E: CHRONOLOGY OF WORLD OIL MARKET EVENTS	177
MAJOR EVENTS AND REAL WORLD OIL PRICES, 1970-2005.....	179
GLOSSARY	181

TABLE TITLES

TABLE 1. MEASURES OF ENERGY DEMAND AND DEMAND ACTIVITIES, SELECTED SURVEY YEARS	17
TABLE 2. ANNUAL PERCENT CHANGE IN MEASURES OF ENERGY DEMAND, SELECTED SURVEY YEARS	18
TABLE 3. COMPARING COMPONENT EFFECTS, 1988-1991, 1991-1994, AND 1994-2001	41
TABLE 4. NUMBER OF HOUSEHOLDS WITH VEHICLES BY HOUSEHOLD COMPOSITION (LIFECYCLE), SELECTED SURVEY YEARS	44
TABLE 5. NUMBER OF VEHICLES AND VEHICLE OWNERSHIP BY HOUSEHOLD COMPOSITION (LIFECYCLE), SELECTED SURVEY YEARS	44
TABLE 6. SHARES OF VEHICLES BY TYPE AND HOUSEHOLD COMPOSITION (LIFECYCLE), SELECTED SURVEY YEARS	45
TABLE 7. VEHICLE-MILES TRAVELED PER VEHICLE BY TYPE AND HOUSEHOLD COMPOSITION (LIFECYCLE), SELECTED SURVEY YEARS	46
TABLE 8. GASOLINE-EQUIVALENT GALLONS PER 1000 MILES BY TYPE AND HOUSEHOLD COMPOSITION (LIFECYCLE), SELECTED SURVEY YEARS	47
TABLE 9. NUMBER OF SAMPLED VEHICLES BY TYPE AND HOUSEHOLD COMPOSITION (LIFECYCLE), SELECTED SURVEY YEARS	48

DETAILED TABLE TITLES [U.S. EQUIVALENTS]

TABLE A1. U.S. NUMBER OF VEHICLES, VEHICLES-MILES, MOTOR FUEL CONSUMPTION AND EXPENDITURES, 2001	53
TABLE A2. U.S. PER HOUSEHOLD VEHICLE-MILES TRAVELED, VEHICLE FUEL CONSUMPTION AND EXPENDITURES, 2001	57
TABLE A3. U.S. PER VEHICLE AVERAGE MILES TRAVELED, VEHICLE FUEL CONSUMPTION AND EXPENDITURES, 2001 [SEE TABLE A20 FOR INTERNATIONAL UNITS]	60
TABLE A4. U.S. VEHICLES BY MODEL YEAR, 2001 (MILLION VEHICLES)	64
TABLE A5. U.S. VEHICLE FUEL ECONOMY BY MODEL YEAR, 2001 (MILES PER GALLON)	68
TABLE A6. U.S. AVERAGE VEHICLE FUEL CONSUMPTION BY MODEL YEAR, 2001 (GALLONS PER VEHICLE)	72
TABLE A7. U.S. VEHICLE-MILES TRAVELED BY FAMILY INCOME AND POVERTY STATUS, 2001 (BILLION MILES)	76
TABLE A8. U.S. VEHICLE FUEL CONSUMPTION BY FAMILY INCOME AND POVERTY STATUS, 2001 (BILLION GALLONS)	80
TABLE A9. U.S. AVERAGE VEHICLE-MILES TRAVELED BY FAMILY INCOME AND POVERTY STATUS, 2001 (THOUSAND MILES PER HOUSEHOLD)	84
TABLE A10. U.S. AVERAGE VEHICLE FUEL CONSUMPTION BY FAMILY INCOME AND POVERTY STATUS, 2001 (GALLONS PER HOUSEHOLD)	87
TABLE A11. U.S. VEHICLES BY NHTS HOUSEHOLD COMPOSITION, 2001 (MILLION VEHICLES)	90
TABLE A12. U.S. AVERAGE VEHICLE-MILES TRAVELED BY NHTS HOUSEHOLD COMPOSITION, 2001 (THOUSAND MILES PER HOUSEHOLD)	94

TABLE A13. U.S. AVERAGE VEHICLE-MILES TRAVELED BY VEHICLE FUEL ECONOMY CATEGORY, 2001 (THOUSAND MILES PER VEHICLE)	96
TABLE A14. U.S. VEHICLE FUEL CONSUMPTION BY VEHICLE TYPE, 2001 (BILLION GALLONS)	100
TABLE A15. U.S. AVERAGE VEHICLE-MILES TRAVELED BY VEHICLE TYPE, 2001 (THOUSAND MILES PER VEHICLE)	104
TABLE A16. U.S. NUMBER OF VEHICLES BY VEHICLE TYPE, 2001 (MILLION VEHICLES).....	108
TABLE A17. U.S. NUMBER OF HOUSEHOLDS BY VEHICLE FUEL EXPENDITURES, 2001 (MILLION HOUSEHOLDS).....	112
TABLE A18. U.S. VEHICLES BY EIA HOUSEHOLD COMPOSITION, 2001(MILLION VEHICLES) ...	115
TABLE A19. U.S. AVERAGE VEHICLE-MILES TRAVELED BY EIA HOUSEHOLD COMPOSITION, 2001 (THOUSAND MILES PER HOUSEHOLD)	119

DETAILED TABLE TITLE [INTERNATIONAL SYSTEM OF UNITS (SI)]

TABLE A20. U.S. PER VEHICLE AVERAGE KILOMETERS TRAVELED, VEHICLE FUEL CONSUMPTION AND EXPENDITURES, 2001 [SEE TABLE A3 FOR U.S. EQUIVALENTS]	121
--	-----

FIGURES

FIGURE ES1. SCHEMA FOR ESTIMATING ENERGY AND ENERGY-RELATED STATISTICS, 2001	1
FIGURE ES2. ANNUAL INDICES OF REAL DISPOSABLE INCOME, VEHICLE-MILES TRAVELED, CONSUMER PRICE INDEX (CPI-U), AND REAL AVERAGE RETAIL GASOLINE PRICE, 1978-2004, 1985=100	3
FIGURE ES3. SALES-WEIGHTED HORSEPOWER AND ON-ROAD FUEL ECONOMY FOR NEW LIGHT-DUTY VEHICLES, 1975-2004 MODEL YEARS.....	6
FIGURE ES4. SALES-WEIGHTED INERTIA WEIGHT AND ON-ROAD FUEL ECONOMY FOR NEW LIGHT-DUTY VEHICLES, 1975-2004 MODEL YEARS	6
FIGURE ES5. ACTUAL ANNUAL ENERGY GROWTH – ALL EFFECTS ARE INCLUDED	7
FIGURE ES6. FUEL ECONOMY EFFECTS ON ANNUAL ENERGY GROWTH	7
FIGURE ES7. ADJUSTED ANNUAL ENERGY GROWTH – NO FUEL ECONOMY EFFECTS.....	7
FIGURE 1. TOTAL ENERGY CONSUMPTION BY END-USE SECTOR, 1949-2004	13
FIGURE 2. ENERGY CONSUMPTION OF VEHICLES, SELECTED SURVEY YEARS	15
FIGURE 3. EXAMPLE OF A LASPEYRES DECOMPOSITION	16
FIGURE 4. VEHICLE OWNERSHIP BY HOUSEHOLD COMPOSITION (LIFECYCLE), SELECTED SURVEY YEARS	20
FIGURE 5. VEHICLE OWNERSHIP BY NOMINAL FAMILY INCOME, 2001	21
FIGURE 6. NUMBER AND SHARE OF NEW VEHICLES SOLD IN THE UNITED STATES BY VEHICLE TYPE AND YEAR.....	22
FIGURE 7. DISTRIBUTION OF VEHICLE STOCK, 2001	22
FIGURE 8. AVERAGE VEHICLE TRIP LENGTH, SELECTED SURVEY YEARS	24
FIGURE 9. AVERAGE ANNUAL VEHICLE TRIPS PER HOUSEHOLD, SELECTED SURVEY YEARS	24
FIGURE 10. ANNUAL INDICES OF REAL DISPOSABLE INCOME, VEHICLE-MILES TRAVELED, CONSUMER PRICE INDEX (CPI-U), AND REAL AVERAGE RETAIL GASOLINE PRICE, 1978-2004, 1985=100	26
FIGURE 11. SALES-WEIGHTED ON-ROAD FUEL ECONOMY BY VEHICLE TYPE, 1975-2004 MODEL YEARS	27

FIGURE 12. AVERAGE ON-ROAD, IN-USE FUEL ECONOMY BY VEHICLE TYPE, 2001	27
FIGURE 13. SALES-WEIGHTED ON-ROAD ENERGY INTENSITY BY VEHICLE TYPE, 1975-2004 MODEL YEARS	27
FIGURE 14. AVERAGE ON-ROAD, IN-USE ENERGY INTENSITY BY VEHICLE TYPE, 2001	27
FIGURE 15. AVERAGE ON-ROAD, IN-USE ENERGY INTENSITY, SELECTED SURVEY YEARS.....	29
FIGURE 16. AVERAGE VEHICLE-MILES TRAVELED PER VEHICLE, SELECTED SURVEY YEARS	29
FIGURE 17. SALES-WEIGHTED HORSEPOWER AND ON-ROAD FUEL ECONOMY FOR PASSENGER CARS, 1975-2004 MODEL YEARS	30
FIGURE 18. SALES-WEIGHTED VEHICLE WEIGHT AND ON-ROAD FUEL ECONOMY FOR PASSENGER CARS, 1975-2004 MODEL YEARS	30
FIGURE 19. SALES-WEIGHTED HORSEPOWER AND ON-ROAD FUEL ECONOMY FOR VANS, 1975- 2004 MODEL YEARS	31
FIGURE 20. SALES-WEIGHTED VEHICLE WEIGHT AND ON-ROAD FUEL ECONOMY FOR VANS, 1975-2004 MODEL YEARS	31
FIGURE 21. SALES-WEIGHTED HORSEPOWER AND ON-ROAD FUEL ECONOMY FOR SUVs, 1975- 2004 MODEL YEARS	32
FIGURE 22. SALES-WEIGHTED VEHICLE WEIGHT AND ON-ROAD FUEL ECONOMY FOR SUVs, 1975-2004 MODEL YEARS	32
FIGURE 23. SALES-WEIGHTED HORSEPOWER AND ON-ROAD FUEL ECONOMY FOR PICKUPS, 1975-2004 MODEL YEARS	33
FIGURE 24. SALES-WEIGHTED VEHICLE WEIGHT AND ON-ROAD FUEL ECONOMY FOR PICKUPS, 1975-2004 MODEL YEARS	33
FIGURE 25. DECOMPOSITION 4942 OF ENERGY NEEDS, 1988 AND 2001	37
FIGURE 26. ENERGY SAVINGS FROM ENERGY INTENSITY EFFECT, 2001	37
FIGURE 27. DECOMPOSITION 4941 OF ENERGY NEEDS, 1988 AND 2001	39
FIGURE 28. ENERGY SAVINGS FROM ENERGY INTENSITY, 2001	39
FIGURE 29. DECOMPOSITION 4941 OF ENERGY USE, 1988-1991, 1991-1994, AND 1994-2001....	40
FIGURE 30. DECOMPOSITION 4941 OF ENERGY USE BY EFFECT, 1988-1991, 1991-1994, AND 1994-2001	40
FIGURE 31. CONCLUDED ENERGY SAVINGS, 1991 (BILLION GEG)	42
FIGURE 32. CONCLUDED ENERGY SAVINGS, 1994 (BILLION GEG)	42
FIGURE 33. CONCLUDED ENERGY SAVINGS, 2001 (BILLION GEG)	42
FIGURE B1. ESTIMATION SCHEMATIC.....	131
FIGURE B2. MILES PER GASOLINE EQUIVALENT GALLON ADJUSTMENT PROCEDURES	136
FIGURE B3. AREA MAP FOR REFORMULATED GASOLINE	148
FIGURE B4. MAP OF PETROLEUM ADMINISTRATION FOR DEFENSE DISTRICTS	149
FIGURE C1. SCHEMATIC FOR LINKING OR MATCHING A NHTS SAMPLE VEHICLE TO ELIGIBLE EPA/NHTSA VEHICLES	154
FIGURE C2. DISTRIBUTION OF NHTS SAMPLE VEHICLES "MATCHED" WITH VEHICLES "DONATED" BY NHTSA FILE RECORDS	157
FIGURE D1. RELATIONSHIPS AMONG DATA FILES RELEASED BY EIA AND NHTS	165
FIGURE D2. MAP OF U.S. CENSUS AND DIVISION AREAS.....	175
FIGURE E1. MAJOR EVENTS AND REAL WORLD OIL PRICES, 1970-2005	179

This page left blank.

EXECUTIVE SUMMARY

This page left blank.

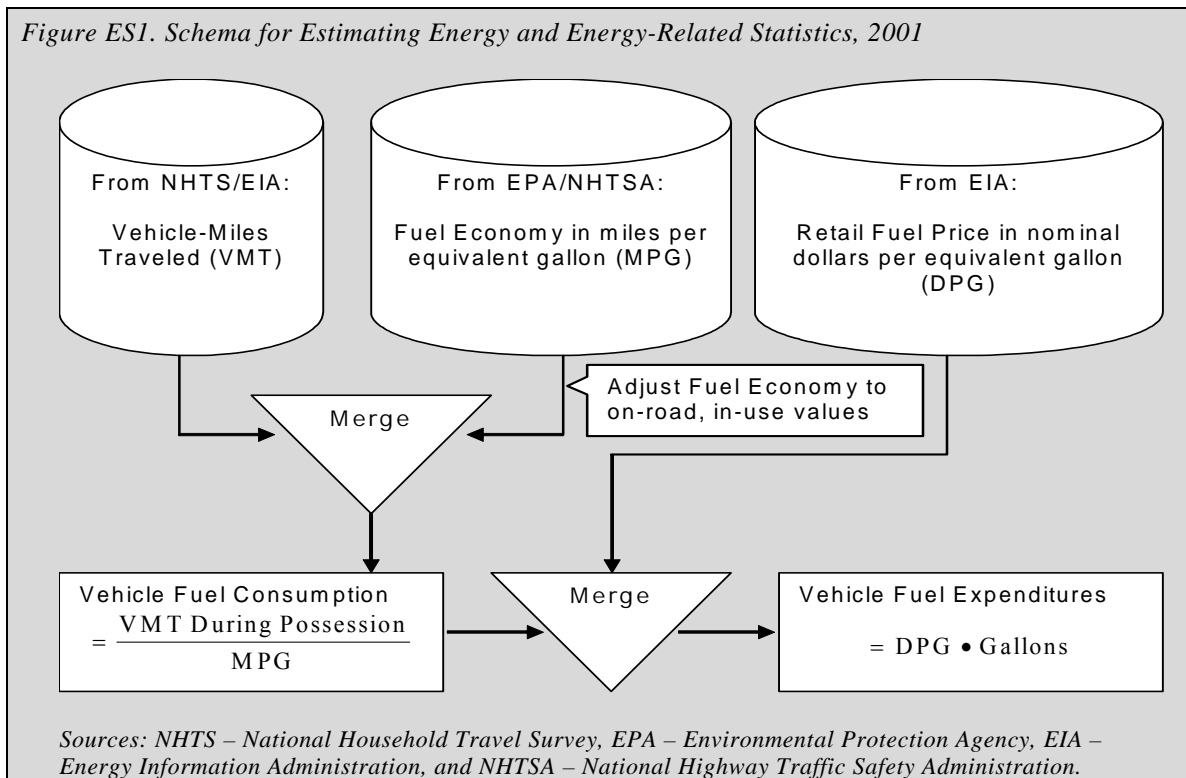
EXECUTIVE SUMMARY

INTRODUCTION

This report, *Household Vehicles Energy Use: Latest Data & Trends*, provides details on the nation's energy use for household passenger travel. A primary purpose of this report is to release the latest consumer-based data on household vehicles and expenditures, derived from the U.S. Department of Transportation's 2001 National Household Travel Survey (NHTS) and independent estimates of vehicle miles per gallon and fuel prices at that time (see Figure ES1).

This report also draws on data programs made available to the Energy Information Administration (EIA) from other Federal agencies, the five past Residential Transportation Energy Consumption Surveys¹ (RTECS) conducted by EIA and other EIA data sources and projections to assess household transport energy use from 1983 to the present time and into the near future. The data and analysis in this report center on several important intensities of use for travel: number and type of vehicles per household; annual miles per household and per vehicle; gallons of fuel consumed and type of fuel used; prices paid for fuel and total expenditures; and fuel economy.

Figure ES1. Schema for Estimating Energy and Energy-Related Statistics, 2001



¹ The RTECS was conducted on a multi-year basis: 1983, 1985, 1988, 1991, and 1994, after which it was discontinued by EIA.

HIGHLIGHTS

1. The energy consumed by light-duty vehicles focuses attention on the volatility of crude oil prices and the prospects for reducing reliance on oil imports, as well as the potential environmental impacts.

In 2001, the United States consumed 113.1 billion gasoline-equivalent gallons (GEG) to fuel passenger travel by light-duty vehicles, a rise of 3.3 percent per year from 1994, when 90.6 billion was consumed. That fuel consumption by light-duty vehicles, stored in a tank the size of a regulation football field, would require the tank to have walls nearly 50 miles high.² The *entire* transport sector is not only the second largest consumer of energy, but it also has recently become the largest contributor to the nation's greenhouse gas emissions of carbon dioxide, topping industrial emissions in 1999, primarily due to transport's heavy reliance on petroleum products, such as motor gasoline.³

The nation currently cannot provide for all its petroleum demand with domestically produced crude oil. The decline in domestic oil production, coupled with a rise in oil consumption, resulted in net imports of crude oil and petroleum products surpassing 11.8 million barrels per day in 2004, with imports reaching an all-time high of just over 12.9 million barrels per day, of which over 40 percent had originated at countries belonging to the Organization of Petroleum Exporting Countries (OPEC). Furthermore, motor gasoline accounted for nearly one-half (8.9 million barrels per day) of the 20 million barrels per day of petroleum products consumed domestically in 2004, with 13.6 million barrels per day of that total identified as transport sector use.

2. Costlier energy, in part, powers consumers' expenditures to higher levels, as they paid nearly equal amounts for household services and for their transport energy needs.

For consumers, energy costs are a foremost concern. Transportation costs have increased due to many factors related to travel and prices paid for transportation fuel, while being somewhat offset by improved fuel economy. In 2001, consumers paid nearly equal amounts for energy used for household services (ranging from cooking and water heating to refrigeration and lighting) and for personal transport. The average household spent \$1,520 for transport and remitted \$1,493 for household services, just \$27 more per year, as measured in nominal dollars.

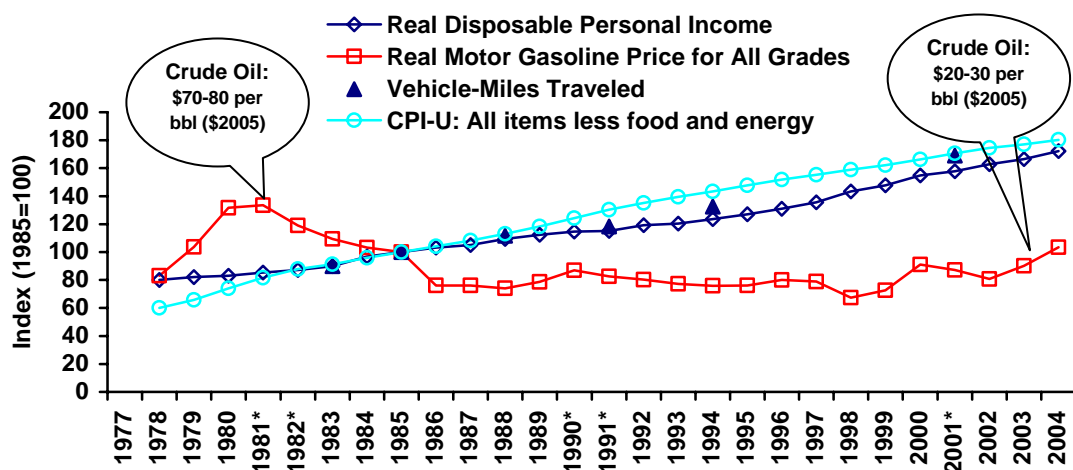
By contrast, an average household paid \$1,174 for passenger travel in 1994, while having paid \$1,620 for household services in 1993 – a year in which heating and cooling seasons were

² A ft³ equals 7.48 gallons. See www.ncaa.org/champadmin/football/football_field.gif for field dimensions.

³ Burning a gallon of gasoline releases 8.9 kilograms (373.8 kg per bbl) of carbon dioxide into the atmosphere. See *National Research Council, Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards* (Washington, D.C.: National Academy of Sciences, 2002), p. 85.

well within 30-year norms. It can be argued that, based on those statistics, what America drives on its roadways⁴ has become as important energy-wise as what heating equipment it places in its basements and appliances in its electrical sockets.

Figure ES2. Annual Indices of Real Disposable Income, Vehicle-Miles Traveled, Consumer Price Index (CPI-U), and Real Average Retail Gasoline Price, 1978-2004, 1985=100



Sources: Energy Information Administration, *Annual Energy Review 2004*; Bureau of Economic Analysis;
Note * = recession year.

While the real retail price of gasoline has risen and fallen over the past two decades, there has been an overall decline of 1.3 percent per year between 1983 and 2001, with substantial drops in 1986 and 1998 and somewhat smaller ones in 1991 and 2001 (see Figure E1 for a Chronology of World Oil Prices, as this price explains most of the variations found in refined gasoline prices). In contrast, the prices of other consumer products⁵ have risen dramatically, taking a higher real percentage of consumers' budgets. Given the minor role fuel prices have played in determining vehicle use, there is little surprise that vehicle-miles traveled is better correlated with disposable income than retail prices; furthermore, the improvement in energy intensity, though unexceptional, might have further weakened a diminished price signal by mitigating the effect of fuel prices, where consumers could travel further on a single dollar of transportation fuel. Given that retail price is primarily based on the price paid for crude oil, price signals to consumers should mimic world crude oil prices, which have exceeded \$50 per barrel (bbl) – at times surpassing \$60 per bbl.⁶

⁴ 8.3 million lane-miles. See *Federal Highway Administration, Highway Statistics 2003* (U.S. Department of Transportation, Washington, DC) table HM-60.

⁵ See components of the Consumer Price Index conducted by the U.S. Bureau of Labor Statistics.

⁶ See *Federal Trade Commission, Gasoline Price Changes: the Dynamic of Supply, Demand, and Competition*, July 5, 2005, Washington, DC. Accessed <http://www.ftc.gov/opa/2005/07/gaspricefactor.htm> on July 25, 2005.

3. Vehicle fuel expenditures are expected to rise in the near term, all else being equal.

Based on expected future energy prices which partially reflect producers' acquisition costs, the gap between transport cost and household services cost may expand. Between 2001 and 2006, expenditures for motor gasoline are expected to increase from \$1,370 per household per year to \$2,327 in 2006, up nearly \$960 per household. For comparison, in 2001, gasoline prices averaged \$1.43 per gallon; in 2006, gasoline prices are expected to average \$2.43 per gallon (a 71-percent increase in nominal terms and 52-percent increase when adjusted by inflation)⁷

4. Households, on average, have increased their mobility.

In 2001 there were 107.4 million households in the United States, of which nearly 98.9 million (92 percent) actually owned or possessed one or more vehicles, an increase of 1.8 percent per year from 1983, when 86 percent, or 72.2 million out of 84.4 million households, had possessed one or more vehicles. The increasing number of households and a greater fraction of those possessing a vehicle, all else been equal, should result in increased energy needs for the nation.

Since 1983, with some minor deviations, the growth in vehicle-miles traveled has mirrored the increases in real disposable income. For instance, between 1983 and 1985, when annual real gasoline prices dropped 4.4 percent per year, the annual growth of vehicle-miles traveled (i.e., overall travel) and disposable income rose 5.4 and 5.5 percent, respectively. Despite some inconsistencies when travel activity grew faster than disposable income, their overall growth between 1983 and 2001 is in near lock-step formation, with real disposable income registering a rise of 3.2 percent per year and travel activity growing at an annual rate of 3.6 percent.

5. Based on new vehicle sales figures, consumers' preferences for sports-utility vehicles is unmistakable, although cars still rank as the single largest segment of the nation's vehicle stock – accounting for nearly 6 out of every 10 vehicles on American roadways.

Even though sports-utility vehicles (SUVs) are increasingly popular among Americans, passenger cars still rank as their overall vehicle of choice, as they make up the majority of vehicles on America's roadways. Cars, including station wagons, represented just over 50 percent

⁷ Energy Information Administration, Short-Term Energy Outlook. Accessed <http://www.eia.doe.gov/emeu/steo/pub/contents.html> on November 14, 2005.

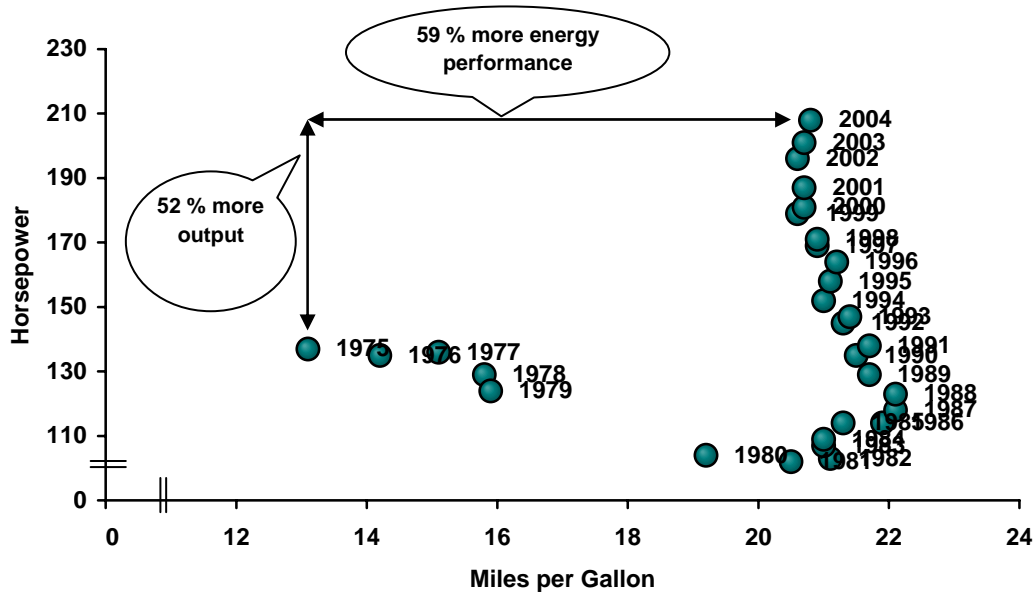
of the new vehicle purchases in 2001, as reported by the EPA, though in each of the subsequent years they have lost market share to SUVs. As of 2001, a recession year, the distribution of sales and scrappage rates had resulted in a household vehicle fleet of 191.0 million vehicles: 112.4 million (58 percent) passenger cars, 18.4 million (10 percent) vans, 23.2 million (12 percent) SUVs, 35.6 million (19 percent) pickups, and 1.4 million (1 percent) recreational vehicles.

6. The vehicles desired by consumers over the past 15 or 20 years have led to heavier, more powerful, and faster vehicles, equipped with increasingly powerful engines, generally exhibiting unexceptional improvements in energy performance (defined as gallons of fuel needed to travel one thousand miles or liters to travel 100 kilometers).

Tracking an economy's energy intensity – one measure of energy performance – as the ratio of energy per Gross Domestic Product (GDP) or the environmentally analogous intensity of carbon dioxide emitted per GDP⁸ is common in energy economics, and such a technique can be applied to transport. Instead of a ratio of economy-wide energy use per GDP, a ratio of gasoline-equivalent gallons (GEG) per vehicle-miles traveled for the *entire* vehicle stock is calculated. That overall intensity of energy use has steadily improved since 1983, though the greatest strides in lowering (improving) energy intensity had occurred before 1991. Post-1991 intensity improvements (i.e., *energy performance*) slowed dramatically, yielding an overall annual improvement of 1.6 percent between 1983 and 2001, as compared to the 3.2 and 4.2 percent gains seen in the 1983-1985 and 1985-1988 time periods, respectively. Figures ES3 and ES4 provide evidence of the lopsided improvement in the nation's energy performance. Moreover, this report also decomposes the change in energy use over time.

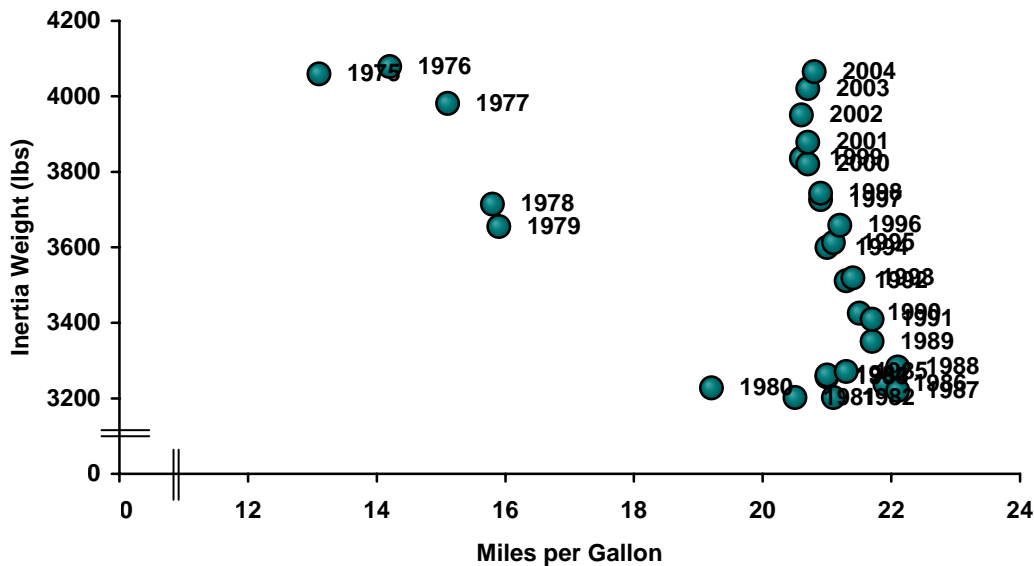
⁸ Emissions from petroleum-powered vehicles are directly proportional to energy use.

Figure ES3. Sales-Weighted Horsepower and On-Road Fuel Economy for New Light-Duty Vehicles, 1975-2004 Model Years



Source: Environmental Protection Agency, Fuel Economy Trends 2004.

Figure ES4. Sales-Weighted Inertia Weight and On-Road Fuel Economy for New Light-Duty Vehicles, 1975-2004 Model Years

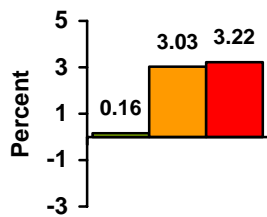


Source: Environmental Protection Agency, Fuel Economy Trends 2004.

DECOMPOSING ENERGY USE

7. Over time, fuel economy's influence on driving down energy use has lessened. Decomposing the change in energy use reveals such influences that fueled the growth in energy use, as well as deflated it, shedding light on the nation's continuing economic exposure to oil.

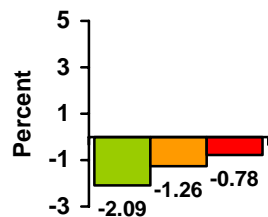
Figure ES5. Actual Annual Energy Growth – All Effects Are Included



Source: Energy Information Administration.

■ 1988-1991

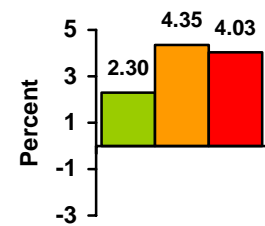
Figure ES6. Fuel Economy Effects on Annual Energy Growth



Source: Energy Information Administration.

■ 1991-1994

Figure ES7. Adjusted Annual Energy Growth – No Fuel Economy Effects



Source: Energy Information Administration.

■ 1994-2001

Consumers' energy needs for travel using personally owned vehicles (POV) grew unevenly between 1988 and 2001, averaging 2.46 percent per year. Measuring...

the effect on the change in energy use from improving technologies shows that Fuel Economy effects had dampened energy use, but those effects have sharply diminished over time, suggesting significant savings occurred prior to 1991 and much less so in following years. By excluding the effects of technology advancements affecting fuel economy...

energy use would have surged to even higher levels, climbing higher than the actual amounts because of those exclusions – 2.30 percent per year versus 0.16 percent between 1988 and 1991; 4.35 percent versus 3.03 percent between 1991 and 1994; 4.03 percent versus 3.22 percent between 1994 and 2001, resulting in billions of gallons of energy "savings" and decreasing, though at a declining rate, the nation's exposure to oil.

In addition to Fuel Economy Effects, there are numerous other factors affecting the change in energy use – though not always as an offset. Decomposition is a means of analyzing an overall change over time. The key is identifying intermediate predictors that are measurable and dimensionally intertwined with each other in measurable ratios such that an overall ratio can be "decomposed" into the product of two or more "effects," effectively linking them together. One then can conclude that the components represent the contributions of the change in each of the effects represented by the component ratios to the overall change.