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Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2003

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Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2003

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For More Information

Light-Duty Automotive Technology and Fuel Economy Trends 1975 through 2003 (EPA420-R-02-015) is available electronically on the Office of Transportation and Air Quality's (OTAQ) Web site at:

http://www.epa.gov/otaq/fetrends.htm

You can also contact the OTAQ library for document information at:

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A copy of the *Fuel Economy Guide* giving city and highway fuel economy data for individual models is available at

http://www.fueleconomy.gov

or by calling the U.S. Department of Energy's National Alternative Fuels Hotline at (800) 423-1363.

EPA's *Green Vehicle Guide* provides information about the air pollution emissions and fuel economy performance of vehicles; it is available on EPA's web site at

http://www.epa.gov/greenvehicles/

Table of Contents

Page
Number

Table of Contents, cont.

Appendixes

Page
Number

I. Executive Summary

Introduction

This report summarizes key fuel economy and technology usage trends related to model year 1975 through 2003 light vehicles sold in the United States. Light vehicles are those vehicles that EPA classifies as cars or light-duty trucks (sport utility vehicles, vans, and pickup trucks with less than 8,500 pounds gross vehicle weight ratings).

Model year 2003 light vehicles average 20.8 miles per gallon. New vehicle fuel economy peaked in 1987 and 1988 at 22.1 MPG and has been on a general downward trend since 1988. The average fuel economy for all model year 2003 light vehicles is six percent lower than it was in 1988. These fuel economy values are based on 'real world' estimates provided by the Federal government to consumers and are about 15 percent lower than the fuel economy values used by manufacturers and DOT for compliance with the Corporate Average Fuel Economy (CAFE) program.

In order to estimate the average fleet fuel economy for each model year, the measured fuel economy for each model is weighted by its sales volume. For model year 2003, EPA has used projected sales data that the auto companies are required to submit to the Agency. When EPA publishes the 2004 Trends Report, it will provide revised data based on actual sales information available at that time.

EPA has analyzed the variation in average fleet fuel economy that would have occurred in previous years as a result of using projected rather than actual sales. The variation is very low — plus or minus two percent (about 0.5 MPG). Readers therefore are encouraged to keep in mind that the data presented in this report may change slightly when the figures are re-calculated after the end of the model year.

Importance of Fuel Economy

Fuel economy continues to be a major area of public and policy interest for several reasons, including:

1. Light vehicles account for approximately 40 percent of all U.S. oil consumption. Crude oil, from which nearly all light-vehicle fuels are made, is considered to be a finite natural resource.

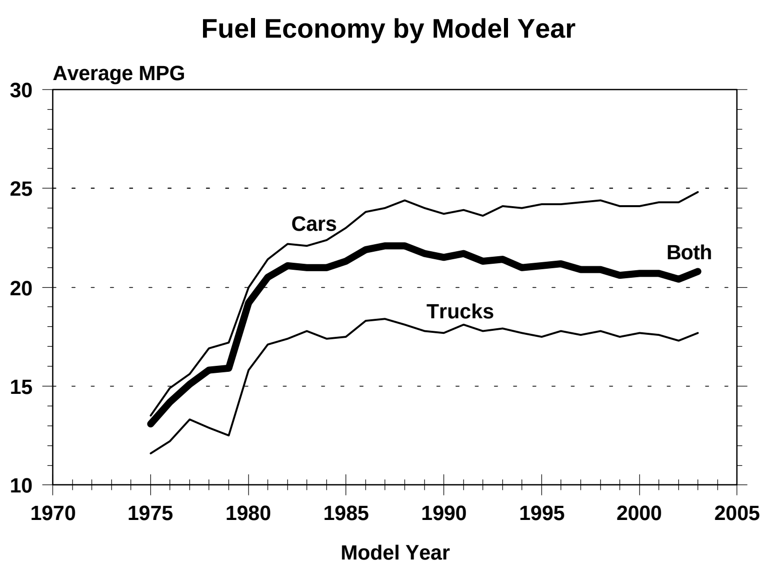
2. Fuel economy is directly related to the cost of fueling a vehicle and is of great interest when oil and gasoline prices rise.

3. Fuel economy affects the level of the nation's energy efficiency. Increases in energy efficiency can enhance energy security and reduce emissions of greenhouse gases. Fuel economy is directly related to carbon dioxide emissions, the most prevalent greenhouse gas. Light vehicles contribute about 20 percent of all U.S. carbon dioxide emissions.

Highlight #1: Fuel Economy is 20.8 MPG for Model Year 2003

> *There has been a general overall declining trend in new light-vehicle fuel economy since 1988. The average fuel economy for all model year 2003 light vehicles is 20.8 MPG - six percent lower than the peak value of 22.1 MPG achieved in 1987 and 1988. Average model year 2003 fuel economy is 24.8 MPG for cars and 17.7 MPG for light trucks.*

New light-vehicle fuel economy improved fleet-wide from the middle 1970s through the late 1980s, but it has been generally falling since then due primarily to the increase in the sales fraction of less efficient light-duty trucks. Viewed separately, the average fuel economy for new cars has changed very little since 1986, varying between 23.6 to 24.8 MPG. Similarly, the average fuel economy for new light trucks has been largely unchanged since 1986, ranging from 17.3 to 18.4 MPG.



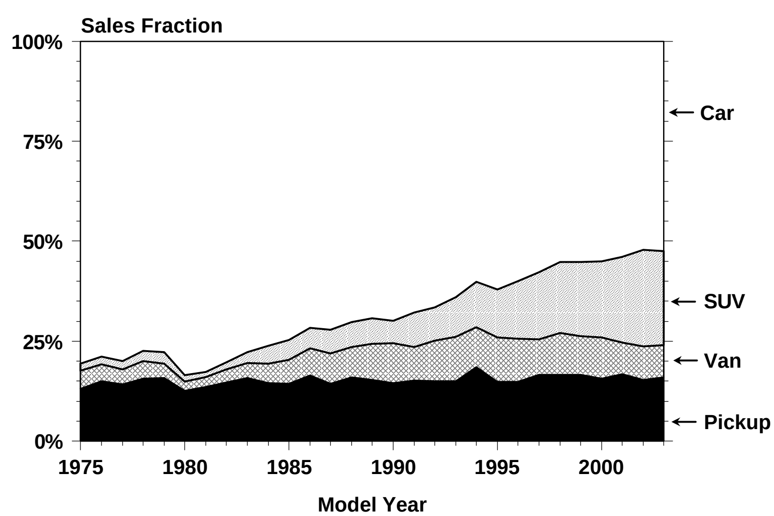
Highlight #2: Trucks Represent Nearly Half of New Vehicle Sales

Sales of light trucks, which include sport utility vehicles (SUVs), vans, and pickup trucks, have risen steadily for over 20 years and now make up 48 percent of the U.S. light vehicle market—more than twice their market share in 1983.

Growth in the light truck market has been led recently by the increase in the market share of SUVs. The SUV market share increased by more than a factor of ten, from less than two percent of the overall new light vehicle market in 1975 to 24 percent of the market in 2003. Over the same period, the market share for vans increased by 80 percent, while that for pickups remained relatively constant. Between 1975 and 2003, market share for new passenger cars and station wagons decreased from 81 to 52 percent. For model year 2003, cars average 24.8 MPG, vans 19.6 MPG, SUVs 17.8 MPG, and pickups 16.8 MPG.

The increasing market share of light trucks, which in recent years has averaged more than six MPG less than cars, accounts for much of the decline in fuel economy of the overall new light vehicle fleet.

Sales Fraction by Vehicle Type

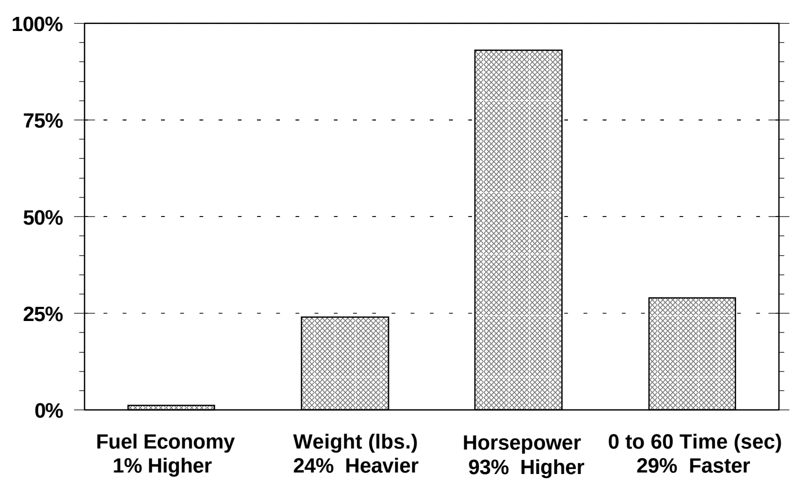


Highlight #3: Over the Past Two Decades, Fuel Economy Has Been Relatively Constant, While Vehicle Weight and Power Have Been Increasing

> *Technologies continue to enter the new light vehicle fleet and are being used, for example, to increase light vehicle acceleration performance, while fuel economy is not being increased. Based on accepted engineering relationships, however, had the new 2003 light vehicle fleet had the same average performance and same distribution of weight as in 1981, it could have achieved about 33 percent higher fuel economy.*

Technologies—such as engines with more valves and more sophisticated fuel injection systems, and transmissions with lockup torque convertors and extra gears—continue to penetrate the new light vehicle fleet. The trend has clearly been to apply these new technologies to accommodate increases in average new vehicle weight, power, and performance while maintaining a constant level of fuel economy. This is reflected by heavier average vehicle weight, rising average horsepower, and faster average 0 to 60 mile-per-hour acceleration time.

Percent Change from 1981 to 2003 in Average Vehicle Characteristics



Important Notes With Respect to the Data Used in This Report

Unless otherwise indicated, the fuel economy values in this report are based on laboratory data and have been adjusted downward by about 15 percent so that this data is equivalent to the real world estimates provided to consumers on new vehicle labels, in the EPA/DOE *Fuel Economy Guide,* and in EPA's *Green Vehicle Guide*. These adjusted fuel economy values are significantly lower than those used by the U.S. Department of Transportation (DOT) for compliance with Corporate Average Fuel Economy (CAFE) standards as, in addition to the 15-percent downward adjustment for real world driving, they also exclude credits for alternative fuel capability and test procedure changes that are included in the CAFE data reported by the U.S. DOT.

When comparing data in this report with those in previous reports in this series, please note that revisions are made in the data for some recent model years for which more complete and accurate sales and fuel economy data have become available.

Sales data for recent model years are based on confidential information provided to the government by the manufacturers. The sales data for model years 2002 and 2003 used in this report have been adjusted to take into account data available at the time the data base was frozen in September 2002.

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This report is available electronically at:

http://www.epa.gov/otaq/fetrends.htm

A copy of the *Fuel Economy Guide* giving city and highway fuel economy data for individual models is available at:

http://www.fueleconomy.gov

and EPA's *Green Vehicle Guide* is available on EPA's web site at:

http://www.epa.gov/greenvehicles

II. General Car and Truck Trends

Table 1 gives sales, fuel economy, and related information for passenger cars, light trucks, and all light-duty vehicles (cars and light trucks) for model years 1975 to 2003. As Figure 1 shows, the fuel economy of the combined car and light truck fleet increased from 13.1 MPG in 1975 to a peak value of 22.1 MPG in 1987 and 1988. Since then, fuel economy has gradually declined about six percent. For MY2003, average adjusted MPG of all cars and trucks combined is projected to be 20.8 (0.4 MPG greater than last year). Using the MY2003 fuel economy average values for cars and light trucks and computing a hypothetical fleet average based on the light truck market share in 1987, not 2003, a value of 22.3 MPG can be estimated which is within one percent of the value obtained in the peak years of 1987-8, indicating that much of the decline since then can be attributed to the increasing sales fraction of light trucks which have lower average fuel economy than cars. The increase in the light truck share of the market is the most important trend in the light vehicle fleet over recent years and one which may now only be beginning to level off.

The figures and tables in this report provide fuel economy data using two different approaches: the "laboratory" based or "unadjusted" values which have been used in many previous reports in this series and "adjusted" MPG values which are based on the adjustments made to the laboratory fuel economy values for the fuel economy information programs: the *Fuel Economy Guide*, new vehicle fuel economy labels, and the *Green Vehicle Guide*. The adjusted city MPG value is 0.90 times the laboratory city MPG value, and the adjusted highway MPG value is 0.78 times the laboratory MPG value. As described in the appendixes, these city and highway values are combined to form a composite 55/45 combined city/highway MPG. For a typical vehicle, the adjusted 55/45 MPG is about 15 percent less than the laboratory 55/45 MPG. Presenting both types of MPG values facilitates the use of this report by those who study either type of fuel economy metric.

In this report, "ton-MPG" is defined as a vehicle's adjusted MPG multiplied by its inertia weight in tons. This metric provides an indication of a vehicle's ability to move weight (i.e., its own plus a nominal payload). Ton-MPG is a measure of powertrain/drive-line efficiency. Just as an increase in vehicle MPG at constant weight can be considered an improvement in a vehicle's efficiency, an increase in a vehicle's weight-carrying capacity at constant MPG can also be considered an "improvement." Appendix A contains a further description of the database and calculation methods used in this report.

The fuel economy databases that EPA uses for this report and other purposes are based on the consumer information and regulatory databases maintained by the Agency. For a given model year, these databases change with calendar time as the initial MPG values and sales projections available in the Fall of the year evolve toward final and more complete MPG data and actual production data. This calendar time-based process can take more than one year to complete and during this time, the database is changing. Therefore, the results that are obtained from using the database depend on when the analysis is done. This report is being released earlier in the process than recent previous reports to be more consistent with the release of the consumer MPG information in the EPA/DOE fuel economy *Guide,* and therefore the data are representative of the 2003 database in its earliest state.

Figure 1 shows that the estimated light truck share of the market is about 48 percent, more than double what it was in any year between 1975 and 1983. Vans and SUVs combined account for nearly a third of this year’s fleet, compared to about a sixteenth of the 1975 fleet.

Table 2 shows some of the characteristics of each year’s fleet. At 3974 lb., the average weight of the MY2003 fleet is 18 lb. heavier than last year’s, 773 lb. heavier than it was at the minimum in 1981-82, and the fourth heaviest since 1975. The MY2003 fleet is also the most powerful and estimated to be as fast as it has ever been.

Fuel Economy by Model Year

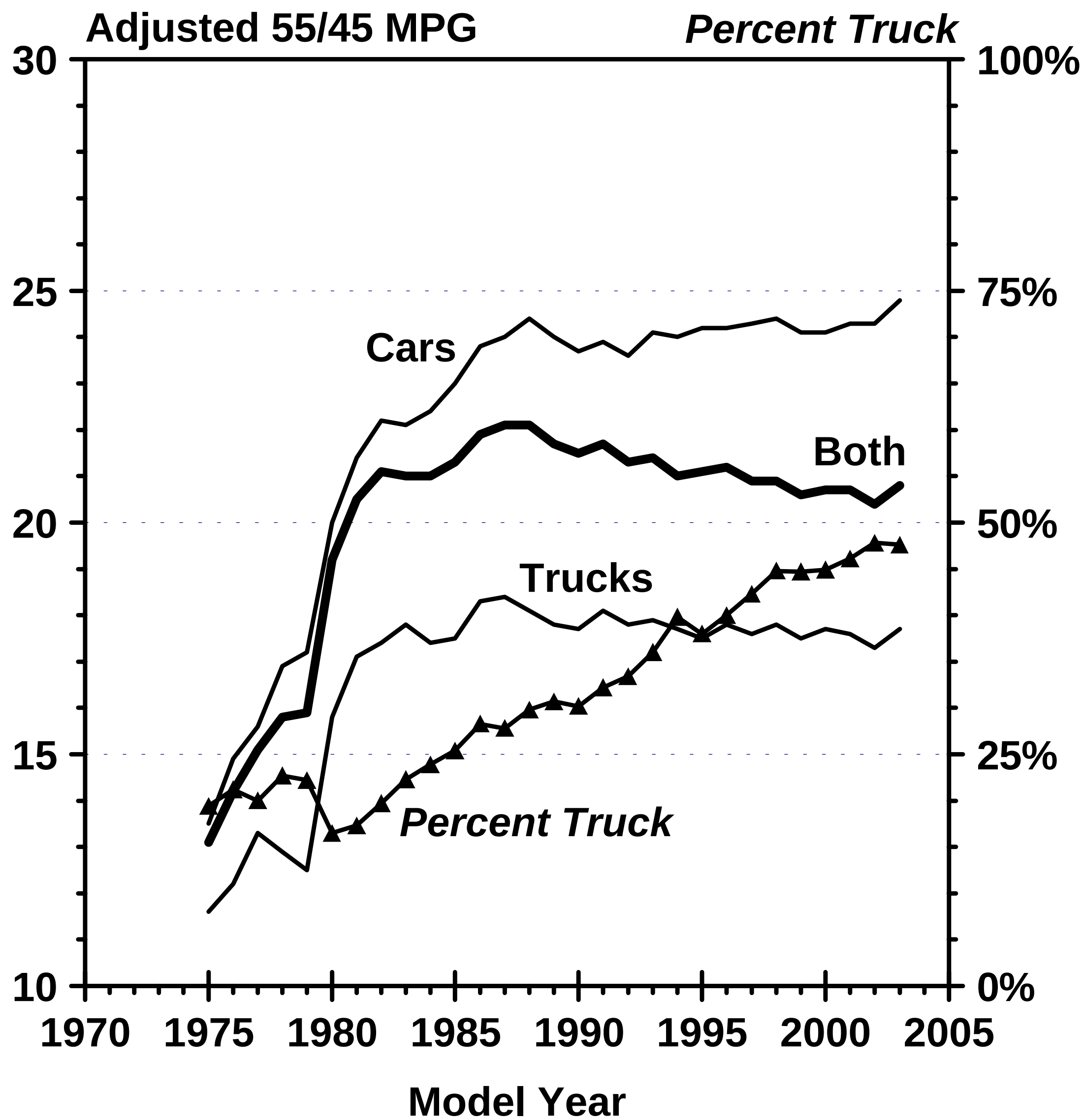

Figure 1

Table 1

Fuel Economy Characteristics of 1975 to 2003 Light-Duty Vehicles

Cars

MODEL YEAR	SALES (000)	FRAC	<---- FUEL ECONOMY LAB 55/45	ADJ CITY	ADJ HWY	----> ADJ 55/45	TON -MPG	CU-FT -MPG	CU-FT-TON-MPG
1975	8237	.806	15.8	12.3	15.2	13.5	27.6		
1976	9722	.788	17.5	13.7	16.6	14.9	30.2		
1977	11300	.800	18.3	14.4	17.4	15.6	31.0	1780	3423
1978	11175	.773	19.9	15.5	19.1	16.9	30.6	1908	3345
1979	10794	.778	20.3	15.9	19.2	17.2	30.2	1922	3301
1980	9443	.835	23.5	18.3	22.6	20.0	31.2	2136	3273
1981	8733	.827	25.1	19.6	24.2	21.4	33.1	2338	3547
1982	7819	.803	26.0	20.1	25.5	22.2	34.2	2419	3645
1983	8002	.777	25.9	19.9	25.5	22.1	34.7	2476	3776
1984	10675	.761	26.3	20.2	26.0	22.4	35.1	2482	3776
1985	10791	.746	27.0	20.7	26.8	23.0	35.8	2551	3881
1986	11015	.717	27.9	21.3	27.7	23.8	36.4	2608	3914
1987	10731	.722	28.1	21.5	28.0	24.0	36.5	2604	3900
1988	10736	.702	28.6	21.8	28.5	24.4	37.3	2662	4007
1989	10018	.693	28.1	21.4	28.3	24.0	37.4	2630	4034
1990	8810	.698	27.8	21.1	28.1	23.7	37.8	2574	4055
1991	8524	.678	28.0	21.2	28.3	23.9	37.8	2597	4055
1992	8108	.666	27.6	20.8	28.3	23.6	38.4	2598	4169
1993	8457	.640	28.2	21.3	28.8	24.1	38.8	2655	4214
1994	8414	.602	28.1	21.1	28.8	24.0	39.1	2638	4237
1995	9396	.620	28.3	21.2	29.3	24.2	39.6	2676	4315
1996	7890	.600	28.3	21.2	29.3	24.2	39.8	2671	4342
1997	8335	.577	28.4	21.3	29.4	24.3	39.9	2674	4341
1998	7972	.552	28.5	21.3	29.6	24.4	40.5	2684	4401
1999	8446	.553	28.1	21.1	29.2	24.1	40.6	2658	4446
2000	9124	.551	28.2	21.1	29.1	24.1	40.7	2668	4466
2001	8405	.539	28.4	21.4	29.3	24.3	41.4	2700	4525
2002	8190	.522	28.5	21.4	29.3	24.3	41.7	2721	4594
2003	8388	.524	29.0	21.8	29.7	24.8	42.6	2775	4688

Table 1, Continued

Fuel Economy Characteristics of 1975 to 2003 Light-Duty Vehicles

Trucks

MODEL YEAR	SALES (000)	FRAC	<---- FUEL ECONOMY LAB 55/45	ADJ CITY	ADJ HWY	----> ADJ 55/45	TON -MPG
1975	1987	.194	13.7	10.9	12.7	11.6	24.2
1976	2612	.212	14.4	11.5	13.2	12.2	26.0
1977	2823	.200	15.6	12.6	14.1	13.3	28.0
1978	3273	.227	15.2	12.4	13.7	12.9	27.5
1979	3088	.222	14.7	12.1	13.1	12.5	27.3
1980	1863	.165	18.6	14.8	17.1	15.8	30.9
1981	1821	.173	20.1	16.0	18.6	17.1	33.0
1982	1914	.197	20.5	16.3	19.0	17.4	33.7
1983	2300	.223	20.9	16.5	19.6	17.8	34.0
1984	3345	.239	20.5	16.1	19.3	17.4	33.5
1985	3669	.254	20.6	16.2	19.4	17.5	33.7
1986	4350	.283	21.4	16.9	20.2	18.3	34.4
1987	4134	.278	21.6	16.9	20.7	18.4	34.5
1988	4559	.298	21.2	16.5	20.4	18.1	34.9
1989	4435	.307	20.9	16.3	20.1	17.8	35.2
1990	3805	.302	20.7	16.1	20.2	17.7	35.6
1991	4049	.322	21.3	16.4	20.7	18.1	36.0
1992	4064	.334	20.8	16.1	20.4	17.8	36.2
1993	4754	.360	21.0	16.1	20.7	17.9	36.6
1994	5572	.398	20.8	16.0	20.4	17.7	36.7
1995	5749	.380	20.5	15.8	20.2	17.5	36.9
1996	5254	.400	20.8	16.0	20.7	17.8	37.8
1997	6117	.423	20.6	15.8	20.4	17.6	38.3
1998	6477	.448	20.9	16.0	20.8	17.8	38.3
1999	6839	.447	20.5	15.7	20.3	17.5	38.6
2000	7434	.449	20.8	16.0	20.5	17.7	38.9
2001	7189	.461	20.6	15.9	20.2	17.6	39.3
2002	7511	.478	20.3	15.6	20.1	17.3	39.7
2003	7612	.476	20.8	15.9	20.5	17.7	40.8

Table 1, Continued

Fuel Economy Characteristics of 1975 to 2003

Cars and Light Trucks

MODEL YEAR	SALES (000)	FRAC	<---- FUEL ECONOMY ----> LAB 55/45	ADJ CITY	ADJ HWY	ADJ 55/45	TON -MPG
Both							
1975	10224	1.000	15.3	12.0	14.6	13.1	26.9
1976	12334	1.000	16.7	13.2	15.7	14.2	29.3
1977	14123	1.000	17.7	14.0	16.6	15.1	30.4
1978	14448	1.000	18.6	14.7	17.5	15.8	29.9
1979	13882	1.000	18.7	14.9	17.4	15.9	29.5
1980	11306	1.000	22.5	17.6	21.5	19.2	31.2
1981	10554	1.000	24.1	18.8	23.0	20.5	33.1
1982	9732	1.000	24.7	19.2	23.9	21.1	34.1
1983	10302	1.000	24.6	19.0	23.9	21.0	34.5
1984	14020	1.000	24.6	19.1	24.0	21.0	34.7
1985	14460	1.000	25.0	19.3	24.4	21.3	35.3
1986	15365	1.000	25.7	19.9	25.1	21.9	35.8
1987	14865	1.000	25.9	20.0	25.5	22.1	35.9
1988	15295	1.000	25.9	19.9	25.5	22.1	36.6
1989	14453	1.000	25.4	19.5	25.2	21.7	36.7
1990	12615	1.000	25.2	19.3	25.1	21.5	37.1
1991	12573	1.000	25.4	19.4	25.3	21.7	37.2
1992	12172	1.000	24.9	18.9	25.0	21.3	37.6
1993	13211	1.000	25.1	19.1	25.2	21.4	38.0
1994	13986	1.000	24.6	18.7	24.7	21.0	38.2
1995	15145	1.000	24.7	18.8	25.0	21.1	38.6
1996	13144	1.000	24.8	18.7	25.1	21.2	39.0
1997	14451	1.000	24.5	18.6	24.8	20.9	39.2
1998	14449	1.000	24.5	18.5	24.9	20.9	39.5
1999	15285	1.000	24.1	18.3	24.4	20.6	39.7
2000	16558	1.000	24.3	18.4	24.5	20.7	39.9
2001	15594	1.000	24.2	18.4	24.3	20.7	40.4
2002	15700	1.000	23.9	18.2	24.0	20.4	40.7
2003	16000	1.000	24.4	18.6	24.5	20.8	41.7

Table 2

Vehicle Size and Design Characteristics of 1975 to 2003 Cars

	<------------ **MEASURED CHARACTERISTICS** -------------->									<-- **PERCENT BY:** -->		
										VEHICLE SIZE		
MODEL YEAR	SALES (000)	FRAC	ADJ 55/45 MPG	VOL CU-FT	INERTIA WGHT LB	ENG HP	HP/ WT	0-60 TIME	TOP SPD	SMALL	MID	LARGE
1975	8237	.806	13.5		4057	136	.0331	14.2	111	55.4	23.3	21.3
1976	9722	.788	14.9		4058	134	.0324	14.4	110	55.4	25.2	19.4
1977	11300	.800	15.6	110	3943	133	.0335	14.0	111	51.9	24.5	23.5
1978	11175	.773	16.9	109	3587	124	.0342	13.7	111	44.7	34.4	21.0
1979	10794	.778	17.2	108	3484	119	.0338	13.8	110	43.7	34.2	22.1
1980	9443	.835	20.0	104	3101	100	.0322	14.3	107	54.4	34.4	11.3
1981	8733	.827	21.4	106	3075	99	.0320	14.4	106	51.5	36.4	12.2
1982	7819	.803	22.2	106	3054	99	.0320	14.4	106	56.5	31.0	12.5
1983	8002	.777	22.1	108	3111	104	.0330	14.0	108	53.1	31.8	15.1
1984	10675	.761	22.4	107	3098	106	.0339	13.8	109	57.4	29.4	13.2
1985	10791	.746	23.0	108	3092	111	.0355	13.3	111	55.7	28.9	15.4
1986	11015	.717	23.8	107	3040	111	.0360	13.2	111	59.5	27.9	12.6
1987	10731	.722	24.0	106	3030	112	.0365	13.0	112	63.5	24.3	12.2
1988	10736	.702	24.4	107	3046	116	.0375	12.8	113	64.8	22.3	12.8
1989	10018	.693	24.0	107	3099	121	.0387	12.5	115	58.3	28.2	13.5
1990	8810	.698	23.7	107	3175	129	.0401	12.1	117	58.6	28.7	12.8
1991	8524	.678	23.9	106	3153	132	.0413	11.8	118	61.5	26.2	12.3
1992	8108	.666	23.6	108	3239	141	.0428	11.5	120	56.5	27.8	15.6
1993	8457	.640	24.1	108	3207	138	.0425	11.6	120	57.2	29.5	13.3
1994	8414	.602	24.0	108	3249	143	.0432	11.4	121	58.5	26.1	15.4
1995	9396	.620	24.2	108	3262	152	.0460	10.9	125	57.3	28.6	14.0
1996	7890	.600	24.2	108	3281	154	.0464	10.8	125	54.3	32.0	13.6
1997	8335	.577	24.3	108	3274	156	.0469	10.7	126	55.1	30.6	14.3
1998	7972	.552	24.4	108	3306	159	.0475	10.6	127	49.4	39.1	11.4
1999	8446	.553	24.1	109	3365	164	.0481	10.5	128	47.4	40.0	12.5
2000	9124	.551	24.1	109	3369	168	.0492	10.4	129	47.5	34.3	18.2
2001	8405	.539	24.3	109	3379	168	.0492	10.3	129	50.9	32.3	16.8
2002	8190	.522	24.3	109	3405	175	.0507	10.1	131	48.7	34.8	16.4
2003	8388	.524	24.8	109	3410	175	.0508	10.1	131	52.0	32.7	15.4

Table 2, Continued

Vehicles Size and Design Characteristics of 1975 to 2003 Light Trucks

	<----- MEASURED CHARACTERISTICS							------------>	<---------- PERCENT BY:					-------->
MODEL YEAR	SALES (000)	FRAC	ADJ 55/45 MPG	INERTIA WGHT LB	ENG HP	HP/ WT	0-60 TIME	TOP SPD	VEHICLE SIZE SMALL	MID	LARGE	VEHICLE TYPE VAN	SUV	PICKUP
1975	1987	.194	11.6	4072	142	.0349	13.6	114	10.9	24.2	64.9	23.0	9.4	67.6
1976	2612	.212	12.2	4154	141	.0340	13.8	113	9.0	20.3	70.7	19.2	9.3	71.4
1977	2823	.200	13.3	4135	147	.0356	13.3	115	11.1	20.3	68.5	18.2	10.0	71.8
1978	3273	.227	12.9	4151	146	.0351	13.4	114	10.9	22.7	66.3	19.1	11.6	69.3
1979	3088	.222	12.5	4251	138	.0325	14.3	111	15.2	19.5	65.3	15.6	13.0	71.5
1980	1863	.165	15.8	3868	121	.0313	14.5	108	28.4	17.6	54.0	13.0	9.9	77.1
1981	1821	.173	17.1	3805	119	.0311	14.6	108	23.2	19.1	57.7	13.5	7.5	79.1
1982	1914	.197	17.4	3805	120	.0317	14.5	109	21.1	31.0	47.9	16.2	8.5	75.3
1983	2300	.223	17.8	3763	118	.0313	14.5	108	16.6	45.9	37.6	16.6	12.6	70.8
1984	3345	.239	17.4	3782	118	.0310	14.7	108	19.5	46.4	34.1	20.2	18.7	61.1
1985	3669	.254	17.5	3795	124	.0326	14.1	110	19.2	48.5	32.3	23.3	20.0	56.6
1986	4350	.283	18.3	3737	123	.0330	14.0	110	23.5	48.5	28.0	24.0	17.8	58.2
1987	4134	.278	18.4	3712	131	.0351	13.3	113	19.9	59.6	20.6	26.9	21.1	51.9
1988	4559	.298	18.1	3841	141	.0366	12.9	115	15.0	57.2	27.8	24.8	21.2	53.9
1989	4435	.307	17.8	3921	146	.0372	12.8	116	13.9	58.9	27.2	28.8	20.9	50.3
1990	3805	.302	17.7	4005	151	.0377	12.6	117	13.4	57.1	29.6	33.2	18.6	48.2
1991	4049	.322	18.1	3948	150	.0379	12.6	117	11.4	67.2	21.4	25.5	27.0	47.4
1992	4064	.334	17.8	4055	155	.0382	12.5	118	10.4	64.0	25.6	30.0	24.7	45.3
1993	4754	.360	17.9	4073	162	.0398	12.1	120	8.8	65.3	25.9	30.3	27.6	42.1
1994	5572	.398	17.7	4129	166	.0402	12.0	121	9.8	62.5	27.7	25.0	28.5	46.5
1995	5749	.380	17.5	4184	168	.0401	12.0	121	8.6	63.5	27.9	28.9	31.6	39.5
1996	5254	.400	17.8	4224	179	.0423	11.5	124	6.5	67.1	26.4	26.8	36.0	37.2
1997	6117	.423	17.6	4344	187	.0429	11.4	126	10.1	52.5	37.3	20.7	40.0	39.3
1998	6477	.448	17.8	4282	187	.0435	11.2	126	8.9	58.7	32.4	23.0	39.8	37.3
1999	6839	.447	17.5	4412	197	.0446	11.0	128	7.7	55.8	36.5	21.4	41.4	37.2
2000	7434	.449	17.7	4375	197	.0448	11.0	128	6.7	55.7	37.5	22.7	42.2	35.1
2001	7189	.461	17.6	4462	209	.0466	10.6	131	6.6	47.4	46.0	17.2	46.3	36.5
2002	7511	.478	17.3	4556	219	.0479	10.4	133	6.2	45.1	48.6	17.4	50.5	32.1
2003	7612	.476	17.7	4595	220	.0478	10.4	133	6.4	48.1	45.5	17.0	49.3	33.7

Table 2, Continued

Vehicles Size and Design Characteristics of 1975 to 2003 Cars and Light Trucks

	<---------- **MEASURED CHARACTERISTICS**							---------->	<-- **PERCENT BY**:		-->
MODEL YEAR	SALES (000)	FRAC	ADJ 55/45 MPG	INERTIA WGHT LB	ENG HP	HP/ WT	0-60 TIME	TOP SPD	VEHICLE SIZE SMALL	MID	LARGE
1975	10224	1.000	13.1	4060	137	.0335	14.1	112	46.8	23.5	29.8
1976	12334	1.000	14.2	4079	135	.0328	14.3	111	45.6	24.2	30.3
1977	14123	1.000	15.1	3981	136	.0339	13.8	112	43.8	23.7	32.5
1978	14448	1.000	15.8	3715	129	.0344	13.6	112	37.0	31.7	31.2
1979	13882	1.000	15.9	3655	124	.0335	13.9	110	37.3	30.9	31.7
1980	11306	1.000	19.2	3227	104	.0320	14.3	107	50.1	31.6	18.3
1981	10554	1.000	20.5	3201	102	.0318	14.4	107	46.6	33.4	20.0
1982	9732	1.000	21.1	3201	103	.0320	14.4	107	49.6	31.0	19.5
1983	10302	1.000	21.0	3257	107	.0327	14.1	108	44.9	34.9	20.1
1984	14020	1.000	21.0	3261	109	.0332	14.0	109	48.4	33.4	18.2
1985	14460	1.000	21.3	3271	114	.0347	13.5	110	46.5	33.9	19.7
1986	15365	1.000	21.9	3237	114	.0351	13.4	111	49.3	33.7	17.0
1987	14865	1.000	22.1	3220	118	.0361	13.1	112	51.4	34.1	14.5
1988	15295	1.000	22.1	3283	123	.0372	12.8	114	50.0	32.7	17.3
1989	14453	1.000	21.7	3351	129	.0382	12.5	115	44.7	37.6	17.7
1990	12615	1.000	21.5	3426	135	.0394	12.2	117	44.9	37.2	17.8
1991	12573	1.000	21.7	3409	138	.0402	12.1	118	45.3	39.4	15.2
1992	12172	1.000	21.3	3512	145	.0413	11.8	120	41.1	39.9	19.0
1993	13211	1.000	21.4	3518	147	.0416	11.8	120	39.8	42.4	17.8
1994	13986	1.000	21.0	3600	152	.0420	11.7	121	39.1	40.6	20.3
1995	15145	1.000	21.1	3612	158	.0438	11.3	123	38.8	41.9	19.3
1996	13144	1.000	21.2	3658	164	.0447	11.1	125	35.2	46.0	18.7
1997	14451	1.000	20.9	3727	169	.0452	11.0	126	36.1	39.9	24.1
1998	14449	1.000	20.9	3743	171	.0457	10.9	126	31.3	47.9	20.8
1999	15285	1.000	20.6	3834	179	.0465	10.7	128	29.7	47.1	23.3
2000	16558	1.000	20.7	3821	181	.0472	10.6	129	29.2	43.9	26.9
2001	15594	1.000	20.7	3879	187	.0480	10.5	130	30.4	39.3	30.3
2002	15700	1.000	20.4	3956	196	.0494	10.2	132	28.4	39.8	31.8
2003	16000	1.000	20.8	3974	197	.0494	10.2	132	30.3	40.0	29.7

The distribution of MPG in any model year is of interest. In Figure 2, highlights of the distribution of car MPG are shown. Since 1975, the distribution has both narrowed and widened. Half of the cars have consistently been within a few MPG of each other, but the range of the highest to lowest has increased from about 3:1 in 1975 to about 6:1 today. In absolute terms, the fuel economy difference between the least efficient and most efficient car increased from about 20 MPG in 1975 to nearly 40 MPG a decade later in 1985 and became, with the introduction for sale of the Honda Insight gasoline-electric hybrid vehicle in model year 2000, more than 50 MPG.

The overall MPG distribution trend for trucks (see Figure 3) is similar to that for cars, but narrower with a peak in the efficiency of the most efficient truck in the early 1980s when small pickup trucks equipped with Diesel engines were being sold. As a result, the fuel economy range between the most efficient and least efficient truck has narrowed from about 30 MPG in 1983 to about 14 MPG this year. Like cars, half of the trucks built each year have always been within a few MPG of each year's average fuel economy value.

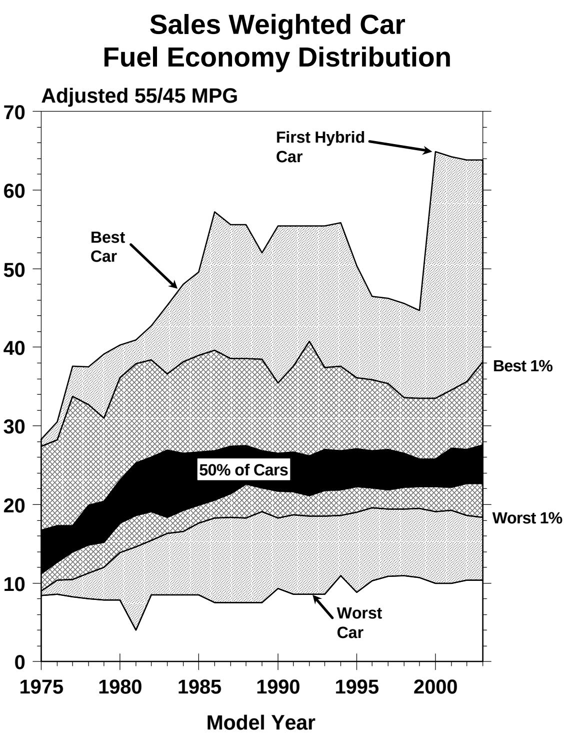

Figure 2

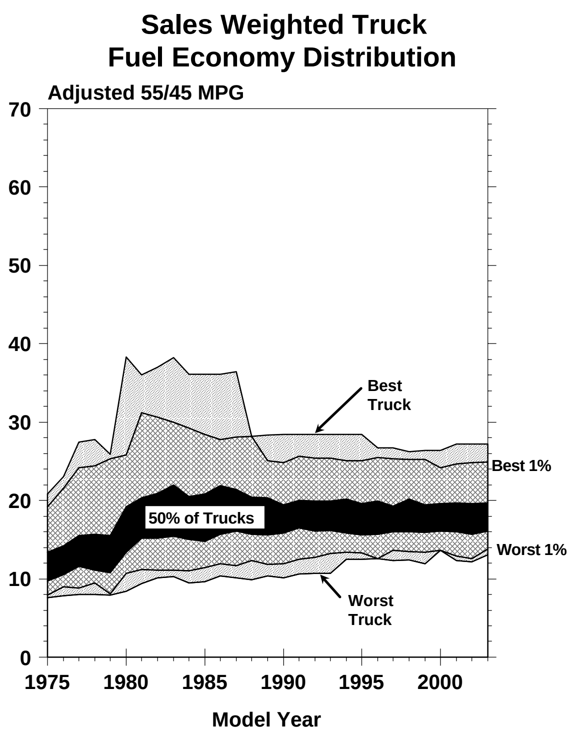

Figure 3

III. Technology Trends

Table 3 repeats some of the data from Tables 1 and 2 and adds powertrain information including front-wheel drive percent, transmission type, fuel metering, and percent of vehicles equipped with engines that have four valves per cylinder. Cars are predominantly powered by gasoline-fueled engines that use port fuel injection and have four valves per cylinder, and use lockup automatic transmissions driving the front wheels. Trucks have gasoline-fueled engines with port fuel injection and have two valves per cylinder, and use lockup automatic transmissions that drive the rear or all four wheels.

Table 4 compares technology usage for MY2003 by vehicle type and size. For this table, the car classes are separated into cars and station wagons, so that the table stratifies light-duty vehicles into a total of 15 vehicle types and sizes. Note that this table does not contain any data for small vans and large wagons, because none have been produced since 1996. In addition, in some of the tables and figures, only four types are used. In these cases, wagons have been merged with cars. This is because the wagon sales fraction for some instances is so small that the information is more conveniently represented by combining the two vehicle types. When they have been combined, the differences between them are not important

Front-wheel drive (FWD) is used heavily in all of the car classes, in small wagons, and midsize vans. By comparison, none of this year’s pickups will have front-wheel drive, and very little use of it is found in large vans or any of the SUVs. Conversely, four-wheel drive (4WD) is used heavily in SUVs and pickups. Many of the midsize wagons also have 4WD, but very little use of it is made in vans and cars.

Manual transmissions are used in small and mid-size vehicles in 2003. Similarly, usage of engines with four valves per cylinder is prevalent on small vehicles and also midsize cars, wagons, and SUVs.

Detailed tabulations of different technology types, including technology usage percentages for other model years, can be found in the Appendixes.

Table 3

Powertrain Characteristics of 1975 to 2003 Vehicles (Percentage Basis)

MODEL YEAR	SALES (000)	FRAC	ADJ 55/45 MPG	ENGINE CID	ENGINE HP	HP/ CID	DRIVETRAIN FRONT	DRIVETRAIN 4WD	TRANSMISSION MANUAL	TRANSMISSION LOCK	FI	FUEL METERING PORT	FUEL METERING TBI	FUEL METERING CARB	DSL	FOUR VALVE
Cars																
1975	8237	.806	13.5	288	136	.515	6.5	.0	19.9	.0	5.1	5.1	.0	94.6	.2	.0
1976	9722	.788	14.9	287	134	.502	5.8	.0	17.1	.0	3.2	3.2	.0	96.6	.3	.0
1977	11300	.800	15.6	279	133	.516	6.8	.0	16.8	.0	4.2	4.2	.0	95.3	.5	.0
1978	11175	.773	16.9	251	124	.538	9.6	.0	20.2	6.7	5.1	5.1	.0	94.0	.9	.0
1979	10794	.778	17.2	238	119	.545	11.9	.3	22.3	8.0	4.7	4.7	.0	93.2	2.1	.0
1980	9443	.835	20.0	188	100	.583	29.7	.9	31.9	16.5	6.9	6.2	.7	88.7	4.4	.0
1981	8733	.827	21.4	182	99	.594	37.0	.7	30.4	33.3	8.8	6.1	2.6	85.3	5.9	.0
1982	7819	.803	22.2	175	99	.609	45.6	.8	29.7	51.4	17.0	7.2	9.8	78.4	4.7	.0
1983	8002	.777	22.1	182	104	.615	47.3	3.1	26.5	56.7	28.3	9.5	18.9	69.6	2.1	.0
1984	10675	.761	22.4	179	106	.637	53.7	1.0	24.1	58.3	39.4	15.0	24.4	58.9	1.7	.0
1985	10791	.746	23.0	177	111	.671	61.6	2.1	22.8	58.7	53.5	21.4	32.0	45.6	.9	.0
1986	11015	.717	23.8	167	111	.701	71.1	1.1	24.8	58.0	65.1	36.7	28.4	34.5	.3	1.6
1987	10731	.722	24.0	162	112	.732	77.0	1.1	24.9	59.5	73.0	42.5	30.5	26.8	.3	5.6
1988	10736	.702	24.4	160	116	.759	81.7	.8	24.3	66.1	83.7	53.7	30.0	16.3	.0	10.4
1989	10018	.693	24.0	163	121	.783	82.5	1.0	21.0	69.3	90.2	62.4	27.8	9.7	.0	12.8
1990	8810	.698	23.7	163	129	.829	84.6	1.0	19.6	72.9	98.6	77.5	21.1	1.4	.0	25.7
1991	8524	.678	23.9	163	132	.851	83.2	1.4	20.5	73.5	99.8	78.0	21.8	.0	.1	28.2
1992	8108	.666	23.6	170	141	.868	80.8	1.1	17.4	76.4	99.9	89.5	10.4	.0	.1	29.7
1993	8457	.640	24.1	166	138	.865	85.1	1.2	17.8	76.9	100.0	91.6	8.4	.0	.0	32.8
1994	8414	.602	24.0	168	143	.884	84.4	.4	16.7	79.3	100.0	94.9	5.1	.0	.0	38.9
1995	9396	.620	24.2	167	152	.945	82.0	1.2	16.3	81.9	99.9	98.8	1.2	.0	.1	52.1
1996	7890	.600	24.2	165	154	.958	86.5	1.5	14.9	83.6	99.9	98.8	1.1	.0	.1	56.2
1997	8335	.577	24.3	164	156	.974	86.5	1.7	13.5	85.8	99.9	99.1	.8	.0	.1	57.4
1998	7972	.552	24.4	164	159	.993	87.0	2.3	12.3	87.3	99.8	99.7	.1	.0	.2	60.5
1999	8446	.553	24.1	166	164	1.009	86.5	3.0	11.0	88.4	99.8	99.7	.1	.0	.2	59.7
2000	9124	.551	24.1	165	168	1.032	84.9	2.1	11.2	87.7	99.8	99.7	.1	.0	.2	63.2
2001	8405	.539	24.3	165	168	1.042	84.1	3.2	11.4	87.5	99.7	99.7	.0	.0	.3	61.8
2002	8190	.522	24.3	168	175	1.063	83.1	3.8	14.0	85.1	99.8	99.8	.0	.0	.2	64.5
2003	8388	.524	24.8	165	175	1.083	82.4	3.6	14.7	84.7	99.6	99.6	.0	.0	.4	70.4
Trucks																
1975	1987	.194	11.6	311	142	.476	.0	17.1	37.0	.0	.1	.0	.0	99.9	.0	.0
1976	2612	.212	12.2	319	141	.458	.0	22.9	34.8	.0	.1	.0	.0	99.9	.0	.0
1977	2823	.200	13.3	318	147	.482	.0	23.6	32.0	.0	.1	.0	.0	99.9	.0	.0
1978	3273	.227	12.9	314	146	.481	.0	29.0	32.4	.0	.1	.0	.0	99.1	.8	.0
1979	3088	.222	12.5	298	138	.486	.0	18.0	35.2	2.1	.3	.0	.0	97.9	1.8	.0
1980	1863	.165	15.8	248	121	.528	1.4	25.0	53.0	24.6	1.7	.0	.0	94.9	3.5	.0
1981	1821	.173	17.1	247	119	.508	1.9	20.1	51.6	31.1	1.1	.0	.0	93.3	5.6	.0
1982	1914	.197	17.4	243	120	.524	1.7	20.0	45.7	33.2	.7	.0	.0	90.0	9.3	.0
1983	2300	.223	17.8	231	118	.543	1.4	25.8	45.9	36.1	.6	.0	.0	94.7	4.7	.0
1984	3345	.239	17.4	224	118	.557	4.9	31.0	42.1	35.1	2.6	.0	.0	95.1	2.3	.0
1985	3669	.254	17.5	224	124	.586	7.1	30.6	37.1	42.2	12.3	.0	.2	86.7	1.1	.0
1986	4350	.283	18.3	211	123	.621	5.9	30.3	42.7	42.0	40.5	21.8	18.7	58.7	.7	.0
1987	4134	.278	18.4	210	131	.654	7.4	31.5	39.9	44.8	66.9	33.3	33.6	32.9	.3	.0
1988	4559	.298	18.1	227	141	.650	9.0	33.3	35.5	53.1	87.7	43.3	44.4	12.1	.2	.0
1989	4435	.307	17.8	234	146	.653	9.9	32.0	32.7	56.8	93.5	45.9	47.6	6.3	.2	.0
1990	3805	.302	17.7	237	151	.668	15.5	31.3	28.1	67.4	96.0	55.2	40.8	3.9	.2	.0
1991	4049	.322	18.1	228	150	.681	9.7	35.3	31.0	67.4	98.2	55.0	43.2	1.6	.1	.0
1992	4064	.334	17.8	234	155	.685	13.6	31.4	27.3	71.5	98.4	65.9	32.5	1.5	.1	.0
1993	4754	.360	17.9	235	162	.710	15.1	29.5	23.3	75.7	99.0	73.4	25.7	1.0	.0	.2
1994	5572	.398	17.7	240	166	.716	13.3	37.4	23.3	75.2	99.6	76.8	22.8	.4	.0	2.5
1995	5749	.380	17.5	244	168	.715	17.7	40.7	20.5	78.6	100.0	79.8	20.2	.0	.0	8.1
1996	5254	.400	17.8	243	179	.757	20.1	37.1	15.6	83.5	99.9	99.9	.0	.0	.1	10.4
1997	6117	.423	17.6	248	187	.775	13.9	43.3	14.6	84.9	100.0	100.0	.0	.0	.0	11.3
1998	6477	.448	17.8	242	187	.795	18.7	42.0	13.5	86.0	100.0	100.0	.0	.0	.0	15.2
1999	6839	.447	17.5	249	197	.814	17.4	44.6	9.1	90.5	100.0	100.0	.0	.0	.0	16.2
2000	7434	.449	17.7	242	197	.832	19.4	42.5	8.0	91.7	100.0	100.0	.0	.0	.0	20.5
2001	7189	.461	17.6	243	209	.882	18.5	43.8	6.3	93.4	100.0	100.0	.0	.0	.0	27.1
2002	7511	.478	17.3	246	219	.910	18.3	48.0	6.4	93.2	100.0	100.0	.0	.0	.0	32.2
2003	7612	.476	17.7	245	220	.919	18.1	49.1	5.9	93.3	100.0	100.0	.0	.0	.0	33.7

Table 3, Continued

Powertrain Characteristics of 1975 to 2003 Cars and Light Trucks (Percentage Basis)

MODEL YEAR	SALES (000)	FRAC	ADJ 55/45 MPG	ENGINE CID	ENGINE HP	HP/ CID	DRIVETRAIN FRONT	DRIVETRAIN 4WD	TRANSMISSION MANUAL	TRANSMISSION LOCK	FI	FUEL METERING PORT	FUEL METERING TBI	FUEL METERING CARB	DSL	FOUR VALVE
1975	10224	1.000	13.1	293	137	.507	5.3	3.3	23.2	.0	4.1	4.1	.0	95.7	.2	.0
1976	12334	1.000	14.2	294	135	.493	4.6	4.8	20.9	.0	2.5	2.5	.0	97.3	.2	.0
1977	14123	1.000	15.1	287	136	.510	5.5	4.7	19.8	.0	3.4	3.4	.0	96.2	.4	.0
1978	14448	1.000	15.8	266	129	.525	7.4	6.6	23.0	5.2	3.9	3.9	.0	95.2	.9	.0
1979	13882	1.000	15.9	252	124	.532	9.2	4.3	25.1	6.7	3.7	3.7	.0	94.2	2.0	.0
1980	11306	1.000	19.2	198	104	.574	25.0	4.9	35.4	17.8	6.0	5.2	.6	89.7	4.3	.0
1981	10554	1.000	20.5	193	102	.580	31.0	4.0	34.1	33.0	7.5	5.1	2.2	86.7	5.9	.0
1982	9732	1.000	21.1	188	103	.593	37.0	4.6	32.8	47.8	13.8	5.8	7.9	80.6	5.6	.0
1983	10302	1.000	21.0	193	107	.599	37.0	8.1	30.8	52.1	22.1	7.3	14.7	75.2	2.7	.0
1984	14020	1.000	21.0	190	109	.618	42.1	8.2	28.4	52.8	30.6	11.4	18.6	67.6	1.8	.0
1985	14460	1.000	21.3	189	114	.650	47.8	9.3	26.5	54.5	43.0	16.0	23.9	56.1	.9	.0
1986	15365	1.000	21.9	180	114	.678	52.6	9.3	29.8	53.5	58.2	32.5	25.7	41.4	.4	1.1
1987	14865	1.000	22.1	175	118	.710	57.7	9.6	29.1	55.4	71.3	39.9	31.4	28.4	.3	4.0
1988	15295	1.000	22.1	180	123	.726	60.0	10.5	27.6	62.2	84.9	50.6	34.3	15.0	.1	7.3
1989	14453	1.000	21.7	185	129	.743	60.2	10.5	24.6	65.5	91.2	57.3	33.9	8.7	.1	8.9
1990	12615	1.000	21.5	185	135	.781	63.8	10.1	22.2	71.2	97.8	70.8	27.0	2.1	.1	17.9
1991	12573	1.000	21.7	184	138	.796	59.6	12.3	23.9	71.6	99.3	70.6	28.7	.6	.1	19.1
1992	12172	1.000	21.3	191	145	.807	58.4	11.2	20.7	74.8	99.4	81.6	17.8	.5	.1	19.8
1993	13211	1.000	21.4	191	147	.809	59.9	11.4	19.8	76.5	99.7	85.0	14.6	.3	.0	21.1
1994	13986	1.000	21.0	196	152	.817	56.1	15.1	19.4	77.7	99.9	87.7	12.2	.1	.0	24.4
1995	15145	1.000	21.1	196	158	.857	57.6	16.2	17.9	80.7	100.0	91.6	8.4	.0	.0	35.4
1996	13144	1.000	21.2	197	164	.878	60.0	15.7	15.2	83.5	99.9	99.3	.7	.0	.1	37.9
1997	14451	1.000	20.9	199	169	.890	55.8	19.3	14.0	85.4	99.9	99.5	.5	.0	.1	37.9
1998	14449	1.000	20.9	199	171	.904	56.4	20.1	12.8	86.7	99.9	99.8	.1	.0	.1	40.2
1999	15285	1.000	20.6	203	179	.921	55.5	21.6	10.2	89.3	99.9	99.9	.1	.0	.1	40.3
2000	16558	1.000	20.7	200	181	.942	55.5	20.2	9.7	89.5	99.9	99.8	.0	.0	.1	44.0
2001	15594	1.000	20.7	201	187	.968	53.8	22.0	9.0	90.2	99.9	99.9	.0	.0	.1	45.8
2002	15700	1.000	20.4	205	196	.990	52.1	25.0	10.3	89.0	99.9	99.9	.0	.0	.1	49.1
2003	16000	1.000	20.8	203	197	1.005	51.8	25.2	10.5	88.8	99.8	99.8	.0	.0	.2	52.9

Table 4

MY2003 Technology Usage by Vehicle Type and Size
(Percent of Vehicle Type/Size Strata)

Vehicle Type	Size	Front Wheel Drive	Four Wheel Drive	Manual Trans.	Four Valves per Cylinder
Car	Small	80	4	25	76
	Midsize	91	1	5	74
	Large	76	0	0	36
	All	83	2	15	69
Wagon	Small	89	9	16	95
	Midsize	56	44	12	84
	Large	--	--	--	--
	All	77	22	15	91
Van	Small	--	--	--	--
	Midsize	85	8	0	27
	Large	2	25	0	2
	All	76	10	0	24
SUV	Small	13	74	26	79
	Midsize	17	65	4	55
	Large	0	67	1	37
	All	10	67	4	50
Pickup	Small	0	41	37	100
	Midsize	0	38	20	10
	Large	0	45	6	6
	All	0	43	11	15
All	Cars	82	4	15	70
All	Trucks	18	49	6	34
All	Vehicles	52	25	11	53

Figures 4 through 8 show trends in drive use for the five vehicle classes. Cars used to be all rear-wheel drive (RWD), now they are over 80-percent front-wheel drive with a small four-wheel drive fraction, and the trend is flat. Only about 10 percent of wagons still have rear-wheel drive, but in recent years they have made substantial use of 4WD.

Drive usage for vans is similar to that for cars, although the trend since the introduction of FWD vans is sharper than it was for cars and appears to be continuing. SUVs are mostly 4WD; with the beginning of a trend toward FWD just showing up recently. Pickups remain the bastion of RWD with the increasing amount of 4WD the only other drive option. Except for a brief period in the early 1980s, front-wheel drive has not been used in pickups.

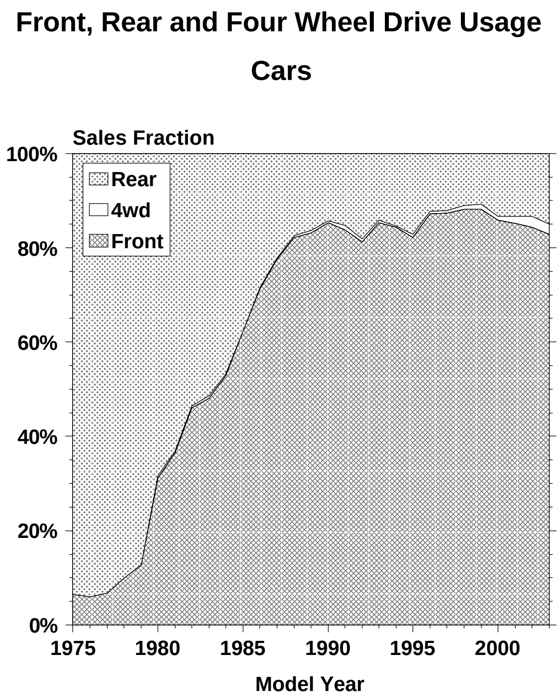

Figure 4

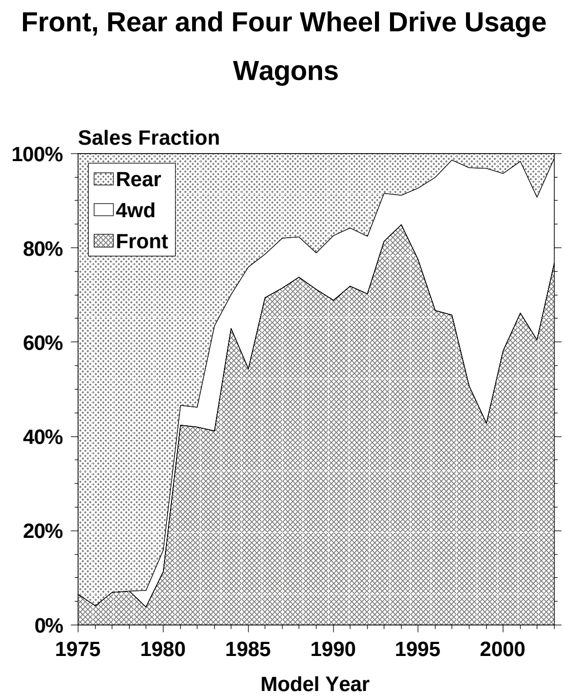

Figure 5

Front, Rear and Four Wheel Drive Usage

Vans

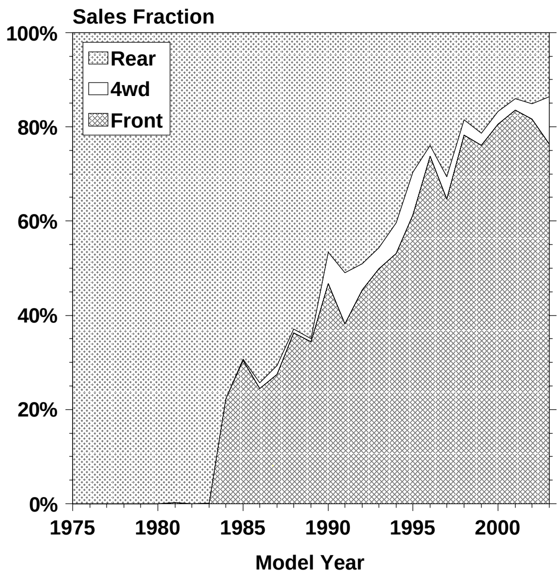

Figure 6

Front, Rear and Four Wheel Drive Usage

SUVs

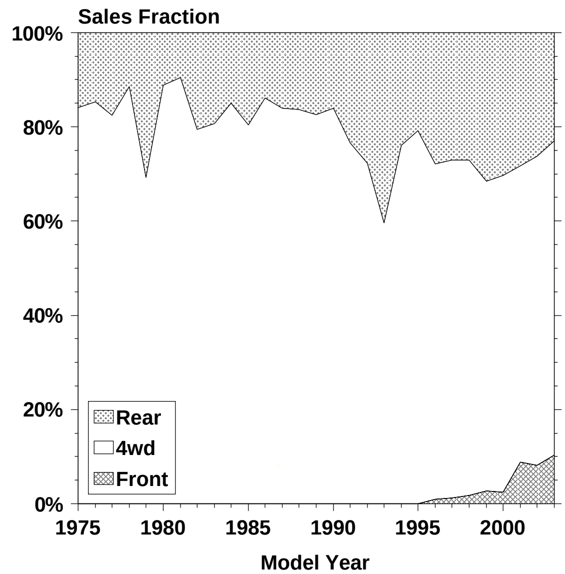

Figure 7

Front, Rear and Four Wheel Drive Usage

Pickups

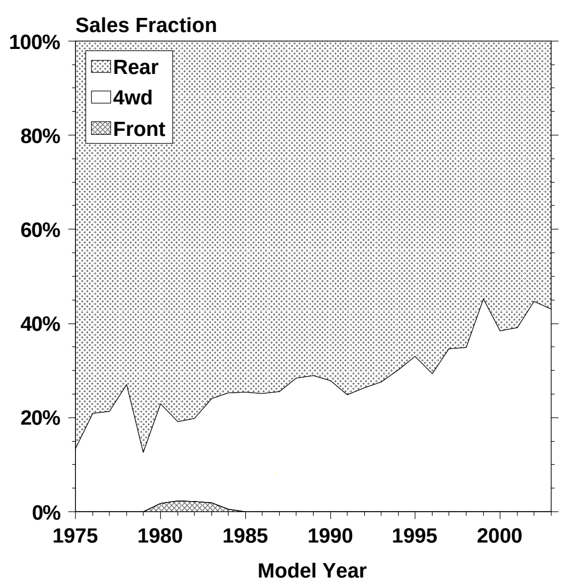

Figure 8

Transmission Sales Fraction

Cars

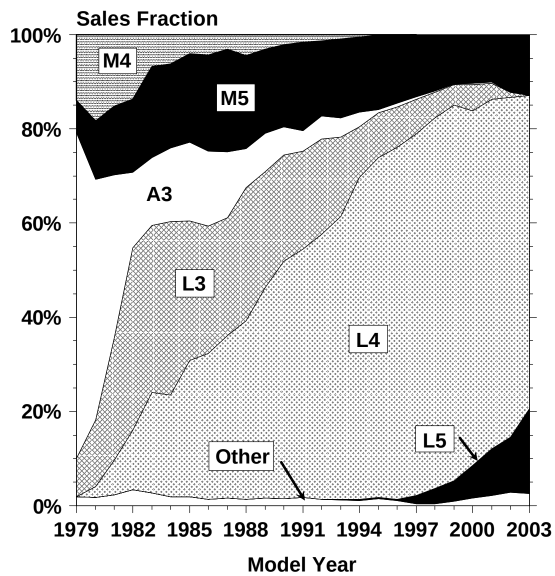

Figure 9

Transmission Sales Fraction

Vans

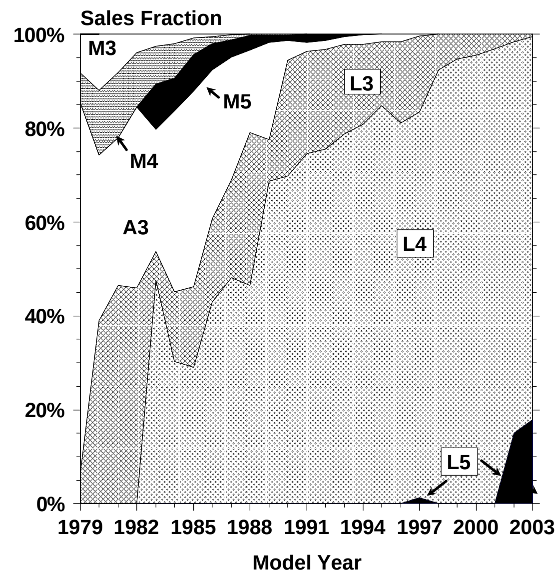

Figure 10

Transmission Sales Fraction

SUVs

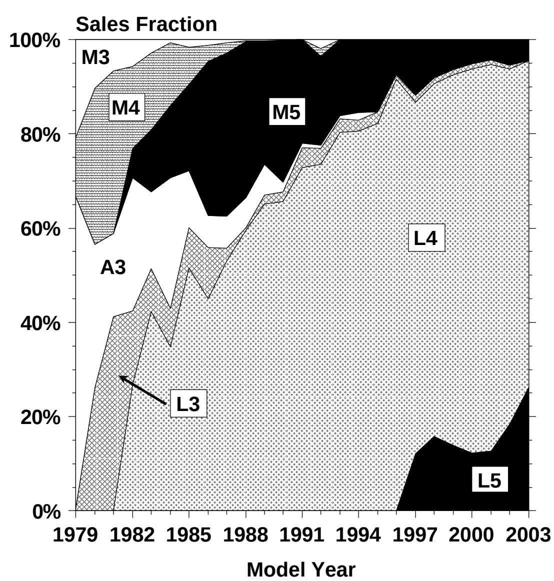

Figure 11

Transmission Sales Fraction

Pickups

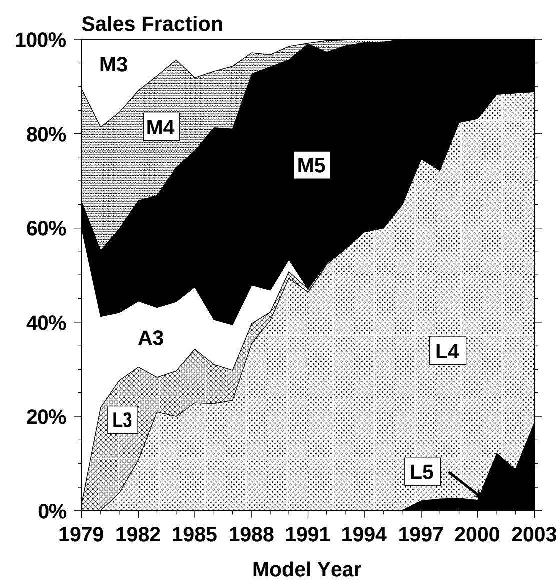

Figure 12

Three important changes in transmission design have occurred in recent years:

1) the addition of a gear for both automatic and manual transmissions,

2) for the automatics, conversion to lockup (L3, L4, or L5) torque converter transmissions, and

3) the use of continuously variable transmissions (CVTs).

Figures 9 to 12 indicate that the L4 transmission is currently the predominant transmission type for all vehicle classes. For purposes of this analysis, cars and wagons have been combined as "cars," because the trends for wagons are not significantly different from that for cars. Where manual transmissions are used, the 5-speed (M5) transmission now predominates. A small fraction of vehicles are equipped with M6 and L6 transmissions in MY2003. More data stratified by transmission type can be found in Appendix J.

The increasing trend in ton-MPG shown in Table 1 can be attributed to better vehicle design, including more efficient engines, better transmission design, and better matching of the engine and transmission. Powertrains are matched to the load better when the engine operates closer to its best efficiency point more of the time. For many conventional engines, this point is approximately 2000 RPM and 2/3 of the maximum torque at that speed. One way to make the engine operate more closely to its best efficiency point is to increase the number of gears in the transmission and, for automatic transmissions, employing a lockup torque converter.

Table 5 compares ton-MPG by transmission and vehicle type between 1988, the peak year for passenger car fuel economy, and this year. For nearly every strata for which the equivalent vehicle type used the same transmission type in both years shown in the table, ton-MPG will be higher this year than it was in 1988. For model year 2003, cars and SUVs equipped with L5 transmissions will achieve about the same ton-MPG as their MY2003 M5-equipped counterparts. Similarly, for all four vehicle types, MY2003 vehicles with L4 transmissions achieve the same or better ton-MPG this year than any of the corresponding vehicles did in 1988.

Table 5

Ton-MPG by Transmission and Vehicle Type

	Car		Van		SUV		Pickup	
Trans	2003	1988	2003	1988	2003	1988	2003	1988
M5	44	38	--	38	39	34	40	36
M6	39	--	--	--	--	--	--	--
L3	--	37	34	37	--	34	--	32
L4	42	38	44	37	41	34	40	34
L5	43	--	45	--	41	--	39	--
L6	42	--	--	--	--	--	--	--

A recent powertrain trend has been the development and introduction of CVTs in some vehicle models. These transmissions differ from conventional automatic transmissions and manual transmissions in that CVTs do not have a fixed number of gears. Transmissions alter the ratio of engine speed to drive wheel speed. In conventional transmissions, this speed ratio is limited to a fixed number of discrete values. For a CVT, the ratio is continuous.

In addition to novelty, the advantage of a CVT is that the engine speed/drive wheel speed ratio can be altered to enhance vehicle performance or fuel economy in ways not available with conventional transmissions.

In order to assess the relative efficiency of CVTs compared to conventional transmissions, vehicle models were selected that were available with more than one transmission type. In many cases, the resulting matches turned out to involve vehicles of slightly different weight, which would add additional complexity to an analysis using fuel economy as the variable, so ton-miles per gallon was used as the measure of comparison to account for the weight differences. The ton-mpg values from the 2003 database were normalized, and the results as shown below.

Table 6

Model Year 2003 CVT
Ton-MPG Normalized to M5 = 1.00

		Normalized Ton-MPG	
Vehicle	City	Highway	55/45
Mini Cooper	0.87	0.87	0.87
Civic Hybrid	1.06	0.94	1.01
Insight	1.05	0.92	0.99
Audi A4	1.04	0.94	1.00
Saturn Vue	0.94	0.99	0.96
Average	0.99	0.93	0.97

The results in Table 6 and Figure 13 show that from a ton-MPG basis, CVTs, compared to manual transmissions, are about the same or better in MPG based on the city cycle and somewhat less efficient on the highway cycle. Since the mechanism used for providing the CVT function is generally considered to be less efficient than a geartrain, it appears that the optimization and calibration flexibility offered by the CVT on the city cycle may be more than enough to overcome the mechanism efficiency difference. It should be pointed out that there could be other vehicle and engine differences between the compared vehicles, such as engine emission control calibrations which could influence the comparisons.

CVTs are less than one percent of the market for 2003. If CVT market penetration increases, more data will be available for more detailed analysis.

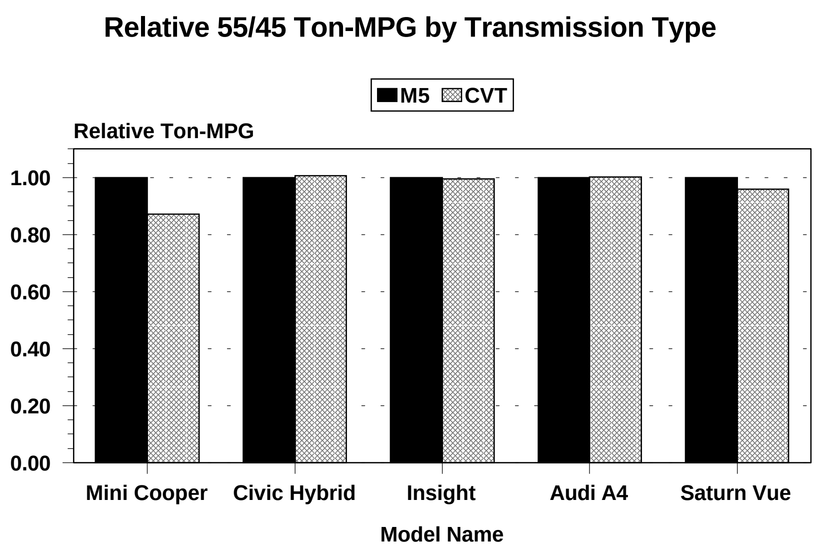

Figure 13

Figures 14 through 17 compare the trends since 1975 for horsepower (HP), displacement (CID), and specific power or horsepower per cubic inch (HP/CID) for passenger cars, wagons, vans, SUVs, and pickups. For all five vehicle types, significant CID reductions occurred in the late 1970s and early 1980s. Since 1985, however, engine displacement has been flat for cars, wagons, and vans but has increased for SUVs and particularly for pickups. Average horsepower has increased substantially for all of these vehicle types since 1981 with the highest increase occurring for pickups whose HP is now almost double what it was then.

Light-duty vehicle engines, thus, have also improved in HP/CID, with engines used in passenger cars improving at a faster rate than truck engines. In fact, for the past several years, car and wagon engines have averaged at least 1.0 HP/CID, but vans, SUVs, and pickups have yet to reach the 1.0 HP/CID level.

Car Horsepower, CID and Horsepower per CID

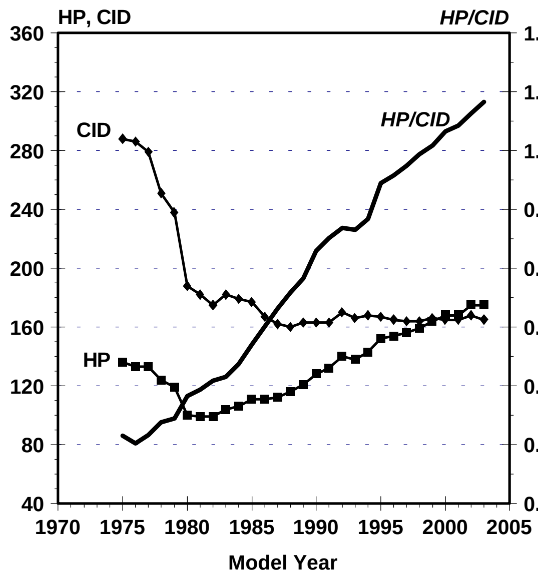

Figure 14

Van Horsepower, CID and Horsepower per CID

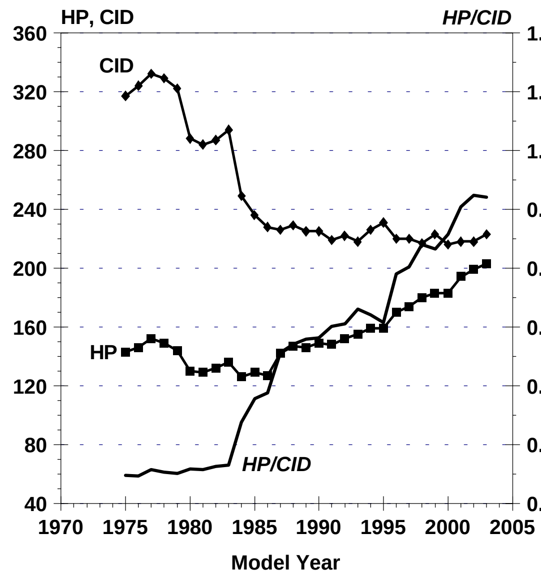

Figure 15

SUV Horsepower, CID and Horsepower per CID

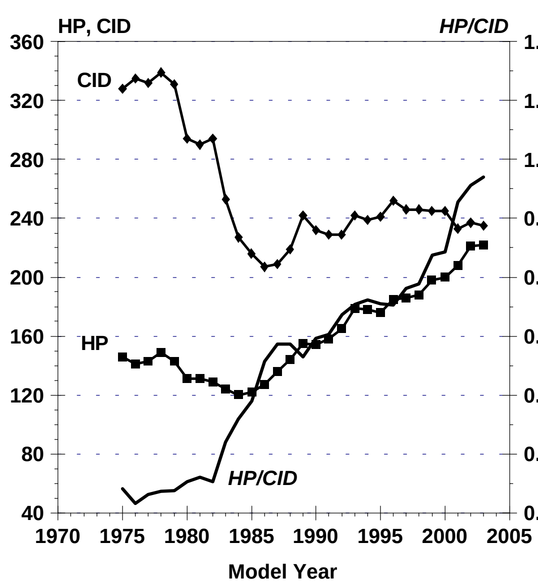

Figure 16

Pickup Horsepower, CID and Horsepower per CID

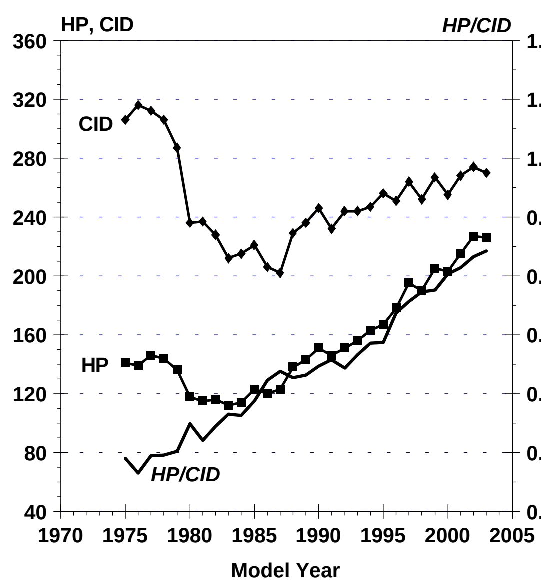

Figure 17

As shown in Table 7, for model year 2003 depending on the vehicle type, truck engines average approximately 20- to 40-percent more horsepower but require about 30- to 85-percent greater displacement, compared to the average passenger-car engine because of the differences in specific power. Note that the specific power of the light-duty fleet now exceeds the 1.0 HP/CID level.

Table 7

MY2003 Engine Characteristics by Vehicle Type

Vehicle Type	HP	CID	HP/ CID	Percent 4 Valve
Car	175	165	1.08	70
Van	203	223	0.92	24
SUV	222	235	0.97	50
Pickup	226	270	0.84	15
All	197	203	1.01	53

Table 8 compares CID, HP, and HP/CID by vehicle type and number of cylinders for model years 1988 and 2003. Note that, for purposes of this table, cars and wagons have been combined into one vehicle type. Since 1988, changes in engine size have been relatively small for all strata shown in the table, particularly when compared to the changes in horsepower that have taken place with specific power improvements related to the use of multivalve engines likely accounting for the difference. Four-cylinder engines used in cars, vans, and SUVs have exceeded the one HP-per-CID level, but the same cannot be said of pickup trucks.

At the number-of-cylinders level of stratification, model year 2003 cars achieve higher specific power than SUVs, vans, and pickup trucks. Similarly, this year’s pickup truck engines achieve lower specific power than the engines used in vans, SUVs, and cars.

A reason for the lower specific power of some truck engines is that these vehicles may be used to carry heavy loads or pull trailers and thus need more “torque rise,” (i.e., an increase in torque as engine speed falls from the peak power point) to achieve acceptable driveability. Engines equipped with four valves per cylinder typically have inherently lower torque rise than two-valve engines with lower specific power.

Table 8

Improvement in Horsepower and Specific Power by Vehicle Type and Number of Cylinders

Vehicle Type	Cyl.	CID 1988	CID 2003	Percent Change	HP 1988	HP 2003	Percent Change	HP/CID 1988	HP/CID 2003	Percent Change
Car	4	118	125	6%	95	139	46%	.805	1.119	39%
	6	193	194	1%	142	201	42%	.744	1.048	41%
	8	301	268	-11%	164	267	63%	.544	1.004	85%
Van	4	145	148	2%	98	150	53%	.677	1.014	50%
	6	213	217	2%	149	199	34%	.722	.923	28%
	8	322	321	0%	168	276	64%	.520	.860	65%
SUV	4	122	138	13%	94	150	60%	.773	1.088	41%
	6	211	215	2%	147	213	45%	.706	1.003	42%
	8	338	310	-8%	183	267	46%	.541	.863	60%
Pickup	4	142	146	3%	97	140	44%	.685	.957	40%
	6	229	233	2%	142	185	30%	.644	.800	24%
	8	329	312	-5%	180	264	47%	.544	.849	56%

Figures 18 through 21 show that engines with more valves per cylinder deliver higher values of HP per CID. Improvements in HP per CID apply to all of the engines, regardless of the number of valves they have. Engines with *only* two valves per cylinder deliver substantially more horsepower per CID then they used to, typically about a 50-percent increase for the time period shown. The difference in HP and HP-per-CID is because the different vehicle types use different technologies. Figures 22 through 25 show that many cars are equipped with 4-valve engines; the other classes don’t employ this technology as extensively.

HP/CID by Number of Valves Per Cylinder
Cars

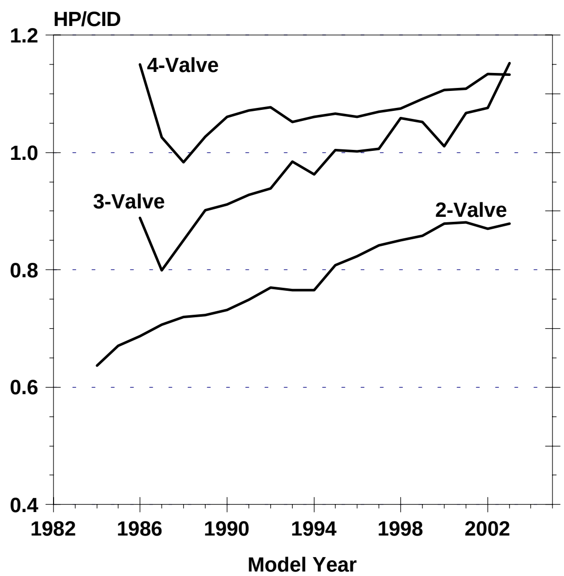

Figure 18

HP/CID by Number of Valves Per Cylinder
Vans

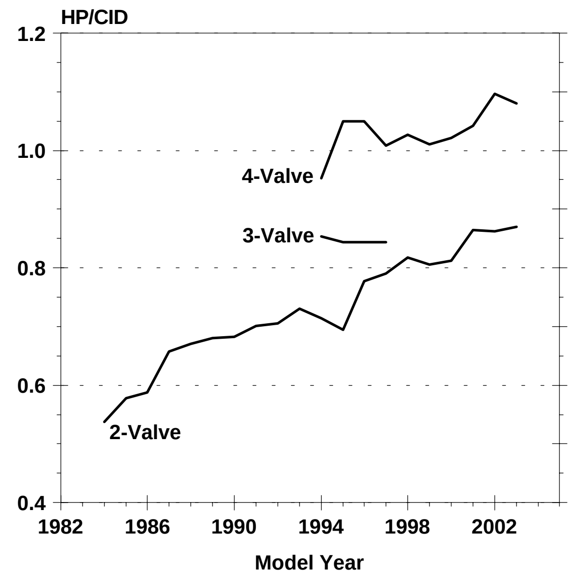

Figure 19

HP/CID by Number of Valves Per Cylinder
SUVs

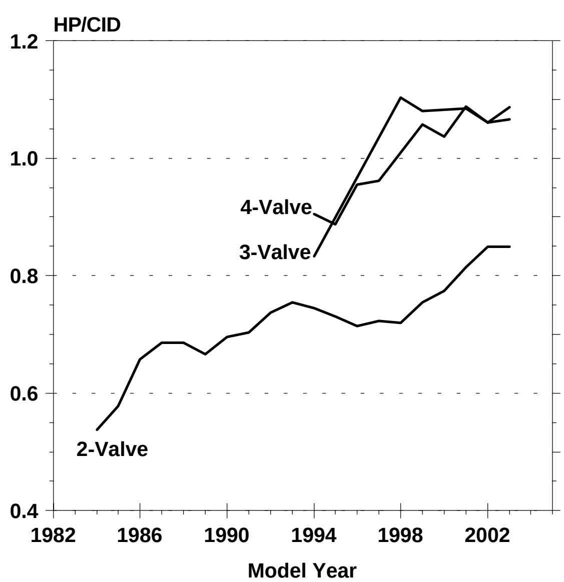

Figure 20

HP/CID by Number of Valves Per Cylinder
Pickups

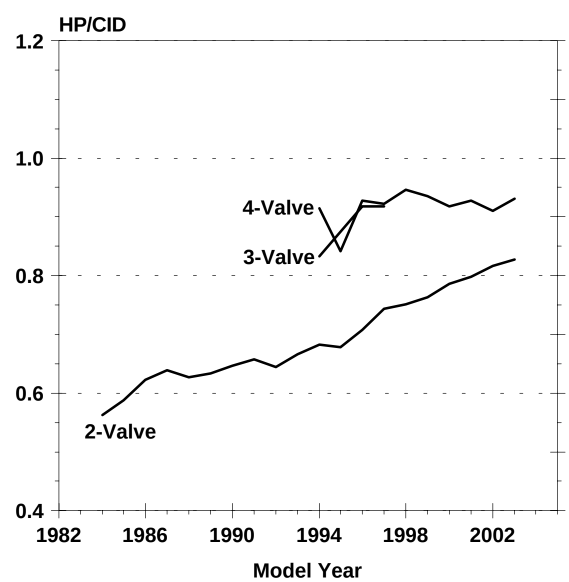

Figure 21

Number of Valves per Cylinder
Cars

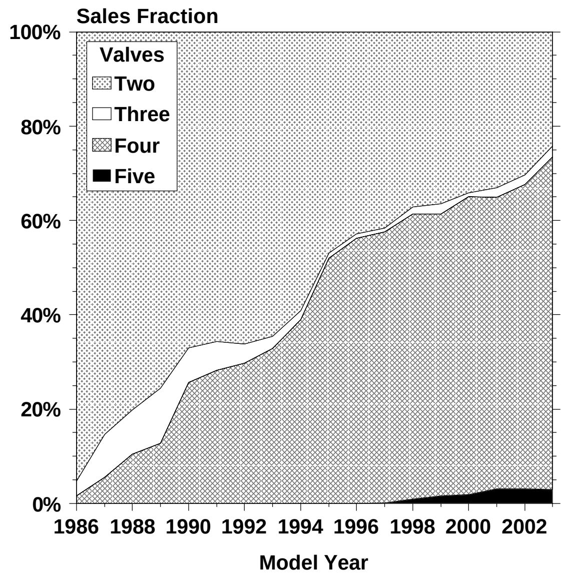

Figure 22

Number of Valves per Cylinder
Vans

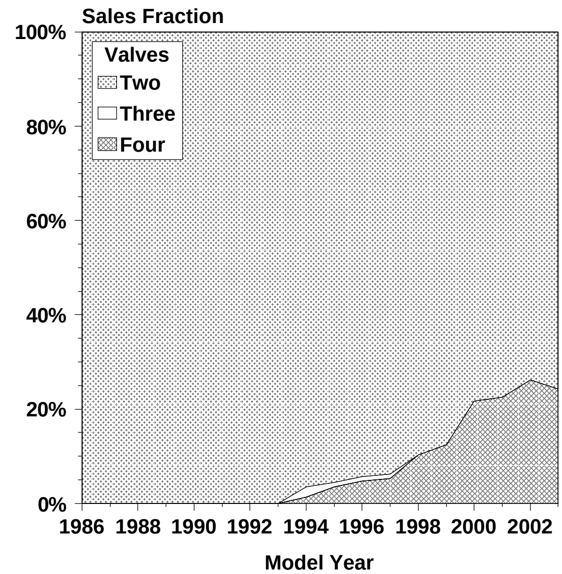

Figure 23

Number of Valves per Cylinder
SUVs

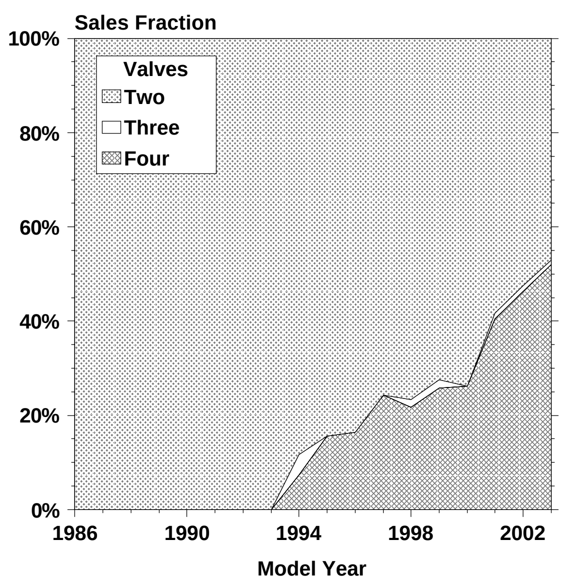

Figure 24

Number of Valves per Cylinder
Pickups

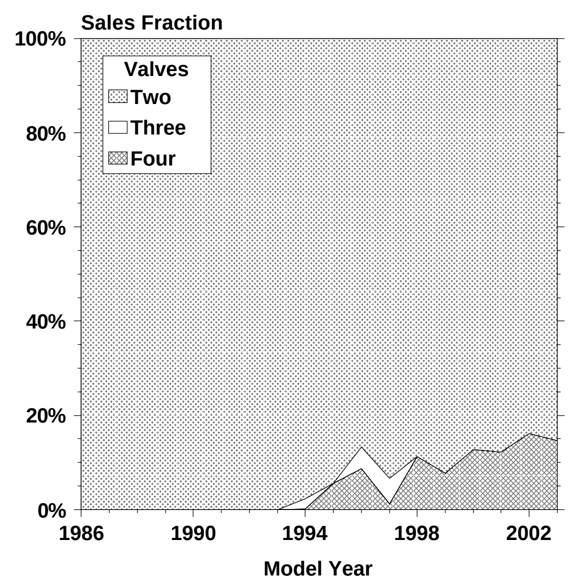

Figure 25

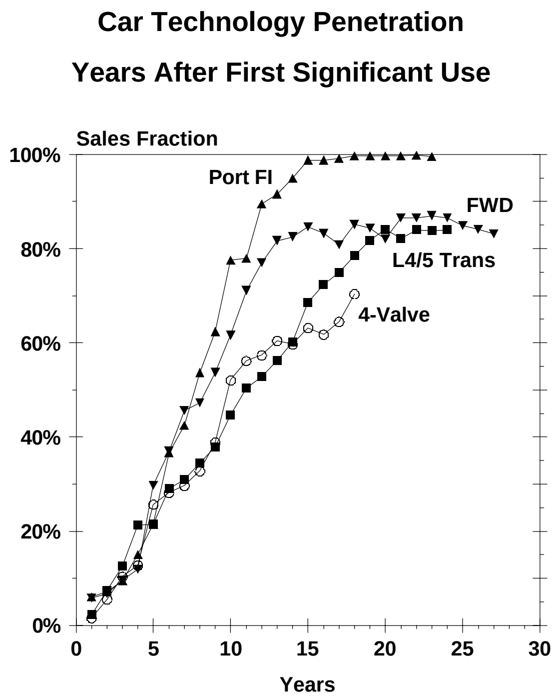

Figure 26

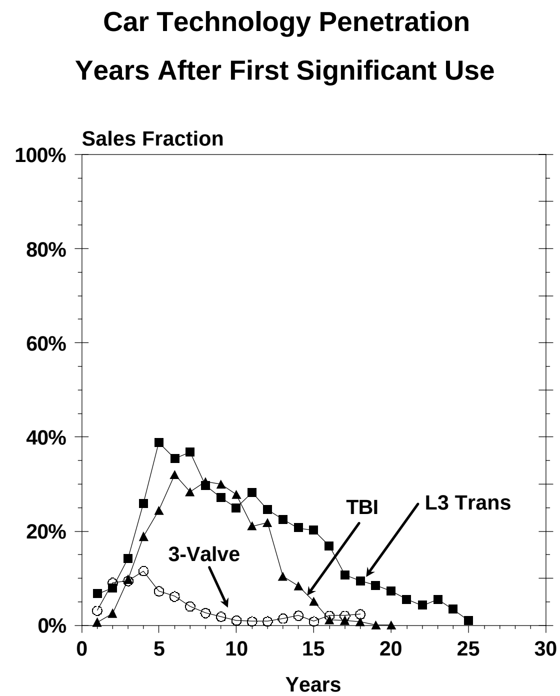

Figure 27

Figure 26 compares penetration rates for four passenger car technologies, namely port fuel injection (Port FI), front-wheel drive (FWD), four valves per cylinder (4-Valve) and four- and five-speed lockup transmissions (L4 and L5). This figure indicates that it may take a decade for a technology to prove itself and attain a sales fraction of 40 to 50 percent and as long as another five or ten years to reach maximum market penetration. It thus takes some time after the introduction of a new technology for it to fully penetrate the market.

A similar comparison of three technologies whose sales fraction peaked out at about 40 percent or less is shown in Figure 27. This figure shows that it may also take a number of years for technologies such as 3-valve-per-cylinder engines (3-valve), throttle body fuel injection (TBI), and lockup 3-speed (L3) transmissions to reach their maximum sales fraction, and, even then, use of these technologies may continue for a decade or longer. For the limited number of cases studied, the time a given technology needs to attain and then pass a market share of about 40 to 50 percent appears to be an indicator of whether it will ever attain a stabilized high level of market penetration.

In model year 2003, three hybrids are in the fleet: the Honda Insight, the Honda Civic, and the Toyota Prius. These hybrid vehicles have gasoline-fueled engines, batteries, and motor/generators as key parts of their propulsion systems. Even though these vehicles are not yet sales significant (comprising just a few tenths of a percent of the market), their technology may be quite significant. How the MPG of these vehicles differs from other vehicles can be used to determine the significance of the new technology they represent.

Table 9

Characteristics of MY2003 Cars with Relatively High Fuel Economy

Manufacturer Model Name		Honda Insight Hybrid	Honda Insight Hybrid	Toyota Prius Hybrid	Honda Civic Hybrid	Honda Civic Hybrid	VW Jetta Diesel	Average
EPA Size Class		Two Seater	Two Seater	Compact Car	Compact Car	Compact Car	Small Wagon	Small Car
Interior Vol		50.0	50.0	100.4	101.5	101.5	122.5	100.0
Inertia Wt.		2000	2250	3000	3000	3000	3500	3152
Drive Transmission		Front M5	Front CVT	Front CVT	Front CVT	Front M5	Front M5	
Engine	CID HP	61 67	61 65	91 70	82 85	82 85	116 90	142 157
Cylinders Valves/Cylinder		3 4	3 4	4 4	4 4	4 4	4 2	
Adjusted Fuel Economy	City Hwy 55/45	60.6 68.0 63.8	56.5 55.7 56.1	51.6 45.2 48.5	48.4 47.4 48.0	45.8 50.6 47.9	42.0 49.9 45.2	23.6 31.3 26.6
Lab Fuel Economy	City Hwy 55/45	67.4 87.2 75.1	62.8 71.4 66.4	57.3 57.9 57.6	53.8 60.8 56.7	50.9 64.9 56.4	46.7 64.0 53.2	26.2 40.1 31.1
Ton-MPG (Lab)	City Hwy 55/45	67.4 87.2 75.1	70.7 80.3 74.7	86.0 86.9 86.4	80.7 91.2 85.1	76.4 97.4 84.6	81.7 112.0 93.0	41.3 63.2 49.0
Cu. Ft.- MPG (Lab)	City Hwy 55/45	3,369 4,361 3,753	3,140 3,570 3,320	5,751 5,811 5,777	5,462 6,173 5,761	5,168 6,589 5,723	5,722 7,842 6,515	2,622 4,013 3,107
Cu. Ft.- Ton-MPG (Lab)	City Hwy 55/45	3,369 4,361 3,753	3,533 4,016 3,735	8,626 8,716 8,666	8,193 9,259 8,641	7,752 9,884 8,585	10,014 13,723 11,401	4,133 6,324 4,896

In Table 9, the three hybrids are compared to a Diesel and the average of all small cars. When looked at on the basis of adjusted MPG, the vehicles are ranked from high to low in the same way as shown in the Table, the Insight first, the Jetta last. If ton-MPG is the comparison, the Diesel goes from last on the list to first.

Another way to look at the MPG performance of the hybrids is on a distribution of MPG values with other vehicles in the same weight or class. Figure 28 is a histogram of data for vehicles in the 3000-lb weight class. Unadjusted MPG is used here to provide another way to compare MPG, and also as a reminder that hybrid technology was not being used when the MPG adjustment factors were determined. Hybrids and Diesels stand out.

The same comparison is made in Figure 29 but with vehicles in the compact car class. The same relationship prevails for the MPG distribution. When the fuel economy of vehicles in the small car class is compared in Figure 30, similar results are obtained. Figure 31 shows the same small car class, but with ton-MPG as the basis of comparison.

Distribution of Unadjusted 55/45
MY2003 3000 lb. Cars

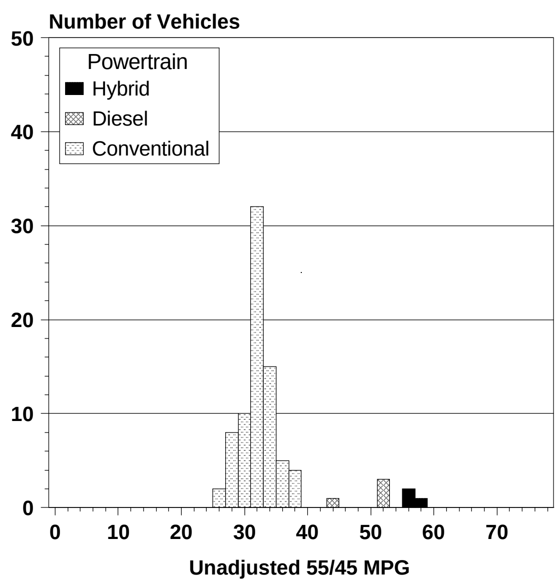

Figure 28

Distribution of Unadjusted 55/45 MPG
MY2003 Compact Cars

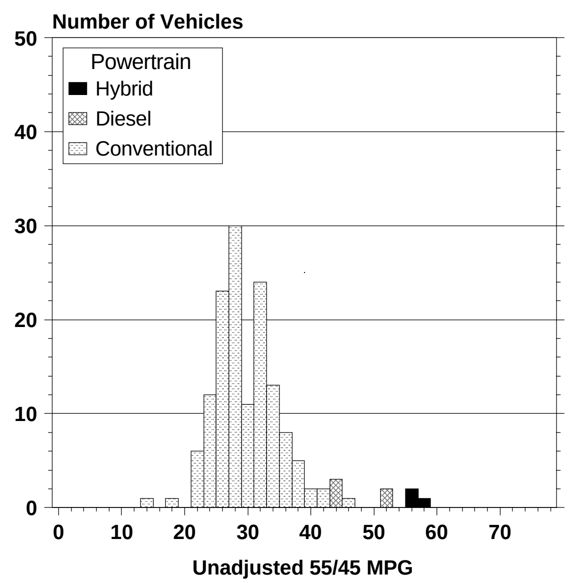

Figure 29

Distribution of Unadjusted 55/45 MPG
MY2003 Small Cars

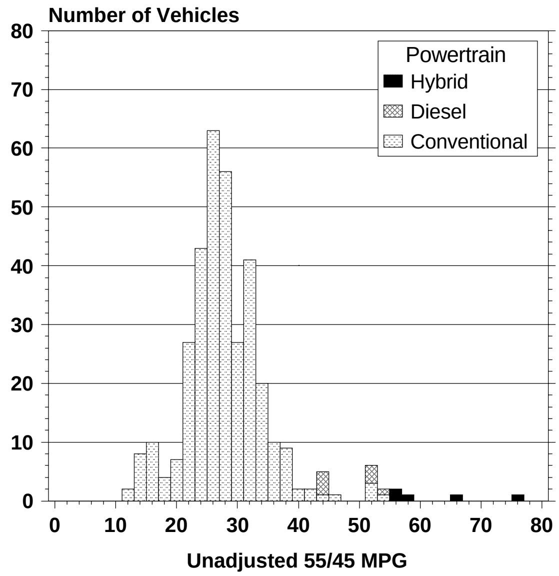

Figure 30

Distribution of Unadjusted Ton MPG
MY2003 Small Cars

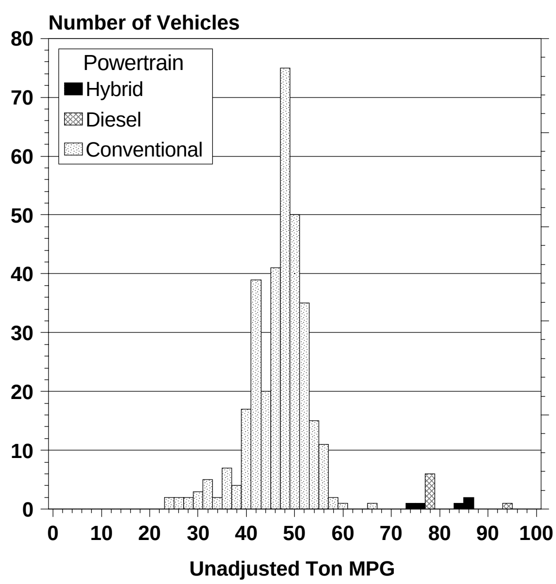

Figure 31

IV. Trends by Vehicle Type and Size Class

Figure 1 and Table 1 show that trucks are expected to account for 48 percent of light-duty vehicles produced during model year 2003. In the next series of figures and tables, cars and light trucks are classified into five vehicle types: cars (i.e., coupes, sedans, and hatchbacks), station wagons, vans, sports utility vehicles (SUVs), and pickup trucks; and three vehicle sizes: small, midsize, and large. Note that vehicles have not been produced recently in the Small Van and Large Wagon classes. Appendixes E and F contains a series of tables describing light-duty vehicles at the vehicle size/type level of stratification in more detail.

Table 10 compares sales fractions by vehicle type and size for model years 1975, 1988, and 2003. Since 1975, the largest increases in sales fraction on this basis have been for midsize and large SUVs. These two classes are expected to account for over 21 percent of the vehicles built this year, compared to a combined total of about 1.3 and 4.5 percent in 1975 and 1988, respectively. Conversely, the largest sales fraction decrease has occurred for small cars which accounted for 40 percent of all light-duty vehicles produced in 1975 and nearly 44 percent in 1988.

While the small car sales fraction has consistently remained the largest of the 15 vehicle sizes and types, it has since decreased to about 25 percent. An overall decrease has occurred for large cars which accounted for about 15 percent of total light-duty sales in 1975 when they ranked third. Between then and 1988, their sales fraction dropped almost in half.

Considering the five classes: cars, wagons, SUVs, vans, and pickups, since 1975 the biggest increase in market share has been for SUVs, up from less than two percent to 23 percent this year, and the biggest decrease for cars, down from over 70 percent to less than 50 percent.

Table 11 shows the average, lowest, and highest adjusted MPG performance in the five classes for the three selected years. Improvements in nearly every class are seen from 1975 to 1988. For 2003, the MPG performance is such that the large vehicles in some categories have better fuel economy than the corresponding entry for small vehicles in 1975.

Table 10

Sales Fractions of MY1975, MY1988, and MY2003
Light-Duty Vehicles by Vehicle Size and Type

Vehicle Type	Size	Sales Fraction 1975	1988	2003	Differences in Sales Fraction: From 1975 To 2003	From 1975 To 1988	From 1988 To 2003
Car	Small	40.0%	43.8%	24.7%	-15.3%	3.8%	-19.1%
	Midsize	16.0%	13.8%	15.6%	-0.4%	-2.2%	1.8%
	Large	15.2%	8.5%	8.1%	-7.1%	-6.7%	-0.4%
	All	71.2%	66.1%	48.4%	-22.8%	-5.1%	-17.7%
Wagon	Small	4.7%	1.7%	2.5%	-2.2%	-3.0%	0.8%
	Midsize	2.8%	1.9%	1.5%	-1.3%	-0.9%	-0.4%
	Large	1.9%	0.5%	0.0%	-1.9%	-1.4%	-0.5%
	All	9.4%	4.1%	4.0%	-5.4%	-5.3%	-0.1%
Van	Small	0.0%	0.4%	0.0%	0.0%	0.4%	-0.4%
	Midsize	3.0%	6.2%	7.3%	4.3%	3.2%	1.1%
	Large	1.5%	0.9%	0.8%	-0.7%	-0.6%	-0.1%
	All	4.5%	7.5%	8.1%	3.6%	3.0%	0.6%
SUV	Small	0.5%	1.9%	1.7%	1.2%	1.4%	-0.2%
	Midsize	1.2%	4.0%	12.8%	11.6%	2.8%	8.8%
	Large	0.1%	0.5%	8.9%	8.8%	0.4%	8.4%
	All	1.8%	6.4%	23.4%	21.6%	4.6%	17.0%
Pickup	Small	1.6%	2.2%	1.3%	-0.3%	0.6%	-0.9%
	Midsize	0.5%	6.9%	2.8%	2.3%	6.4%	-4.1%
	Large	11.0%	7.0%	11.9%	0.9%	-4.0%	4.9%
	All	13.1%	16.1%	16.0%	2.9%	3.0%	-0.1%

Table 11

Lowest, Average, and Highest Adjusted Fuel Economy by Vehicle Type and Size

Vehicle Type	Size	1975 Low	1975 Avg.	1975 High	1988 Low	1988 Avg.	1988 High	2003 Low	2003 Avg.	2003 High
Car	Small	8.6	15.6	28.3	7.5	26.0	55.6	10.4	26.6	63.8
	Midsize	8.6	11.6	18.4	10.6	22.8	28.0	11.8	23.8	29.0
	Large	8.4	11.2	14.6	10.1	20.7	26.3	11.8	22.1	25.1
	All	8.4	13.4	28.3	7.5	24.5	55.6	10.4	24.8	63.8
Wagon	Small	11.8	19.1	24.1	17.3	26.6	33.7	18.5	25.0	45.2
	Midsize	8.4	11.3	25.0	17.7	22.4	28.0	16.9	23.9	30.6
	Large	8.4	10.2	12.8	19.4	19.5	19.6	*****	*****	*****
	All	8.4	13.8	25.0	17.3	23.5	33.7	16.9	24.6	45.2
Van	Small	16.2	17.5	18.5	15.7	20.8	25.3	*****	*****	*****
	Midsize	8.2	11.3	18.4	11.4	18.6	23.7	15.0	20.3	23.1
	Large	8.9	10.7	14.5	10.0	14.4	17.0	13.8	15.4	17.4
	All	8.2	11.1	18.5	10.0	18.0	25.3	13.8	19.6	23.1
SUV	Small	10.2	13.7	16.3	15.8	20.6	28.2	17.4	21.6	27.2
	Midsize	8.2	10.2	18.4	10.3	16.6	23.9	13.4	19.0	25.3
	Large	7.9	10.3	13.7	12.3	14.2	19.0	13.1	15.8	20.1
	All	7.9	11.0	18.4	10.3	17.4	28.2	13.1	17.8	27.2
Pickup	Small	13.0	19.2	20.8	13.5	21.2	24.9	17.4	20.1	24.2
	Midsize	17.8	17.9	18.0	15.5	21.5	26.2	14.5	18.7	25.9
	Large	7.6	11.1	18.5	9.9	15.4	21.2	13.1	16.1	18.8
	All	7.6	11.9	20.8	9.9	18.3	26.2	13.1	16.8	25.9
All	Cars	8.4	13.5	28.3	7.5	24.4	55.6	10.4	24.8	63.8
All	Trucks	7.6	11.6	20.8	9.9	18.1	28.2	13.1	17.7	27.2
All	Vehicles	7.6	13.1	28.3	7.5	22.1	55.6	10.4	20.8	63.8

Table 12

Percent Change in Lowest, Average, and Highest Adjusted Fuel Economy by Vehicle Type and Size

Vehicle Type	Size	From 1975 to 2003 Low	Avg.	High	From 1975 to 1988 Low	Avg.	High	From 1988 to 2003 Low	Avg.	High
Car	Small	21%	71%	125%	-12%	67%	96%	39%	2%	15%
	Midsize	37%	105%	58%	23%	97%	52%	11%	4%	4%
	Large	40%	97%	72%	20%	85%	80%	17%	7%	-4%
	All	24%	85%	125%	-10%	83%	96%	39%	1%	15%
Wagon	Small	57%	31%	88%	47%	39%	40%	7%	-5%	34%
	Midsize	101%	112%	22%	111%	98%	12%	-4%	7%	9%
	Large	***%	***%	***%	131%	91%	53%	***%	***%	***%
	All	101%	78%	81%	106%	70%	35%	-1%	5%	34%
Van	Small	***%	***%	***%	-2%	19%	37%	***%	***%	***%
	Midsize	83%	80%	26%	39%	65%	29%	32%	9%	-2%
	Large	55%	44%	20%	12%	35%	17%	38%	7%	2%
	All	68%	77%	25%	22%	62%	37%	38%	9%	-8%
SUV	Small	71%	58%	67%	55%	50%	73%	10%	5%	-3%
	Midsize	63%	86%	37%	26%	63%	30%	30%	14%	6%
	Large	66%	53%	47%	56%	38%	39%	7%	11%	6%
	All	66%	62%	48%	30%	58%	53%	27%	2%	-3%
Pickup	Small	34%	5%	16%	4%	10%	20%	29%	-4%	-2%
	Midsize	-18%	4%	44%	-12%	20%	46%	-5%	-12%	0%
	Large	72%	45%	2%	30%	39%	15%	32%	5%	-10%
	All	72%	41%	25%	30%	54%	26%	32%	-7%	0%
All	Cars	24%	84%	125%	-10%	81%	96%	39%	2%	15%
All	Trucks	72%	53%	31%	30%	56%	36%	32%	-1%	-3%
All	Vehicles	37%	59%	125%	0%	69%	96%	39%	-5%	15%

Sales Fraction by Vehicle Type

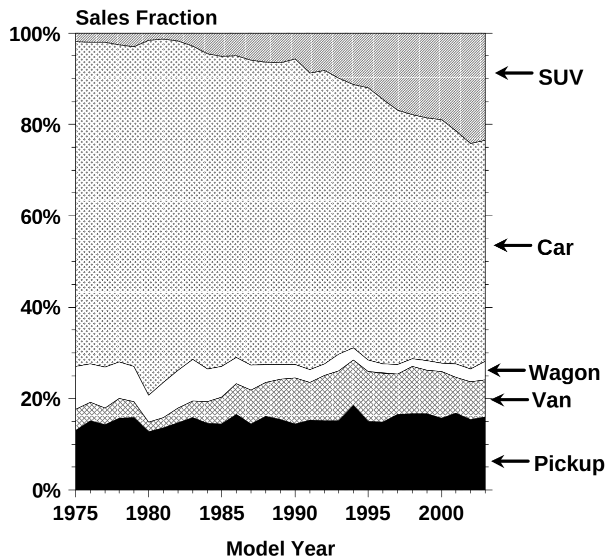

Figure 32

In Table 12, the percentage changes obtainable from the entries in Table 11 are presented. Average MPG for midsize cars and midsize wagons have improved over 100 percent since 1975. Overall, the across-the-board improvements in MPG seen in Table 11 are reproduced here. As shown in Figure 32, the sales fraction for SUVs has increased; the sales fractions for car and wagons declined; that for pickups has remained nearly constant; and vans may be showing a slight decline.

Figures 33 through 36 show trends in performance, weight, and adjusted fuel economy for cars, vans, SUVs, and pickups. All show increasing weight and increased performance over roughly the last two decades. The fuel economy picture is mixed, vans increasing, cars and SUVs about constant, and pickups decreasing during the same time period.

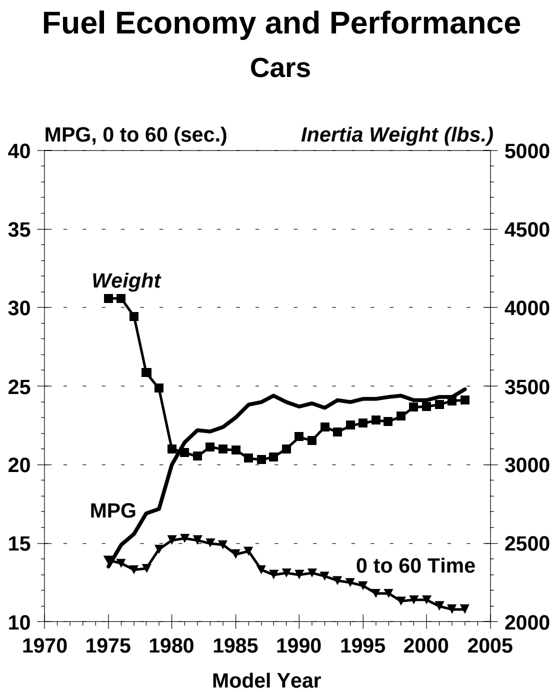

Figure 33

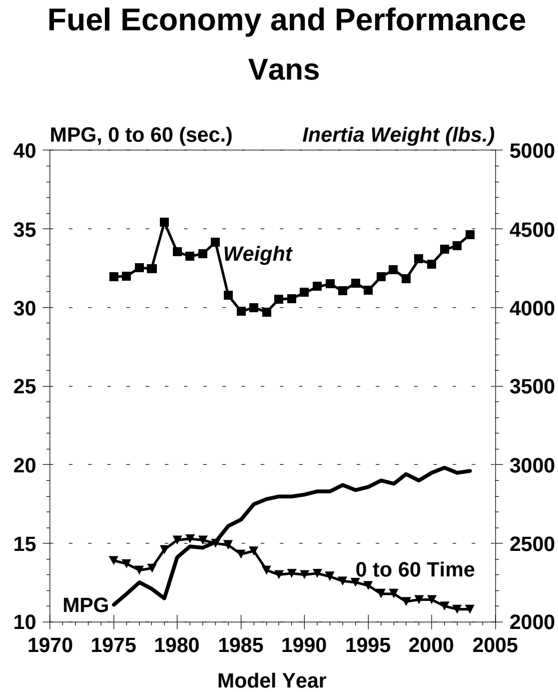

Figure 34

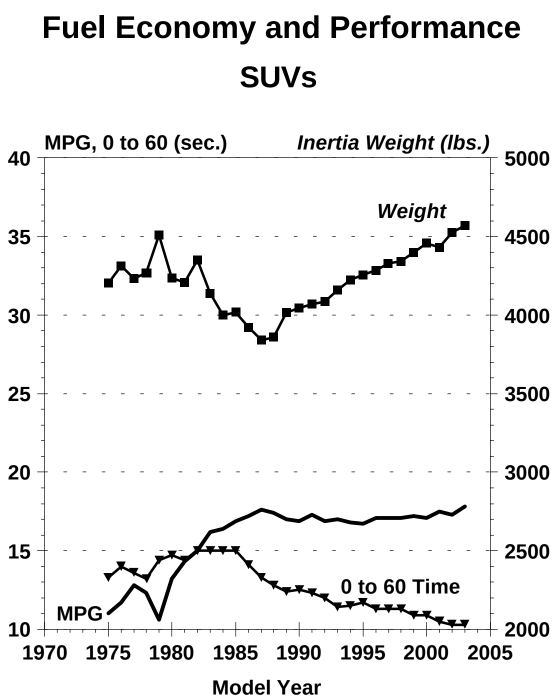

Figure 35

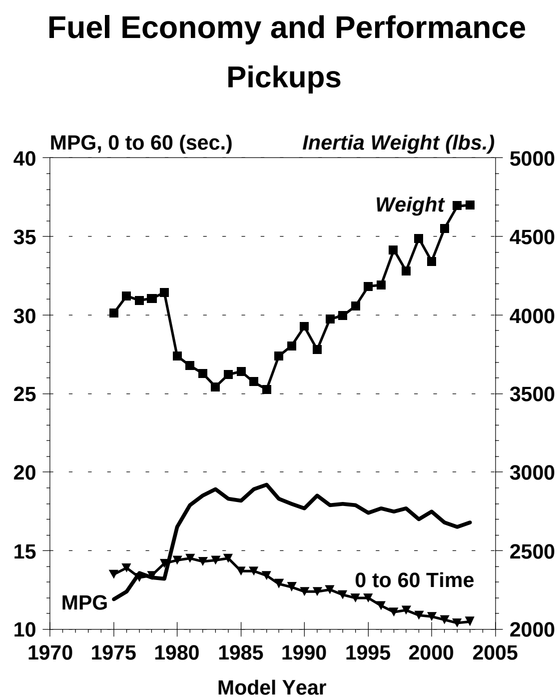

Figure 36

Ton-MPG by Model Year

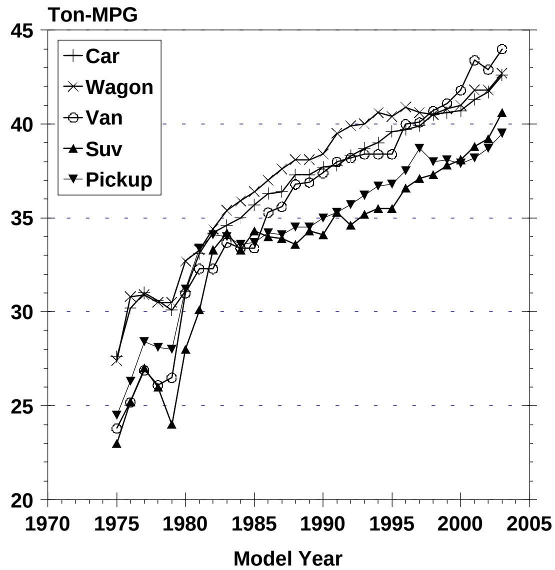

Figure 37

Figure 37 shows the five classes compared on a ton-MPG basis. In this measure of efficiency, vans lead, cars and wagons are about the same and better than SUVs which are like pickups.

Another way to look at the performance of different types of vehicles is by a classification other than size: weight, for example. In Figures 38 through 41, the four classes of vehicles are shown by weight class. Model years 1975 and 2003 are shown. MPG has been improved from 1975 to 2003 in each weight class for every comparison shown in Figures 38 through 41. The graphs also show the same trends with weight—that, as weight increases, MPG tends to decrease. Some of the trends may look flat, because the scales for all four graphs are the same and are influenced by the high MPG of the 2000-lb and 2250-lb car weight classes for recent model years.

Figures 42 through 45 provide an indication of the market share of different weight vehicles within the different classes. Trends within classes are shown which underlie the increasing weight shown by the classes as a whole.

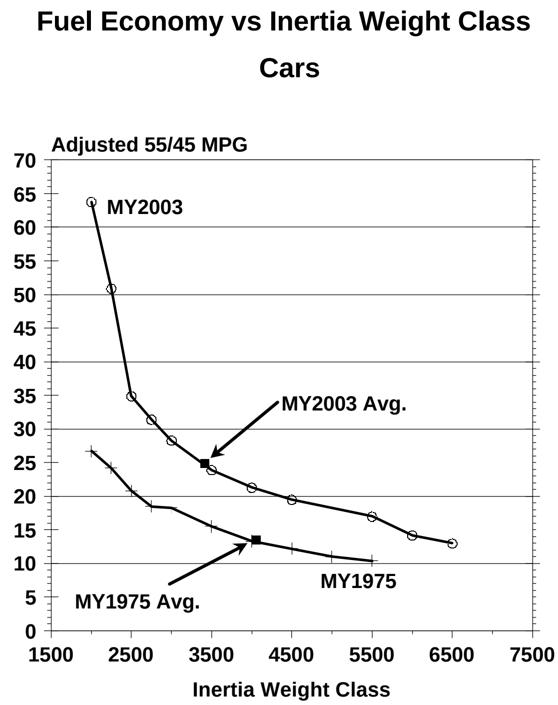

Figure 38

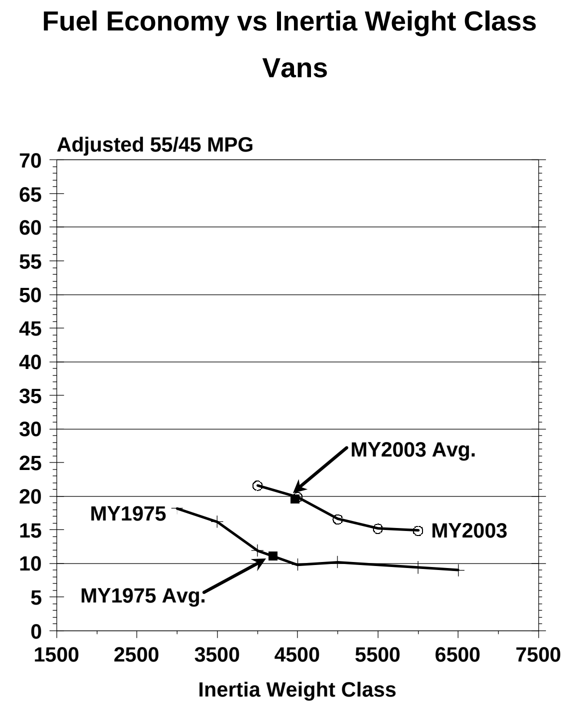

Figure 39

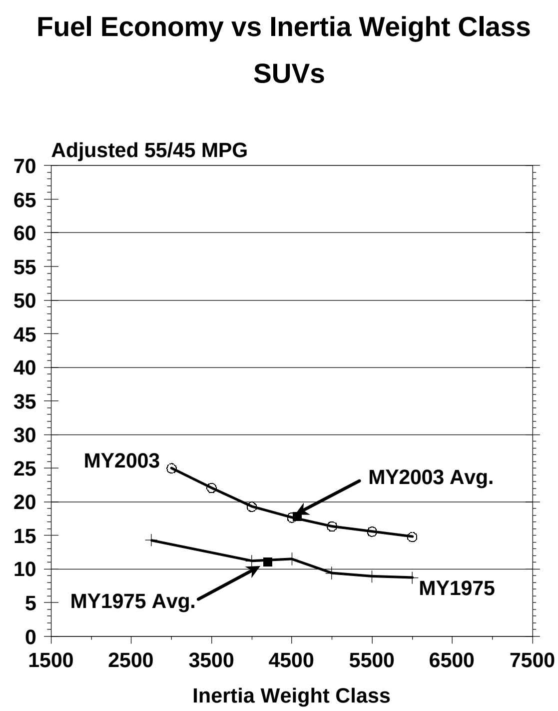

Figure 40

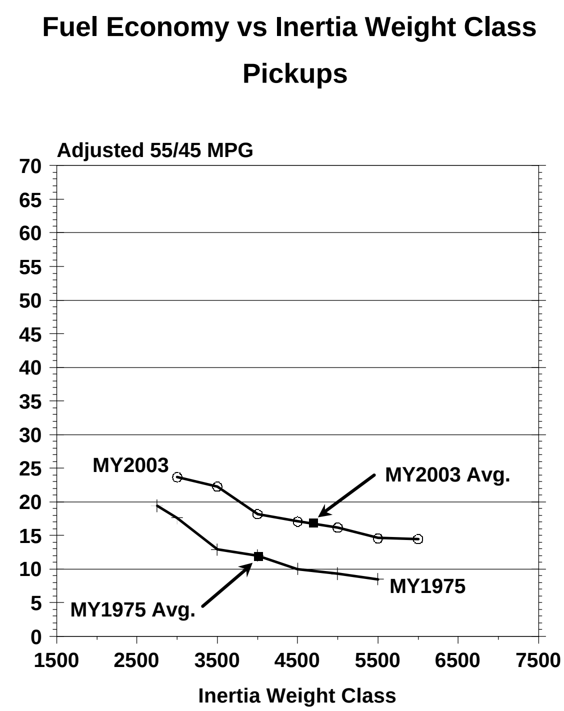

Figure 41

Sales Fraction by Inertia Weight Class

Cars

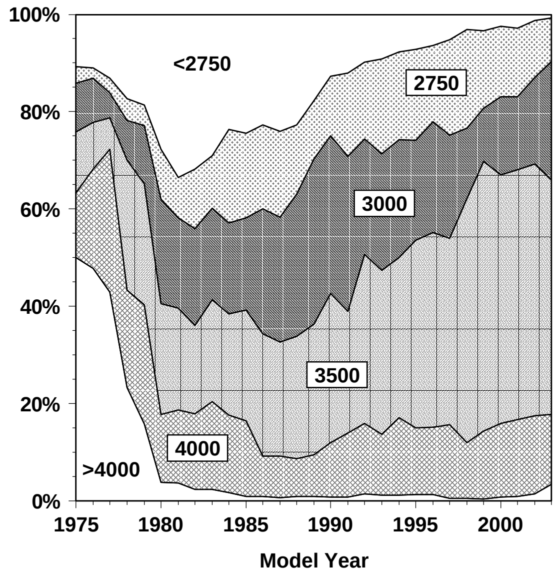

Figure 42

Sales Fraction by Inertia Weight Class

Vans

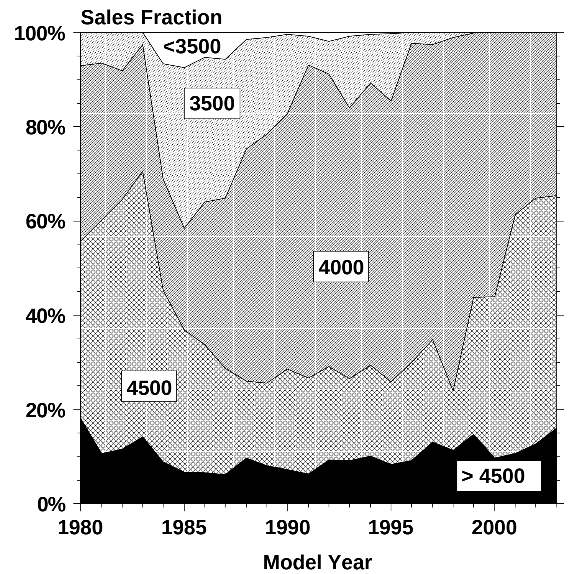

Figure 43

Sales Fraction by Inertia Weight Class

SUVs

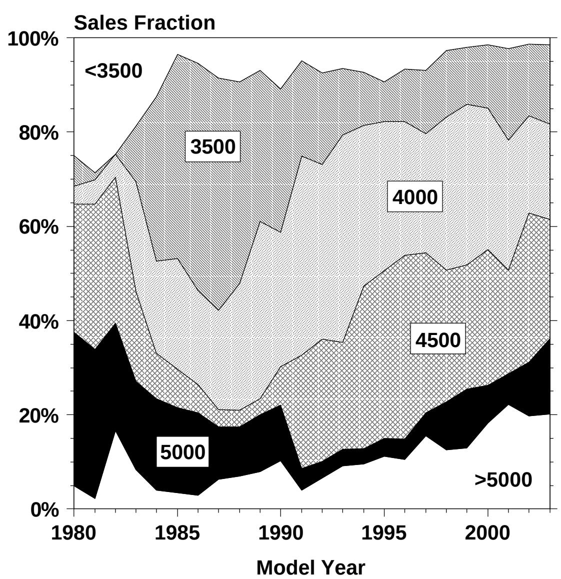

Figure 44

Sales Fraction by Inertia Weight Class

Pickups

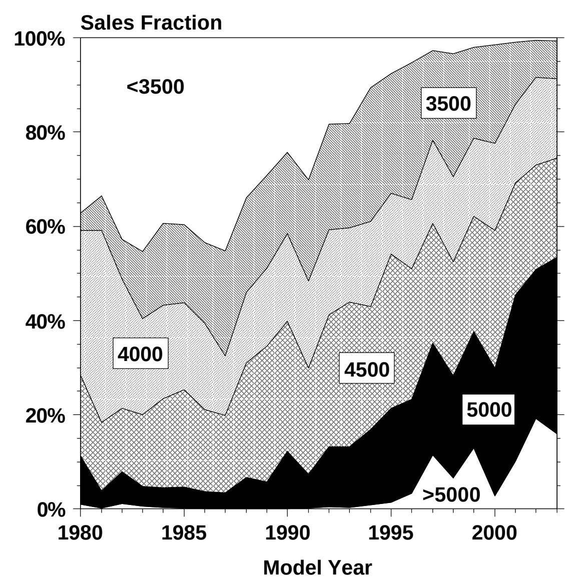

Figure 45

V. <u>Marketing Groups</u>

In its century of evolution, the automotive industry existed first as small, individual companies that relatively quickly went out of business or grew into larger corporations. In that context, the historic term ‘manufacturer’ usually meant a corporation that was associated with a single country that manufactured vehicles for sale in just that country and perhaps exported vehicles to a few other countries, too. Since the first report in this series was prepared, the nature of the automotive industry has changed substantially, and it has evolved into one in which global consolidations and alliances among heretofore independent manufacturers have become the norm, rather than the exception.

The reports in this series include analysis of fuel economy trends in terms of the whole fleet of cars and light trucks and in various subcategories of interest, e.g., by weight class, by size class, etc. In addition, there has been a treatment of trends by groups of manufacturers. Initially, these groups were derived from the “Domestic” and “Import” categories which are part of the automobile fuel economy standards categories. This classification approach evolved into a market segment approach in which cars were apportioned to a “Domestic,” “European,” and “Asian” category, with trucks classified as “Domestic” or “Imported.” As the automotive industry has become more transnational in nature, this type of vehicle classification has become less useful.

In this report, trends by groups of manufacturers are now used instead of the Domestic/Imported type grouping to reflect the transnational and transregional nature of the automobile industry. To reflect the transition to an industry in which there are only a small number of independent companies, the fleet has been divided into segments consisting of three multiple partner “marketing groups,” four groups with just a few partners, and an eighth catch-all group (“Others”) that contains those manufacturers that have not been assigned to one of the seven major marketing groups. Taken together, the seven major marketing groups comprise 98 percent of the MY2003 new vehicle market in the U.S.

The seven major marketing groups are:

1) The General Motors Group includes GM and those companies which GM owns or has a substantial affiliation with, i.e., Opel, Saab, Isuzu, Fiat, Subaru, Suzuki, and Daewoo;

2) The Ford Motor Group includes Ford, Jaguar, Volvo, Land Rover, Aston Martin, and Mazda;

3) The DaimlerChrysler Group includes Chrysler, Mercedes Benz, Mitsubishi, Hyundai, and Kia;

4) Toyota including Lexus;

5) Honda including Acura;

6) Nissan including Infiniti; and

7) VW Group including Volkswagen, Audi, SEAT, Skoda, and Bentley.

It is expected that these marketing groups will continue to expand as other consolidations in the automotive industry occur.

Table 13 compares unadjusted laboratory fuel economy values for the marketing groups described above for model year 2003 with the overall fleet average. The GM, Ford, and DC Groups are all above the fleet average in percent Truck and below the overall fleet average in MPG and that the rest of the Groups: Toyota, Honda, Nissan, and VW are below the fleet average in percent Truck and are above the overall fleet average in MPG.

A more detailed comparison of model year 2003 unadjusted (laboratory) fuel economy, by vehicle type and size is presented in Table 14. The leaders by manufacturer group and vehicle type are: cars – Honda, wagons – Toyota, vans – Toyota, SUVs – Honda, pickups – Nissan. A companion table to Table 14 using adjusted MPG data is Table 15. More information stratified by marketing group can be found in Appendix M.

Table 13

MY2003 Unadjusted (Laboratory) 55/45 Fuel Economy by Marketing Group

Group	Group Member Added	<-- FUEL ECONOMY --> Cars	Trucks	Both	Percent Truck
GM	GM	29.0	19.8	23.3	52%
	Above plus Subaru	28.9	20.0	23.5	52%
	Above plus Isuzu	28.9	20.1	23.5	53%
	Above plus Suzuki	28.9	20.1	23.5	53%
	Above plus Saab	28.9	20.1	23.5	53%
	Above plus Daewoo	28.9	20.1	23.5	53%
	Entire GM Group	28.9	20.1	23.5	53%
Ford	Ford	26.8	20.1	22.3	59%
	Above plus Mazda	27.1	20.3	22.6	59%
	Above plus Volvo	27.1	20.3	22.6	58%
	Above plus Jaguar	26.9	20.3	22.7	56%
	Above plus Land Rover	26.9	20.2	22.6	57%
	Above plus Ast. Mart.	26.9	20.2	22.6	57%
	Entire Ford Group	26.9	20.2	22.6	57%
DC	Chrysler	27.7	21.1	22.8	68%
	Above plus Mitsubishi	27.8	21.2	23.3	62%
	Above plus Mercedes	27.2	21.1	23.3	58%
	Above plus Hyundai	27.9	21.3	24.1	52%
	Above plus Kia	28.2	21.2	24.2	51%
	Entire DC Group	28.2	21.2	24.2	51%
Toyota	Toyota	32.1	21.8	27.1	39%
Honda	Honda	32.6	24.5	29.4	33%
Nissan	Nissan	27.8	21.4	25.0	38%
VW	VW	29.4	20.6	29.2	1%
Others		25.9	20.1	24.7	17%
All	Fleet Average	29.0	20.8	24.4	48%

Table 14

MY2003 Unadjusted Laboratory 55/45 Fuel Economy by Marketing Group and Vehicle Size/Type

VEHICLE TYPE	SIZE	GM	Ford	DC	Toyota	Honda	Nissan	VW	Others	All
Cars	Small	31.4	29.2	29.9	36.1	37.5	27.9	30.1	26.1	31.1
Cars	Midsize	27.0	25.1	26.7	29.2	29.9	27.9	27.4	0.0	27.8
Cars	Large	26.4	24.7	27.0	27.5	0.0	23.0	22.7	24.4	25.8
Cars	All	28.8	26.8	28.6	31.9	32.6	27.8	29.4	25.9	29.0
Wagons	Small	33.9	28.7	25.7	35.2	0.0	0.0	30.2	25.8	29.4
Wagons	Midsize	28.3	27.8	25.9	0.0	0.0	0.0	26.8	0.0	28.0
Wagons	Large	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wagons	All	30.3	27.8	25.7	35.2	0.0	0.0	28.1	25.8	28.8
All Cars	Small	31.6	29.2	29.0	36.0	37.5	27.9	30.1	26.1	30.9
All Cars	Midsize	27.2	25.9	26.7	29.2	29.9	27.9	27.3	0.0	27.8
All Cars	Large	26.4	24.7	27.0	27.5	0.0	23.0	22.7	24.4	25.8
All Cars	All	28.9	26.8	28.2	32.1	32.6	27.8	29.3	25.9	29.0
Vans	Small	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vans	Midsize	23.1	23.1	24.2	24.7	24.1	0.0	21.1	0.0	23.7
Vans	Large	17.8	18.7	17.6	0.0	0.0	0.0	20.0	0.0	18.1
Vans	All	21.8	22.3	24.0	24.7	24.1	0.0	20.6	0.0	23.0
SUVs	Small	26.1	0.0	21.1	29.4	0.0	0.0	0.0	0.0	25.4
SUVs	Midsize	22.6	21.2	22.3	22.5	24.6	20.6	0.0	0.0	22.3
SUVs	Large	18.7	17.8	19.4	17.7	0.0	20.0	0.0	20.1	18.5
SUVs	All	20.3	19.8	21.4	22.1	24.6	20.5	0.0	20.1	20.8
Pickups	Small	26.4	0.0	0.0	22.7	0.0	26.3	0.0	0.0	23.7
Pickups	Midsize	22.0	22.3	18.2	0.0	0.0	0.0	0.0	0.0	22.0
Pickups	Large	18.6	19.2	18.7	18.9	0.0	20.9	0.0	0.0	18.9
Pickups	All	19.3	20.1	18.7	20.9	0.0	22.8	0.0	0.0	19.7
Trucks	All	20.1	20.2	21.2	21.8	24.5	21.4	20.6	20.1	20.8
All	All	23.5	22.6	24.2	27.1	29.4	25.0	29.2	24.7	24.4

Table 15

MY2003 In-use Adjusted 55/45 Fuel Economy by Marketing Group

VEHICLE TYPE/SIZE		GM	Ford	DC	Toyota	Honda	Nissan	VW	Others	All
Cars	Small	26.9	25.0	25.5	30.8	32.0	23.8	25.7	22.3	26.6
Cars	Midsize	23.1	21.5	22.8	25.0	25.6	23.8	23.4	0.0	23.8
Cars	Large	22.7	21.1	23.1	23.5	0.0	19.7	19.4	20.9	22.1
Cars	All	24.6	22.9	24.4	27.2	27.9	23.7	25.2	22.2	24.8
Wagons	Small	28.8	24.5	22.0	29.9	0.0	0.0	25.8	22.1	25.0
Wagons	Midsize	24.1	23.7	22.1	0.0	0.0	0.0	22.9	0.0	23.9
Wagons	Large	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wagons	All	25.8	23.8	22.0	29.9	0.0	0.0	24.1	22.1	24.6
All Cars	Small	27.0	25.0	24.8	30.7	32.0	23.8	25.7	22.3	26.4
All Cars	Midsize	23.3	22.1	22.8	25.0	25.6	23.8	23.3	0.0	23.8
All Cars	Large	22.7	21.1	23.1	23.5	0.0	19.7	19.4	20.9	22.1
All Cars	All	24.8	23.0	24.1	27.4	27.9	23.7	25.1	22.2	24.8
Vans	Small	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vans	Midsize	19.8	19.8	20.7	21.1	20.6	0.0	18.0	0.0	20.3
Vans	Large	15.2	16.0	14.9	0.0	0.0	0.0	17.1	0.0	15.4
Vans	All	18.6	19.0	20.5	21.1	20.6	0.0	17.5	0.0	19.6
SUVs	Small	22.2	0.0	17.9	25.0	0.0	0.0	0.0	0.0	21.6
SUVs	Midsize	19.3	18.1	19.0	19.2	21.0	17.5	0.0	0.0	19.0
SUVs	Large	16.0	15.2	16.5	15.1	0.0	17.1	0.0	17.2	15.8
SUVs	All	17.3	16.9	18.2	18.8	21.0	17.5	0.0	17.2	17.8
Pickups	Small	22.5	0.0	0.0	19.3	0.0	22.4	0.0	0.0	20.1
Pickups	Midsize	18.8	19.0	15.5	0.0	0.0	0.0	0.0	0.0	18.7
Pickups	Large	15.9	16.4	16.0	16.1	0.0	17.8	0.0	0.0	16.1
Pickups	All	16.4	17.1	15.9	17.8	0.0	19.4	0.0	0.0	16.8
Trucks	All	17.2	17.2	18.1	18.6	20.9	18.3	17.5	17.2	17.7
All	All	20.1	19.3	20.6	23.1	25.1	21.3	25.0	21.1	20.8

VI. Fuel Economy Improvement Potential Within the Current Fleet

This chapter is limited to a discussion of some of the technical and engineering factors that affect fuel economy. It does not attempt to evaluate either the benefits or the costs of achieving various fuel economy levels. In addition, the analysis presented in this report also does not attempt to evaluate the marketability or the public acceptance of any of the hypothetical fleets that result from the scenarios studied and discussed below.

As stated earlier in this report, the fuel economy of the combined car and light-truck fleet has decreased about six percent from a peak value of 22.1 MPG achieved in 1987 and 1988 with much of this decline attributable to the increased market share of light trucks. Considered separately, average fuel economy for cars and trucks has remained relatively constant for years, yet the interest in improving automotive fuel economy is increasing.

There are several different ways to look at the potential for improved fuel economy from the light-vehicle fleet. Many of these approaches utilize projections of more fuel efficient technologies that are not in the fleet today. As an example, a fleet made up of a large fraction of fuel cell vehicles could be considered. Such projections can be associated with a good deal of uncertainty, since uncertainty in the projections of market share compound with uncertainties about the MPG performance of yet uncommercialized technology. These uncertainties can be thought of as a combination of technical risk, i.e., can the technology be developed and mass produced?, and market risk, i.e., will people buy vehicles with the improved MPG?

One general approach used in this report is to consider only the MPG performance of those technologies which exist in today’s fleet. This eliminates uncertainty about the feasibility and production readiness of the technology and reduces or eliminates the technical risk but does not treat market risk as mentioned above. Therefore, the analysis can be thought of as the MPG potential now in the fleet, with no new technologies added, if the higher MPG choices available were to be selected.

Figures 2 and 3 in this report showed, particularly for cars, that there was a wide distribution of fuel economy. Because of the interest in the high end of this spectrum, this portion of the database was examined in more detail using a “best in class” (BIC) technique. The BIC analysis in not new, in fact it was one of the methods used to investigate future fleet MPG capability when the original fuel economy standards were set.

Similarly, in any group or class of vehicles there will be a distribution of MPG performance, and the "best in class" method relies on that fact. The analysis involves dividing the fleet of vehicles into classes, selecting a set of representative high MPG "role model" vehicles from each class, and then calculating the average characteristics of the resultant fleet using the same relative sales proportions as in the baseline fleet.

One potential problem with a BIC analysis is that the high MPG cars used in the analysis may be unusual in some way – so unusual that the hypothetical fleet made up of them may be deficient in some other attributes considered desirable by vehicle buyers. Because the BIC analysis is also sensitive to the selection of the best vehicles, three different procedures were used to select the role models.

Two of these selection procedures use the EPA car size classes (which for cars are the same as those used for the EPA/DOE *Fuel Economy Guide*) and the truck type/size classes described previously in this report. Note that this classification system includes nine car and nine truck classes and, for this model year, two of these eighteen classes are not represented (Large Wagons and Small Vans). The third best-in-class role model selection procedure is based on using the vehicle inertia weight classes used for EPA's vehicle testing and certification process.

The advantage of using and analyzing data from the best in size class methods is that, if the sales proportions of each class are held constant, the sales distribution of the resultant fleet by *vehicle type and size* does not change. This means that the size of the average vehicle does not change a lot. Similarly, there also is an advantage in using the inertia weight classes to determine the role models, since, if the sales proportions in each inertia weight class are held constant, the sales distribution of the resultant fleet by *weight* does not change, and in this case the average weight remains the same.

One way of performing a best-in-class (BIC) analysis is to use as role models the four nameplates with the highest fuel economy in each size class. (See Tables N-1 and N-2 in Appendix N.) Under this procedure, all vehicles in a class with the same nameplate are included as role models regardless of vehicle configuration. Each role model nameplate from each class was assigned the same sales weighting factor, but the original sales weighting distribution for different vehicle configurations within a given nameplate (e.g., transmission type, engine size, and/or drive type) was retained. The resulting values were used to recalculate the fleet average values using the same relative proportions in each of the size classes that constitute the fleet.

In cases where two identical vehicles differ by only one characteristic but have slightly different nameplates (such as the two-wheel drive Chevrolet C1500 and the four-wheel drive K1500 pickups), both are considered to have the same nameplate. Conversely, in the cases where there are technically identical vehicles with different nameplates (e.g., the Buick LeSabre and Pontiac Bonneville sedans), only one representative vehicle nameplate was used in the BIC analysis.

The second best-in-class role model selection procedure involves selecting as role models the best dozen vehicles in each size class with each vehicle configuration considered separately. Tables N-3 and N-4 in Appendix N give listings of the representative vehicles used in this method. As with the previous procedure, in cases where technically identical vehicle configurations have different nameplates, only one representative vehicle was used. Under this best-in-class method, the sales data for each role model vehicle in each class was assigned the same value, and the resulting values were used to re-calculate the fleet values again using the same relative proportions in each of the size classes that constitute the fleet.

The third best-in-class procedure involves selecting as role models the best dozen vehicles in each weight class. As with the previous method, each vehicle configuration was considered separately. (See Tables N-5 and N-6 in Appendix N for a listing of the vehicles used in this analysis.) It should be noted that some of the weight classes have less than a dozen representative vehicles. In addition, as in the previous two best-in-class methods, where technically identical vehicle configurations with different nameplates are used, only one representative vehicle was included. As with the two best-in-size class methods, the sales data for each role model vehicle in each class was assigned the same value, and the resulting values were used to recalculate the fleet values again using the same relative proportions in each of the size classes that constitute the fleet.

Tables 16 to 18 compare, for cars, trucks, and both cars and trucks, respectively, the results of the best-in-class analysis with actual average data for model year 2003. As discussed earlier, for the size class scenarios, the percentage of vehicles that are small, midsize, or large are the same as for the baseline fleet, and in the weight class scenarios, the average weight of the BIC data sets is the same as the actual one. Despite the fact that 75 percent of the cars in the BIC weight class data set are classified as “small,” compared to 52 percent in the entire fleet, average interior volume for cars in the BIC weight class analysis is about the same as the overall average (109 vs. 110 cu. ft.). The small differences in interior volume between the size class scenarios and the actual vehicle fleet can be attributed to the fact that, within a size class, there is considerable variation in interior volume (i.e., not all vehicles in each size class have the same interior volume).

Under all of the best-in-class (BIC) scenarios, the vehicles used for the BIC analysis have less powerful engines, have slower 0-to-60 acceleration times, and are more likely to be equipped with manual transmissions than the entire fleet as a whole. The BIC fleets also make more use of hybrids and CVTs. For trucks, however, the BIC data set vehicles make greater use of front-wheel drive. When the best 12 vehicles in size or weight were used as the role model selection criteria, the truck BIC data sets also make less use of four-wheel drive than the actual fleet.

For both cars and trucks, the “Best 12 Vehicles” in Size Class scenario results in significantly higher fuel economy than the actual fleet, but the vehicles in the BIC size set are lighter than their counterparts from the other scenarios. Depending on the scenario chosen, for model year 2003, cars could have achieved from 14- to 19-percent better fuel economy than they did. Similarly, trucks could have achieved from 9- to 13-percent better fuel economy, and the combined car and truck fleet could have been 11- to 16-percent better.

The best-in-class analyses can be thought of as the MPG potential now in the fleet with no new technologies added, if the higher MPG choices available were selected. As such, the best-in-class analyses provide a useful reference point indicating the variation in fuel economy levels that result in large part from consumer preferences as opposed to technological availability. For example, the results show that models with manual transmissions generally achieve slightly higher fuel economy than comparable automatic transmission-equipped models. U.S. consumers, however, have an overwhelming preference for automatic transmissions, and no one would expect that trend to change in the future.

Table 16

Best in Class Results: Model Year 2003 Cars

Vehicle Characteristic	Selection Basis		Actual Data	Size Class	Size Class	Weight Class
	Selection Criteria		All Cars	Best 4 Nameplates	Best 12 Vehicles	Best 12 Vehicles
Fuel Economy	Lab.	55/45	29.0	33.1	34.6	34.6
	Adjusted	City	21.8	25.4	26.5	26.5
	Adjusted	Highway	29.7	32.7	34.4	34.4
	Adjusted	55/45	24.8	28.2	29.6	29.6
Vehicle Size	Weight	(Lb.)	3411	3205	3218	3411
	Volume	(Cu. Ft.)	109.9	108.1	108.3	109.3
	Small		51.9%	51.9%	51.9%	74.5%
	Mid-size		32.7%	32.7%	32.7%	24.1%
	Large		15.4%	15.4%	15.4%	1.4%
Engine	CID		165	135	132	126
	HP		175	148	144	142
	HP/CID		1.083	1.097	1.102	1.123
	HP/WT		.0508	.0457	.0443	.0412
Performance	0 - 60	Time (sec)	10.1	11.2	11.4	12.1
TOP	Top Speed	(mph)	131	124	122	119
	Ton-MPG		42.6	46.9	49.3	52.3
	Cu-Ft. MPG		2775	3177	3344	3390
	Cu-Ft. Ton-MPG		4688	5041	5313	5711
Drivetrain	Front		82.4%	97.0%	95.4%	90.4%
	Four Wheel		3.6%	1.3%	1.5%	7.2%
Transmission	Manual		14.7%	15.3%	51.8%	54.7%
	Lockup		84.7%	74.2%	41.6%	37.6%
	CVT		.6%	10.5%	6.6%	7.7%
Fuel Metering	Port		99.6%	98.5%	91.8%	81.9%
	Diesel		.4%	1.5%	8.2%	18.1%
	Four Valve Usage		70.4%	80.3%	72.0%	53.8%
Hybrid Vehicle			.5%	10.7%	9.8%	6.1%

Table 17

Best in Class Results: Model Year 2003 Trucks

Vehicle Characteristic	Selection Basis		Actual Data	Size Class	Size Class	Weight Class
	Selection Criteria		All Trucks	Best 4 Nameplates	Best 12 Vehicles	Best 12 Vehicles
Fuel Economy	Lab.	55/45	20.8	22.6	23.5	22.6
	Adjusted	City	15.9	17.5	18.2	17.3
	Adjusted	Highway	20.5	22.1	22.8	22.4
	Adjusted	55/45	17.7	19.3	20.0	19.3
Vehicle Size	Weight	(Lb.)	4595	4186	4059	4595
	Van		17.0%	17.0%	17.0%	29.5%
	SUV		49.3%	49.3%	49.3%	48.8%
	Pickup		33.7%	33.7%	33.7%	21.7%
Engine	CID		245	197	187	213
	HP		220	193	179	205
	HP/CID		.919	1.003	.977	.982
	HP/WT		.0478	.0459	.0440	.0444
Performance	0 - 60	Time (sec)	10.4	10.7	11.1	11.0
	Top Speed	(mph)	133	129	126	129
	Ton-MPG		40.8	40.6	40.8	44.2
Drivetrain	Front		18.1%	30.0%	35.3%	32.1%
	Four Wheel		49.1%	46.5%	26.3%	33.3%
Transmission	Manual		5.9%	8.2%	30.0%	20.5%
	Lockup		93.3%	89.1%	65.1%	78.5%
	CVT		.6%	2.6%	.9%	2.6%
Fuel Metering	Port		100%	100%	100%	100%
	Diesel		0%	0%	0%	0%
	Four Valve Usage		33.7%	54.2%	58.9%	45.4%
	Hybrid Vehicle		0%	0%	0%	0%

Table 18

Best in Class Results: Model Year 2003 Both Cars and Trucks

Vehicle Characteristic	Selection Basis		Actual Data	Size Class	Size Class	Weight Class
	Selection Criteria		All Vehicles	Best 4 Nameplates	Best 12 Vehicles	Best 12 Vehicles
Fuel Economy	Lab.	55/45	24.4	27.1	28.3	27.6
	Adjusted	City	18.6	20.9	21.8	21.1
	Adjusted	Highway	24.5	26.6	27.7	27.5
	Adjusted	55/45	20.8	23.1	24.1	23.6
Vehicle Size	Weight	(Lb.)	3974	3671	3618	3974
Engine	CID		203	165	158	168
	HP		197	170	161	172
	HP/CID		1.005	1.052	1.043	1.056
	HP/WT		.0494	.0458	.0442	.0427
Performance	0 - 60	Time (sec)	10.2	11	11.3	11.6
	Top Speed(mph)		132	126	124	124
	Ton-MPG		41.7	43.9	45.3	48.4
Drivetrain	Front		51.8%	65.1%	66.8%	62.7%
	Four Wheel		25.2%	22.8%	13.3%	19.6%
Transmission	Manual		10.5%	11.9%	41.4%	38.4%
	Lockup		88.8%	81.3%	52.8%	57.1%
	CVT		.6%	5.3%	7.6%	3.9%
Fuel Metering	Port		99.8%	99.2%	95.7%	90.5%
	Diesel		.2%	.8%	4.3%	9.5%
	Four Valve Usage		52.9%	67.9%	65.8%	49.8%
	Hybrid Vehicle		.3%	5.6%	5.1%	3.2%

One of the characteristics of the best-in-class analysis is that it typically results in a hypothetical fleet of vehicles which has a larger fraction of manual transmissions than today's fleet does. This is a consequence of the methodology. There has been some discussion of the practicality of such a fleet of vehicles, especially for the U.S. market where automatic transmissions dominate.

Another general approach for determining potential fuel economy improvement is to study the relationships between vehicle technology improvements, vehicle acceleration times, vehicle size, and vehicle weight.

The MPG/performance interdependence was quantified by means of a regression analysis performed on the EPA databases as described in reference 20. This yielded sensitivity coefficients on the order of 0.4, i.e., a 10-percent increase in 0-to-60 time corresponds to a four-percent increase in fuel economy. Using these sensitivities, average MPG data at one 0-to-60 level can be adjusted to what it would have been at a different one.

Similarly, by normalizing either the weight or size distribution, a comparison can be made of what the fuel economy of each year's fleet would have been if it had the same weight or size distribution as in a given base year. For comparison purposes, two base years were analyzed: 1981 and 1988.

Table 19 compares fuel economy, inertia weight, and 0-to-60 time for this year's vehicles with the two baseline years and shows that this year's cars get 3.9 MPG higher fuel economy than their counterparts from 1981 and about the same fuel economy as those built in 1988. This year's cars, moreover, are significantly heavier and have faster 0-to-60 acceleration time than those in both baseline years. Similarly, this year's trucks get about the same fuel economy as the baseline years and are also heavier and have faster 0-to-60 times.

Table 19

Unadjusted Fuel Economy, Inertia Weight, and 0-to-60 Time For Three Model Years

Vehicle Type	Model Year	55/45 MPG	Inertia Weight	0 to 60 Time
Cars	1981	25.1	3076	14.4
	1988	28.6	3047	12.8
	2003	29.0	3410	10.1
Trucks	1981	20.1	3806	14.6
	1988	21.2	3841	12.9
	2003	20.8	4595	10.4
Both	1981	24.1	3201	14.4
Cars and	1988	25.9	3283	12.8
Trucks	2003	24.4	3974	10.2

Figures 46 through 49 provide estimates of what the MPG of the car and truck fleet would have been each model year if:

(1) the weight mix had been kept the same as in each of the two base years,

(2) the average acceleration time was kept at the base year’s acceleration time, and

(3) both the weight distribution and average acceleration time were the same as in the base year.

A similar comparison on the basis of vehicle size and type is presented in Figures 50 through 53.

Effect of Weight and Acceleration on Car Fuel Economy

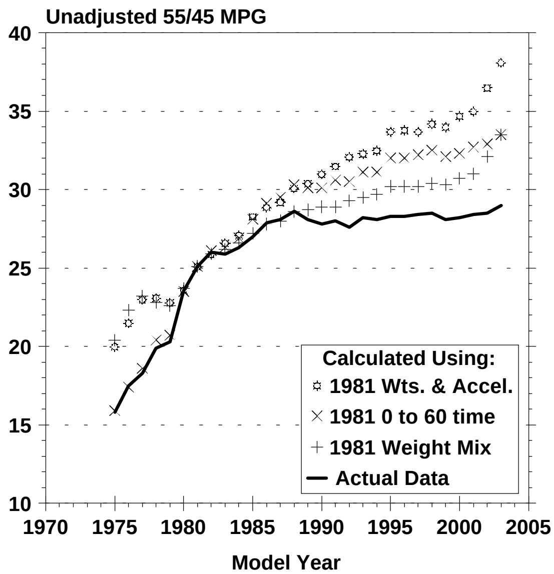

Figure 46

Effect of Weight and Acceleration on Truck Fuel Economy

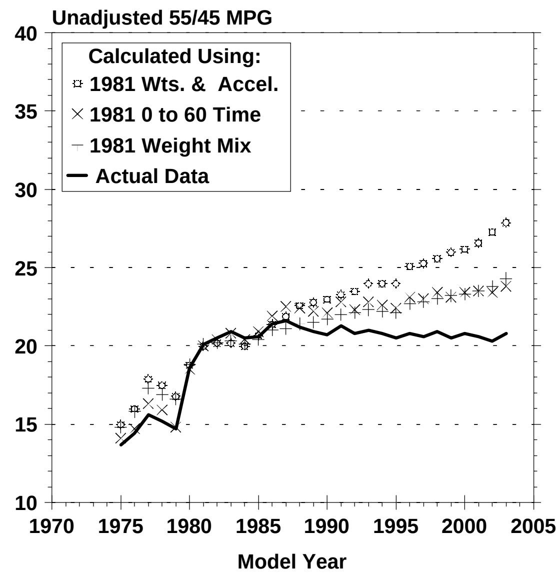

Figure 47

Effect of Weight and Acceleration on Car Fuel Economy

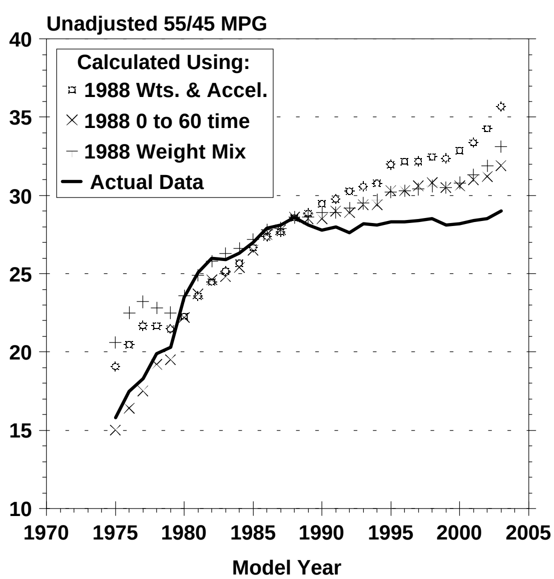

Figure 48

Effect of Weight and Acceleration on Truck Fuel Economy

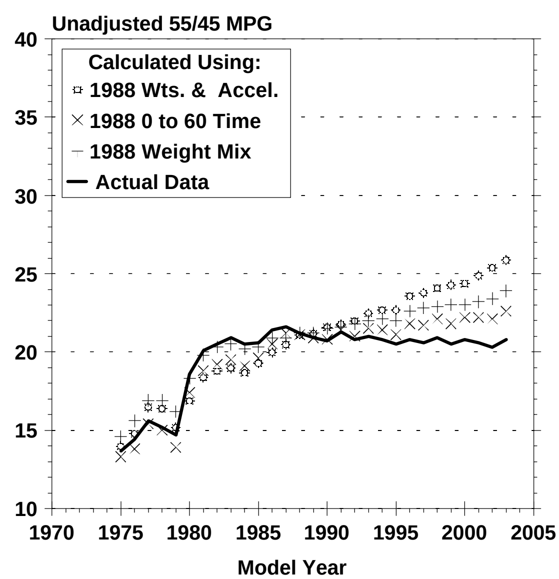

Figure 49

Effect of Vehicle Size, Type & Acceleration on Car Fuel Economy

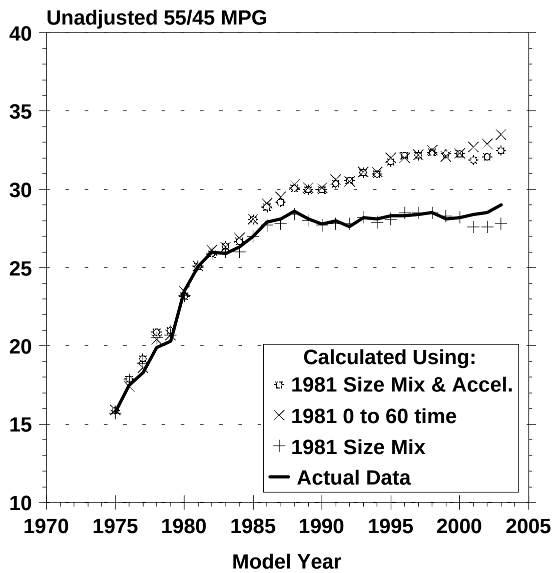

Figure 50

Effect of Vehicle Size, Type & Acceleration on Truck Fuel Economy

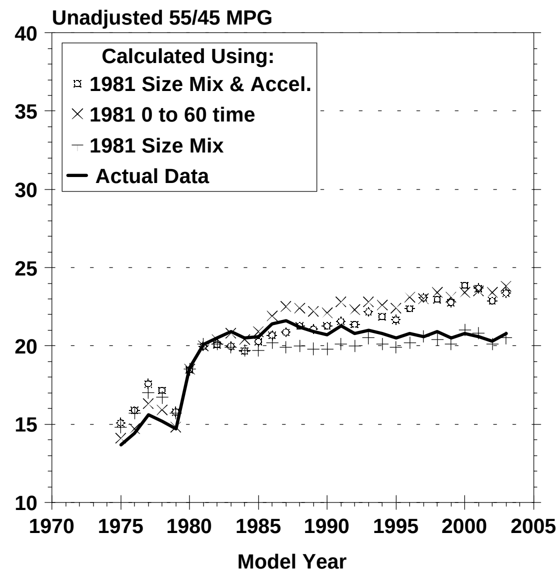

Figure 51

Effect of Vehicle Size, Type & Acceleration on Car Fuel Economy

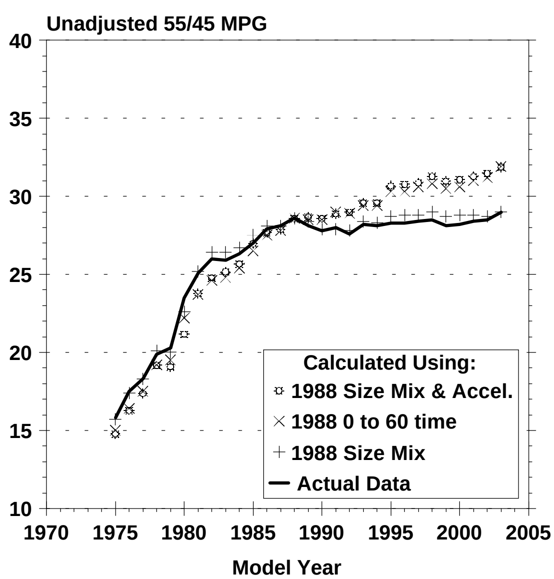

Figure 52

Effect of Vehicle Size, Type & Acceleration on Truck Fuel Economy

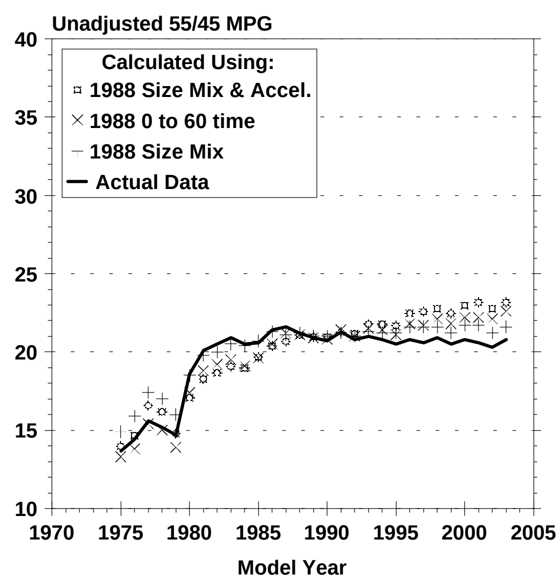

Figure 53

A summary of the different cases is presented in Table 20. Considering the seven different ways in which fuel economy improvements for the fleet can be estimated, based on the characteristics of the existing fleet, the range of improvements for the fleet is from 11 to 33 percent. The average is 17 percent. Different methods and different base years could, of course, yield different results, and, as discussed earlier, the hypothetical fleets that have higher fuel economy tend to be different from today's fleet because, while they have higher fuel economy, they also are slower and lighter.

Table 20

Summary of Fuel Economy Improvement Potential

		Unadjusted 55/45 MPG		
	Scenario	Cars	Trucks	Both
1	Model Year 2003 Actual Average	29.0	20.8	24.4
2	1981 Weight Mix and 0 to 60 Time	38.1	27.9	32.5
3	1988 Weight Mix and 0 to 60 Time	35.7	25.9	30.3
4	1981 Size Mix and 0 to 60 Time	32.5	23.4	27.4
5	1988 Size Mix and 0 to 60 Time	31.9	23.2	27.1
6	Best 4 Nameplates in Size Class	33.1	22.6	27.1
7	Best 12 Vehicles in Size Class	34.6	23.5	28.3
8	Best 12 Vehicles in Weight Class	34.6	22.6	27.6
	Percent Improvement over Model Year 2003 Actual Averages			
2	1981 Weight Mix and 0 to 60 Time	31.4%	34.1%	33.2%
3	1988 Weight Mix and 0 to 60 Time	23.1%	24.5%	24.2%
4	1981 Size Mix and 0 to 60 Time	12.1%	12.5%	12.4%
5	1988 Size Mix and 0 to 60 Time	10.0%	11.5%	10.9%
6	Best 4 Nameplates in Size Class	14.1%	8.7%	11.1%
7	Best 12 Vehicles in Size Class	19.3%	13.0%	16.0%
8	Best 12 Vehicles in Weight Class	19.3%	8.7%	13.1%
	Average (all seven scenarios)	18.5%	16.1%	17.3%

VII. Conclusions

1. Light vehicle fuel economy for model year 2003 is estimated to be 20.8 MPG on an adjusted MPG basis. This is 1.3 MPG less than the 22.1 (highest) MPG attained in model year 1988 and represents a six-percent decline from that peak. The 20.8 MPG value for the light-vehicle fleet represents a 59-percent increase in MPG from that attained in model year 1975, the earliest (and lowest MPG) model year covered in this report.

2. Light Truck Market Share at 48 percent of the light-vehicle fleet represents a trend in market share that has continued to increase for more than 20 years and only now may even be tending to level out. Over the past 10 years, increases in market share of Sport Utility Vehicles have been the primary reason for increases in the Light Truck market.

3. Compared to 1981 as a benchmark year, this year’s fleet is 24-percent heavier, 29-percent faster, 93-percent more powerful, and 1-percent better in MPG.

4. Based only on the performance of the higher MPG vehicles in today’s fleet, improved fleet MPG can be inferred.

5. Two new drivetrain technologies, hybrid propulsion systems and continuously variable transmissions, are beginning to appear in the fleet. Although the current market penetration for these technologies is less than 1 percent, both show some promise as avenues toward increased fuel economy.

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