Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2011

United States
Environmental Protection
Agency

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Transportation and Climate Division

Office of Transportation and Air Quality
U.S. Environmental Protection Agency

NOTICE

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I. Executive Summary

Introduction

This report summarizes key trends in carbon dioxide (CO_2) emissions, fuel economy, and CO_2- and fuel economy-related technology for gasoline- and diesel-fueled personal vehicles sold in the United States, from model years (MY) 1975 through 2011. Personal vehicles are those vehicles that EPA classifies as cars, light-duty trucks (sport utility vehicles, minivans, vans, and pickup trucks with gross vehicle weight ratings up to 8500 pounds), or, beginning in MY 2011, medium-duty passenger vehicles (sport utility vehicles or passenger vans with gross vehicle weight ratings between 8500 and 10,000 pounds). The data in this report cover the MY 1975-2011 timeframe, supersede the data in previous reports in this series, and should not be compared with data from previous years' editions of this report due to changes discussed below. Except when noted, CO_2 emissions and fuel economy values in this report have been adjusted to reflect "real world" consumer performance and therefore are not comparable to CO_2 emissions and fuel economy standards.

Data for MY 2010 are final, but data for MY 2011 are preliminary. The fleetwide average real world MY 2010 personal vehicle CO_2 emissions value is 394 grams per mile (g/mi) and fuel economy is 22.6 miles per gallon (mpg), both slight improvements over MY 2009 and the most favorable levels since this analysis began in 1975. Preliminary projections for MY 2011 are for continued slight improvements for both CO_2 emissions and fuel economy. For more discussion of the key conclusions of this report, see the five Highlights at the end of this Executive Summary.

What's New This Year

Most small, 2 wheel drive SUVs have been reclassified from trucks to cars for the entire MY 1975-2011 database. This reflects a regulatory change made by the Department of Transportation's (DOT) National Highway Traffic Safety Administration (NHTSA) for Corporate Average Fuel Economy (CAFE) standards beginning in MY 2011 and which will apply for the joint EPA/NHTSA greenhouse gas emissions and CAFE standards that have been finalized for MY 2012-2016 and proposed for MY 2017-2025. Some examples of the impacts of this change are that, for MY 2010, nearly 1.1 million vehicles are classified as cars that in previous years would have been classified as trucks, the absolute truck share is nearly 10% lower, the projected average adjusted CO_2 emissions for cars are about 9 g/mi higher, the projected average adjusted CO_2 emissions for light trucks are 17 g/mi higher, and the projected average adjusted fuel economies for cars and for light trucks are both 0.7 mpg lower than they would have been under the previous classification approach. Since this classification change does not affect the overall number of vehicles, or vehicle emissions/fuel economy performance, it has no impact on the average adjusted CO_2 emissions and fuel economy for the overall (car plus light truck) fleet. When the car fleet is further subdivided into sub-classes, these re-classified vehicles are referred to as "non-truck SUVs," while the remaining SUVs are termed "truck SUVs."

Beginning with MY 2011, the database now includes medium-duty passenger vehicles (MDPVs), which include larger sport utility vehicles (SUVs) and passenger vans, but not the larger pickup trucks, in the 8500-10,000 pound gross vehicle weight rating (GVWR) range. This change was made because NHTSA includes MDPVs in its CAFE standards beginning with MY 2011, and EPA and NHTSA include MDPVs in future greenhouse gas emissions and CAFE standards (and vehicle labels as well). While EPA will be including MDPV data for all years beginning with MY 2011, EPA does not have data for MDPVs for MY 1975-2010, so there is and will continue to be a very small discontinuity in the database beginning in MY 2011. The inclusion of MDPVs in MY 2011 increases projected average adjusted CO_2 emissions for light trucks by about 0.5 g/mi (even less for the overall fleet) and decreases projected average adjusted fuel economy for light trucks by 0.02 mpg (less for the overall fleet) compared to the fleet without MDPVs.

Important Explanation of Data Contained in This Report

Final MY 2010 data are based on formal end-of-year CAFE reports submitted by automakers to EPA and will not change. The preliminary MY 2011 data in this report are based on confidential pre-model year production volume projections provided to EPA by automakers during MY 2010 for the fuel economy label program. Accordingly, there is uncertainty in the MY 2011 data used in this report. For example, while the final MY 2010 values for CO_2 emissions and fuel economy in this report are essentially the same as the projected MY 2010 values that were provided in last year's report, in some previous years the preliminary projections were not good predictors of actual CO_2 and fuel economy performance. This report will often focus on the final MY 2010 data, rather than on the preliminary MY 2011 data, as we have done in prior reports.

The reader is advised to be cautious in making data comparisons between MY 2009 and MY 2010 as the former was a year of considerable turmoil in the automotive market. Due primarily to the economic recession, light-duty vehicle production was 34% lower in MY 2009 than in MY 2008, and the lowest since the database began in 1975.

The great majority of the CO_2 emissions and fuel economy values in this report are adjusted (ADJ) EPA real-world estimates provided to consumers and based on EPA's 5-cycle test methodology (which represent city, highway, high speed/high acceleration, high temperature/air conditioning, and cold temperature driving) that was first implemented in MY 2008. Appendix A provides a detailed explanation of the method used to calculate these adjusted fuel economy and CO_2 values, which last changed with the 2007 version of this report. In 2011, EPA and NHTSA revised the fuel economy and environment label to include, among other things, CO_2 emissions per mile and a fuel economy and greenhouse gas emissions rating (76 Federal Register 39478, July 6, 2011).

In some tables, the report also provides unadjusted EPA laboratory (LAB) values, which are based on a 2-cycle test methodology (city and highway tests only) and are the basis for automaker compliance with CO_2 emissions and CAFE standards. All combinations of adjusted or laboratory, and CO_2 emissions or fuel economy values, may be reported as city, highway, or, most commonly, as composite (combined city/highway, or COMP).

Because the underlying methodology for generating unadjusted laboratory CO_2 emissions and fuel economy values has not changed since this series began in the mid-1970s, these values provide a basis for comparing long-term CO_2 emissions and fuel economy trends from the perspective of vehicle design, apart from the factors that affect real-world driving that are reflected in the adjusted values. These unadjusted laboratory values form the basis for automaker compliance with CO_2 emissions and CAFE standards. Laboratory composite values represent a harmonic average of 55 percent city and 45 percent highway operation, or "55/45." For 2005 and later model years, unadjusted laboratory composite CO_2 emissions values are, on average, about 20 percent lower than adjusted composite CO_2 values, and unadjusted laboratory composite fuel economy values are, on average, about 25 percent greater than adjusted composite fuel economy values.

Regulatory Context

CAFE standards have been in place since 1978. NHTSA has the responsibility for setting and enforcing CAFE standards. EPA is responsible for establishing fuel economy test procedures and calculation methods, and for collecting data used to determine vehicle fuel economy and manufacturer CAFE levels. For MY 2011, the footprint-based CAFE standards are projected to achieve average industry-wide compliance levels of 30.4 mpg for cars (including a 27.8 mpg alternative minimum standard for domestic cars for all manufacturers) and 24.4 mpg for light trucks (75 FR 25330, May 7, 2010). There are no greenhouse gas emissions standards for MY 2011.

For MY 2012 and later, EPA and NHTSA have been jointly developing a harmonized National Program to establish EPA greenhouse gas emissions standards and NHTSA CAFE standards that allow manufacturers to build a single national fleet to meet requirements of both programs while ensuring that consumers have a full range of vehicle choices. The National Program has been supported by a wide range of stakeholders: most major automakers, the United Auto Workers, the State of California, and major consumer and environmental groups.

In 2010, the agencies finalized the first harmonized standards for MY 2012-2016 (75 Federal Register 25324, May 7, 2010). The standards for MY 2012 are now in effect. By MY 2016, the average industry-wide compliance levels for these footprint-based standards are projected to be 250 g/mi CO_2 and 34.1 mpg CAFE. The 250 g/mi CO_2 compliance level would be equivalent to 35.5 mpg if all CO_2 emissions reductions are achieved through fuel economy improvements. In 2011, the agencies proposed additional harmonized standards for MY 2017-2025 (76 FR 74854, December 1, 2011). Under the currently-proposed footprint-based standards, by MY 2025 the average industry-wide compliance levels are projected to be 163 g/mi CO_2 and 49.6 mpg CAFE. The 163 g/mi CO_2 compliance level would be equivalent to 54.5 mpg if all CO_2 emissions reductions are achieved solely through improvements in fuel economy. For both MY 2012-2016 and MY 2017-2025, the agencies expect that a portion of the required CO_2 emissions improvements will be achieved by reductions in air conditioner refrigerant leakage, which would not contribute to higher fuel economy.

These projected levels for MY 2025 represent an approximate halving of CO_2 emissions and doubling of fuel economy levels since the National Program was announced in May 2009. Taken together, the MY 2011 CAFE standards, the MY 2012-2016 greenhouse gas emissions and CAFE standards, and the proposed MY 2017-2025 greenhouse gas emissions and CAFE standards are projected to save approximately 6 billion metric tons of greenhouse gas emissions and 12 billion barrels of oil over the lifetimes of the vehicles produced in MY 2011-2025. Based on the agencies' most recent estimates of the cost and effectiveness of future technologies, Department of Energy forecasts of future fuel prices, and other assumptions, the fuel savings to consumers are projected to far outweigh the higher initial cost of the vehicle technology that will be necessary to meet the new standards.

With real world (i.e., 5-cycle label) adjustments, alternative fuel vehicle credits, and test procedure adjustments, fleetwide CAFE compliance values are a minimum of 25 percent higher than EPA adjusted (5-cycle) fuel economy values. See Appendix A for a detailed comparison of EPA adjusted and laboratory fuel economy values and CAFE compliance values.

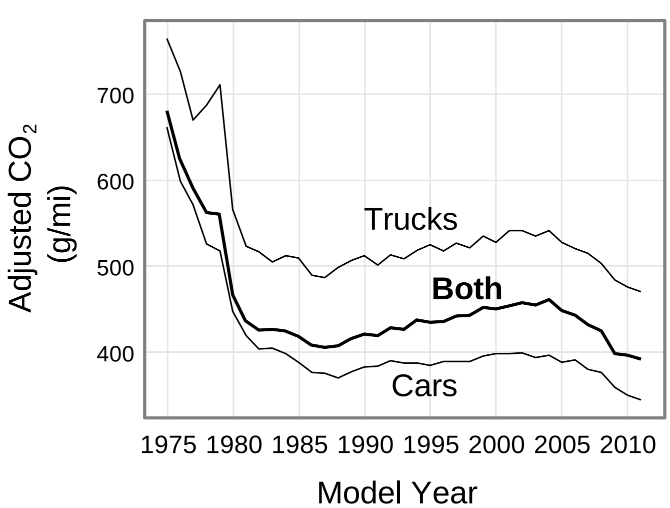
Highlight #1: MY 2010 had the lowest CO_2 emission rate and highest fuel economy since the database began in 1975.

MY 2010 adjusted composite CO_2 emissions were 394 g/mi, a record low for the post-1975 database and a 3 g/mi decrease relative to MY 2009. MY 2010 adjusted composite fuel economy was 22.6 mpg, an all-time high since the database began in 1975, and 0.2 mpg higher than in MY 2009. Preliminary MY 2011 values are 391 g/mi CO_2 emissions and 22.8 mpg fuel economy, reflecting slight improvements over MY 2010.

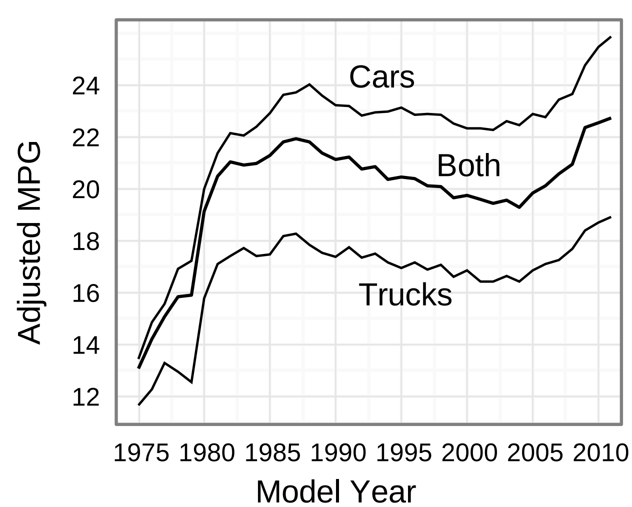
While year-to-year changes often receive the most public attention, the greatest value of the historical trends database is the identification and documentation of long-term trends. Since 1975, overall new light-duty vehicle CO_2 emissions have moved through four phases: 1) a rapid decrease from MY 1975 through MY 1981; 2) a slower decrease until reaching a valley in MY 1987; 3) a gradual increase until MY 2004; and 4) a decrease for the seven years beginning in MY 2005, with the largest decrease in MY 2009. Since fuel economy has an inverse relationship to tailpipe CO_2 emissions, overall new light-duty vehicle fuel economy has moved in opposite phases.

The recent improvements in CO_2 emissions and fuel economy reverse the trend of increasing CO_2 emissions and decreasing fuel economy that occurred from MY 1987 through MY 2004. From MY 2004 to MY 2010, CO_2 emissions decreased by 67 g/mi (15 percent), and fuel economy increased by 3.3 mpg (17 percent). Prior to MY 2009, the previous records for lowest CO_2 emissions and highest fuel economy were in MY 1987. Compared to MY 1987, MY 2010 CO_2 emissions were 11 g/mi (3 percent) lower, and fuel economy was 0.6 mpg (3 percent) higher.

Adjusted CO_2 Emissions



Adjusted Fuel Economy



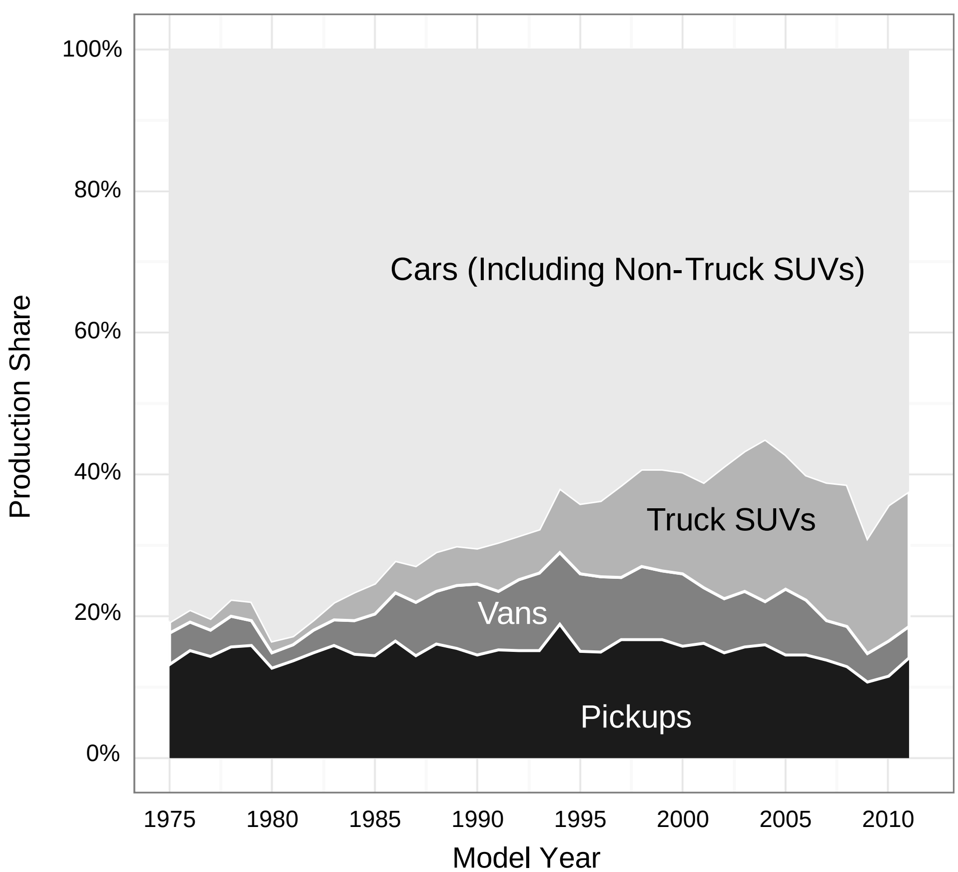
MY 2010 unadjusted laboratory composite values, which reflect vehicle design considerations only and do not account for the many factors which affect real world CO_2 emissions and fuel economy performance, were also at an all-time low for CO_2 emissions (313 g/mi) and a record high for fuel economy (28.4 mpg) since the database began in 1975.

Highlight #2: MY 2010 truck market share increased by 5 percent compared to MY 2009, but is at the second lowest level since 1996.

Light trucks, which include SUVs, minivans/vans, and pickup trucks, accounted for 36 percent of all light-duty vehicle sales in MY 2010. This represents a 5 percent increase over MY 2009, but that was a year of market turmoil and MY 2009 truck share was 8 percent lower than MY 2008. Truck market share is now at the second lowest level since MY 1996 and 9 percent lower than the peak in MY 2004. The MY 2011 light truck market share is projected to be 38 percent, based on pre-model year production projections by automakers.

There were two changes to the database this year that affect truck market share. The first change, as discussed above, is that most small, 2 wheel drive SUVs from MY 1975-2011 have been reclassified from trucks to cars. This lowers the absolute truck share, particularly since the mid-1980s when SUV sales began to increase rapidly, so truck share values in this report should not be compared to those in past versions of this report. For example, for MY 2010 data in this report, nearly 1.1 million vehicles are reclassified from trucks to cars, representing a 10 percent absolute change in both the car and truck production share. The second change, also discussed above, is that, for the first time, the preliminary data for MY 2011 include MDPVs. EPA does not have data for MDPVs for MY 1975-2010, so there is a small discontinuity in the database beginning in MY 2011. The projected production volume for MDPVs in MY 2011 is approximately 10,000 vehicles, which increases the projected truck share of the overall fleet in MY 2011 by less than 0.1 percent.

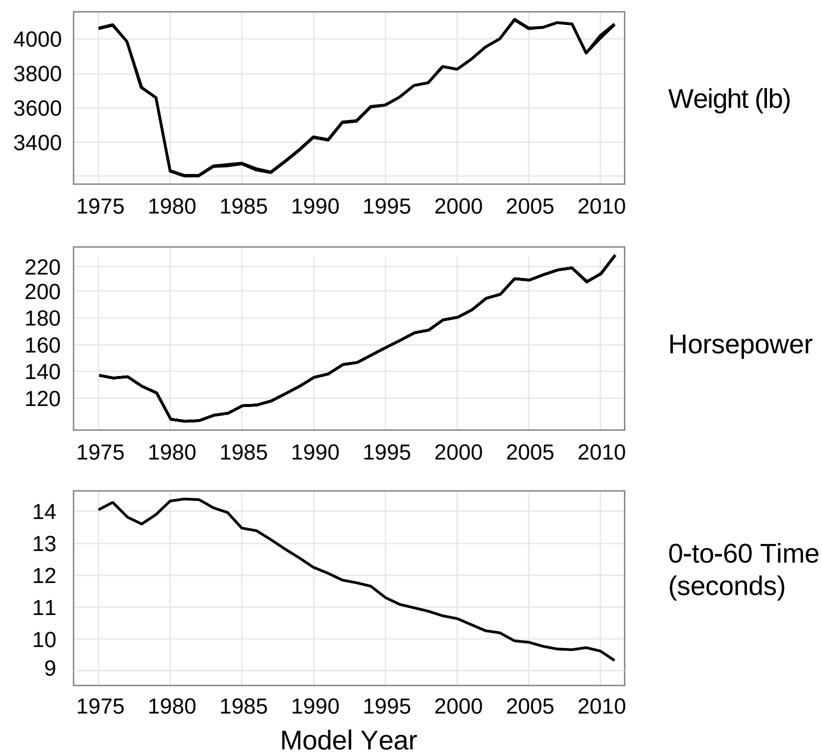
Production Share by Vehicle Type



Highlight #3: MY 2010 weight and power increased from MY 2009, but decreased relative to MY 2008.

MY 2010 vehicle weight averaged 4002 pounds, an increase of 88 pounds compared to MY 2009, but the second lowest average weight since MY 2004. The average car and truck weight both increased by about 25 pounds each, and the remaining difference was due to higher truck market share. In MY 2010, the average vehicle power was 214 horsepower, an increase of 6 horsepower since MY 2009, but lower than in MY 2007-2008. Car power increased slightly and truck power was unchanged, so the primary factor in increasing the overall power level was higher truck market share. Estimated MY 2010 0-to-60 acceleration time decreased slightly to 9.6 seconds.

Weight, Horsepower and 0-to-60 Performance



Vehicle weight and performance are two of the most important engineering parameters that help determine a vehicle's CO_2 emissions and fuel economy. All other factors being equal, higher vehicle weight (which supports new options and features) and faster acceleration performance (e.g., lower 0-to-60 mile-per-hour acceleration time), both increase a vehicle's CO_2 emissions and decrease fuel economy. Automotive engineers are constantly developing more efficient vehicle technologies. From MY 1987 through MY 2004, on a fleetwide basis, this technology innovation was generally utilized to support market-driven attributes other than CO_2 emissions and fuel economy, such as vehicle weight, performance, and utility. Beginning in MY 2005, technology has been used to increase both fuel economy (which has reduced CO_2 emissions) and performance, while keeping vehicle weight relatively constant.

Preliminary MY 2011 values suggest that average vehicle weight and performance will both increase, though these projections are uncertain and EPA will not have final data until next year's report.

Highlight #4: Most manufacturers increased fuel economy in MY 2010, resulting in lower CO_2 emission rates.

Nine of the 13 highest-selling manufacturers increased fuel economy (which also reduced CO_2 g/mi emission rates) from MY 2009 to MY 2010, the last two years for which we have definitive data, and 4 manufacturers increased fuel economy by 1 mpg or more.

Adjusted CO_2 emissions and fuel economy values are shown for the 13 highest-selling manufacturers, which accounted for 99 percent of the market in MY 2010, in order from lowest to highest CO_2 emissions for MY 2010. Manufacturers are defined in accordance with current NHTSA CAFE guidelines, and these definitions are applied retroactively for the entire database back to 1975 for purposes of maintaining integrity of trends over time. In MY 2010, the last year for which EPA has final production data, Hyundai had the lowest fleetwide adjusted composite CO_2 emissions performance, followed very closely by Kia and then Toyota. Hyundai and Kia tied for the highest fleetwide adjusted composite fuel economy value. Daimler had the highest CO_2 emissions (and lowest fuel economy), followed by Chrysler and Ford. Kia had the biggest improvement in adjusted CO_2 (and fuel economy) performance from MY 2009 to MY 2010, with a 37 g/mi reduction in fleetwide CO_2 emissions (and 2.8 mpg fuel economy improvement), followed by Hyundai (26 g/mi reduction in CO_2 emissions) and Mazda (19 g/mi reduction in CO_2 emissions).

Preliminary MY 2011 values suggest that 11 of the 13 manufacturers will improve further in MY 2011, though these projections are uncertain and EPA will not have final data until next year's report.

MY 2009–2011 Manufacturer Fuel Economy and CO_2 Emissions (Adjusted Composite Values)

Manufacturer	MY2009 MPG	MY2009 CO_2 (g/mi)	MY2010 MPG	MY2010 CO_2 (g/mi)	MY2011 MPG	MY2011 CO_2 (g/mi)
Hyundai	25.1	355	27.0	329	27.5	323
Kia	24.2	367	27.0	330	27.2	327
Toyota	25.4	349	25.4	350	25.1	354
Honda	24.6	361	24.9	357	25.7	345
VW	23.8	379	25.0	363	25.2	360
Mazda	23.2	383	24.4	364	25.0	355
Subaru	22.6	393	23.4	379	23.9	371
Nissan	23.6	377	23.1	384	24.2	368
BMW	21.9	407	22.1	404	23.0	389
GM	20.6	432	21.3	418	20.6	431
Ford	20.5	433	20.4	435	21.3	417
Chrysler	19.2	464	19.5	455	19.7	451
Daimler	19.5	457	18.9	471	20.0	447
All	22.4	397	22.6	394	22.8	391

EPA fuel economy and CO_2 emissions data is based on model year production. This means that year-to-year comparisons can be affected by longer or shorter vehicle model year designations by the manufacturers. Section VII has greater detail on the fuel economy and CO_2 emissions for these 13 manufacturers, as well as for these manufacturers' individual makes (i.e., brands).

Highlight #5: Many new technologies are rapidly gaining market share.

Several advanced powertrain technologies are making significant inroads into the mainstream market. For example, in terms of market share, gasoline direct injection doubled in MY 2010 and is projected to triple from MY 2009-2011, turbocharging is projected to double in MY 2011, cylinder deactivation is projected to nearly double in MY 2011, and both 6-speed and 7-speed transmissions approximately doubled from MY 2009-2011. These and other technology trends help to explain the improvements in CO_2 and fuel economy over the last seven years.

Personal vehicle technology has changed significantly since the database began in MY 1975. New technologies are continually being introduced into the marketplace, while older and less effective technologies are removed from the market. For example, in MY 1975 most engines relied on carburetors to deliver fuel to the engine. Carburetors were replaced by fuel injection systems in the 1980s. Now, in some vehicles, conventional fuel injection systems are being replaced by gasoline direct injection systems.

Understanding trends in these technologies and their relationship to CO_2 emissions and fuel economy enables a better understanding of the personal vehicle market. Below is a snapshot of several important technologies for seven selected model years. The first column of data is from MY 1975, the first year of data for this report. The next two years, MY 1987 and 2004, were historical inflection points for CO_2 emissions and fuel economy (see Highlight #1). The table also contains data from several recent years.

Light Duty Vehicle Characteristics for Seven Model Years

	1975	1987	2004	2008	2009	2010	2011
Adjusted CO_2 Emissions (g/mi)	681	405	461	424	397	394	391
Adjusted Fuel Economy (MPG)	13.1	22.0	19.3	21.0	22.4	22.6	22.8
Weight (lb)	4060	3221	4111	4085	3914	4002	4084
Horsepower	137	118	211	219	208	214	228
0-to-60 Time (sec.)	14.1	13.1	9.9	9.7	9.7	9.6	9.3
Truck Production	19%	27%	45%	39%	31%	36%	38%
Four-Cylinder Engine	20%	55%	28%	38%	51%	50%	47%
Eight-Cylinder Engine	62%	15%	24%	17%	12%	14%	16%
Multi-Valve Engine	-	-	62%	76%	84%	85%	85%
Variable Valve Timing	-	-	39%	58%	72%	84%	94%
Cylinder Deactivation	-	-	-	6.7%	7.3%	6.4%	11.1%
Gasoline Direct Injection	-	-	-	2.3%	4.2%	8.3%	13.7%
Turbocharged or Supercharged	-	-	2.9%	3.3%	3.5%	3.5%	7.4%
Manual Transmission	23.0%	29.1%	6.8%	5.2%	4.8%	3.8%	5.1%
Continuously Variable Transmission	-	-	1.2%	7.9%	9.4%	10.9%	10.8%
6 Speed Transmission	-	-	3.0%	19.4%	24.5%	38.1%	52.4%
7+ Speed Transmission	-	-	0.2%	2.0%	2.6%	2.8%	4.9%
Hybrid	-	-	0.5%	2.5%	2.3%	3.8%	4.0%
Diesel	0.2%	0.3%	0.1%	0.1%	0.5%	0.7%	0.6%

Additional Notes on Data Contained in This Report

This report supersedes all previous reports in this series. Users of this report should rely exclusively on data in this latest report, which covers MY 1975 through 2011, and not make comparisons to data in previous reports in this series. There are several reasons for this.

One, EPA revised the methodology for estimating "real-world" (i.e., label) fuel economy values in December 2006. Every adjusted (ADJ) fuel economy value in this report for 1986 and later model years is lower than given in reports in this series prior to the 2007 report. See Appendix A for more in-depth discussion of the current methodology and how it affects both the adjusted fuel economy values for individual models and the historical fuel economy trends database. This same methodology is used to calculate adjusted CO_2 emissions values as well. Two, as discussed above, for the first time in this version of the report, EPA reclassifies most small, 2 wheel drive SUVs from trucks to cars for the entire MY 1975-1011 database. Beginning with this report, all car/truck classifications in this database are consistent with determinations made by NHTSA for CAFE standards beginning in MY 2011 and EPA for CO_2 emissions standards for MY 2012 and later. Three, when EPA changes a manufacturer or vehicle make definition to reflect a change in the industry's current financial arrangements, EPA makes the same adjustment in the historical database as well. This maintains a consistent manufacturer/make definition over time, which allows the identification of long-term trends. On the other hand, it means that the database does not necessarily reflect actual past financial arrangements. For example, the 2011 database, which includes data for the entire time series MY 1975 through 2011, accounts for all Chrysler vehicles in the 1975-2011 timeframe under the Chrysler manufacturer designation, and no longer reflects the fact that Chrysler was combined with Daimler for several years.

Through MY 2010, the CO_2 emissions, fuel economy, vehicle characteristics, and vehicle production volume data used for this report were from the formal end-of-year submissions from automakers obtained from EPA's fuel economy database that is used for CAFE compliance purposes. For MY 2011, EPA has exclusively used confidential pre-model year production volume projections from automaker label submissions. Accordingly, MY 2011 projections are uncertain. Historically, the differences between the initial estimates based on vehicle production projections and later, final values have ranged between 0.4 mpg lower to 0.6 mpg higher. But, the market turmoil in MY 2009 was a major exception in this regard, as the final MY 2009 value from the 2010 report was 1.3 mpg higher than the preliminary value for MY 2009 from the 2009 report based on projected production volumes.

The database in this report includes data from vehicles certified to operate on gasoline or diesel fuel, from laboratory testing with test fuels as defined in EPA test protocols (e.g., with zero ethanol). It includes data from ethanol flexible fuel vehicles, which can operate on gasoline or an 85 percent ethanol/15 percent gasoline blend or any mixture in between, operated on gasoline only. Data from the small number of vehicles that are certified to operate only on alternative fuels or are expected to operate frequently on alternative fuels (such as plug-in hybrid electric vehicles or dual-fuel compressed natural gas vehicles) are not included in this database because they currently represent less than 0.2 percent of all sales and because the emissions and fuel economy data from alternative fuel vehicles raise issues with respect to the metrics that are used in this report.

Vehicle population data in this report represent production delivered for sale in the U.S., rather than actual sales data. Automakers submit production data in formal end-of-year CAFE compliance reports to EPA, which is the basis for this report. Accordingly, the production data in this report may differ from sales data reported by press sources, because not all vehicles produced for sale in a given model year will necessarily be sold in that model year. In addition, the data presented in this report are tabulated on a model year, not calendar year, basis.

For More Information

Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 through 2011 (EPA-420-R-12-001a) is available on the Office of Transportation and Air Quality's (OTAQ) Web site at:

www.epa.gov/otaq/fetrends.htm

Printed copies are available from the OTAQ library at:

U.S. Environmental Protection Agency
Office of Transportation and Air Quality Library
2000 Traverwood Drive
Ann Arbor, MI 48105
(734) 214-4311

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

www.fueleconomy.gov

or by calling the U.S. Department of Energy at (800) 423-1363.

For information about EPA's Greenhouse Gas Emissions Standards, see:

http://epa.gov/otaq/climate/regulations.htm

For information about the EPA/Department of Transportation (DOT) Fuel Economy and Environment Labels, see:

http://epa.gov/otaq/carlabel

For information about DOT's Corporate Average Fuel Economy (CAFE) program, including a program overview, related rulemaking activities, and summaries of the fuel economy performance of individual manufacturers since 1978, see:

http://www.nhtsa.dot.gov/fuel-economy

II. Introduction

This report examines light-duty vehicle technology, CO_2 emissions, and fuel economy trends since MY 1975 using the latest and most complete EPA data available. Pre-2009 reports in this series [1-35] [1] presented fuel economy and technology trends only, and did not include CO_2 emissions data. Beginning in 2009, reports [36-37] have included key CO_2 emissions summary tables as well. When comparing data in this and previous reports, please note that revisions are made for some prior model years for which more complete data have become available. In addition, important changes have been made periodically in the database, e.g., reflecting changes in manufacturer definitions, the methodology by which we calculate adjusted fuel economy values, car-truck classifications, and whether MDPVs are included in the database. Thus, it is often not appropriate to compare values from this report with others in this series and it is not necessary to do so since each report reflects the entire database back to MY 1975.

The EPA CO_2 emissions and fuel economy database used in this report was frozen in October 2010. Through MY 2010, the CO_2 emissions, fuel economy, vehicle characteristics, and production volume data used for this report came from the formal end-of-year submissions from automakers obtained from EPA's database that is used for CAFE compliance purposes, and can be considered to be final. For MY 2011, EPA has exclusively used confidential pre-model year production projections submitted to EPA by automakers. Vehicle population data in this report represent production delivered for sale in the U.S., rather than actual sales data. Accordingly, the vehicle production data in this report may differ from sales data reported by press sources. In addition, the data presented in this report were tabulated on a model year, not calendar year, basis. In years past, manufacturers typically used a consistent approach toward model year designations, i.e., from fall of one year to the fall of the following year. More recently, however, many manufacturers have used a more flexible approach and it is not uncommon to see a new or redesigned model be introduced in the spring or summer, rather than the fall. This means that a model year for an individual vehicle can be "stretched out." Accordingly, year-to-year comparisons can be affected by these model year anomalies, though these even out over a multi-year period.

All fuel economy values in this report are production-weighted harmonic averages (necessary to maintain mathematical integrity) and all CO_2 emissions values are production-weighted arithmetic averages. In earlier reports in this series through MY 2000, the only fuel economy values used were the unadjusted laboratory-based city, highway, and composite (combined city/highway) mpg values—which are used as the basis for compliance with the fuel economy standards and the gas guzzler tax. Since the laboratory mpg values tend to over predict the mpg achieved in actual use, adjusted mpg values are used for the Government's fuel economy information programs: fueleconomy.gov, the *Fuel Economy Guide*, and the *Fuel Economy and Environment Labels* that are on new vehicles. Starting with the MY 2001 report, this series has provided fuel economy trends in adjusted mpg values in addition to the laboratory mpg values. Now, most of the tables exclusively show the adjusted CO_2 emissions and fuel economy values. A few tables include both adjusted city, highway, and composite fuel economy values and laboratory 55/45 fuel economy values. In the tables, these two mpg values are called "Adjusted MPG" and "Laboratory MPG" and are abbreviated as "ADJ" MPG and "LAB" MPG. These same metrics are used for CO_2 emissions values as well.

Where only one CO_2 or mpg value is presented in this report and it is not explicitly identified otherwise, it is the "adjusted composite" value. This value represents a combined city/highway CO_2 or fuel economy value, and is based on equations (see Appendix A) that allow a computation of adjusted city and highway values based on laboratory city and highway test values.

[1] Numbers in brackets denote references listed in the references section of this report.

It is important to note that EPA revised the methodology by which EPA estimates adjusted fuel economy values in December 2006. Every adjusted fuel economy value in this report for 1986 and later model years is lower than given in pre-2007 reports. Accordingly, adjusted fuel economy values for 1986 and later model years should not be compared with corresponding values from older reports. These new downward adjustments are phased in, linearly, beginning in 1986, and for 2005 and later model years the new adjusted composite values are, on average, about six percent lower than under the methodology previously used by EPA. This same methodology is used to generate adjusted CO_2 emissions values as well. See Appendix A for more in-depth discussion of this new methodology and how it affects both the adjusted CO_2 and fuel economy values for individual models and the historical trends database.

Data are tabulated on a model year basis, but some figures use three-year moving averages which effectively smooth the trends, and these three-year moving averages are tabulated at their midpoint. For example, the midpoint for model years 2009, 2010, and 2011 is MY 2010. The fuel economy values reported by the Department of Transportation (DOT) for compliance with the Corporate Average Fuel Economy (CAFE) program are higher than the data in this report for three reasons:

1. The DOT data do not include the EPA real world fuel economy adjustments for city and highway mpg;

2. The DOT data include CAFE credits for those manufacturers that produce dedicated alternative fuel vehicles and flexible fuel vehicles (credits generated through the production of flexible fuel vehicles are currently capped at 1.2 mpg per fleet);

3. The DOT data include credits for test procedure adjustments for cars.

Accordingly, the fuel economy values in this series of reports are always lower than those reported by DOT. Table A-6, Appendix A, compares CAFE data reported by DOT with EPA adjusted and laboratory fuel economy data for MY 1975-2011. Table A-7 shows a more detailed comparison for MY 2010, by manufacturer, of values for EPA laboratory fuel economy, alternative fuel vehicle credits, test procedure adjustment credits for cars, and NHTSA CAFE performance.

Beginning in MY 2011, footprint data is obtained from the pre-model year reports provided by automakers to DOT/NHTSA. For MY 2008-2010, EPA generated footprint data from external sources such as individual manufacturer websites, Edmonds.com, and Motortrend.com. Since the MY 2008-2010 footprint data was generated in a more piecemeal fashion, there is some uncertainty associated with this data.

In the various appendices to this report, when there is no entry under "Model Year," that means there was no production volume for the parameter in question.

While this report contains data through MY 2011, it is important to emphasize that the data through MY 2010 is based on formal end-of-year CAFE data submitted by automakers to EPA and therefore is final data that will not change. On the other hand, the MY 2011 data is based on confidential pre-model year production volume projections provided by manufacturers to EPA in the spring/summer of 2010 and therefore are projections that may well change when final production data is presented in the next report. Given the uncertainty in the MY 2011 data, this report will often focus more on the MY 2010 data than on the MY 2011 data.

Other Variables

All vehicle weight data are based on inertia weight class (nominally curb weight plus 300 pounds). For vehicles with inertia weights up to and including the 3000-pound inertia weight class, these classes have 250-pound increments. For vehicles above the 3000-pound inertia weight class (i.e., vehicles 3500 pounds and above), 500-pound increments are used.

The light truck data in this report include vehicles classified as light-duty trucks with gross vehicle weight ratings (GVWR) up to 8500 pounds as well as, for the first time beginning with MY 2011, medium-duty passenger vehicles (MDPVs). MDPVs are large SUVs and passenger vans with GVWRs between 8500 and 10,000 pounds (MDPVs do not include the much larger number of pickup trucks in the same GVWR range). EPA does not have data for MDPVs for MY 1975-2010, so there is and will continue to be a small discontinuity in the database beginning in MY 2011. For the overall fleet in MY 2011, the inclusion of MDPVs increased projected average adjusted CO_2 emissions by 0.3 g/mi and decreased projected average adjusted fuel economy by 0.01 mpg compared to the fleet without MDPVs. For the light truck fleet in MY 2011, the inclusion of MDPVs increased projected CO_2 emissions by 0.5 g/mi and decreased average adjusted fuel economy by 0.02 mpg.

"Ton-MPG" is defined as a vehicle's mpg multiplied by its weight in tons. 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 at constant mpg can also be considered an improvement. "CO_2/ton" is the equivalent CO_2 metric and is reported in Section IV.

"Cubic-feet-MPG" for cars is defined in this report as the product of a car's mpg and its interior volume, including trunk space. This metric associates a relative measure of a vehicle's ability to transport both passengers and their cargo. An increase in vehicle volume at constant mpg could be considered an improvement just as an increase in mpg at constant volume can be. "CO_2/cubic feet" values are given in Section IV.

"Cubic-feet-ton-MPG" is defined in this report as a combination of the two previous metrics, i.e., a car's mpg multiplied by its weight in tons and also by its interior volume. It ascribes vehicle utility to fuel economy, weight and volume. "CO_2/ton-cubic feet"" is the equivalent CO_2 metric and is shown in Section IV.

This report also includes an estimate of 0-to-60 mph acceleration time--calculated from engine rated horsepower and vehicle weight—from the relationship:

$$t = F\,(HP/WT)^{-f}$$

where the coefficients F and f are empirical parameters determined in the literature by obtaining a least-squares fit for available test data. The values for the F and f coefficients are .892 and .805, respectively, for vehicles with automatic transmissions and .967 and .775, respectively, for those with manual transmissions [38]. Other authors [39, 40, and 41] have evaluated the relationships between weight, horsepower, and 0-to-60 acceleration time and have calculated and published slightly different values for the F and f coefficients. Since the equation form and coefficients were developed for vehicles with conventional powertrains with gasoline-fueled engines, we have not used the equation to estimate 0-to-60 time for vehicles with hybrid powertrains or diesel engines. Published values are used for these vehicles instead.

The 0-to-60 estimate used in this report is intended to provide a quantitative time "index" of vehicle performance capability. It is the authors' engineering judgment that, given the differences in test methods for measuring 0-to-60 time and given the fact that the weight is based on inertia weight, use of these other published values for the F and f coefficients would not result in statistically significantly different 0-to-60 averages or trends.

Car-truck classifications are based on the regulatory definitions used by NHTSA for fuel economy standards compliance beginning in MY 2011 and by EPA for CO_2 emissions standards compliance beginning in MY 2012. Accordingly, some small 2 wheel drive SUVs that had previously been considered trucks in previous versions of this report are now classified as cars throughout the entire MY 1975-2011 database. In some tables and figures, these vehicles are identified as “non-truck SUVs.” The overall car class is typically sub-divided into cars, wagons, and non-truck SUVs. The reclassification of small 2 wheel drive SUVs from trucks to cars affects about 1.1 million vehicles in MY 2010 and MY 2011, and reduces the absolute truck share by about 10% compared to the classification used in previous reports.

Cars and wagons are sometimes further divided into sub-classes in three different ways. One approach generally follows the fuel economy label and *Fuel Economy Guide* protocol. With this approach, sedan and wagon sub-classes are based on the interior volume (passenger plus cargo) thresholds described in the *Fuel Economy Guide* (since interior volume is undefined for the two-seater class, this report assigns an interior volume value of 50 cubic feet for all two-seater cars):

Class	Interior Volume (cubic feet)
Minicompact sedan	Up to 84
Subcompact sedan	85 to 99
Compact sedan	100 to 109
Midsize sedan	110 to 119
Large sedan	120 or more
Small wagon	Up to 129
Midsize wagon	130 to 159
Large wagon	160 or more

In the second approach for car sub-classes, large sedans and wagons are aggregated as "Large," midsize sedans and wagons are aggregated as "Midsize," and all other cars are aggregated as “Small.” The third approach uses Large Cars, Large Wagons, Midsize Cars, Midsize Wagons, Small Cars, and Small Wagons with the EPA Two-Seater, Mini compact, Subcompact, and Compact sedan classes combined into the "Small Car" class. In some tables and figures in this report wagons have been merged with cars. This is because the wagon production fraction, in 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 insignificant.

The truck sub-classification scheme divides pickups, vans, and SUVs into "Small," "Midsize," and "Large." These truck size classifications are based primarily on published wheelbase data according to the following criteria:

	Pickup	Van	Truck SUV
Small	Less than 105"	Less than 109"	Less than 100"
Midsize	105" to 115"	109" to 124"	100" to 110"
Large	More than 115"	More than 124"	More than 110"

This classification scheme is similar to that used in many trade and consumer publications. For those vehicle nameplates with a variety of wheelbases, the size classification was determined by considering only the smallest wheelbase produced.

Published data from external sources is also used for three other engine or vehicle characteristics for which data has not always been submitted to EPA by the automotive manufacturers, or to supplement data that is submitted to EPA: (1) engines with variable valve timing (VVT) that use either cams or electric solenoids to provide variable intake and/or exhaust valve timing and in some cases valve lift; (2) engines with cylinder deactivation, which involves allowing the valves of selected cylinders of the engine to remain closed under certain driving conditions; and (3) vehicle footprint, which is the product of wheelbase times average track width and upon which future CAFE (MY 2011 and later) and CO_2 emissions standards are based. Beginning with MY 2012, manufacturers will be submitting data on these engine or vehicle characteristics to EPA.

III. Fuel Economy Trends

Figure 1 and Table 1 depict time trends in car, light truck, and car-plus-light truck fuel economy, as well as truck production share, with the individual data points representing the data for each year, and trend lines representing three-year moving averages. Since 1975, the fuel economy of the combined car and light truck fleet has moved through several phases:

1. A rapid increase from 1975 through 1981;
2. A slow increase until reaching its peak in 1987;
3. A gradual decline until 2004; and
4. An increase beginning in 2005, with the largest increase in 2009.

Figure 1

Adjusted Fuel Economy and Percent Truck by Model Year
(with Three-Year Moving Average)

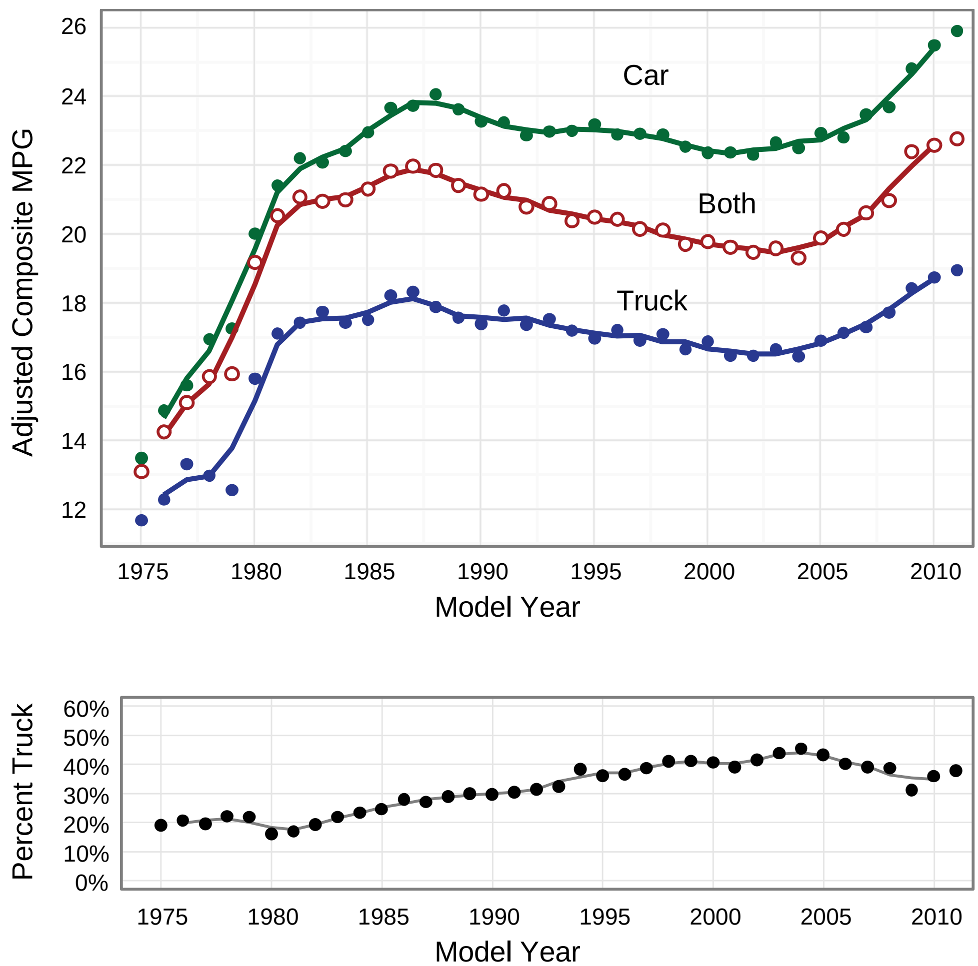


Table 1

Fuel Economy of MY 1975 to 2011 Light Duty Vehicles

Cars

Model Year	Production (000)	Production Percent	Lab City MPG	Lab Hwy MPG	Lab 55/45 MPG	Adj City MPG	Adj Hwy MPG	Adj Comp MPG	Ton-MPG	Cu Ft-MPG	Cu Ft-Ton-MPG
1975	8265	80.8%	13.7	19.4	15.8	12.3	15.2	13.5	27.5	-	-
1976	9754	79.1%	15.2	21.3	17.4	13.7	16.6	14.9	30.2	-	-
1977	11344	80.3%	16.0	22.2	18.3	14.4	17.3	15.6	31.0	1779	3424
1978	11213	77.6%	17.2	24.5	19.9	15.5	19.1	16.9	30.6	1907	3344
1979	10819	77.9%	17.7	24.6	20.2	15.9	19.2	17.2	30.2	1921	3300
1980	9448	83.6%	20.3	29.0	23.5	18.3	22.6	20.0	31.2	2136	3274
1981	8736	82.8%	21.7	31.1	25.1	19.5	24.2	21.4	33.1	2338	3547
1982	7837	80.5%	22.3	32.7	26.0	20.1	25.5	22.2	34.2	2418	3644
1983	8037	78.0%	22.1	32.6	25.9	19.9	25.5	22.1	34.7	2476	3776
1984	10735	76.6%	22.4	33.2	26.3	20.2	25.9	22.4	35.1	2481	3778
1985	10895	75.3%	22.9	34.2	26.9	20.6	26.7	23.0	35.8	2551	3888
1986	11083	72.1%	23.7	35.5	27.8	21.2	27.5	23.7	36.2	2597	3901
1987	10836	72.9%	23.8	35.8	28.0	21.2	27.7	23.7	36.2	2581	3874
1988	10853	71.0%	24.2	36.5	28.5	21.4	28.1	24.1	36.9	2627	3963
1989	10138	70.1%	23.7	36.2	28.1	20.8	27.8	23.6	36.8	2587	3977
1990	8882	70.4%	23.4	35.9	27.7	20.4	27.4	23.3	37.1	2526	3984
1991	8755	69.6%	23.4	35.9	27.8	20.3	27.4	23.2	37.0	2532	3974
1992	8361	68.7%	22.9	35.9	27.4	19.8	27.2	22.9	37.3	2524	4071
1993	8941	67.7%	23.2	36.1	27.6	19.9	27.2	23.0	37.4	2555	4097
1994	8747	61.9%	23.2	36.4	27.7	19.8	27.4	23.0	37.7	2541	4107
1995	9708	64.1%	23.3	37.1	28.0	19.8	27.8	23.2	38.2	2571	4174
1996	8379	63.7%	23.1	36.7	27.7	19.5	27.3	22.9	38.1	2549	4196
1997	8897	61.5%	23.3	36.8	27.9	19.5	27.3	22.9	38.1	2540	4174
1998	8570	59.3%	23.3	36.9	27.9	19.4	27.3	22.9	38.5	2542	4222
1999	9019	59.3%	23.0	36.5	27.6	19.1	26.8	22.5	38.5	2512	4249
2000	9899	59.7%	23.0	36.2	27.5	18.9	26.5	22.4	38.3	2505	4248
2001	9549	61.2%	23.1	36.2	27.6	18.9	26.4	22.4	38.8	2525	4322
2002	9484	58.8%	23.2	36.1	27.7	18.9	26.2	22.3	39.0	2548	4391
2003	8937	56.7%	23.6	36.9	28.2	19.0	26.7	22.7	39.7	2573	4442
2004	8649	55.1%	23.5	36.9	28.1	18.8	26.5	22.5	40.1	2583	4525
2005	9088	57.2%	24.2	37.6	28.8	19.2	26.9	22.9	40.8	2664	4648
2006	9070	60.0%	24.0	37.5	28.6	19.1	26.8	22.8	41.4	2652	4723
2007	9345	61.2%	24.8	38.5	29.5	19.7	27.5	23.5	42.5	2725	4820
2008	8546	61.5%	25.1	38.9	29.8	19.9	27.8	23.7	43.1	2748	4878
2009	6448	69.2%	26.4	40.6	31.3	20.9	28.9	24.8	44.2	2859	4986
2010	7147	64.3%	27.3	41.7	32.3	21.5	29.7	25.5	46.4	2998	5275
2011	-	62.4%	27.5	42.7	32.8	21.7	30.4	25.9	47.4	3039	5405

Table 1 (Continued)

Fuel Economy of MY 1975 to 2011 Light Duty Vehicles

Trucks

Model Year	Production (000)	Production Percent	Lab City MPG	Lab Hwy MPG	Lab 55/45 MPG	Adj City MPG	Adj Hwy MPG	Adj Comp MPG	Ton-MPG
1975	1959	19.2%	12.1	16.2	13.7	10.9	12.7	11.6	24.2
1976	2580	20.9%	12.8	16.9	14.4	11.6	13.2	12.2	26.0
1977	2779	19.7%	14.1	18.1	15.6	12.7	14.2	13.3	28.0
1978	3235	22.4%	13.8	17.5	15.3	12.4	13.7	13.0	27.5
1979	3063	22.1%	13.4	16.8	14.7	12.1	13.1	12.5	27.3
1980	1859	16.4%	16.5	22.0	18.6	14.8	17.1	15.8	30.9
1981	1818	17.2%	17.8	23.9	20.1	16.0	18.6	17.1	33.0
1982	1896	19.5%	18.1	24.4	20.5	16.3	19.0	17.4	33.8
1983	2266	22.0%	18.3	25.1	20.8	16.5	19.6	17.7	34.0
1984	3285	23.4%	17.9	24.7	20.4	16.1	19.3	17.4	33.5
1985	3564	24.7%	18.0	24.8	20.6	16.2	19.4	17.5	33.7
1986	4282	27.9%	18.8	25.9	21.5	16.8	20.2	18.2	34.3
1987	4030	27.1%	18.8	26.4	21.6	16.8	20.5	18.3	34.2
1988	4442	29.0%	18.3	26.1	21.2	16.2	20.1	17.9	34.5
1989	4316	29.9%	18.1	25.8	20.9	15.9	19.8	17.6	34.7
1990	3733	29.6%	17.8	25.8	20.7	15.6	19.8	17.4	35.1
1991	3818	30.4%	18.2	26.5	21.2	15.9	20.2	17.8	35.4
1992	3811	31.3%	17.8	26.1	20.8	15.4	19.9	17.3	35.5
1993	4269	32.3%	18.0	26.6	21.0	15.5	20.1	17.5	36.0
1994	5378	38.1%	17.7	26.0	20.7	15.2	19.6	17.2	35.8
1995	5436	35.9%	17.5	25.9	20.5	14.9	19.5	17.0	35.8
1996	4766	36.3%	17.7	26.5	20.8	15.0	19.8	17.2	36.7
1997	5562	38.5%	17.5	26.0	20.5	14.8	19.4	16.9	37.1
1998	5887	40.7%	17.6	26.6	20.8	14.8	19.7	17.1	37.0
1999	6200	40.7%	17.3	25.8	20.3	14.5	19.1	16.6	37.2
2000	6675	40.3%	17.7	26.2	20.7	14.7	19.3	16.9	37.4
2001	6061	38.8%	17.3	25.5	20.2	14.3	18.7	16.4	37.5
2002	6635	41.2%	17.3	25.7	20.3	14.2	18.8	16.4	38.2
2003	6838	43.3%	17.6	26.1	20.6	14.3	19.0	16.6	38.9
2004	7061	44.9%	17.3	26.0	20.4	14.1	18.9	16.4	39.6
2005	6806	42.8%	17.8	26.9	21.0	14.4	19.4	16.9	40.4
2006	6035	40.0%	18.1	27.2	21.3	14.6	19.7	17.1	41.0
2007	5932	38.8%	18.2	27.6	21.5	14.7	19.9	17.3	42.4
2008	5354	38.5%	18.7	28.3	22.1	15.0	20.4	17.7	43.3
2009	2867	30.8%	19.5	29.5	23.0	15.6	21.3	18.4	44.2
2010	3964	35.7%	19.8	30.0	23.4	15.9	21.6	18.7	45.2
2011	-	37.6%	20.0	30.5	23.6	16.0	21.9	18.9	46.6

Table 1 (Continued)

Fuel Economy of MY 1975 to 2011 Light Duty Vehicles

Cars and Trucks

Model Year	Production (000)	Lab City MPG	Lab Hwy MPG	Lab 55/45 MPG	Adj City MPG	Adj Hwy MPG	Adj Comp MPG	Ton-MPG
1975	10224	13.4	18.7	15.3	12.0	14.6	13.1	26.9
1976	12334	14.6	20.2	16.7	13.2	15.7	14.2	29.3
1977	14123	15.6	21.3	17.7	14.0	16.6	15.1	30.4
1978	14448	16.3	22.5	18.6	14.7	17.5	15.8	29.9
1979	13882	16.5	22.3	18.7	14.9	17.4	15.9	29.5
1980	11306	19.6	27.5	22.5	17.6	21.5	19.2	31.2
1981	10554	20.9	29.5	24.1	18.8	23.0	20.5	33.1
1982	9732	21.3	30.7	24.7	19.2	23.9	21.1	34.1
1983	10302	21.2	30.6	24.6	19.0	23.9	21.0	34.5
1984	14020	21.2	30.8	24.6	19.1	24.0	21.0	34.7
1985	14460	21.5	31.3	25.0	19.3	24.4	21.3	35.3
1986	15365	22.1	32.2	25.7	19.8	25.0	21.8	35.7
1987	14865	22.2	32.6	25.9	19.8	25.3	22.0	35.7
1988	15295	22.1	32.7	25.9	19.6	25.2	21.9	36.2
1989	14453	21.7	32.3	25.4	19.1	24.8	21.4	36.2
1990	12615	21.4	32.2	25.2	18.7	24.6	21.2	36.5
1991	12573	21.6	32.5	25.4	18.8	24.7	21.3	36.5
1992	12172	21.0	32.1	24.9	18.2	24.4	20.8	36.8
1993	13211	21.2	32.4	25.1	18.2	24.4	20.9	37.0
1994	14125	20.8	31.6	24.6	17.8	23.8	20.4	37.0
1995	15145	20.8	32.1	24.7	17.7	24.1	20.5	37.3
1996	13144	20.8	32.2	24.8	17.6	24.0	20.4	37.6
1997	14459	20.6	31.8	24.5	17.4	23.6	20.1	37.7
1998	14458	20.6	31.9	24.5	17.2	23.6	20.1	37.9
1999	15218	20.3	31.2	24.1	16.9	23.0	19.7	38.0
2000	16574	20.5	31.4	24.3	16.9	23.0	19.8	38.0
2001	15610	20.5	31.1	24.2	16.8	22.8	19.6	38.3
2002	16119	20.4	30.9	24.1	16.6	22.5	19.5	38.7
2003	15775	20.6	31.3	24.3	16.7	22.7	19.6	39.4
2004	15711	20.2	31.0	24.0	16.3	22.4	19.3	39.9
2005	15893	21.0	32.1	24.8	16.8	23.1	19.9	40.6
2006	15105	21.2	32.6	25.2	17.0	23.4	20.1	41.2
2007	15277	21.8	33.4	25.8	17.4	24.0	20.6	42.5
2008	13900	22.1	34.0	26.3	17.7	24.4	21.0	43.2
2009	9315	23.8	36.4	28.2	18.9	26.0	22.4	44.2
2010	11111	24.1	36.6	28.4	19.1	26.2	22.6	45.9
2011	-	24.1	37.1	28.6	19.1	26.6	22.8	47.1

As shown in Table 1, the final fleetwide MY 2010 adjusted composite fuel economy is 22.6 mpg, an all-time high. This MY 2010 value is 0.2 mpg higher than in MY 2009 and 3.3 mpg higher than in MY 2004, a 17% increase. The projected MY 2011 fleetwide fuel economy value is 22.8 mpg, but there is uncertainty about MY 2011 projections given that they are based on automaker submissions to EPA in the spring and summer of 2010. Average fleetwide fuel economy has now increased for six consecutive years and is projected to increase for a seventh year. These increases reverse the longer term trend of declining adjusted composite fuel economy from 1987 through 2004. Based on laboratory 55/45 fuel economy values which reflect vehicle design considerations only, the MY 2010 unadjusted fuel economy value of 28.4 mpg is an all-time record, and is 2.5 mpg higher than the previous peak of 25.9 mpg in 1987 and 1988.

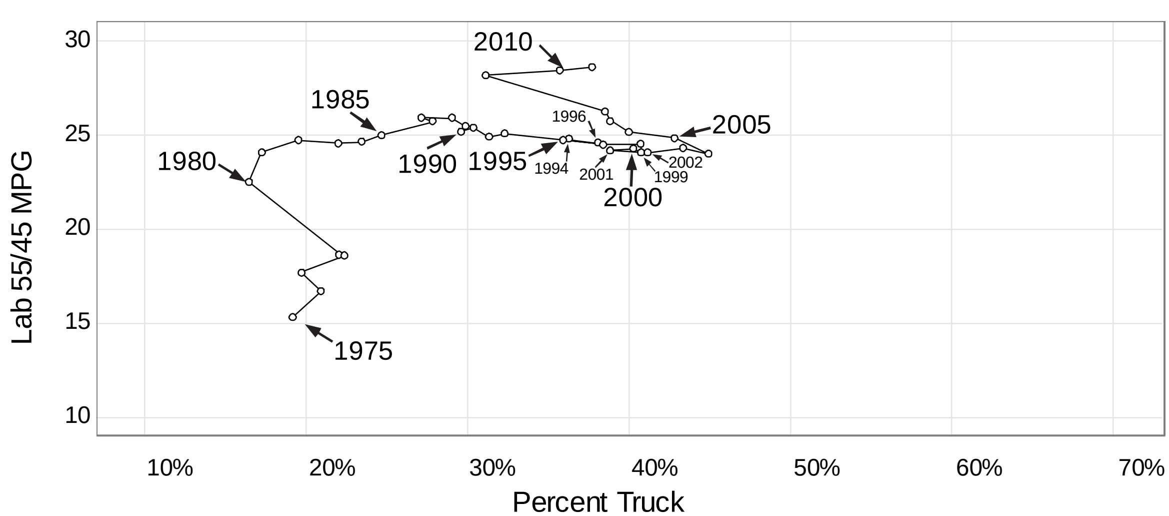
Table 1 also shows that light truck production share peaked at 45% in 2004, decreased significantly to 31% in MY 2009, and is 36% in MY 2010. It is not clear whether the 5% increase in truck production share in MY 2010 is significant, given that truck production share had decreased by 7.5% in MY 2009, and that MY 2009 was a year of considerable market turmoil. The MY 2011 projection is for truck production share to increase by 2%.

Figure 1 shows the long-term fuel economy trends and truck market share trends with a three-year moving average, which tends to even out year-to-year fluctuations, such as in MY 2009. Figure 2 shows laboratory 55/45 fuel economy values for the combined car and truck fleet plotted against truck production share.

The MY 2010 adjusted fuel economy for cars is 25.5 mpg, which is an all-time high. For MY 2010, the adjusted fuel economy for light trucks is 18.7 mpg, also a record high. Fuel economy standards were unchanged for MY 1996 through MY 2004. In 2003, DOT raised the truck CAFE standards for MY 2005–2007, and DOT subsequently raised the truck CAFE standards for MY 2008–2016 through three separate final rules. The recent fuel economy improvement for trucks is likely due, in part, to these higher standards. The CAFE standard for cars has also been raised for MY 2011–2016 as a result of two recent final rules. The final rule for MY 2012-2016 for both cars and trucks is at 75 Federal Register 25324, May 7, 2010.

Figure 2

Truck Production Share vs. Fleet MPG by Model Year

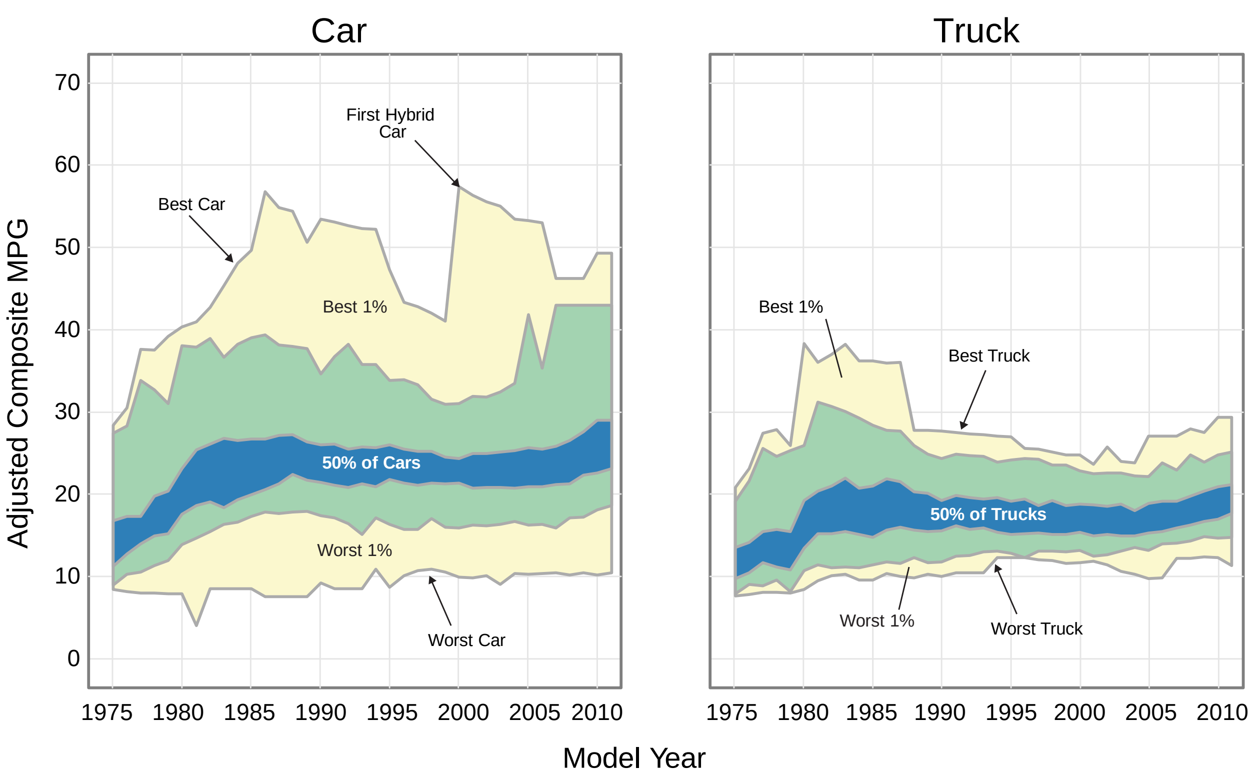


The distribution of fuel economy by model year is of interest. In Figure 3, highlights of the distribution of car and truck mpg are shown. Since 1975, half of the cars have consistently been within a few mpg of each other. The fuel economy difference between the least efficient and most efficient car increased from about 20 mpg in 1975 to nearly 50 mpg in 1986. The increased production share of hybrid cars accounts for the increase in the fuel economy of the best one percent of cars with the cut point for this stratum now over 40 mpg. The ratio of the highest to lowest has increased from about three to one in 1975 to nearly five to one today, because the fuel economy of the least fuel efficient cars has remained roughly constant in comparison to the most fuel efficient cars whose fuel economy has nearly doubled since 1975.

The overall fuel economy distribution trend for trucks is narrower than that for cars, with a peak in the efficiency of the most efficient truck in the early 1980s when small pickup trucks equipped with diesel engines were sold. As a result, the fuel economy range between the most efficient and least efficient truck peaked at about 25 mpg in 1982. The fuel economy range for trucks then narrowed, but with the introduction of the hybrid Escape SUV in MY 2005, it is now about 20 mpg. Like cars, half of the trucks built each year have always been within a few mpg of each year's average fuel economy value. Appendix C contains additional fuel economy distribution data.

Figure 3

Production Weighted Fuel Economy Distribution



As shown in Table 2, MY 2010 vehicle weight averaged 4002 pounds. This reflects an increase of 88 pounds (2%) compared to MY 2009. This is the largest annual increase since MY 2004, but this is due in part to an unusual MY 2009 when weight decreased by 171 pounds and even with the increase this year, MY 2010 weight is still less than in MY 2008. The average car and truck weight in MY 2010 both increased by about 25 pounds, and the remaining impact was due to higher truck production share. In MY 2010, the average vehicle power was 214 horsepower. Average vehicle power increased by 6 horsepower (3%), with most of the increase explained by cars having higher horsepower levels and trucks having higher production share. Both weight and power are projected to increase in MY 2011, with the biggest increase by far being a 25 hp, or 10%, increase in truck power levels.

Table 2 also includes vehicle footprint in square feet since MY 2008. Footprint is one metric for vehicle size, and is the product of wheelbase and average track width. Essentially, footprint is the area defined by the four points where the tires touch the ground. Footprint is a very important parameter as MY 2011 passenger car and light truck CAFE standards, and MY 2012–2016 CAFE and CO_2 emissions standards, are all footprint-based, i.e., vehicles with different footprint values have different fuel economy and CO_2 compliance targets. The MY 2008-2010 footprint data in Table 2 is tabulated from external sources such as individual manufacturer websites, Edmunds.com, and Motortrend.com, while the MY 2011 data came from pre-model year CAFE reports provided to DOT/NHTSA from the manufacturers. Accordingly, due to the more piecemeal way that the 2008-2010 footprint data were obtained, there is some uncertainty in comparing values through MY 2010 with values beginning in MY 2011 and the most meaningful footprint trends will be those based on comparisons in MY 2011 and later.

For MY 2010, industry-wide footprint values were 45.4 square feet for cars, 54.1 square feet for trucks, and 48.5 square feet for cars and trucks combined. Car and truck footprints were essentially unchanged in MY 2010 compared to MY 2009; however, the overall industry footprint increased by 0.3 square feet due to the increase in truck production share. Industry projections for MY 2011 cars are for an increase of 1.1 square feet compared to MY 2010. The average footprint in MY 2011 is projected to increase by 0.4 square feet for cars, and by 1.8 square feet for trucks, but again there is some uncertainty in these comparisons since the footprint data sources for MY 2011 are different than for MY 2010, as discussed above.

The long-term trend since 1981 for both weight and power has been steady increases. MY 2010 weight is 800 pounds greater, and MY 2010 power has more than doubled, as compared to MY 1981. As shown in Figure 4, since 1975, Ton-MPG for both cars and trucks increased substantially (nearly 70% for cars and 90% for trucks). Typically, Ton-MPG for both vehicle types has increased at a rate of about one or two percent a year.

Table 2

Vehicle Size and Design Characteristics of MY 1975 to 2011 Light Duty Vehicles

Cars

Model Year	Production Percent	Adj Comp MPG	Vol (cu ft)	Weight (lb)	Footprint (sq ft)	HP	HP/ Weight	0-to-60 Time	Small	Midsize	Large
1975	80.8%	13.5	-	4058	-	136	0.0331	14.2	55.3%	23.4%	21.3%
1976	79.1%	14.9	-	4060	-	134	0.0324	14.4	55.3%	25.3%	19.4%
1977	80.3%	15.6	110	3945	-	133	0.0335	14.0	51.8%	24.6%	23.5%
1978	77.6%	16.9	109	3590	-	124	0.0342	13.7	44.6%	34.4%	21.0%
1979	77.9%	17.2	109	3485	-	119	0.0338	13.8	43.7%	34.2%	22.1%
1980	83.6%	20.0	104	3102	-	100	0.0322	14.3	54.4%	34.4%	11.3%
1981	82.8%	21.4	107	3076	-	99	0.0320	14.4	51.5%	36.4%	12.2%
1982	80.5%	22.2	106	3054	-	99	0.0321	14.4	56.6%	31.0%	12.5%
1983	78.0%	22.1	109	3112	-	104	0.0330	14.0	53.0%	31.9%	15.0%
1984	76.6%	22.4	108	3101	-	106	0.0338	13.8	57.1%	29.7%	13.2%
1985	75.3%	23.0	108	3098	-	111	0.0354	13.3	55.2%	29.6%	15.2%
1986	72.1%	23.7	107	3044	-	111	0.0360	13.2	59.1%	28.4%	12.5%
1987	72.9%	23.7	107	3036	-	113	0.0365	13.0	63.1%	24.9%	12.1%
1988	71.0%	24.1	107	3052	-	116	0.0375	12.8	64.5%	22.8%	12.7%
1989	70.1%	23.6	108	3105	-	121	0.0387	12.4	57.9%	28.8%	13.3%
1990	70.4%	23.3	107	3179	-	129	0.0401	12.1	58.4%	29.0%	12.6%
1991	69.6%	23.2	107	3169	-	133	0.0413	11.9	60.4%	27.7%	12.0%
1992	68.7%	22.9	109	3255	-	141	0.0427	11.5	55.4%	29.4%	15.2%
1993	67.7%	23.0	109	3242	-	140	0.0427	11.5	54.7%	32.8%	12.6%
1994	61.9%	23.0	109	3268	-	144	0.0432	11.4	57.0%	28.2%	14.8%
1995	64.1%	23.2	109	3284	-	153	0.0459	10.9	55.8%	30.7%	13.6%
1996	63.7%	22.9	110	3325	-	155	0.0461	10.8	51.7%	35.5%	12.8%
1997	61.5%	22.9	109	3315	-	157	0.0467	10.7	52.8%	33.6%	13.6%
1998	59.3%	22.9	110	3348	-	160	0.0473	10.6	46.9%	41.8%	11.3%
1999	59.3%	22.5	110	3404	-	165	0.0479	10.5	45.1%	42.6%	12.4%
2000	59.7%	22.4	111	3414	-	169	0.0489	10.4	45.1%	37.4%	17.5%
2001	61.2%	22.4	111	3450	-	171	0.0490	10.3	46.3%	37.0%	16.7%
2002	58.8%	22.3	113	3472	-	176	0.0503	10.1	43.8%	39.0%	17.2%
2003	56.7%	22.7	112	3481	-	179	0.0509	10.0	45.5%	38.2%	16.3%
2004	55.1%	22.5	113	3534	-	186	0.0520	9.8	41.9%	40.9%	17.2%
2005	57.2%	22.9	114	3524	-	185	0.0517	9.9	39.6%	42.5%	17.9%
2006	60.0%	22.8	114	3594	-	195	0.0536	9.6	40.7%	37.9%	21.5%
2007	61.2%	23.5	113	3577	-	192	0.0530	9.6	38.7%	43.9%	17.4%
2008	61.5%	23.7	113	3592	45.6	195	0.0535	9.6	38.4%	41.5%	20.1%
2009	69.2%	24.8	113	3526	45.5	187	0.0522	9.8	41.7%	40.4%	17.9%
2010	64.3%	25.5	114	3552	45.4	191	0.0529	9.6	41.4%	41.4%	17.2%
2011	62.4%	25.9	114	3589	45.8*	198	0.0541	9.5	34.8%	44.3%	20.9%

*Note: the footprint value for MY 2011 is preliminary, and is based on different data sources than values for MY 2008-2010.

Table 2 (continued)

Vehicle Size and Design Characteristics of MY 1975 to 2011 Light Duty Vehicles

Trucks

Model Year	Production Percent	Adj Comp MPG	Weight (lb)	Footprint (sq ft)	HP	HP/ Weight	0-to-60 Time	Van	SUV	Pickup
1975	19.2%	11.6	4069	-	142	0.0349	13.6	23.3%	8.1%	68.5%
1976	20.9%	12.2	4153	-	141	0.0340	13.8	19.5%	8.2%	72.3%
1977	19.7%	13.3	4133	-	147	0.0356	13.3	18.5%	8.6%	72.9%
1978	22.4%	13.0	4150	-	146	0.0351	13.4	19.3%	10.6%	70.1%
1979	22.1%	12.5	4256	-	138	0.0325	14.3	15.7%	12.3%	72.0%
1980	16.4%	15.8	3867	-	121	0.0313	14.5	13.0%	9.7%	77.3%
1981	17.2%	17.1	3805	-	118	0.0311	14.6	13.5%	7.3%	79.2%
1982	19.5%	17.4	3812	-	120	0.0317	14.5	16.4%	7.6%	76.0%
1983	22.0%	17.7	3772	-	118	0.0313	14.6	16.9%	11.2%	71.9%
1984	23.4%	17.4	3786	-	118	0.0310	14.7	20.6%	17.2%	62.2%
1985	24.7%	17.5	3800	-	124	0.0326	14.1	24.0%	17.7%	58.3%
1986	27.9%	18.2	3740	-	123	0.0330	14.0	24.4%	16.5%	59.1%
1987	27.1%	18.3	3716	-	131	0.0351	13.4	27.6%	19.1%	53.3%
1988	29.0%	17.9	3849	-	141	0.0365	13.0	25.5%	19.1%	55.3%
1989	29.9%	17.6	3931	-	146	0.0371	12.8	29.6%	18.7%	51.7%
1990	29.6%	17.4	4013	-	151	0.0377	12.7	33.8%	17.0%	49.2%
1991	30.4%	17.8	3961	-	150	0.0379	12.6	27.1%	22.6%	50.3%
1992	31.3%	17.3	4078	-	155	0.0380	12.6	32.0%	19.7%	48.3%
1993	32.3%	17.5	4099	-	160	0.0391	12.2	33.8%	19.3%	46.9%
1994	38.1%	17.2	4149	-	166	0.0401	12.0	26.4%	24.0%	49.6%
1995	35.9%	17.0	4199	-	168	0.0400	12.0	30.6%	27.7%	41.8%
1996	36.3%	17.2	4246	-	180	0.0422	11.5	29.6%	29.4%	41.0%
1997	38.5%	16.9	4386	-	189	0.0429	11.4	22.8%	33.9%	43.3%
1998	40.7%	17.1	4320	-	188	0.0434	11.3	25.3%	33.7%	41.0%
1999	40.7%	16.6	4463	-	199	0.0445	11.0	23.6%	35.3%	41.0%
2000	40.3%	16.9	4425	-	199	0.0448	11.0	25.3%	35.5%	39.1%
2001	38.8%	16.4	4556	-	212	0.0464	10.6	20.3%	38.1%	41.6%
2002	41.2%	16.4	4635	-	223	0.0479	10.4	18.7%	45.4%	35.9%
2003	43.3%	16.6	4676	-	224	0.0478	10.4	18.0%	45.8%	36.2%
2004	44.9%	16.4	4818	-	241	0.0499	10.1	13.5%	51.0%	35.5%
2005	42.8%	16.9	4774	-	242	0.0505	10.0	21.8%	44.4%	33.8%
2006	40.0%	17.1	4776	-	240	0.0502	10.0	19.3%	44.4%	36.3%
2007	38.8%	17.3	4906	-	256	0.0519	9.8	14.3%	50.1%	35.6%
2008	38.5%	17.7	4871	54.5	256	0.0521	9.8	14.8%	51.7%	33.5%
2009	30.8%	18.4	4788	54.3	254	0.0526	9.7	12.8%	52.6%	34.5%
2010	35.7%	18.7	4811	54.1	254	0.0525	9.7	14.1%	53.7%	32.2%
2011	37.6%	18.9	4905	55.9*	279	0.0564	9.1	11.9%	50.7%	37.5%

*Note: the footprint value for MY 2011 is preliminary, and is based on different data sources than values for MY 2008-2010.

Table 2 (continued)

Vehicle Size and Design Characteristics of MY 1975 to 2011 Light Duty Vehicles

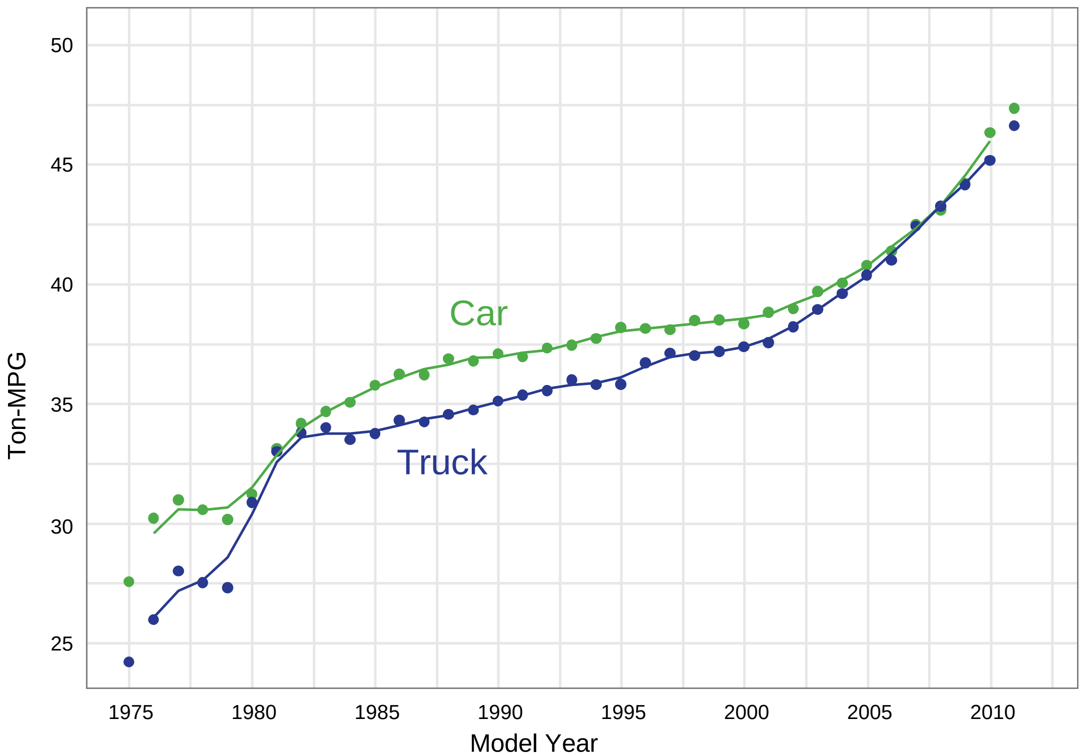
Cars and Trucks

Model Year	Adj Comp MPG	Weight (lb)	Footprint (sq ft)	HP	HP/ Weight	0-to-60 Time
1975	13.1	4060	-	137	0.0335	14.1
1976	14.2	4079	-	135	0.0328	14.3
1977	15.1	3982	-	136	0.0339	13.8
1978	15.8	3715	-	129	0.0344	13.6
1979	15.9	3655	-	124	0.0335	13.9
1980	19.2	3228	-	104	0.0320	14.3
1981	20.5	3202	-	102	0.0318	14.4
1982	21.1	3202	-	103	0.0320	14.4
1983	21.0	3257	-	107	0.0327	14.1
1984	21.0	3262	-	109	0.0332	14.0
1985	21.3	3271	-	114	0.0347	13.5
1986	21.8	3238	-	114	0.0351	13.4
1987	22.0	3221	-	118	0.0361	13.1
1988	21.9	3283	-	123	0.0372	12.8
1989	21.4	3351	-	129	0.0382	12.5
1990	21.2	3426	-	135	0.0394	12.2
1991	21.3	3410	-	138	0.0402	12.1
1992	20.8	3512	-	145	0.0413	11.8
1993	20.9	3519	-	147	0.0416	11.8
1994	20.4	3603	-	152	0.0420	11.7
1995	20.5	3613	-	158	0.0438	11.3
1996	20.4	3659	-	164	0.0447	11.1
1997	20.1	3727	-	169	0.0452	11.0
1998	20.1	3744	-	171	0.0457	10.9
1999	19.7	3835	-	179	0.0465	10.7
2000	19.8	3821	-	181	0.0472	10.6
2001	19.6	3879	-	187	0.0480	10.5
2002	19.5	3951	-	195	0.0493	10.3
2003	19.6	3999	-	199	0.0496	10.2
2004	19.3	4111	-	211	0.0511	9.9
2005	19.9	4059	-	209	0.0512	9.9
2006	20.1	4067	-	213	0.0522	9.8
2007	20.6	4093	-	217	0.0525	9.7
2008	21.0	4085	49.0	219	0.0529	9.7
2009	22.4	3914	48.2	208	0.0523	9.7
2010	22.6	4002	48.5	214	0.0527	9.6
2011	22.8	4084	49.6*	228	0.0549	9.3

*Note: the footprint value for MY 2011 is preliminary, and is based on different data sources than values for MY 2008-2010.

Figure 4

Ton-MPG by Model Year
(with Three-Year Moving Average)



Another dramatic long-term trend has been the substantial increase in performance of cars and light trucks as measured by their estimated 0-to-60 mph acceleration time. These trends are shown graphically in Figure 5, which plots fuel economy versus performance for model years since 1975. Both graphs show the same story: in the late 1970s and early 1980s, responding to the regulatory requirements for mpg improvement, the industry increased mpg and kept performance roughly constant. After the regulatory mpg requirements stabilized, mpg improvements ended and performance dramatically improved through 2005 or so. In recent years, both fuel economy and performance have improved.

Figure 6 is similar to Figure 5, but shows the trends in weight and laboratory fuel economy. Weight decreased from the mid-1970s to the mid-1980s, then increased dramatically until about 2005 or so, and has been more stable in recent years.

Figure 5

Laboratory MPG vs. 0-to-60 Time by Model Year

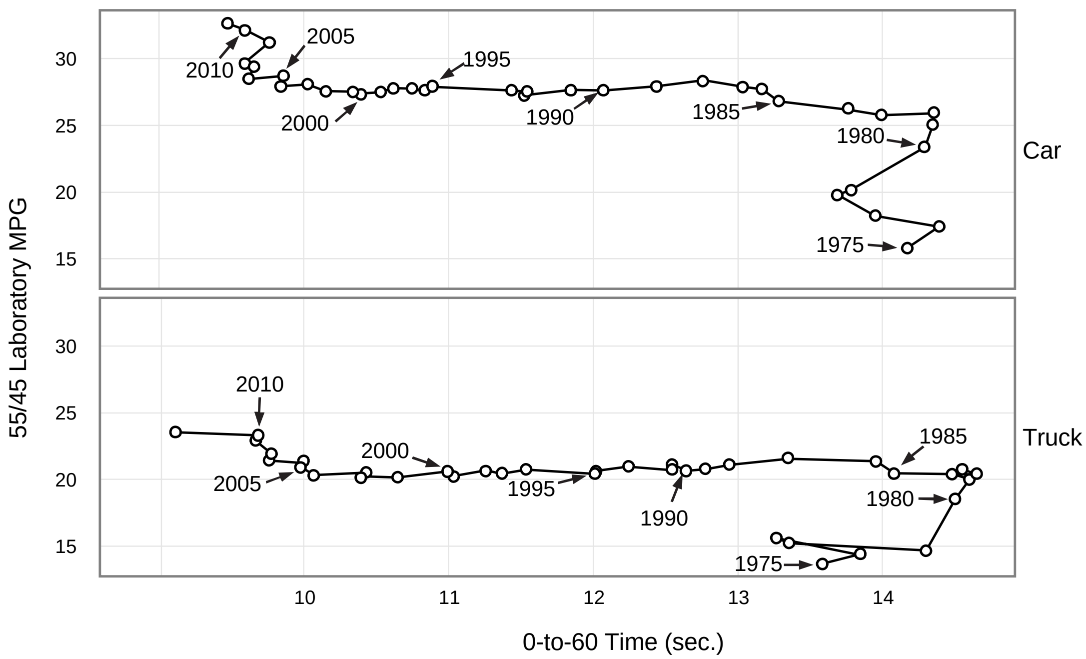
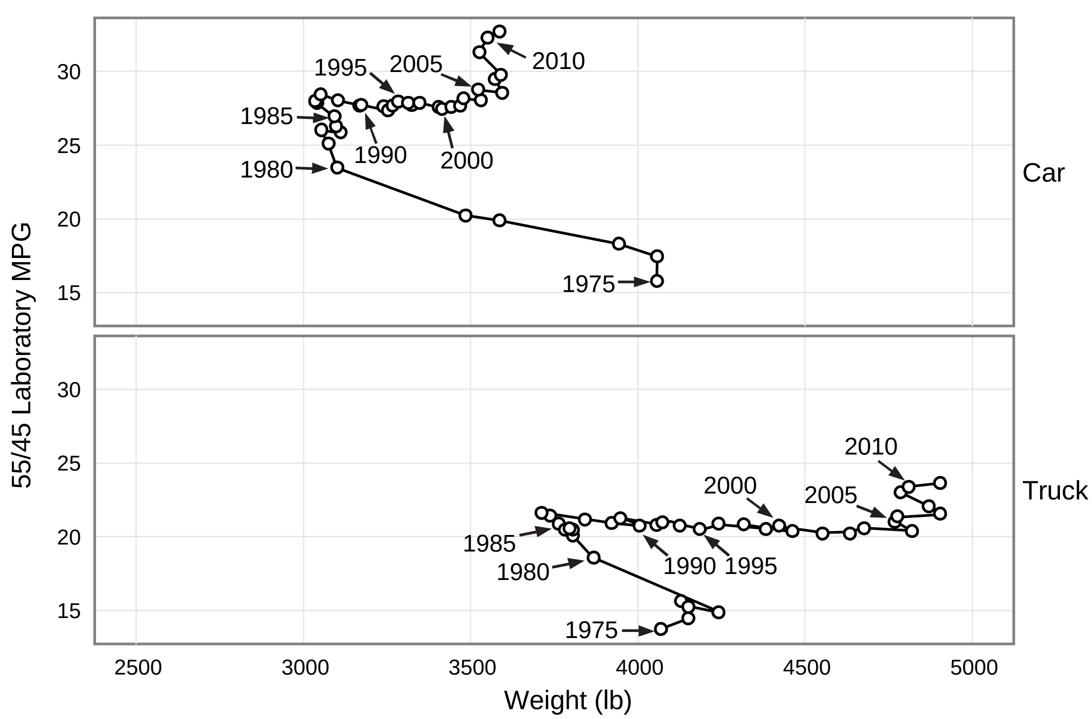


Figure 6

Laboratory MPG vs. Vehicle Weight by Model Year



IV. Carbon Dioxide Emissions Trends

This section focuses on light-duty vehicle tailpipe carbon dioxide (CO_2) emissions data that are measured over the EPA city and highway test procedures. As discussed below, the CO_2 emissions data, along with data for carbon monoxide and hydrocarbon emissions, are used to calculate the vehicle fuel economy levels presented in the rest of this report.

CO_2 is the most important greenhouse gas, responsible for a majority of all global, anthropogenic greenhouse gas emissions. Light-duty vehicles directly emit approximately 17% of total U.S. CO_2 emissions.[2] In April 2007, the U.S. Supreme Court determined that CO_2 is a pollutant under the Clean Air Act[3], and in December 2009, EPA published two findings that CO_2 and other greenhouse gases from new motor vehicles and new motor vehicle engines contribute to air pollution, and that the air pollution may reasonably be anticipated to endanger public health and welfare.[4] In May 2010, EPA published the first-ever light-duty vehicle greenhouse gas emissions standards, under the Clean Air Act, for MY 2012-2016.[5] These standards are part of a new, harmonized National Program that also includes new CAFE standards for MY 2012-2016, established and administered by NHTSA. One of the goals of the National Policy is to establish a harmonized set of greenhouse gas emissions and CAFE standards that automakers can meet with a single national fleet. In December 2011, EPA and NHTSA proposed new light-duty vehicle greenhouse gas emissions and CAFE standards for MY 2017-2025.[6]

Pre-2009 reports in this series presented fuel economy data only and did not include CO_2 emissions data. Beginning with the 2009 report, EPA has added CO_2 emissions data. Rather than adding CO_2 emissions data to all or most of the large number of tables and figures in this report, we are providing a few key summary tables and figures dedicated to CO_2 emissions in this section as well as a methodology with which a reader can convert fuel economy values from other sections of this report to equivalent CO_2 emissions levels. Section III and Sections V through VII of this report, as well as all of the appendices, continue to focus exclusively on fuel economy data.

The light-duty vehicle tailpipe CO_2 emissions data provided in this report represent the sum of three pollutants that EPA and automakers directly measure in the formal emissions certification and fuel economy compliance test programs:

- CO_2 emissions;

- Carbon monoxide emissions, converted to an equivalent CO_2 level on a mass basis by multiplying by a factor of 1.57, which is based on the ratio of molecular weights; and

- Hydrocarbon emissions, converted to an equivalent CO_2 level on a mass basis by multiplying by a factor of approximately 3.17, which is dependent on the measured carbon weight fraction of vehicle test fuel.

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[2] U.S. EPA, 2009, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007, EPA 430-R-09-004.
[3] 549 U.S. 497 (2007).
[4] 74 Federal Register 66496 (December 15, 2009).
[5] 75 Federal Register 25324 (May 7, 2010)
[6] 76 Federal Register 74854 (December 1, 2011).

While including the carbon monoxide and hydrocarbon emissions adds, on average, less than one percent to the tailpipe CO_2-equivalent emissions for late model year light-duty vehicles, they are included in the CO_2 emissions values for three reasons:

- Atmospheric processes convert carbon monoxide and hydrocarbons to CO_2 relatively quickly compared to the much longer atmospheric lifetime of CO_2;

- Carbon monoxide and hydrocarbon emissions are included, along with CO_2, in the "carbon balance" equations that EPA uses to calculate fuel economy values, so they must also be included in the CO_2 values to maintain the mathematical integrity of the equations given below to convert between CO_2 emissions and fuel economy values; and

- Including carbon monoxide and hydrocarbon emissions is consistent with EPA's light-duty vehicle CO_2 emissions standard-setting approach.

EPA routinely measures CO_2, carbon monoxide, and hydrocarbon emissions as part of its compliance programs. The individual fuel economy test values that comprise the EPA fuel economy trends database are calculated from a set of "carbon balance" equations based on direct measurement of CO_2, carbon monoxide, and total hydrocarbon emissions. Since carbon is neither created nor destroyed in the combustion process, quantifying the various carbon-containing compounds in the vehicle exhaust as well as the carbon weight fraction of the gasoline test fuel allows the precise calculation of the amount of fuel that was combusted in the vehicle engine. Ironically, while the fuel economy values are calculated from CO_2, carbon monoxide, and hydrocarbon emissions data, the historic EPA fuel economy trends database files do not include the direct emissions data. In order to add CO_2 emissions data to the historical database, EPA has back-calculated the CO_2 emissions (and associated carbon monoxide and hydrocarbon emissions, converted to CO_2 on a mass basis) levels from fuel economy values by reversing the carbon balance equations.

As with the fuel economy data in this report, the light-duty vehicle CO_2 emissions values are expressed in two ways: unadjusted/laboratory values (which will be used for CO_2 emissions regulatory compliance beginning in MY 2012) and adjusted/real world values (which are used for consumer information and environmental analysis). The CO_2 emissions values do not represent total light-duty vehicle greenhouse gas emissions, as there are other sources of greenhouse gas emissions beyond the tailpipe CO_2 emissions values. It is also important to note that the tailpipe CO_2 emissions data in this report do not reflect greenhouse gas emissions associated with vehicle assembly, component manufacturing, or vehicle disposal, nor upstream fuel-related production or distribution.

The unadjusted/laboratory CO_2 emissions values are the direct emissions data measured over the EPA city and highway tests. The vehicle air conditioner is turned off during these tests. The EPA city and highway tests will be used for compliance with future EPA light-duty vehicle CO_2 emissions standards (CO_2 standards allow the use of air conditioning and other credits so that the unadjusted CO_2 tailpipe emissions data in this report may not align perfectly with the EPA CO_2 standards or tailpipe compliance values). For late model year vehicles, the unadjusted CO_2 emissions values represent about 90% of total unadjusted light-duty vehicle greenhouse gas emissions. The remaining 10% of total light-duty vehicle greenhouse gas emissions is comprised of air conditioner efficiency-related CO_2 emissions (about 4%), air conditioner hydrofluorocarbon refrigerant emissions leaks (approximately 5%), tailpipe nitrous oxide emissions (about 2%), and tailpipe methane emissions (methane is one hydrocarbon compound with a longer atmospheric lifetime and higher global warming potency, but its mass emissions are so low from gasoline vehicles that its potency-adjusted CO_2-equivalent emissions are about 0.2% of total light-duty vehicle greenhouse gas emissions).[7]

The adjusted CO_2 emissions values are calculated by increasing the unadjusted/laboratory CO_2 emissions test data to account for the many variables that can affect real world vehicle CO_2 emissions. For a detailed discussion of the methodology that EPA uses to convert unadjusted vehicle fuel economy values to adjusted fuel economy values, see Appendix A. This same methodology is used to calculate adjusted CO_2 emissions values as well. On average, based on the current fleet mix, adjusted CO_2 emissions levels are about 25% higher than unadjusted CO_2 values. Because the adjusted CO_2 values take the impact of air conditioner operation on vehicle tailpipe CO_2 emissions into account, adjusted CO_2 values represent about 95% of total adjusted real world light-duty vehicle greenhouse gas emissions, with the remainder composed of air conditioner hydrofluorocarbon refrigerant emissions leaks, tailpipe nitrous oxide emissions, and the higher global warming potency associated with tailpipe methane emissions.

Table 3 gives key light-duty vehicle CO_2 emissions data for the entire data series from 1975 through 2011 for cars only, trucks only, and cars and trucks combined. Table 3 is very similar to Table 1, except that the fuel economy data in Table 1 is replaced with CO_2 emissions data in Table 3.

[7] 75 Federal Register 25421-25425 (May 7, 2010).

Table 3

Carbon Dioxide Emissions of MY 1975 to 2011 Light Duty Vehicles

Cars

Model Year	Production (000)	Production Percent	Lab City CO_2 (g/mi)	Lab Hwy CO_2 (g/mi)	Lab 55/45 CO_2 (g/mi)	Adj City CO_2 (g/mi)	Adj Hwy CO_2 (g/mi)	Adj Comp CO_2 (g/mi)	CO_2/ Ton	CO_2/ Cu Ft	CO_2/ Ton/ Cu Ft
1975	8265	80.8%	650	457	563	722	586	661	327	-	-
1976	9754	79.1%	584	418	510	649	536	598	297	-	-
1977	11344	80.3%	556	400	486	618	513	571	290	5.2	2.7
1978	11213	77.6%	517	364	448	574	466	526	294	4.9	2.8
1979	10819	77.9%	504	363	440	560	465	517	298	4.8	2.9
1980	9448	83.6%	439	308	380	488	395	446	289	4.4	2.9
1981	8736	82.8%	412	288	356	458	369	418	273	4.0	2.7
1982	7837	80.5%	401	273	343	445	350	403	264	3.9	2.6
1983	8037	78.0%	402	273	344	447	350	403	259	3.8	2.5
1984	10735	76.6%	397	268	339	441	343	397	256	3.8	2.5
1985	10895	75.3%	389	260	331	432	333	387	251	3.7	2.4
1986	11083	72.1%	376	251	319	420	323	375	247	3.6	2.4
1987	10836	72.9%	374	249	317	420	321	374	247	3.6	2.4
1988	10853	71.0%	368	244	312	416	316	369	243	3.5	2.3
1989	10138	70.1%	375	246	317	427	320	376	243	3.5	2.3
1990	8882	70.4%	380	248	321	435	324	382	241	3.6	2.3
1991	8755	69.6%	379	247	320	437	325	382	242	3.6	2.3
1992	8361	68.7%	388	248	325	449	327	389	240	3.6	2.3
1993	8941	67.7%	384	246	322	447	326	387	239	3.6	2.2
1994	8747	61.9%	383	244	320	449	325	386	237	3.6	2.2
1995	9708	64.1%	381	239	317	449	320	383	234	3.5	2.2
1996	8379	63.7%	384	242	320	456	325	388	234	3.6	2.2
1997	8897	61.5%	382	241	319	456	325	388	234	3.6	2.2
1998	8570	59.3%	382	241	318	458	326	388	232	3.6	2.2
1999	9019	59.3%	386	244	322	467	331	394	232	3.6	2.2
2000	9899	59.7%	387	245	323	470	335	397	233	3.6	2.2
2001	9549	61.2%	384	245	322	470	337	397	231	3.6	2.1
2002	9484	58.8%	383	246	321	471	339	398	230	3.6	2.1
2003	8937	56.7%	376	241	315	467	333	392	226	3.6	2.1
2004	8649	55.1%	379	241	317	473	335	395	224	3.6	2.0
2005	9088	57.2%	368	236	309	463	331	388	220	3.5	2.0
2006	9070	60.0%	371	237	311	467	332	390	217	3.5	2.0
2007	9345	61.2%	358	231	301	452	323	379	212	3.4	1.9
2008	8546	61.5%	355	229	298	448	320	375	209	3.4	1.9
2009	6448	69.2%	337	219	284	426	307	359	203	3.2	1.8
2010	7147	64.3%	326	214	275	414	300	349	197	3.1	1.8
2011	-	62.4%	323	208	271	410	293	343	192	3.1	1.7

Table 3 (continued)

Carbon Dioxide Emissions of MY 1975 to 2011 Light Duty Vehicles

Trucks

Model Year	Production (000)	Production Percent	Lab City CO_2 (g/mi)	Lab Hwy CO_2 (g/mi)	Lab 55/45 CO_2 (g/mi)	Adj City CO_2 (g/mi)	Adj Hwy CO_2 (g/mi)	Adj Comp CO_2 (g/mi)	CO_2/ Ton
1975	1959	19.2%	733	548	650	815	702	764	374
1976	2580	20.9%	692	525	617	769	673	726	349
1977	2779	19.7%	632	490	568	703	628	669	323
1978	3235	22.4%	645	507	583	716	650	687	330
1979	3063	22.1%	663	530	604	737	679	711	333
1980	1859	16.4%	541	406	481	601	521	565	294
1981	1818	17.2%	502	374	444	558	479	523	275
1982	1896	19.5%	496	368	439	552	472	516	272
1983	2266	22.0%	489	356	429	543	456	504	268
1984	3285	23.4%	497	361	436	552	462	512	270
1985	3564	24.7%	494	358	433	549	460	508	267
1986	4282	27.9%	473	343	415	529	441	489	261
1987	4030	27.1%	472	336	411	530	434	486	261
1988	4442	29.0%	485	341	420	548	441	498	259
1989	4316	29.9%	492	345	426	558	449	506	258
1990	3733	29.6%	499	344	429	569	449	511	255
1991	3818	30.4%	487	335	419	559	439	500	253
1992	3811	31.3%	500	340	428	576	447	512	252
1993	4269	32.3%	494	335	422	573	442	507	249
1994	5378	38.1%	501	342	429	584	453	518	250
1995	5436	35.9%	508	343	434	595	457	524	250
1996	4766	36.3%	502	336	427	591	448	517	244
1997	5562	38.5%	508	341	433	602	458	526	241
1998	5887	40.7%	504	335	428	600	450	521	242
1999	6200	40.7%	514	344	437	614	465	534	241
2000	6675	40.3%	503	340	430	606	461	527	240
2001	6061	38.8%	513	348	439	621	474	541	239
2002	6635	41.2%	513	346	438	624	473	540	235
2003	6838	43.3%	506	340	432	619	467	534	230
2004	7061	44.9%	513	342	436	631	471	541	226
2005	6806	42.8%	499	331	423	618	457	527	222
2006	6035	40.0%	491	327	417	609	452	519	218
2007	5932	38.8%	488	322	413	605	446	514	211
2008	5354	38.5%	476	314	403	591	435	502	207
2009	2867	30.8%	457	301	387	568	418	483	203
2010	3964	35.7%	449	296	380	559	411	475	199
2011	-	37.6%	445	292	376	555	405	469	193

Table 3 (continued)

Carbon Dioxide Emissions of MY 1975 to 2011 Light Duty Vehicles

Cars and Trucks

Model Year	Production (000)	Production Percent	Lab City CO_2 (g/mi)	Lab Hwy CO_2 (g/mi)	Lab 55/45 CO_2 (g/mi)	Adj City CO_2 (g/mi)	Adj Hwy CO_2 (g/mi)	Adj Comp CO_2 (g/mi)	CO_2/ Ton
1975	10224	100.0%	666	474	580	740	608	681	336
1976	12334	100.0%	607	440	532	674	565	625	308
1977	14123	100.0%	571	418	502	635	535	590	296
1978	14448	100.0%	545	396	478	606	508	562	302
1979	13882	100.0%	539	399	476	599	512	560	306
1980	11306	100.0%	456	324	397	507	416	466	290
1981	10554	100.0%	428	303	371	475	388	436	274
1982	9732	100.0%	419	292	362	466	374	425	266
1983	10302	100.0%	421	291	363	468	373	426	261
1984	14020	100.0%	421	290	362	467	371	424	259
1985	14460	100.0%	414	284	356	461	364	417	255
1986	15365	100.0%	403	276	346	450	356	407	251
1987	14865	100.0%	400	272	343	450	352	405	251
1988	15295	100.0%	402	272	343	454	353	407	247
1989	14453	100.0%	410	275	349	466	359	415	247
1990	12615	100.0%	415	276	353	475	361	420	245
1991	12573	100.0%	412	274	350	474	360	418	245
1992	12172	100.0%	423	277	357	488	365	427	243
1993	13211	100.0%	419	275	354	488	364	426	242
1994	14125	100.0%	428	281	362	500	374	436	242
1995	15145	100.0%	426	277	359	501	369	434	240
1996	13144	100.0%	427	276	359	505	370	435	238
1997	14459	100.0%	431	280	363	512	376	441	237
1998	14458	100.0%	431	279	363	516	377	442	236
1999	15218	100.0%	438	285	369	527	386	451	235
2000	16574	100.0%	434	283	366	525	386	450	236
2001	15610	100.0%	434	285	367	529	390	453	234
2002	16119	100.0%	436	287	369	534	394	457	232
2003	15775	100.0%	432	284	366	533	391	454	227
2004	15711	100.0%	439	286	370	544	396	461	225
2005	15893	100.0%	424	277	358	529	385	447	221
2006	15105	100.0%	419	273	353	523	380	442	218
2007	15277	100.0%	409	266	345	511	371	431	212
2008	13900	100.0%	401	261	338	503	364	424	208
2009	9315	100.0%	374	244	315	470	341	397	203
2010	11111	100.0%	370	243	313	465	340	394	197
2011	-	100.0%	369	240	311	465	335	391	192

Figure 7 plots the adjusted CO_2 emissions values over time, for cars only, trucks only, and both cars and trucks combined.

Figure 7

Adjusted CO_2 Emissions by Model Year (grams/mile)

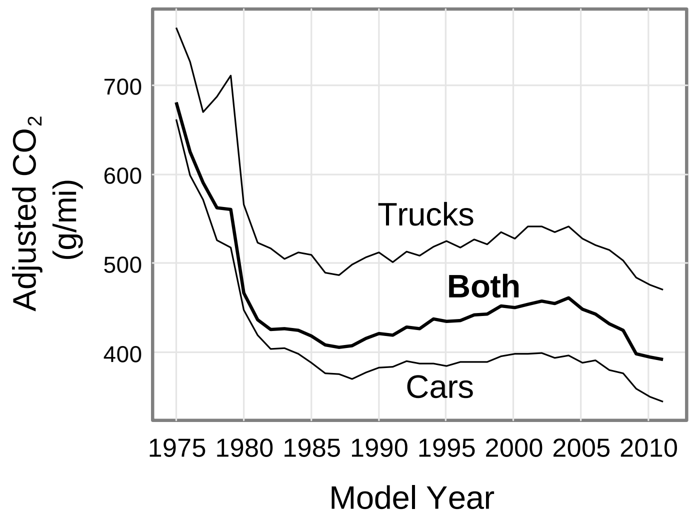


Table 3 and Figure 7 show that, over the last 35 years, adjusted (real world) CO_2 emissions rates have gone through four distinct phases. Most dramatically, adjusted composite (city/highway) CO_2 emissions rates for the combined car/truck fleet fell sharply from 681 grams per mile (g/mi) in MY 1975 to 436 g/mi in MY 1981, for a 36% reduction over 6 years. Adjusted CO_2 emissions continued to decline, though much more slowly, reaching 405 g/mi in MY 1987, which represents a 41% reduction from MY 1975. The trend then reversed, as adjusted CO_2 levels rose slowly over the next 17 years, reaching 461 g/mi in MY 2004, a 14% increase relative to the MY 1987 low. Adjusted CO_2 emissions have decreased for each of the last seven years. The MY 2010 value, based on final CAFE reports, is 394 g/mi, which is an all-time low, and represents a 15% reduction relative to MY 2004. The preliminary MY 2011 value, based on automaker production projections made prior to the beginning of the model year, is 391 g/mi, which if accurate, would be another all-time low.

Laboratory CO_2 emissions values are also given in Table 3. Because laboratory values do not reflect the changes that EPA made to its methodology for adjusting fuel economy and CO_2 emissions levels for real world estimates for consumers, they are the best metric for evaluating CO_2 emissions trends solely on vehicle design considerations. Based on the 55/45 (city/highway) laboratory CO_2 values in Table 3, the 313 g/mi value in MY 2010 and the preliminary MY 2011 value of 311 g/mi also represent all-time lows.

Table 4 shows key light-duty vehicle characteristics, along with the adjusted composite CO_2 emissions values, for the MY 1975 through 2011 timeframe for cars only, trucks only, and cars and trucks combined. Table 4 is very similar to Table 2, except that the fuel economy data in Table 2 is replaced with CO_2 emissions data in Table 4.

Table 4

Vehicle Size and Design Characteristics of MY 1975 to 2011 Light Duty Vehicles

Cars

Model Year	Production Percent	Adj Comp CO_2 (g/mi)	Vol (cu ft)	Weight (lb)	Footprint (sq ft)	HP	HP/ Weight	0-to-60 Time	Small	Midsize	Large
1975	80.8%	661	-	4058	-	136	0.0331	14.2	55.3%	23.4%	21.3%
1976	79.1%	598	-	4060	-	134	0.0324	14.4	55.3%	25.3%	19.4%
1977	80.3%	571	110	3945	-	133	0.0335	14.0	51.8%	24.6%	23.5%
1978	77.6%	526	109	3590	-	124	0.0342	13.7	44.6%	34.4%	21.0%
1979	77.9%	517	109	3485	-	119	0.0338	13.8	43.7%	34.2%	22.1%
1980	83.6%	446	104	3102	-	100	0.0322	14.3	54.4%	34.4%	11.3%
1981	82.8%	418	107	3076	-	99	0.0320	14.4	51.5%	36.4%	12.2%
1982	80.5%	403	106	3054	-	99	0.0321	14.4	56.6%	31.0%	12.5%
1983	78.0%	403	109	3112	-	104	0.0330	14.0	53.0%	31.9%	15.0%
1984	76.6%	397	108	3101	-	106	0.0338	13.8	57.1%	29.7%	13.2%
1985	75.3%	387	108	3098	-	111	0.0354	13.3	55.2%	29.6%	15.2%
1986	72.1%	375	107	3044	-	111	0.0360	13.2	59.1%	28.4%	12.5%
1987	72.9%	374	107	3036	-	113	0.0365	13.0	63.1%	24.9%	12.1%
1988	71.0%	369	107	3052	-	116	0.0375	12.8	64.5%	22.8%	12.7%
1989	70.1%	376	108	3105	-	121	0.0387	12.4	57.9%	28.8%	13.3%
1990	70.4%	382	107	3179	-	129	0.0401	12.1	58.4%	29.0%	12.6%
1991	69.6%	382	107	3169	-	133	0.0413	11.9	60.4%	27.7%	12.0%
1992	68.7%	389	109	3255	-	141	0.0427	11.5	55.4%	29.4%	15.2%
1993	67.7%	387	109	3242	-	140	0.0427	11.5	54.7%	32.8%	12.6%
1994	61.9%	386	109	3268	-	144	0.0432	11.4	57.0%	28.2%	14.8%
1995	64.1%	383	109	3284	-	153	0.0459	10.9	55.8%	30.7%	13.6%
1996	63.7%	388	110	3325	-	155	0.0461	10.8	51.7%	35.5%	12.8%
1997	61.5%	388	109	3315	-	157	0.0467	10.7	52.8%	33.6%	13.6%
1998	59.3%	388	110	3348	-	160	0.0473	10.6	46.9%	41.8%	11.3%
1999	59.3%	394	110	3404	-	165	0.0479	10.5	45.1%	42.6%	12.4%
2000	59.7%	397	111	3414	-	169	0.0489	10.4	45.1%	37.4%	17.5%
2001	61.2%	397	111	3450	-	171	0.0490	10.3	46.3%	37.0%	16.7%
2002	58.8%	398	113	3472	-	176	0.0503	10.1	43.8%	39.0%	17.2%
2003	56.7%	392	112	3481	-	179	0.0509	10.0	45.5%	38.2%	16.3%
2004	55.1%	395	113	3534	-	186	0.0520	9.8	41.9%	40.9%	17.2%
2005	57.2%	388	114	3524	-	185	0.0517	9.9	39.6%	42.5%	17.9%
2006	60.0%	390	114	3594	-	195	0.0536	9.6	40.7%	37.9%	21.5%
2007	61.2%	379	113	3577	-	192	0.0530	9.6	38.7%	43.9%	17.4%
2008	61.5%	375	113	3592	45.6	195	0.0535	9.6	38.4%	41.5%	20.1%
2009	69.2%	359	113	3526	45.5	187	0.0522	9.8	41.7%	40.4%	17.9%
2010	64.3%	349	114	3552	45.4	191	0.0529	9.6	41.4%	41.4%	17.2%
2011	62.4%	343	114	3589	45.8*	198	0.0541	9.5	34.8%	44.3%	20.9%

*Note: the footprint value for MY 2011 is preliminary, and is based on different data sources than values for MY 2008-2010.

Table 4 (continued)

Vehicle Size and Design Characteristics of MY 1975 to 2011 Light Duty Vehicles

Trucks

Model Year	Production Percent	Adj Comp CO_2 (g/mi)	Weight (lb)	Footprint (sq ft)	HP	HP/ Weight	0-to-60 Time	Small	Midsize	Large	Van	SUV	Pickup
1975	19.2%	764	4069	-	142	0.0349	13.6	10.7%	23.8%	65.5%	23.3%	8.1%	68.5%
1976	20.9%	726	4153	-	141	0.0340	13.8	8.8%	20.0%	71.3%	19.5%	8.2%	72.3%
1977	19.7%	669	4133	-	147	0.0356	13.3	10.7%	20.0%	69.3%	18.5%	8.6%	72.9%
1978	22.4%	687	4150	-	146	0.0351	13.4	10.7%	22.5%	66.9%	19.3%	10.6%	70.1%
1979	22.1%	711	4256	-	138	0.0325	14.3	14.9%	19.3%	65.8%	15.7%	12.3%	72.0%
1980	16.4%	565	3867	-	121	0.0313	14.5	28.4%	17.4%	54.1%	13.0%	9.7%	77.3%
1981	17.2%	523	3805	-	118	0.0311	14.6	23.3%	19.0%	57.8%	13.5%	7.3%	79.2%
1982	19.5%	516	3812	-	120	0.0317	14.5	20.7%	30.9%	48.4%	16.4%	7.6%	76.0%
1983	22.0%	504	3772	-	118	0.0313	14.6	16.3%	45.6%	38.1%	16.9%	11.2%	71.9%
1984	23.4%	512	3786	-	118	0.0310	14.7	19.7%	45.6%	34.7%	20.6%	17.2%	62.2%
1985	24.7%	508	3800	-	124	0.0326	14.1	19.8%	47.0%	33.2%	24.0%	17.7%	58.3%
1986	27.9%	489	3740	-	123	0.0330	14.0	23.9%	47.7%	28.5%	24.4%	16.5%	59.1%
1987	27.1%	486	3716	-	131	0.0351	13.4	19.8%	59.1%	21.1%	27.6%	19.1%	53.3%
1988	29.0%	498	3849	-	141	0.0365	13.0	14.5%	56.9%	28.6%	25.5%	19.1%	55.3%
1989	29.9%	506	3931	-	146	0.0371	12.8	13.5%	58.5%	27.9%	29.6%	18.7%	51.7%
1990	29.6%	511	4013	-	151	0.0377	12.7	12.9%	56.9%	30.1%	33.8%	17.0%	49.2%
1991	30.4%	500	3961	-	150	0.0379	12.6	10.8%	66.4%	22.7%	27.1%	22.6%	50.3%
1992	31.3%	512	4078	-	155	0.0380	12.6	9.8%	62.9%	27.3%	32.0%	19.7%	48.3%
1993	32.3%	507	4099	-	160	0.0391	12.2	8.7%	62.5%	28.8%	33.8%	19.3%	46.9%
1994	38.1%	518	4149	-	166	0.0401	12.0	9.2%	61.9%	28.9%	26.4%	24.0%	49.6%
1995	35.9%	524	4199	-	168	0.0400	12.0	8.6%	61.8%	29.6%	30.6%	27.7%	41.8%
1996	36.3%	517	4246	-	180	0.0422	11.5	6.3%	64.6%	29.1%	29.6%	29.4%	41.0%
1997	38.5%	526	4386	-	189	0.0429	11.4	9.2%	49.9%	40.8%	22.8%	33.9%	43.3%
1998	40.7%	521	4320	-	188	0.0434	11.3	8.4%	56.9%	34.8%	25.3%	33.7%	41.0%
1999	40.7%	534	4463	-	199	0.0445	11.0	7.4%	53.2%	39.3%	23.6%	35.3%	41.0%
2000	40.3%	527	4425	-	199	0.0448	11.0	5.5%	53.6%	40.9%	25.3%	35.5%	39.1%
2001	38.8%	541	4556	-	212	0.0464	10.6	5.4%	43.0%	51.6%	20.3%	38.1%	41.6%
2002	41.2%	540	4635	-	223	0.0479	10.4	6.6%	41.0%	52.5%	18.7%	45.4%	35.9%
2003	43.3%	534	4676	-	224	0.0478	10.4	5.8%	44.0%	50.1%	18.0%	45.8%	36.2%
2004	44.9%	541	4818	-	241	0.0499	10.1	5.2%	41.3%	53.5%	13.5%	51.0%	35.5%
2005	42.8%	527	4774	-	242	0.0505	10.0	2.6%	43.9%	53.5%	21.8%	44.4%	33.8%
2006	40.0%	519	4776	-	240	0.0502	10.0	2.3%	44.5%	53.2%	19.3%	44.4%	36.3%
2007	38.8%	514	4906	-	256	0.0519	9.8	2.3%	39.7%	58.1%	14.3%	50.1%	35.6%
2008	38.5%	502	4871	54.5	256	0.0521	9.8	3.0%	43.6%	53.4%	14.8%	51.7%	33.5%
2009	30.8%	483	4788	54.3	254	0.0526	9.7	2.7%	46.1%	51.2%	12.8%	52.6%	34.5%
2010	35.7%	475	4811	54.1	254	0.0525	9.7	2.9%	46.3%	50.8%	14.1%	53.7%	32.2%
2011	37.6%	469	4905	55.9*	279	0.0564	9.1	2.0%	36.2%	61.8%	11.9%	50.7%	37.5%

*Note: the footprint value for MY 2011 is preliminary, and is based on different data sources than values for MY 2008-2010.

Table 4 (continued)

Vehicle Size and Design Characteristics of MY 1975 to 2011 Light Duty Vehicles

Cars and Trucks

Model Year	Adj Comp CO_2 (g/mi)	Weight (lb)	Footprint (sq ft)	HP	HP/ Weight	0-to-60 Time
1975	681	4060	-	137	0.0335	14.1
1976	625	4079	-	135	0.0328	14.3
1977	590	3982	-	136	0.0339	13.8
1978	562	3715	-	129	0.0344	13.6
1979	560	3655	-	124	0.0335	13.9
1980	466	3228	-	104	0.0320	14.3
1981	436	3202	-	102	0.0318	14.4
1982	425	3202	-	103	0.0320	14.4
1983	426	3257	-	107	0.0327	14.1
1984	424	3262	-	109	0.0332	14.0
1985	417	3271	-	114	0.0347	13.5
1986	407	3238	-	114	0.0351	13.4
1987	405	3221	-	118	0.0361	13.1
1988	407	3283	-	123	0.0372	12.8
1989	415	3351	-	129	0.0382	12.5
1990	420	3426	-	135	0.0394	12.2
1991	418	3410	-	138	0.0402	12.1
1992	427	3512	-	145	0.0413	11.8
1993	426	3519	-	147	0.0416	11.8
1994	436	3603	-	152	0.0420	11.7
1995	434	3613	-	158	0.0438	11.3
1996	435	3659	-	164	0.0447	11.1
1997	441	3727	-	169	0.0452	11.0
1998	442	3744	-	171	0.0457	10.9
1999	451	3835	-	179	0.0465	10.7
2000	450	3821	-	181	0.0472	10.6
2001	453	3879	-	187	0.0480	10.5
2002	457	3951	-	195	0.0493	10.3
2003	454	3999	-	199	0.0496	10.2
2004	461	4111	-	211	0.0511	9.9
2005	447	4059	-	209	0.0512	9.9
2006	442	4067	-	213	0.0522	9.8
2007	431	4093	-	217	0.0525	9.7
2008	424	4085	49.0	219	0.0529	9.7
2009	397	3914	48.2	208	0.0523	9.7
2010	394	4002	48.5	214	0.0527	9.6
2011	391	4084	49.6*	228	0.0549	9.3

*Note: the footprint value for MY 2011 is preliminary, and is based on different data sources than values for MY 2008-2010.

Table 4 shows that average, combined car/truck, weight and horsepower levels declined significantly from MY 1975 through MY 1981, with weight decreasing by over 850 pounds (21%) and power decreasing by 35 horsepower (26%). Average vehicle weight grew slowly in the 1980s, and more rapidly thereafter, and by MY 2004 average weight had reached an all-time high of 4111 pounds. It has dropped slightly since. Average vehicle horsepower grew steadily since MY 1981, until decreasing by 11 horsepower in MY 2009 and then increasing by 6 horsepower in MY 2010. The projected MY 2011 level of 228 horsepower represents a 66% increase over MY 1975, and a 124% increase relative to MY 1981, which was the all-time low for this data series. Table 4 also shows that average MY 2010 footprint values were 45.4 square feet for cars, 54.1 square feet for trucks, and 48.5 square feet for cars and trucks combined.

The manufacturer definitions in this report are those used by NHTSA for purposes of implementation of and manufacturer compliance with the CAFE program. Make is typically included in the model name and is generally recognized by consumers as the "brand" of the vehicle. The Pontiac, Saturn, and Mercury makes no longer exist, but are included since Table 5 also includes MY 2009 and 2010. For more details on this vehicle grouping approach, and the thresholds that were used to identify the 13 manufacturers and 30 makes shown in Table 5, see the more detailed discussion in Section VII. It is important to note that when a manufacturer or make grouping is changed to reflect a change in the industry's financial structure, EPA makes the same adjustment in the historical database back to 1975. This maintains a consistent manufacturer (or make) definition over time, which allows a better identification of long-term trends. On the other hand, this also means that the current database does not necessarily reflect actual financial or structural arrangements in the past. For example, the 2011 database no longer accounts for the fact that Chrysler was combined with Daimler for several years, and Table 5 shows data for a Chrysler Ram make for MY 2009, even though Ram did not formally become a separate make until MY 2010.

Table 5 gives adjusted CO_2 emissions values for cars, trucks, and cars and trucks combined for MY 2009-2011, for the 13 highest-selling manufacturers and 30 largest makes associated with those manufacturers. Manufacturers are listed in order of increasing MY 2010 car plus truck CO_2 emissions rate. By including data from both MY 2009 and MY 2010, with formal end-of-year data for both years, it is possible to identify meaningful changes from year-to-year. Because of the uncertainty associated with the MY 2011 projections, changes from MY 2010 to MY 2011 are less meaningful. EPA anticipates that the MY 2011 results for all manufacturers will change after the final data has been submitted to EPA, and the final MY 2011 data will be included in next year's report.

Table 5

Adjusted Carbon Dioxide Emissions by Manufacturer and Make for MY 2009-2011 (g/mi)

Manufacturer	Make	2009 Cars	2009 Trucks	2009 Cars and Trucks	2010 Cars	2010 Trucks	2010 Cars and Trucks	2011 Cars	2011 Trucks	2011 Cars and Trucks
Hyundai	**All**	**348**	**447**	**355**	**325**	**386**	**329**	**318**	**395**	**323**
Kia	**All**	**347**	**461**	**367**	**318**	**445**	**330**	**316**	**395**	**327**
Toyota	Toyota	312	437	341	293	463	343	301	448	354
Toyota	Lexus	401	482	425	385	416	397	353	416	373
Toyota	Scion	350	-	350	343	-	343	314	-	314
Toyota	**All**	**322**	**442**	**349**	**306**	**454**	**350**	**310**	**444**	**354**
Honda	Honda	330	428	354	321	418	349	313	405	338
Honda	Acura	381	496	424	382	473	413	373	472	417
Honda	**All**	**334**	**438**	**361**	**327**	**425**	**357**	**318**	**416**	**345**
VW	VW	360	456	365	341	451	346	332	421	338
VW	Audi	391	488	410	380	463	404	379	429	395
VW	**All**	**370**	**475**	**379**	**351**	**459**	**363**	**347**	**427**	**360**
Mazda	**All**	**373**	**414**	**383**	**352**	**431**	**364**	**346**	**455**	**355**
Subaru	**All**	**389**	**397**	**393**	**373**	**382**	**379**	**371**	**371**	**371**
Nissan	Nissan	341	459	371	338	482	378	332	456	361
Nissan	Infiniti	421	506	437	420	554	449	406	522	421
Nissan	**All**	**349**	**462**	**377**	**346**	**487**	**384**	**341**	**461**	**368**
BMW	BMW	417	491	432	422	480	434	398	448	408
BMW	Mini	293	-	293	305	-	305	290	-	290
BMW	**All**	**390**	**491**	**407**	**390**	**480**	**404**	**377**	**448**	**389**
GM	Chevrolet	362	517	430	360	487	407	343	496	421
GM	GMC	519	517	517	356	484	465	346	496	484
GM	Buick	366	464	390	420	459	435	396	454	413
GM	Cadillac	466	574	487	434	489	449	431	508	461
GM	Pontiac	378	447	379	348	-	348	-	-	-
GM	Saturn	371	462	393	404	450	432	-	-	-
GM	**All**	**374**	**514**	**432**	**371**	**485**	**418**	**357**	**495**	**431**
Ford	Ford	372	507	433	364	513	437	357	483	416
Ford	Mercury	408	443	414	387	463	401	405	416	406
Ford	Lincoln	439	480	443	430	470	441	420	488	440
Ford	**All**	**383**	**505**	**433**	**370**	**510**	**435**	**363**	**483**	**417**
Chrysler	Dodge	418	498	429	410	461	428	391	463	421
Chrysler	Chrysler	404	452	436	398	452	430	386	425	409
Chrysler	Jeep	436	512	494	424	500	484	405	488	471
Chrysler	Ram	-	563	563	-	556	556	-	553	553
Chrysler	**All**	**417**	**501**	**464**	**409**	**488**	**455**	**392**	**484**	**451**
Daimler	Mercedes-Benz	454	542	476	451	522	474	441	509	462
Daimler	Smart	239	-	239	241	-	241	239	-	239
Daimler	**All**	**432**	**542**	**457**	**446**	**522**	**471**	**421**	**509**	**447**
Other	**All**	**395**	**526**	**419**	**391**	**517**	**436**	**382**	**493**	**413**
Fleet		**359**	**483**	**397**	**349**	**475**	**394**	**343**	**469**	**391**

Nine of the 13 manufacturers reduced CO_2 emissions in MY 2010, and the industry level of 394 g/mi represents an all-time low. In terms of manufacturers, Hyundai had the lowest MY 2010 adjusted CO_2 emissions performance of 329 g/mi, followed closely by Kia at 330 g/mi. Toyota was next lowest at 350 g/mi. Daimler had the highest MY 2010 adjusted CO_2 emissions performance for any manufacturer, 471 g/mi, and was followed by Chrysler at 455 g/mi and Ford at 435 g/mi. In terms of improvement from MY 2009 to MY 2010, Kia had the largest reduction of 37 g/mi, followed by Hyundai at 26 g/mi and Mazda with 19 g/mi.

In terms of makes in MY 2010, the Smart had the lowest CO_2 emissions of 241 g/mi. Of course, the Smart Fortwo is the smallest and lightest car in the U.S. market and has very small production volumes. The make with the second-lowest CO_2 emissions performance in MY 2010 is the Mini, which also produces relatively low volumes of small vehicles, at 305 g/mi. Of the makes with higher production, Hyundai had the lowest CO_2 emissions at 329 g/mi, followed by Kia at 330 g/mi and Toyota and Scion at 343 g/mi.

Preliminary projections suggest that 11 of the 13 manufacturers will improve CO_2 emissions performance further in MY 2011, though EPA will not have actual data for MY 2011 until later this year. Hyundai, Kia, and Honda are projected to be the overall CO_2 emissions leaders for MY 2011.

While Tables 3, 4, and 5 provide key summary CO_2 emissions data, EPA recognizes that many users will want the CO_2 emissions values equivalent to the fuel economy values in many other tables in this report. Converting fuel economy values from tables in this report to approximate equivalent CO_2 emissions values is fairly straightforward.

If it is known that a fuel economy value in this report is based on a single gasoline vehicle, or a 100% gasoline vehicle fleet, one can calculate the precise corresponding CO_2 value by simply dividing 8887 (which is a typical value for the grams of CO_2 per gallon of gasoline test fuel, assuming all the carbon is converted to CO_2) by the fuel economy value in miles per gallon. For example, 8887 divided by a gasoline vehicle fuel economy of 30 mpg would yield an equivalent CO_2 emissions value of 296 grams per mile.

Since gasoline vehicle production has accounted for 99+% of all light-duty vehicle production for all model years since 1975 except for the six years from 1979 through 1984, this simple approach yields very accurate results for most model years.

Diesel fuel has 14.5% higher carbon content per gallon than gasoline. To calculate a CO_2 equivalent value for a diesel vehicle, one should divide 10,180 by the diesel vehicle fuel economy value. Accordingly, a 30 mpg diesel vehicle would have a CO_2 equivalent value of 339 grams per mile.

Table 6 should be used by those who want to make the most accurate conversions of industry-wide fuel economy values to CO_2 emissions values. Table 6 gives model year-specific industry-wide values for grams of CO_2 per gallon based on actual light-duty gasoline and diesel vehicle production in that year. Using these model year-specific values and dividing by the fuel economy value in miles per gallon will allow accurate conversions of industry-wide fuel economy values to industry-wide CO_2 emissions values.

Readers will have to make judgment calls about how to best convert fuel economy values that do not represent industry-wide values (e.g., just small cars or vehicles with 5-speed automatic transmissions). If the user knows the gasoline/diesel production volume fractions of the individual database component, it is best to generate a weighted value of grams of CO_2 per gallon based on the 8887 (gasoline) and 10,180 (diesel) factors discussed above. Otherwise, the reader can choose between the model year-specific weighting in Table 6 (which implicitly assumes that the diesel fraction in the database component of interest is similar to that for the overall fleet in that year) or the gasoline value of 8887 (implicitly assuming no diesels in that database component). In nearly all cases, any error associated with either of these approaches will be relatively small.

Table 6

Factors for Converting Industry-wide Fuel Economy Values from this Report to Carbon Dioxide Emissions Values

Model Year	Gasoline Production Share	Diesel Production Share	Weighted CO_2 per Gallon (grams)
1975	99.8%	0.2%	8890
1976	99.8%	0.2%	8890
1977	99.6%	0.4%	8892
1978	99.1%	0.9%	8899
1979	98.0%	2.0%	8913
1980	95.7%	4.3%	8943
1981	94.1%	5.9%	8963
1982	94.4%	5.6%	8959
1983	97.3%	2.7%	8922
1984	98.2%	1.8%	8910
1985	99.1%	0.9%	8899
1986	99.6%	0.4%	8892
1987	99.7%	0.3%	8891
1988	99.9%	0.1%	8888
1989	99.9%	0.1%	8888
1990	99.9%	0.1%	8888
1991	99.9%	0.1%	8888
1992	99.9%	0.1%	8888
1993	100.0%	-	8887
1994	100.0%	0.0%	8887
1995	100.0%	0.0%	8887
1996	99.9%	0.1%	8888
1997	99.9%	0.1%	8888
1998	99.9%	0.1%	8888
1999	99.9%	0.1%	8888
2000	99.9%	0.1%	8888
2001	99.9%	0.1%	8888
2002	99.8%	0.2%	8890
2003	99.8%	0.2%	8890
2004	99.9%	0.1%	8888
2005	99.7%	0.3%	8891
2006	99.6%	0.4%	8892
2007	99.9%	0.1%	8888
2008	99.9%	0.1%	8888
2009	99.5%	0.5%	8893
2010	99.3%	0.7%	8896
2011	99.4%	0.6%	8895

V. Fuel Economy Trends by Vehicle Type, Size, and Weight

Figure 8 shows production share trends by vehicle type. Of the six vehicle classes shown—cars, wagons, non-truck SUVs, truck SUVs, vans, and pickups—the biggest overall increase in production share since 1975 has been for the two categories of SUVs, which, combined, increased from less than two percent in MY 1975 to nearly 30% in MY 2011. The biggest overall decrease has been for cars, down from 71% of the fleet in MY 1975 to about 50% in MY 2011. By comparison, the production fraction for pickup trucks has remained relatively constant at about 15% of overall production.

Figure 9 (size within vehicle type) and Table 7 (across the entire market) compares production fractions by vehicle type and size with the fleet again stratified into six vehicle types (cars, station wagons, non-truck SUVs, vans, truck SUVs, and pickup trucks) and three vehicle sizes (small, midsize, and large). Small cars have historically been the leading segment, but midsize cars now have the highest share. Wagons have decreased from about 10% of production in MY 1975 to about 4% of production today, almost exclusively small wagons.

Since 1975, the largest increases in production fractions have been for SUVs. Truck SUVs and non-truck SUVs (those now classified as cars for regulatory purposes) are expected to account for nearly 30% of all light vehicles sold in MY 2011, compared to combined totals of about 2% in MY 1975 and 6% in MY 1988, respectively. Minivans and vans, whose popularity peaked in the 1990s, now account for less than 5% of production, similar to MY 1975 levels. Almost all of the vans sold today are midsize minivans. Pickups are now dominated by large pickups.

Figure 8

Production Share by Vehicle Type

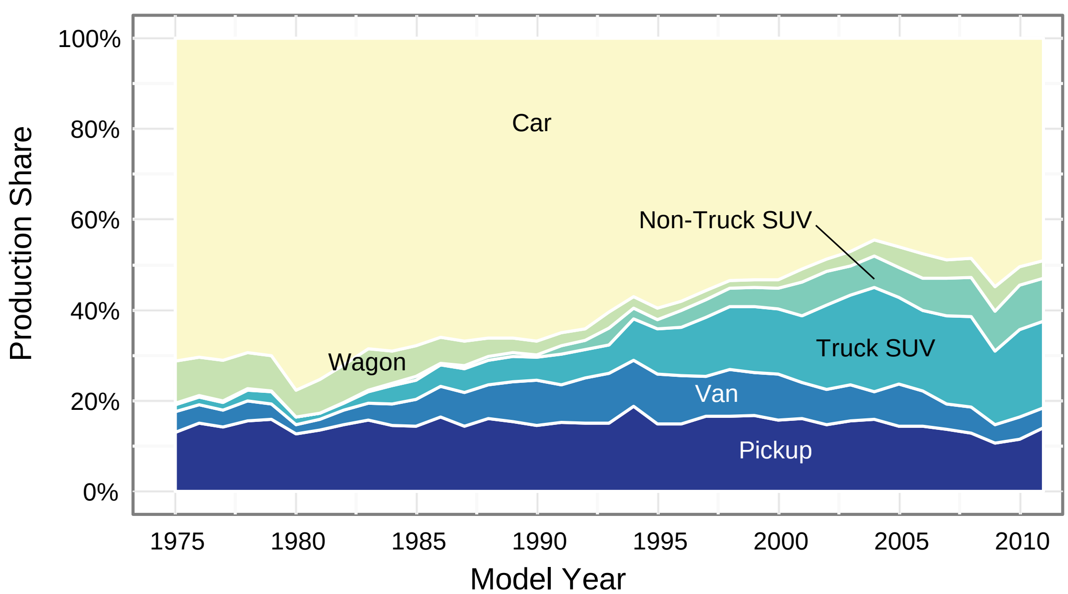


Figure 9

Production Share by Vehicle Size

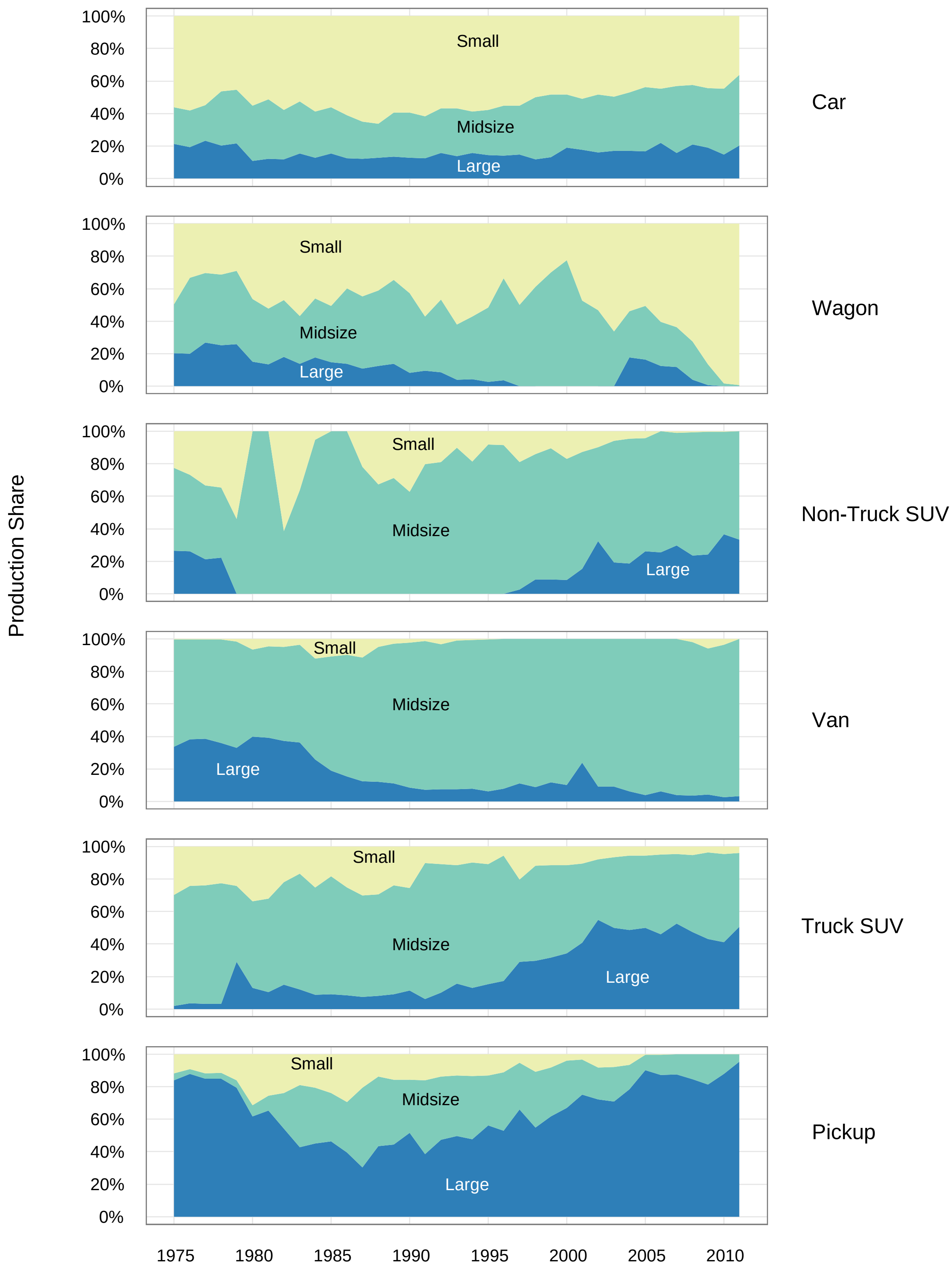


Table 7

Production Shares of MY 1975, 1988, and 2011 by Vehicle Size and Type

Vehicle Type	Size	1975	1988	2011	Difference 1975 to 2011	Difference 1975 to 1988	Difference 1988 to 2011
Car	Small	40.0%	43.8%	17.7%	-22.2%	3.9%	-26.1%
Car	Midsize	16.0%	13.8%	21.4%	5.4%	-2.1%	7.5%
Car	Large	15.2%	8.5%	9.9%	-5.3%	-6.7%	1.4%
Car	All	71.1%	66.2%	49.0%	-22.1%	-5.0%	-17.2%
Wagon	Small	4.7%	1.7%	3.9%	-0.7%	-3.0%	2.3%
Wagon	Midsize	2.8%	1.9%	0.0%	-2.8%	-1.0%	-1.8%
Wagon	Large	1.9%	0.5%	-	-1.9%	-1.4%	-0.5%
Wagon	All	9.4%	4.0%	4.0%	-5.4%	-5.4%	0.0%
Non-Truck SUV	Small	0.1%	0.3%	-	-0.1%	0.2%	-0.3%
Non-Truck SUV	Midsize	0.1%	0.5%	6.3%	6.1%	0.4%	5.7%
Non-Truck SUV	Large	0.1%	-	3.1%	3.1%	-0.1%	3.1%
Non-Truck SUV	All	0.3%	0.8%	9.4%	9.1%	0.5%	8.6%
Van	Small	0.0%	0.4%	-	0.0%	0.3%	-0.4%
Van	Midsize	3.0%	6.2%	4.3%	1.4%	3.2%	-1.8%
Van	Large	1.5%	0.9%	0.1%	-1.4%	-0.6%	-0.7%
Van	All	4.5%	7.4%	4.5%	0.0%	2.9%	-2.9%
Truck SUV	Small	0.5%	1.6%	0.8%	0.3%	1.2%	-0.9%
Truck SUV	Midsize	1.1%	3.5%	8.7%	7.6%	2.4%	5.2%
Truck SUV	Large	0.0%	0.5%	9.6%	9.6%	0.4%	9.2%
Truck SUV	All	1.6%	5.6%	19.1%	17.5%	4.0%	13.5%
Pickup	Small	1.6%	2.2%	-	-1.6%	0.7%	-2.2%
Pickup	Midsize	0.5%	6.9%	0.6%	0.1%	6.3%	-6.3%
Pickup	Large	11.0%	7.0%	13.5%	2.4%	-4.1%	6.5%
Pickup	All	13.1%	16.1%	14.1%	1.0%	2.9%	-2.0%
	All Trucks	19.2%	29.0%	37.6%	18.5%	9.9%	8.6%

Figure 10 shows annual trends in adjusted fuel economy, weight, and performance for cars, wagons, non-truck SUVs, vans, truck SUVs, and pickups. For all six vehicle types, the recent trends, since 2005, have been increasing fuel economy, fairly stable weight, and decreasing 0-60 acceleration time (or increased performance).

Table 8 shows the lowest, average, and highest adjusted mpg performance by vehicle type and size for three selected years. For both MY 1988 and 2011, the mpg performance is such that the midsize vehicles in all vehicle type/size combinations have better fuel economy than the corresponding entry for small vehicles in 1975. In Table 9, the percentage changes obtainable from the entries in Table 8 are presented. Average mpg for four vehicle type/size combinations (midsize cars, large cars, midsize truck SUVs, and large truck SUVs) has more than doubled since 1975. Since 1988, average fuel economy has decreased for midsize wagons and small truck SUVs. Tables 10 and 11 present this same data in terms of fuel consumption.

Figure 10

Fuel Economy and Performance by Vehicle Type

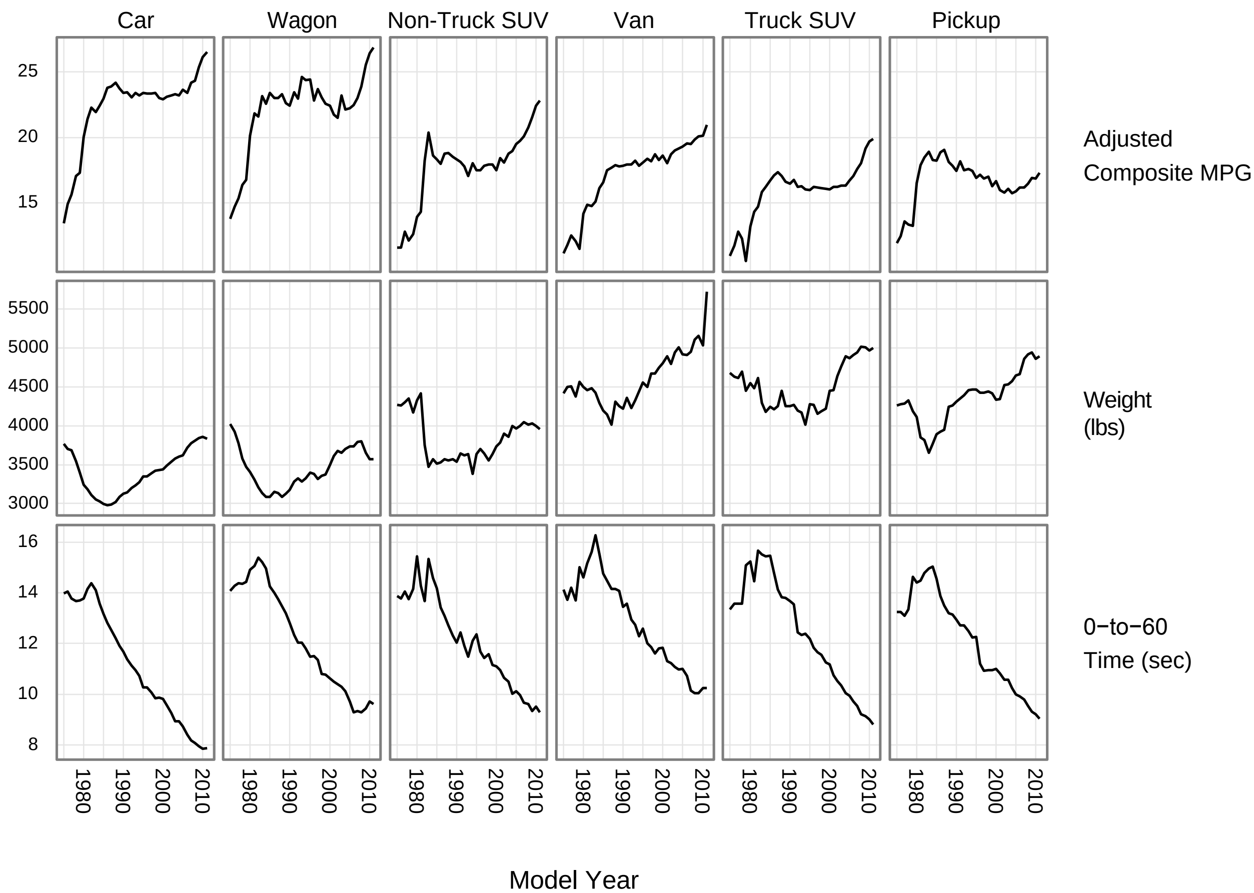


Table 8

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

Car or Truck	Vehicle Type	Size	1975 Low	1975 Average	1975 High	1988 Low	1988 Average	1988 High	2011 Low	2011 Average	2011 High
Car	Car	Small	8.6	15.6	28.3	7.5	25.7	54.4	10.4	27.1	42.9
Car	Car	Midsize	8.6	11.6	18.4	10.5	22.6	27.7	13.3	27.2	49.3
Car	Car	Large	8.4	11.2	14.6	10.0	20.6	26.0	14.2	24.5	28.8
Car	Car	All	8.4	13.4	28.3	7.5	24.2	54.4	10.4	26.5	49.3
Car	Wagon	Small	11.8	19.1	24.1	17.1	26.3	33.2	14.7	26.9	35.6
Car	Wagon	Midsize	8.4	11.3	25.0	17.5	22.2	27.7	19.6	20.0	23.0
Car	Wagon	Large	8.4	10.2	12.8	19.2	19.4	19.4	-	-	-
Car	Wagon	All	8.4	13.8	25.0	17.1	23.3	33.2	14.7	26.8	35.6
Car	Non-Truck SUV	Small	10.2	10.2	10.2	18.6	19.4	20.3	-	-	-
Car	Non-Truck SUV	Midsize	9.9	12.6	18.4	11.6	18.5	23.6	18.3	23.2	31.9
Car	Non-Truck SUV	Large	10.4	11.1	13.7	-	-	-	18.2	22.0	27.0
Car	Non-Truck SUV	All	9.9	11.6	18.4	11.6	18.8	23.6	18.2	22.8	31.9
Truck	Van	Small	16.2	17.5	18.5	15.5	20.6	25.0	-	-	-
Truck	Van	Midsize	8.2	11.3	18.4	11.3	18.4	23.4	13.5	21.3	23.2
Truck	Van	Large	8.9	10.7	14.5	10.0	14.3	16.8	11.3	14.8	17.4
Truck	Van	All	8.2	11.1	18.5	10.0	17.9	25.0	11.3	20.9	23.2
Truck	Truck SUV	Small	12.8	14.3	16.3	15.6	20.5	27.8	17.2	17.5	17.5
Truck	Truck SUV	Midsize	8.2	10.0	16.7	10.2	16.2	22.4	14.3	21.6	29.4
Truck	Truck SUV	Large	7.9	8.8	11.1	12.2	14.0	18.8	12.2	18.8	24.4
Truck	Truck SUV	All	7.9	10.9	16.7	10.2	17.1	27.8	12.2	19.9	29.4
Truck	Pickup	Small	13.0	19.2	20.8	13.3	21.0	24.6	-	-	-
Truck	Pickup	Midsize	17.8	17.9	18.0	15.3	21.3	25.9	20.1	21.7	24.3
Truck	Pickup	Large	7.6	11.1	18.5	9.8	15.2	21.0	12.7	17.1	22.1
Truck	Pickup	All	7.6	11.9	20.8	9.8	18.1	25.9	12.7	17.3	24.3
Car	All	All	8.4	13.5	28.3	7.5	24.1	54.4	10.4	25.9	49.3
Truck	All	All	7.6	11.6	20.8	9.8	17.9	27.8	11.3	18.9	29.4
Fleet	All	All	7.6	13.1	28.3	7.5	21.9	54.4	10.4	22.8	49.3

Table 9

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

Car or Truck	Vehicle Type	Size	1975 to 2011 Low	1975 to 2011 Average	1975 to 2011 High	1975 to 1988 Low	1975 to 1988 Average	1975 to 1988 High	1988 to 2011 Low	1988 to 2011 Average	1988 to 2011 High
Car	Car	Small	21%	74%	52%	-13%	65%	92%	39%	5%	-21%
Car	Car	Midsize	55%	134%	168%	22%	95%	51%	27%	20%	78%
Car	Car	Large	69%	119%	97%	19%	84%	78%	42%	19%	11%
Car	Car	All	24%	98%	74%	-11%	81%	92%	39%	10%	-9%
Car	Wagon	Small	25%	41%	48%	45%	38%	38%	-14%	2%	7%
Car	Wagon	Midsize	133%	77%	-8%	108%	96%	11%	12%	-10%	-17%
Car	Wagon	Large	-	-	-	129%	90%	52%	-	-	-
Car	Wagon	All	75%	94%	42%	104%	69%	33%	-14%	15%	7%
Car	Non-Truck SUV	Small	-	-	-	82%	90%	99%	-	-	-
Car	Non-Truck SUV	Midsize	85%	84%	73%	17%	47%	28%	58%	25%	35%
Car	Non-Truck SUV	Large	75%	98%	97%	-	-	-	-	-	-
Car	Non-Truck SUV	All	84%	97%	73%	17%	62%	28%	57%	21%	35%
Truck	Van	Small	-	-	-	-4%	18%	35%	-	-	-
Truck	Van	Midsize	65%	88%	26%	38%	63%	27%	19%	16%	-1%
Truck	Van	Large	27%	38%	20%	12%	34%	16%	13%	3%	4%
Truck	Van	All	38%	88%	25%	22%	61%	35%	13%	17%	-7%
Truck	Truck SUV	Small	34%	22%	7%	22%	43%	71%	10%	-15%	-37%
Truck	Truck SUV	Midsize	74%	116%	76%	24%	62%	34%	40%	33%	31%
Truck	Truck SUV	Large	54%	114%	120%	54%	59%	69%	0%	34%	30%
Truck	Truck SUV	All	54%	83%	76%	29%	57%	66%	20%	16%	6%
Truck	Pickup	Small	-	-	-	2%	9%	18%	-	-	-
Truck	Pickup	Midsize	13%	21%	35%	-14%	19%	44%	31%	2%	-6%
Truck	Pickup	Large	67%	54%	19%	29%	37%	14%	30%	13%	5%
Truck	Pickup	All	67%	45%	17%	29%	52%	25%	30%	-4%	-6%
Car	All	All	24%	92%	74%	-11%	79%	92%	39%	7%	-9%
Truck	All	All	49%	63%	41%	29%	54%	34%	15%	6%	6%
Fleet	All	All	37%	74%	74%	-1%	67%	92%	39%	4%	-9%

Table 10

Adjusted Fuel Consumption (Gal./100 miles) by Vehicle Type and Size

Car or Truck	Vehicle Type	Size	1975 Low	1975 Average	1975 High	1988 Low	1988 Average	1988 High	2011 Low	2011 Average	2011 High
Car	Car	Small	11.6	6.4	3.5	13.3	3.9	1.8	9.6	3.7	2.3
Car	Car	Midsize	11.6	8.6	5.4	9.5	4.4	3.6	7.5	3.7	2.0
Car	Car	Large	11.9	8.9	6.8	10.0	4.9	3.8	7.0	4.1	3.5
Car	Car	All	11.9	7.5	3.5	13.3	4.1	1.8	9.6	3.8	2.0
Car	Wagon	Small	8.5	5.2	4.1	5.8	3.8	3.0	6.8	3.7	2.8
Car	Wagon	Midsize	11.9	8.8	4.0	5.7	4.5	3.6	5.1	5.0	4.3
Car	Wagon	Large	11.9	9.8	7.8	5.2	5.2	5.2	-	-	-
Car	Wagon	All	11.9	7.2	4.0	5.8	4.3	3.0	6.8	3.7	2.8
Car	Non-Truck SUV	Small	9.8	9.8	9.8	5.4	5.2	4.9	-	-	-
Car	Non-Truck SUV	Midsize	10.1	7.9	5.4	8.6	5.4	4.2	5.5	4.3	3.1
Car	Non-Truck SUV	Large	9.6	9.0	7.3	-	-	-	5.5	4.5	3.7
Car	Non-Truck SUV	All	10.1	8.6	5.4	8.6	5.3	4.2	5.5	4.4	3.1
Truck	Van	Small	6.2	5.7	5.4	6.5	4.9	4.0	-	-	-
Truck	Van	Midsize	12.2	8.8	5.4	8.8	5.4	4.3	7.4	4.7	4.3
Truck	Van	Large	11.2	9.3	6.9	10.0	7.0	6.0	8.8	6.8	5.7
Truck	Van	All	12.2	9.0	5.4	10.0	5.6	4.0	8.8	4.8	4.3
Truck	Truck SUV	Small	7.8	7.0	6.1	6.4	4.9	3.6	5.8	5.7	5.7
Truck	Truck SUV	Midsize	12.2	10.0	6.0	9.8	6.2	4.5	7.0	4.6	3.4
Truck	Truck SUV	Large	12.7	11.4	9.0	8.2	7.1	5.3	8.2	5.3	4.1
Truck	Truck SUV	All	12.7	9.2	6.0	9.8	5.8	3.6	8.2	5.0	3.4
Truck	Pickup	Small	7.7	5.2	4.8	7.5	4.8	4.1	-	-	-
Truck	Pickup	Midsize	5.6	5.6	5.6	6.5	4.7	3.9	5.0	4.6	4.1
Truck	Pickup	Large	13.2	9.0	5.4	10.2	6.6	4.8	7.9	5.8	4.5
Truck	Pickup	All	13.2	8.4	4.8	10.2	5.5	3.9	7.9	5.8	4.1
Car	All	All	11.9	7.4	3.5	13.3	4.1	1.8	9.6	3.9	2.0
Truck	All	All	13.2	8.6	4.8	10.2	5.6	3.6	8.8	5.3	3.4
Fleet	All	All	13.2	7.6	3.5	13.3	4.6	1.8	9.6	4.4	2.0

Table 11

Percent Change* in Adjusted Fuel Consumption by Vehicle Type and Size

Car or Truck	Vehicle Type	Size	1975 to 2011 Low	1975 to 2011 Average	1975 to 2011 High	1975 to 1988 Low	1975 to 1988 Average	1975 to 1988 High	1988 to 2011 Low	1988 to 2011 Average	1988 to 2011 High
Car	Car	Small	17%	42%	34%	-15%	39%	49%	28%	5%	-28%
Car	Car	Midsize	35%	57%	63%	18%	49%	33%	21%	16%	44%
Car	Car	Large	41%	54%	49%	16%	45%	44%	30%	16%	8%
Car	Car	All	19%	49%	43%	-12%	45%	49%	28%	7%	-11%
Car	Wagon	Small	20%	29%	32%	32%	27%	27%	-17%	3%	7%
Car	Wagon	Midsize	57%	43%	-7%	52%	49%	10%	11%	-11%	-19%
Car	Wagon	Large	-	-	-	56%	47%	33%	-	-	-
Car	Wagon	All	43%	49%	30%	51%	40%	25%	-17%	14%	7%
Car	Non-Truck SUV	Small	-	-	-	45%	47%	50%	-	-	-
Car	Non-Truck SUV	Midsize	46%	46%	43%	15%	32%	22%	36%	20%	26%
Car	Non-Truck SUV	Large	43%	50%	49%	-	-	-	-	-	-
Car	Non-Truck SUV	All	46%	49%	43%	15%	38%	22%	36%	17%	26%
Truck	Van	Small	-	-	-	-5%	14%	26%	-	-	-
Truck	Van	Midsize	39%	47%	20%	28%	39%	20%	16%	13%	0%
Truck	Van	Large	21%	27%	17%	11%	25%	13%	12%	3%	5%
Truck	Van	All	28%	47%	20%	18%	38%	26%	12%	14%	-7%
Truck	Truck SUV	Small	26%	19%	7%	18%	30%	41%	9%	-16%	-58%
Truck	Truck SUV	Midsize	43%	54%	43%	20%	38%	25%	29%	26%	24%
Truck	Truck SUV	Large	35%	54%	54%	35%	38%	41%	0%	25%	23%
Truck	Truck SUV	All	35%	46%	43%	23%	37%	40%	16%	14%	6%
Truck	Pickup	Small	-	-	-	3%	8%	15%	-	-	-
Truck	Pickup	Midsize	11%	18%	27%	-16%	16%	30%	23%	2%	-5%
Truck	Pickup	Large	40%	36%	17%	23%	27%	11%	23%	12%	6%
Truck	Pickup	All	40%	31%	15%	23%	35%	19%	23%	-5%	-5%
Car	All	All	19%	47%	43%	-12%	45%	49%	28%	5%	-11%
Truck	All	All	33%	38%	29%	23%	35%	25%	14%	5%	6%
Fleet	All	All	27%	42%	43%	-1%	39%	49%	28%	4%	-11%

*Note: A negative change indicates that fuel consumption has increased.

Cars and light trucks with conventional drive trains have a fuel consumption and weight relationship which is well known and is shown in Figure 11. Fuel consumption increases linearly with weight. Because vehicles with different propulsion systems, i.e., diesels and hybrids, occupy a different place on such a fuel consumption and weight plot, the data for hybrid and diesel vehicles are plotted separately and excluded from the trend lines shown on the graphs. At constant weight, MY 2011 cars consume about 40% less fuel per mile than their MY 1975 counterparts.

On this same constant weight basis, this year's vehicles with diesel engines consume 20-30% less fuel than the conventionally powered ones, while this year's hybrid vehicles are about 20-60% better. Similarly, at constant weight this year's conventionally powered trucks achieve about 50% better fuel consumption than MY 1975 vehicles did.

Figure 11

Laboratory 55/45 Fuel Consumption vs. Vehicle Weight, MY 1975 and MY 2011

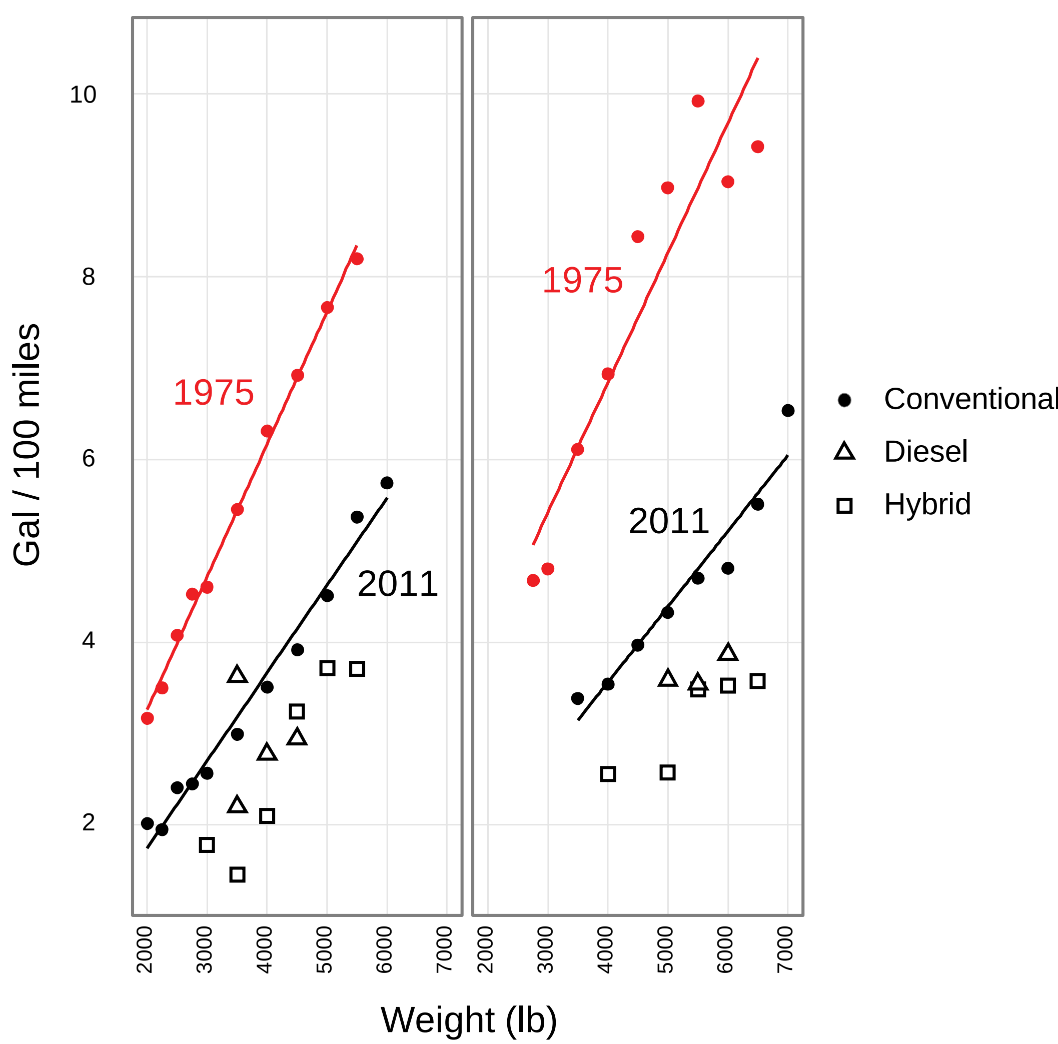


Figure 12 shows that the relationship between interior volume and fuel consumption is currently not as important as in the past. The data points on both of these graphs exclude two seaters and represent production weighted average fuel consumption calculated at increments of 1.0 cu. ft. As was done for Figure 11, the data points for hybrid and diesel vehicles were plotted separately from those for the conventionally powered vehicles.

Figure 12

Laboratory 55/45 Fuel Consumption vs. Interior Volume, MY 1978 and MY 2011 Cars

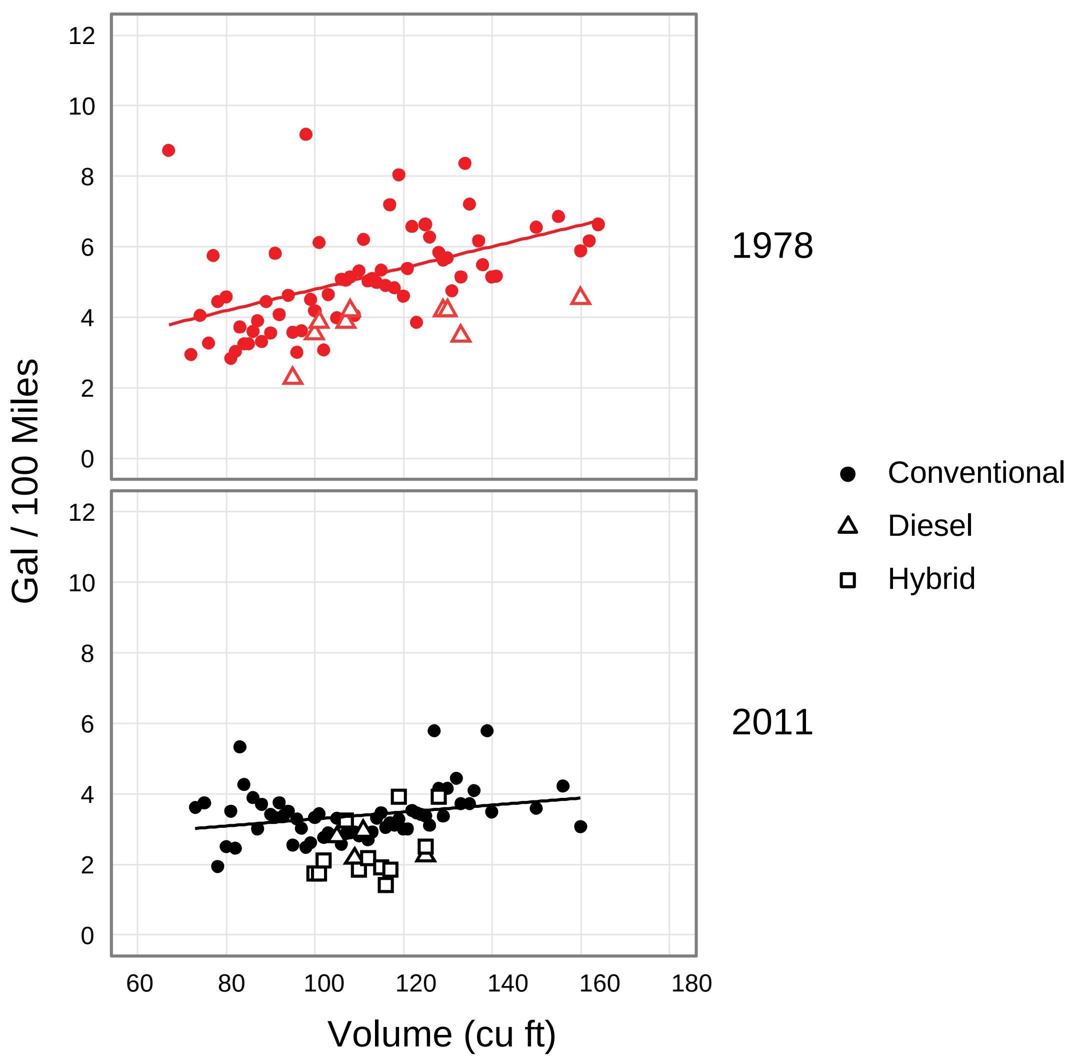


Figure 13 shows laboratory 55/45 fuel consumption versus footprint for MY 2011 cars and trucks, respectively, again with the regression lines excluding the hybrid and diesel data points. Car fuel consumption is more sensitive to footprint than truck fuel consumption. Most cars have footprint values below 50 square feet, and at these footprint levels cars generally have lower fuel consumption than trucks. For the much smaller number of cars that have footprint levels greater than 50 square feet (often high performance cars), these cars generally have higher fuel consumption than trucks of the same footprint.

Figure 13

Laboratory 55/45 Fuel Consumption vs. Footprint, MY 2011 Vehicles

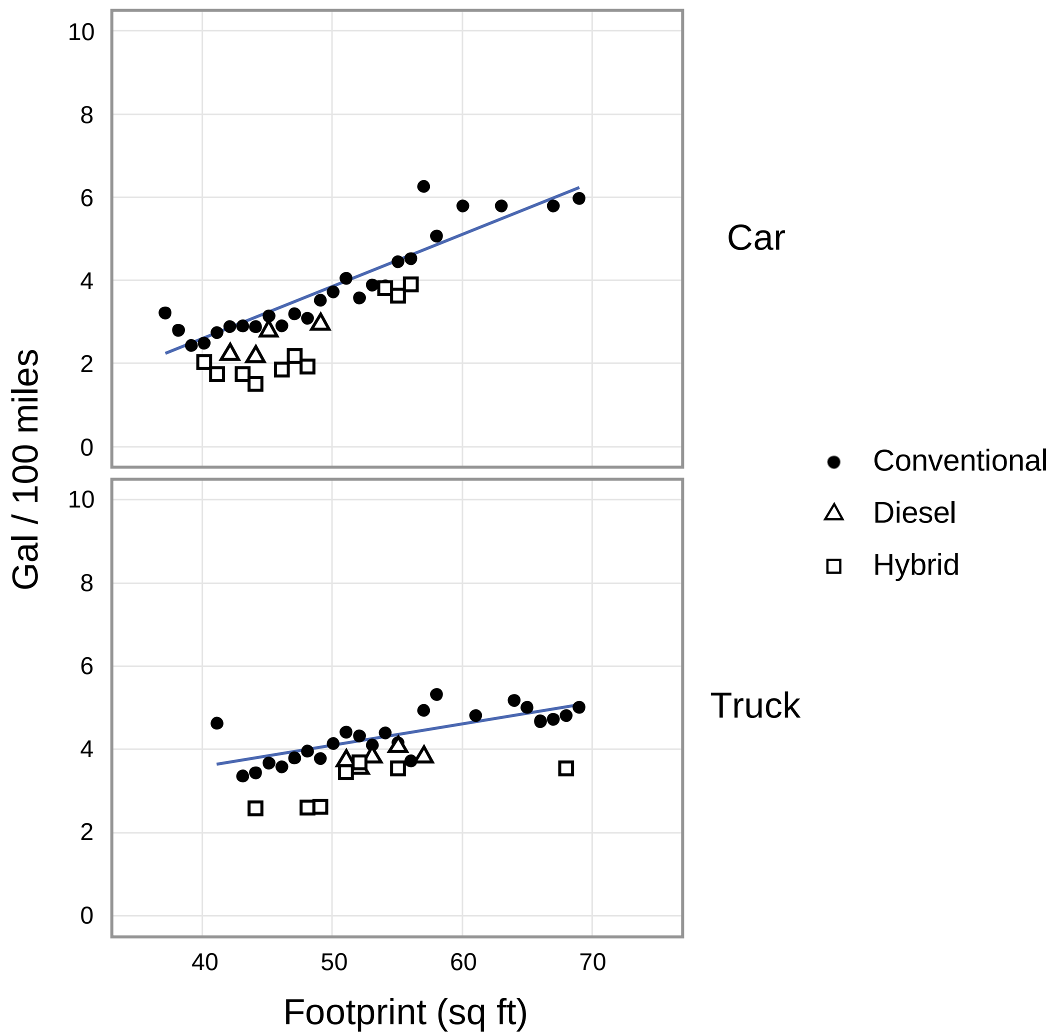


Figure 14 shows the improvement that occurred between MY 1975 and 2011 for fuel consumption as a function of 0-to-60 acceleration time for cars and trucks.

Figure 14

Laboratory 55/45 Fuel Consumption vs. 0-to-60 Time, MY 1975 and MY 2011 Vehicles

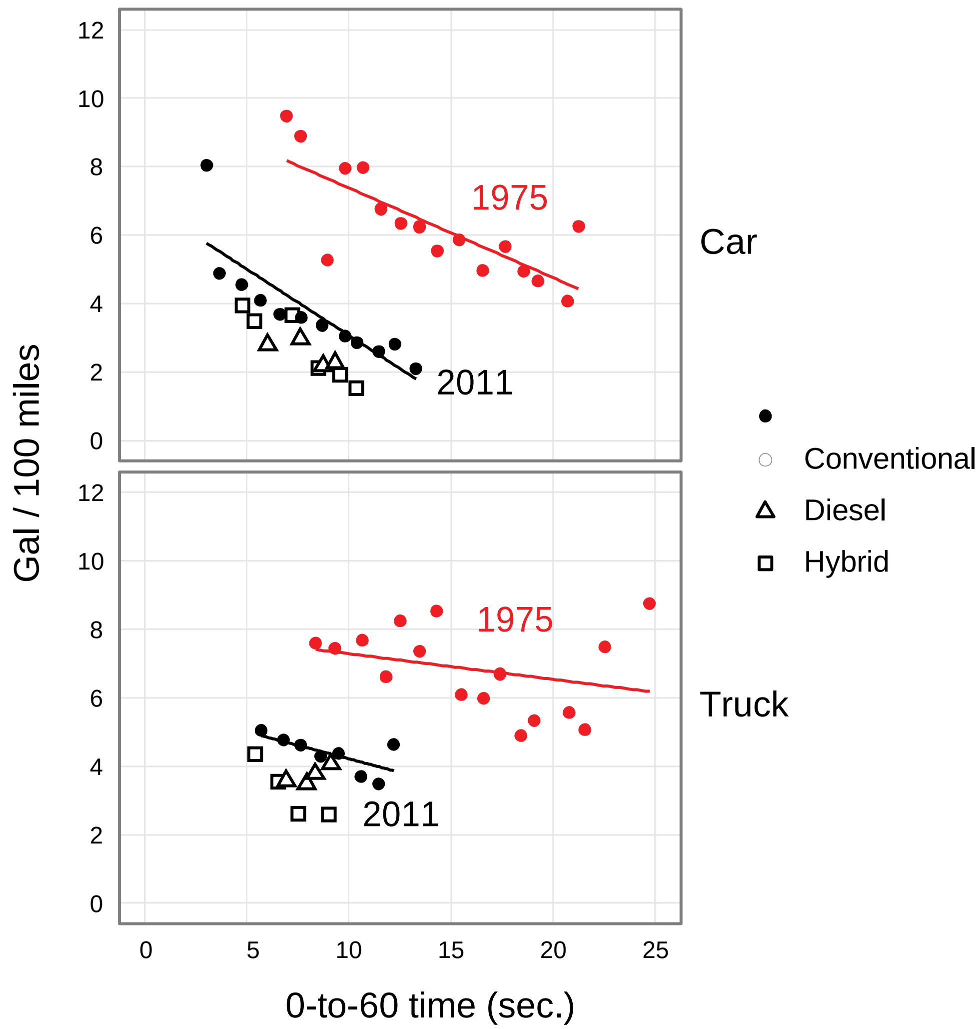


Figure 15 compares Ton-MPG data versus 0-to-60 time and shows that at constant vehicle performance, there has been substantial improvement in Ton-MPG.

Figure 15

Ton-MPG vs. 0-to-60 Time, MY 1975 and MY 2011 Vehicles

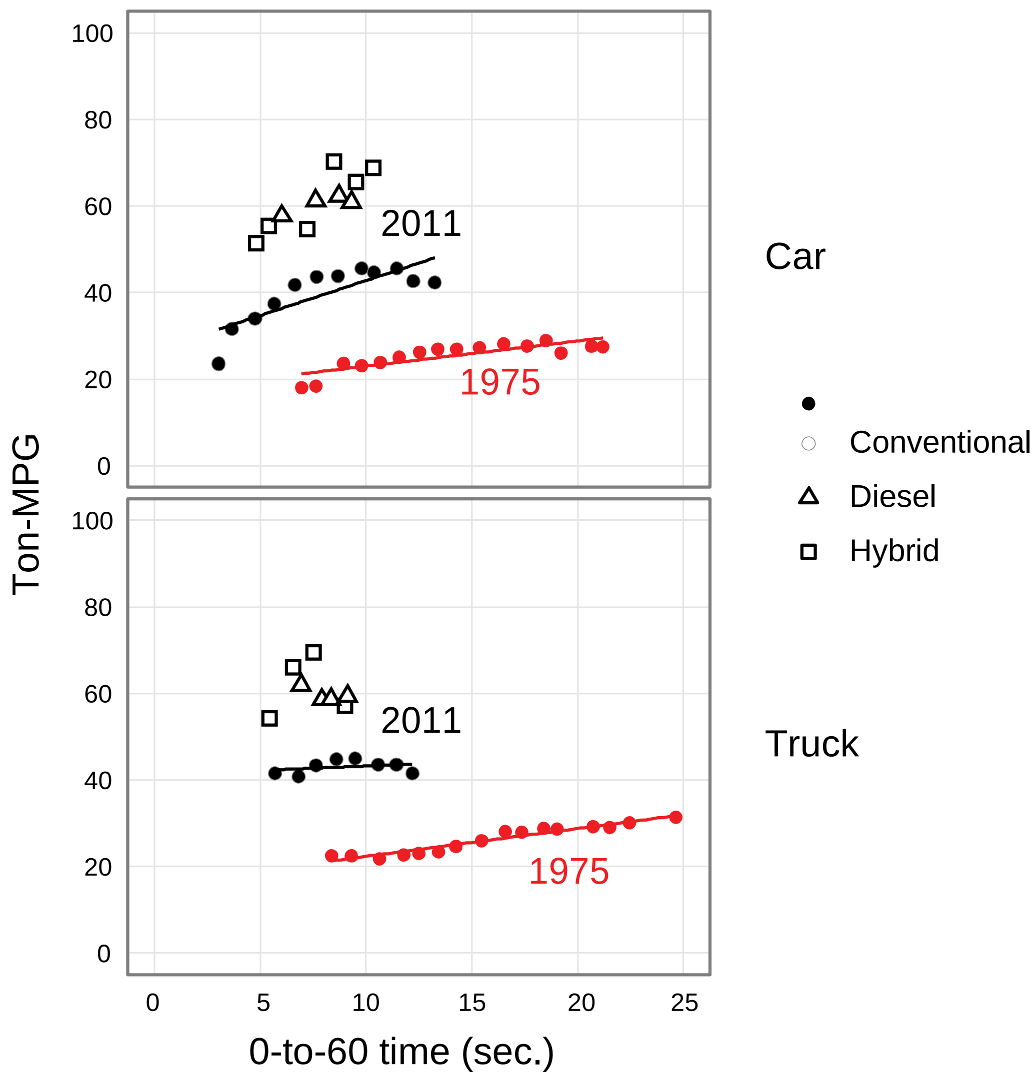


Figure 16 and Table 12 show some of the changes in the distribution of weight that have occurred over the years for the light-duty fleet. In MY 1975, 13% of all light-duty vehicles had weights of less than 3000 lb compared to less than 4% in MY 2011. Since MY 1988, production share for vehicles with weights of 5000 pounds or more has increased from 3% to 21%.

Figure 16

Distribution of Light Vehicle Weight for Three Model Years

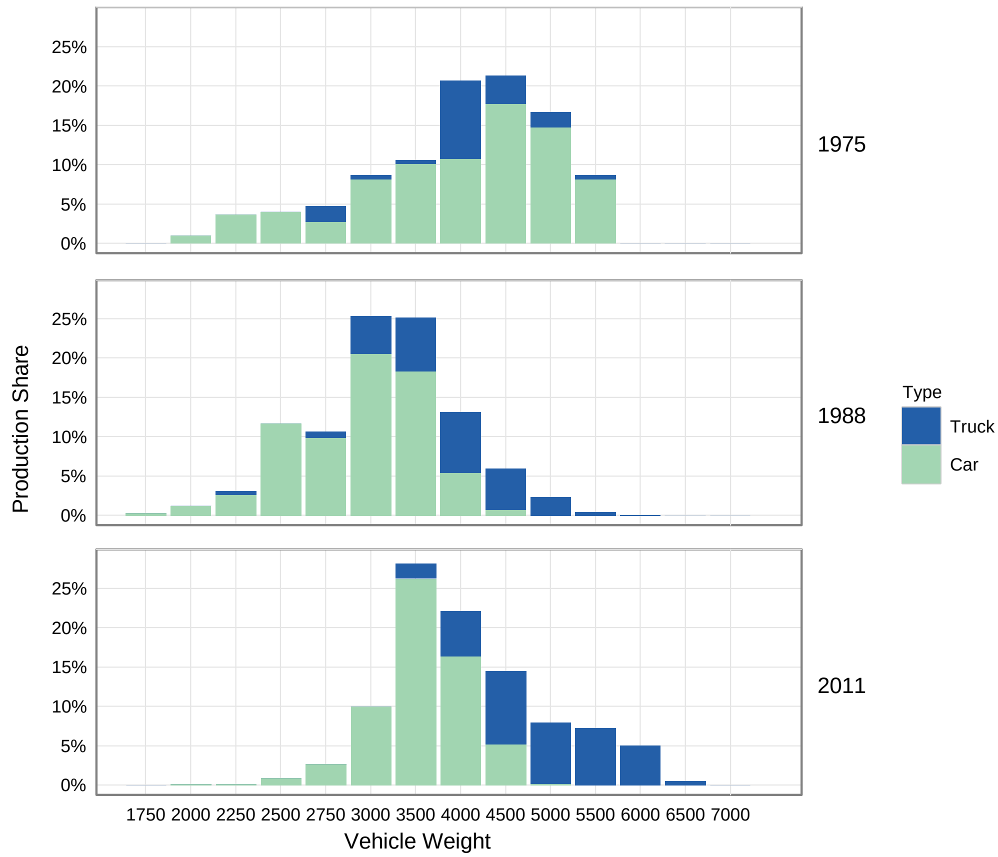


Figure 17 provides data for the annual production share of different weight classes for cars and trucks. In MY 1975, about one-half of the cars were in weight classes greater than 4000 pounds, compared to about one-tenth this year. For MY 2011, three weight classes (3000, 3500, and 4000 lbs) account for over 90% of all cars. Conversely, the production share of trucks in the weight classes of 4500 lb or more have increased substantially, and these vehicles currently account for about 80% of all trucks, compared to about 40% in 1975. Figure 18 provides additional details of the truck data presented in Figure 17 for vans, SUVs, and pickups, respectively. Appendices D, E, and F contain a series of tables describing light-duty vehicles at the vehicle size/type level of stratification in more detail; Appendix G provides similar data by vehicle type and weight class.

Table 12

Light Vehicle Production Share by Weight Class for Three Model Years

Weight (lb)	MY 1975	MY 1988	MY 2011
<3000	13.4%	27.2%	4.0%
3000	8.7%	25.4%	10.0%
3500	10.6%	25.2%	28.2%
4000	20.6%	13.2%	22.2%
4500	21.3%	6.0%	14.6%
5000	16.7%	2.4%	8.0%
5500	8.7%	0.5%	7.3%
>5500	0.0%	0.0%	5.7%
Avg Wt	4060	3283	4084

Figure 17

Production Share by Vehicle Weight Class

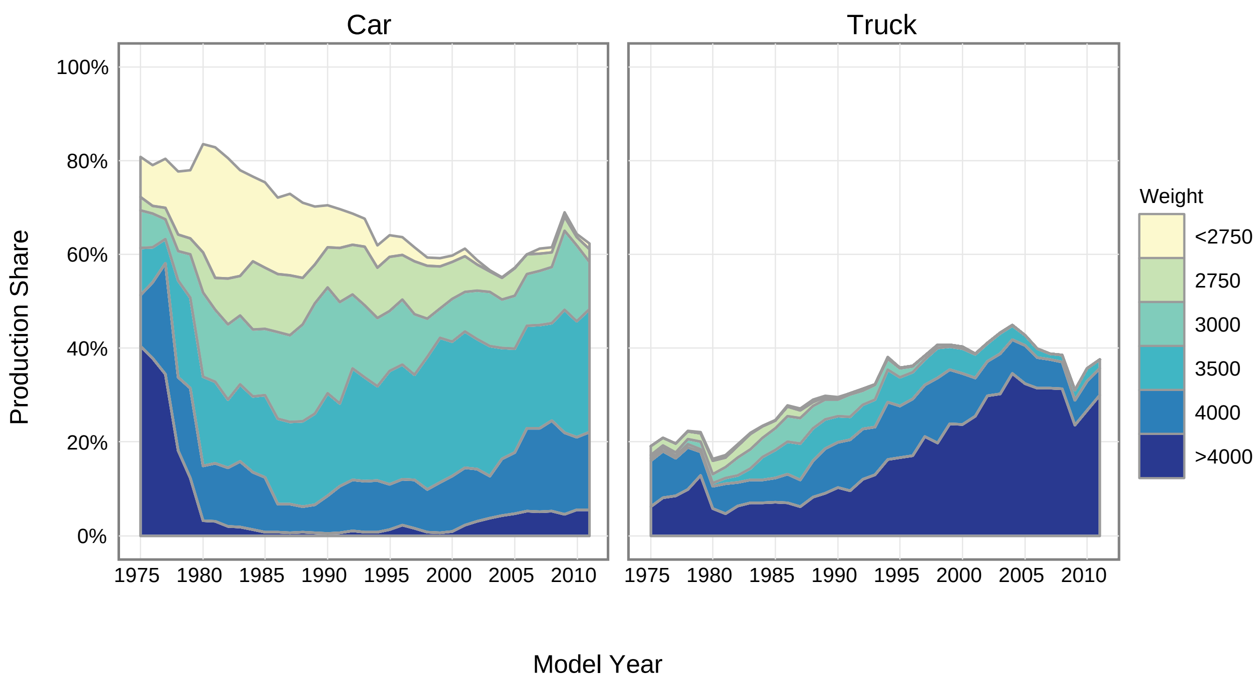
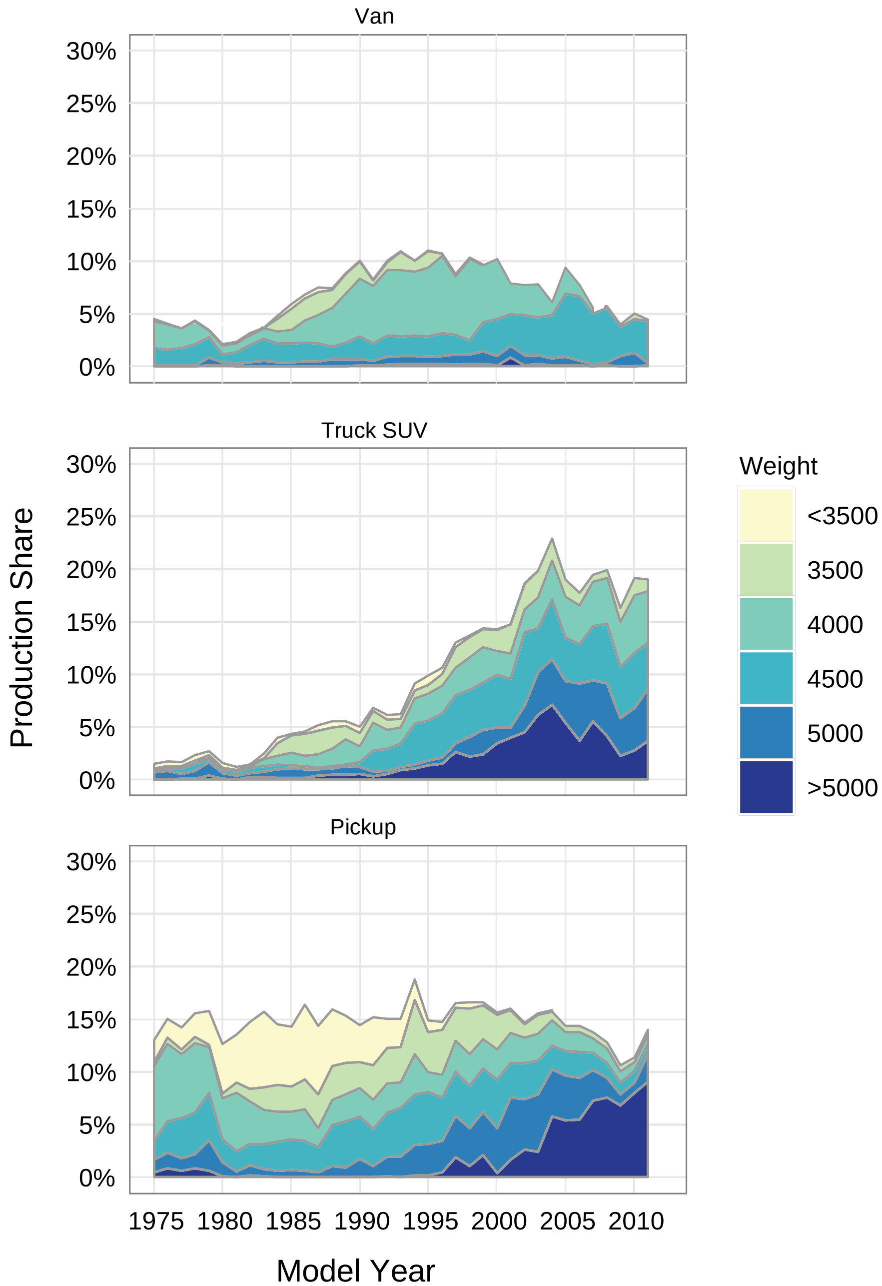


Figure 18

Production Share by Truck Type and Weight Class



VI. Fuel Economy Powertrain Technology Trends

Table 13 presents an overview of key engine technology trends for the MY 1975-2011 database. Conventional gasoline vehicles continue to account for over 95% of all light-duty vehicles. While engine size has been decreasing slightly in recent years, overall engine horsepower has continued to increase, with the notable exception of MY 2009. Nearly all engines now have multiple valves (approximately 85%) and variable valve timing (projected to approach 95% in MY 2011). One very important trend is the recent introduction of several new engine technologies. For example, gasoline direct injection engine production share has increased from essentially zero in MY 2007 to 8% in MY 2010, and is projected to be 14% in MY 2011. The use of cylinder deactivation has increased to 6% of all engines in MY 2010 and is projected to grow to 11% in MY 2011. The use of boost technologies, turbocharging or supercharging, has been in the 2-4% range since MY 1998, but is projected to increase to 7% in MY 2011. Appendix K contains additional data on fuel metering and number of valves per cylinder.

Table 14 presents an overview of key transmission and drive technology trends for MY 1975-2011. The data in this table suggest two important trends with respect to transmission design. One, the use of continuously variable transmissions has increased significantly in recent years, growing from nearly zero in 2002 to over 10% of the fleet. The second trend is an increase in the number of transmission gears. The average number of gears has grown from 4 throughout the 1990s to over 5 in MY 2010, and is projected to be 5.6 in MY 2011. The use of 6-gear transmissions has exploded from less than 5% in 2005 to nearly 40% in MY 2010 and is projected to exceed 50% in MY 2011. Figure 19 shows the same transmission data in graphical format. More data stratified by transmission type can be found in Appendix I. With respect to drive technologies, the market seems to have approximately stabilized, with about 60% front wheel drive, 15% rear wheel drive, and 25% four wheel drive.

The rest of this section examines the engine, transmission, and drive trends in Tables 13 and 14 in more detail.

Table 15 disaggregates some of the engine and transmission technologies for MY 2011 by vehicle type and size. As discussed earlier, wheelbase is used in this report to distinguish whether a truck is small, mid-size, or large, and four EPA car classes (Two-Seater, Minicompact, Compact, and Subcompact) have been combined to form the small car class. For this table, the car classes are separated into cars, station wagons, and non-truck SUVs, so that the table stratifies light-duty vehicles into a total of 18 vehicle types and sizes. Note that this table does not contain any data for large wagons, small non-truck SUVs, small vans, or small pickups, because none have been produced for several years. Front wheel drive (FWD) is used heavily in all of the car, wagon, non-truck SUV, and van classes, except midsize wagons. Conversely, four wheel drive (4WD) is used heavily in truck SUVs and large pickups. Manual transmissions are used primarily in small vehicles, some sports cars, and midsize pickups. Engines with more than two valves per cylinder and VVT are now prevalent for nearly all vehicle types and sizes.

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

Table 13

Engine Characteristics of MY 1975 to MY 2011 Light Duty Vehicles

Cars

	Powertrain			Fuel Injection Metering Method												
Model Year	Gasoline	Gasoline Hybrid	Diesel	Carbureted	GDI	Port	TBI	Diesel	Avg. Number of Cylinders	CID	HP	HP/ CID	Multi-Valve	VVT	CD	Boosted (Turbocharged or Supercharged)
1975	99.8%	-	0.2%	94.7%	-	5.1%	-	0.2%	6.71	288	136	0.515	-	-	-	-
1976	99.7%	-	0.3%	96.6%	-	3.2%	-	0.3%	6.75	287	134	0.502	-	-	-	-
1977	99.5%	-	0.5%	95.3%	-	4.2%	-	0.5%	6.85	279	133	0.516	-	-	-	-
1978	99.1%	-	0.9%	94.0%	-	5.0%	-	0.9%	6.53	252	124	0.538	-	-	-	-
1979	97.9%	-	2.1%	93.2%	-	4.7%	-	2.1%	6.38	238	119	0.545	-	-	-	-
1980	95.6%	-	4.4%	88.7%	-	6.2%	0.7%	4.4%	5.48	188	100	0.583	-	-	-	-
1981	94.1%	-	5.9%	85.3%	-	6.1%	2.6%	5.9%	5.36	182	99	0.594	-	-	-	-
1982	95.3%	-	4.7%	78.4%	-	7.2%	9.8%	4.7%	5.23	175	99	0.609	-	-	-	-
1983	97.9%	-	2.1%	69.7%	-	9.4%	18.8%	2.1%	5.39	182	104	0.615	-	-	-	-
1984	98.3%	-	1.7%	59.2%	-	14.9%	24.2%	1.7%	5.34	179	106	0.637	-	-	-	-
1985	99.1%	-	0.9%	46.1%	-	21.2%	31.8%	0.9%	5.30	177	111	0.671	-	-	-	-
1986	99.7%	-	0.3%	34.5%	-	36.5%	28.7%	0.3%	5.09	167	111	0.701	4.7%	-	-	-
1987	99.8%	-	0.2%	26.6%	-	42.4%	30.8%	0.2%	4.98	162	113	0.732	14.5%	-	-	-
1988	100.0%	-	0.0%	16.1%	-	53.6%	30.3%	0.0%	5.02	161	116	0.758	19.7%	-	-	-
1989	100.0%	-	0.0%	9.6%	-	62.1%	28.2%	0.0%	5.07	163	121	0.781	24.1%	-	-	-
1990	100.0%	-	0.0%	1.4%	-	77.3%	21.2%	0.0%	5.06	163	129	0.828	32.7%	0.6%	-	-
1991	99.9%	-	0.1%	0.1%	-	77.2%	22.6%	0.1%	5.05	164	133	0.847	33.2%	2.4%	-	-
1992	99.9%	-	0.1%	0.0%	-	88.9%	11.0%	0.1%	5.23	171	141	0.864	33.9%	4.4%	-	-
1993	100.0%	-	-	0.0%	-	91.5%	8.5%	-	5.19	170	140	0.859	34.7%	4.5%	-	-
1994	100.0%	-	0.0%	-	-	94.8%	5.2%	0.0%	5.20	169	144	0.880	39.9%	7.7%	-	-
1995	99.9%	-	0.1%	-	-	98.6%	1.3%	0.1%	5.24	169	153	0.939	50.9%	9.5%	-	-
1996	99.9%	-	0.1%	-	-	98.9%	1.0%	0.1%	5.21	169	155	0.948	55.7%	11.0%	-	0.3%
1997	99.9%	-	0.1%	-	-	99.2%	0.7%	0.1%	5.14	167	157	0.965	57.7%	10.6%	-	0.7%
1998	99.8%	-	0.2%	-	-	99.7%	0.1%	0.2%	5.17	168	160	0.981	59.7%	17.1%	-	2.5%
1999	99.8%	-	0.2%	-	-	99.8%	0.1%	0.2%	5.23	170	165	0.997	62.8%	16.1%	-	3.6%
2000	99.7%	0.1%	0.2%	-	-	99.7%	0.1%	0.2%	5.25	170	169	1.017	62.8%	21.8%	-	2.8%
2001	99.7%	0.0%	0.2%	-	-	99.8%	-	0.2%	5.23	170	171	1.030	64.0%	26.6%	-	3.7%
2002	99.4%	0.3%	0.3%	-	-	99.7%	-	0.3%	5.19	171	176	1.055	68.3%	32.9%	-	4.1%
2003	99.1%	0.5%	0.3%	-	-	99.7%	-	0.3%	5.18	170	179	1.077	72.9%	40.6%	-	2.4%
2004	98.9%	0.8%	0.3%	-	-	99.7%	-	0.3%	5.20	173	186	1.093	76.0%	44.0%	-	4.6%
2005	97.7%	1.9%	0.4%	-	-	99.6%	-	0.4%	5.10	170	185	1.106	77.9%	50.4%	0.9%	3.6%
2006	97.8%	1.7%	0.6%	-	-	99.4%	-	0.6%	5.19	175	195	1.134	81.0%	59.0%	2.5%	3.9%
2007	96.7%	3.2%	0.0%	-	-	99.7%	-	0.0%	5.02	169	192	1.150	84.4%	63.8%	1.4%	4.0%
2008	96.7%	3.2%	0.1%	-	3.0%	97.0%	-	0.1%	4.99	168	195	1.172	88.1%	63.2%	1.9%	4.6%
2009	96.5%	2.9%	0.6%	-	4.3%	95.1%	-	0.6%	4.72	158	187	1.189	92.3%	78.8%	2.2%	4.5%
2010	93.9%	5.3%	0.9%	-	8.0%	91.2%	-	0.9%	4.72	159	191	1.200	93.5%	91.0%	2.6%	4.4%
2011	93.7%	5.5%	0.8%	-	13.9%	85.3%	-	0.8%	4.74	159	198	1.248	94.6%	95.3%	2.9%	8.5%

Table 13 (continued)

Engine Characteristics of MY 1975 to MY 2011 Light Duty Vehicles

Trucks

	Powertrain			Fuel Injection Metering Method												
Model Year	Gasoline	Gasoline Hybrid	Diesel	Carbureted	GDI	Port	TBI	Diesel	Avg. Number of Cylinders	CID	HP	HP/ CID	Multi-Valve	VVT	CD	Boosted (Turbocharged or Supercharged)
1975	100.0%	-	-	99.9%	-	-	0.1%	-	7.28	311	142	0.477	-	-	-	-
1976	100.0%	-	-	99.9%	-	-	0.1%	-	7.31	320	141	0.458	-	-	-	-
1977	100.0%	-	-	99.9%	-	-	0.1%	-	7.27	318	147	0.483	-	-	-	-
1978	99.2%	-	0.8%	99.1%	-	-	0.1%	0.8%	7.24	315	146	0.481	-	-	-	-
1979	98.2%	-	1.8%	97.9%	-	-	0.3%	1.8%	7.05	299	138	0.485	-	-	-	-
1980	96.5%	-	3.5%	94.9%	-	-	1.7%	3.5%	6.15	248	121	0.528	-	-	-	-
1981	94.4%	-	5.6%	93.2%	-	-	1.1%	5.6%	6.15	247	118	0.508	-	-	-	-
1982	90.6%	-	9.4%	89.9%	-	-	0.7%	9.4%	6.26	244	120	0.524	-	-	-	-
1983	95.2%	-	4.8%	94.6%	-	-	0.6%	4.8%	6.06	232	118	0.542	-	-	-	-
1984	97.6%	-	2.4%	95.0%	-	2.0%	0.6%	2.4%	5.99	225	118	0.557	-	-	-	-
1985	98.9%	-	1.1%	86.4%	-	9.0%	3.5%	1.1%	5.96	224	124	0.585	-	-	-	-
1986	99.3%	-	0.7%	59.3%	-	22.2%	17.8%	0.7%	5.70	212	123	0.620	-	-	-	-
1987	99.7%	-	0.3%	33.5%	-	33.4%	32.9%	0.3%	5.68	210	131	0.652	-	-	-	-
1988	99.8%	-	0.2%	12.4%	-	43.2%	44.2%	0.2%	6.00	228	141	0.649	-	-	-	-
1989	99.8%	-	0.2%	6.5%	-	46.0%	47.3%	0.2%	6.04	234	146	0.653	-	-	-	-
1990	99.8%	-	0.2%	3.9%	-	55.1%	40.9%	0.2%	6.17	237	151	0.667	-	-	-	-
1991	99.9%	-	0.1%	1.7%	-	55.3%	42.9%	0.1%	5.95	229	150	0.681	-	-	-	-
1992	99.9%	-	0.1%	1.6%	-	65.6%	32.7%	0.1%	6.09	236	155	0.682	-	-	-	-
1993	100.0%	-	-	1.0%	-	71.4%	27.6%	-	6.13	235	160	0.704	-	-	-	-
1994	100.0%	-	-	0.4%	-	76.2%	23.4%	-	6.19	241	166	0.713	5.2%	-	-	-
1995	100.0%	-	-	-	-	79.0%	21.0%	-	6.23	246	168	0.712	8.1%	-	-	-
1996	99.9%	-	0.1%	-	-	99.9%	-	0.1%	6.25	245	180	0.754	10.5%	-	-	-
1997	100.0%	-	0.0%	-	-	100.0%	-	0.0%	6.47	251	189	0.770	10.5%	-	-	-
1998	100.0%	-	0.0%	-	-	100.0%	-	0.0%	6.30	244	188	0.791	13.6%	-	-	-
1999	100.0%	-	0.0%	-	-	100.0%	-	0.0%	6.49	252	199	0.811	15.2%	-	-	-
2000	100.0%	-	-	-	-	100.0%	-	-	6.47	245	199	0.830	18.1%	4.8%	-	-
2001	100.0%	-	-	-	-	100.0%	-	-	6.61	250	212	0.870	25.4%	8.5%	-	-
2002	100.0%	-	-	-	-	100.0%	-	-	6.60	250	223	0.907	31.8%	14.4%	-	-
2003	100.0%	-	-	-	-	100.0%	-	-	6.59	249	224	0.915	32.7%	17.4%	-	0.5%
2004	100.0%	0.0%	0.0%	-	-	100.0%	-	0.0%	6.75	259	241	0.944	45.4%	31.8%	-	0.8%
2005	99.8%	0.1%	0.1%	-	-	99.9%	-	0.1%	6.61	252	242	0.974	49.3%	39.6%	0.6%	0.6%
2006	98.6%	1.2%	0.1%	-	-	99.9%	-	0.1%	6.54	248	240	0.982	57.6%	50.0%	5.3%	0.8%
2007	99.3%	0.6%	0.1%	-	-	99.9%	-	0.1%	6.62	255	256	1.018	51.8%	47.2%	16.6%	1.1%
2008	98.5%	1.3%	0.2%	-	1.1%	98.6%	-	0.2%	6.47	248	256	1.041	57.7%	50.2%	14.3%	1.3%
2009	98.7%	1.0%	0.3%	-	4.1%	95.6%	-	0.3%	6.29	239	254	1.081	64.5%	55.0%	18.7%	1.5%
2010	98.6%	1.0%	0.4%	-	8.8%	90.8%	-	0.4%	6.25	238	254	1.087	71.0%	71.0%	13.4%	1.9%
2011	98.2%	1.4%	0.3%	-	13.3%	86.4%	-	0.3%	6.40	245	279	1.165	68.4%	91.2%	24.6%	5.6%

Table 13 (continued)

Engine Characteristics of MY 1975 to MY 2011 Light Duty Vehicles

Cars and Trucks

	Powertrain			Fuel Injection Metering Method												
Model Year	Gasoline	Gasoline Hybrid	Diesel	Carbureted	GDI	Port	TBI	Diesel	Avg. Number of Cylinders	CID	HP	HP/ CID	Multi-Valve	VVT	CD	Boosted (Turbocharged or Supercharged)
1975	99.8%	-	0.2%	95.7%	-	4.1%	0.0%	0.2%	6.82	293	137	0.507	-	-	-	-
1976	99.8%	-	0.2%	97.3%	-	2.5%	0.0%	0.2%	6.87	294	135	0.493	-	-	-	-
1977	99.6%	-	0.4%	96.2%	-	3.4%	0.0%	0.4%	6.94	287	136	0.510	-	-	-	-
1978	99.1%	-	0.9%	95.2%	-	3.9%	0.0%	0.9%	6.69	266	129	0.525	-	-	-	-
1979	98.0%	-	2.0%	94.2%	-	3.7%	0.1%	2.0%	6.53	252	124	0.532	-	-	-	-
1980	95.7%	-	4.3%	89.7%	-	5.2%	0.8%	4.3%	5.59	198	104	0.574	-	-	-	-
1981	94.1%	-	5.9%	86.7%	-	5.1%	2.4%	5.9%	5.50	193	102	0.580	-	-	-	-
1982	94.4%	-	5.6%	80.6%	-	5.8%	8.0%	5.6%	5.43	188	103	0.593	-	-	-	-
1983	97.3%	-	2.7%	75.2%	-	7.3%	14.8%	2.7%	5.54	193	107	0.599	-	-	-	-
1984	98.2%	-	1.8%	67.6%	-	11.9%	18.7%	1.8%	5.49	190	109	0.618	-	-	-	-
1985	99.1%	-	0.9%	56.1%	-	18.2%	24.8%	0.9%	5.46	189	114	0.650	-	-	-	-
1986	99.6%	-	0.4%	41.4%	-	32.5%	25.7%	0.4%	5.26	180	114	0.678	3.4%	-	-	-
1987	99.7%	-	0.3%	28.4%	-	39.9%	31.4%	0.3%	5.17	175	118	0.710	10.6%	-	-	-
1988	99.9%	-	0.1%	15.0%	-	50.6%	34.3%	0.1%	5.31	180	123	0.726	14.0%	-	-	-
1989	99.9%	-	0.1%	8.7%	-	57.3%	33.9%	0.1%	5.36	185	129	0.743	16.9%	-	-	-
1990	99.9%	-	0.1%	2.1%	-	70.8%	27.0%	0.1%	5.39	185	135	0.781	23.1%	-	-	-
1991	99.9%	-	0.1%	0.6%	-	70.6%	28.7%	0.1%	5.32	184	138	0.796	23.1%	-	-	-
1992	99.9%	-	0.1%	0.5%	-	81.6%	17.8%	0.1%	5.50	191	145	0.807	23.3%	-	-	-
1993	100.0%	-	-	0.3%	-	85.0%	14.6%	-	5.50	191	147	0.809	23.5%	-	-	-
1994	100.0%	-	0.0%	0.1%	-	87.7%	12.1%	0.0%	5.58	197	152	0.816	26.7%	-	-	-
1995	100.0%	-	0.0%	-	-	91.6%	8.4%	0.0%	5.59	196	158	0.857	35.6%	-	-	-
1996	99.9%	-	0.1%	-	-	99.3%	0.7%	0.1%	5.59	197	164	0.878	39.3%	-	-	0.3%
1997	99.9%	-	0.1%	-	-	99.5%	0.5%	0.1%	5.65	199	169	0.890	39.6%	-	-	0.5%
1998	99.9%	-	0.1%	-	-	99.8%	0.1%	0.1%	5.63	199	171	0.904	40.9%	-	-	2.0%
1999	99.9%	-	0.1%	-	-	99.9%	0.1%	0.1%	5.75	203	179	0.921	43.4%	-	-	2.1%
2000	99.8%	0.0%	0.1%	-	-	99.8%	0.0%	0.1%	5.74	200	181	0.942	44.8%	15.0%	-	1.7%
2001	99.8%	0.0%	0.1%	-	-	99.9%	-	0.1%	5.76	201	187	0.968	49.0%	19.6%	-	2.3%
2002	99.6%	0.2%	0.2%	-	-	99.8%	-	0.2%	5.77	203	195	0.994	53.3%	25.3%	-	2.6%
2003	99.5%	0.3%	0.2%	-	-	99.8%	-	0.2%	5.79	204	199	1.007	55.5%	30.6%	-	1.6%
2004	99.4%	0.5%	0.1%	-	-	99.9%	-	0.1%	5.90	212	211	1.026	62.3%	38.5%	-	2.9%
2005	98.6%	1.1%	0.3%	-	-	99.7%	-	0.3%	5.75	205	209	1.049	65.6%	45.8%	0.8%	2.3%
2006	98.1%	1.5%	0.4%	-	-	99.6%	-	0.4%	5.73	204	213	1.073	71.7%	55.4%	3.6%	2.6%
2007	97.7%	2.2%	0.1%	-	-	99.8%	-	0.1%	5.64	203	217	1.099	71.7%	57.3%	7.3%	2.9%
2008	97.4%	2.5%	0.1%	-	2.3%	97.6%	-	0.1%	5.56	199	219	1.122	76.4%	58.2%	6.7%	3.3%
2009	97.2%	2.3%	0.5%	-	4.2%	95.3%	-	0.5%	5.21	183	208	1.156	83.8%	71.5%	7.3%	3.6%
2010	95.6%	3.8%	0.7%	-	8.3%	91.0%	-	0.7%	5.27	188	214	1.160	85.5%	83.8%	6.4%	3.5%
2011	95.4%	4.0%	0.6%	-	13.7%	85.7%	-	0.6%	5.36	191	228	1.216	84.7%	93.8%	11.1%	7.4%

Table 14

Transmission and Drive Characteristics of MY 1975 to MY 2011 Light Duty Vehicles

Cars

Model Year	Manual	Automatic with Lockup	Automatic without Lockup	CVT	4 Gears or Fewer	5 Gears	6 Gears	7 Gears or More	CVT	Average Number of Gears	Front Wheel Drive	Rear Wheel Drive	Four Wheel Drive
1975	19.7%	0.3%	80.0%	-	98.7%	1.3%	-	-	-	-	6.5%	93.5%	-
1976	17.2%	-	82.8%	-	100.0%	-	-	-	-	-	5.8%	94.2%	-
1977	16.9%	-	83.1%	-	100.0%	-	-	-	-	-	6.8%	93.2%	-
1978	19.9%	7.1%	73.0%	-	90.8%	9.2%	-	-	-	-	9.6%	90.4%	-
1979	21.1%	8.8%	69.7%	-	93.1%	6.9%	-	-	-	3.3	11.9%	87.8%	0.3%
1980	30.9%	16.9%	51.6%	-	87.6%	12.4%	-	-	-	3.5	29.7%	69.4%	0.9%
1981	29.8%	33.4%	36.2%	-	85.5%	14.5%	-	-	-	3.5	37.0%	62.3%	0.7%
1982	29.2%	51.3%	19.1%	-	84.6%	15.4%	-	-	-	3.6	45.5%	53.7%	0.8%
1983	26.0%	56.7%	16.9%	-	80.8%	19.2%	-	-	-	3.7	47.1%	49.9%	3.1%
1984	24.1%	58.3%	17.6%	-	82.2%	17.8%	-	-	-	3.7	53.4%	45.6%	1.0%
1985	22.7%	58.8%	18.5%	-	81.4%	18.6%	-	-	-	3.7	61.0%	36.9%	2.1%
1986	24.7%	58.1%	17.2%	-	79.7%	20.3%	-	-	-	3.8	70.7%	28.3%	1.0%
1987	24.8%	59.7%	15.5%	-	78.4%	21.6%	-	-	-	3.8	76.3%	22.6%	1.1%
1988	24.2%	66.2%	9.6%	-	80.3%	19.7%	-	-	-	3.8	80.8%	18.4%	0.8%
1989	21.0%	69.3%	9.5%	0.1%	81.9%	17.9%	0.0%	-	0.1%	3.9	81.5%	17.5%	1.0%
1990	19.7%	72.8%	7.4%	0.0%	82.4%	17.5%	0.1%	-	0.0%	3.9	83.9%	15.1%	1.0%
1991	20.6%	73.6%	5.8%	0.0%	81.0%	18.9%	0.1%	-	0.0%	3.9	81.0%	17.6%	1.3%
1992	17.6%	76.4%	6.0%	0.0%	83.6%	16.3%	0.1%	-	0.0%	3.9	78.4%	20.6%	1.1%
1993	17.5%	77.6%	4.9%	0.0%	83.2%	16.6%	0.2%	-	0.0%	4.0	80.5%	18.4%	1.1%
1994	16.9%	78.9%	4.1%	-	83.4%	16.3%	0.3%	-	-	4.0	81.3%	18.3%	0.4%
1995	16.3%	81.9%	1.8%	-	83.4%	16.2%	0.4%	-	-	4.1	79.3%	19.5%	1.1%
1996	14.7%	83.8%	1.5%	0.0%	85.1%	14.5%	0.3%	-	0.0%	4.1	81.7%	16.9%	1.4%
1997	13.6%	85.5%	0.8%	0.1%	83.5%	16.2%	0.3%	-	0.1%	4.1	81.4%	17.0%	1.6%
1998	12.0%	87.6%	0.3%	0.1%	82.6%	17.1%	0.3%	-	0.1%	4.1	81.5%	16.4%	2.1%
1999	10.6%	88.8%	0.6%	0.0%	83.7%	15.8%	0.5%	-	0.0%	4.1	81.8%	16.1%	2.1%
2000	10.7%	88.3%	1.0%	0.0%	81.5%	17.6%	0.8%	-	0.0%	4.1	79.1%	19.0%	1.9%
2001	10.5%	88.5%	0.8%	0.2%	78.7%	19.9%	1.1%	-	0.2%	4.2	79.1%	18.1%	2.9%
2002	10.3%	89.1%	0.2%	0.4%	76.0%	21.8%	1.8%	-	0.4%	4.2	78.5%	18.1%	3.4%
2003	10.4%	88.2%	-	1.4%	67.1%	28.5%	3.0%	-	1.4%	4.4	78.0%	18.9%	3.1%
2004	9.3%	88.8%	0.2%	1.7%	64.4%	28.8%	4.7%	0.4%	1.7%	4.4	77.1%	18.1%	4.7%
2005	8.6%	88.6%	0.1%	2.7%	57.1%	34.1%	5.6%	0.4%	2.7%	4.5	78.1%	16.8%	5.1%
2006	8.6%	88.6%	0.1%	2.8%	47.0%	36.4%	12.0%	1.8%	2.8%	4.7	74.8%	20.1%	5.1%
2007	7.6%	82.6%	0.0%	9.9%	36.8%	35.1%	16.0%	2.2%	9.9%	4.8	79.8%	15.2%	5.0%
2008	7.0%	81.7%	0.3%	11.1%	39.2%	28.7%	18.5%	2.5%	11.1%	4.8	78.2%	15.5%	6.3%
2009	6.0%	82.5%	0.3%	11.1%	34.4%	31.2%	20.3%	3.0%	11.1%	4.9	83.8%	10.3%	5.9%
2010	4.9%	79.5%	1.7%	13.9%	29.2%	21.2%	32.5%	3.3%	13.9%	5.1	83.3%	11.6%	5.0%
2011	7.2%	75.7%	3.2%	13.8%	14.1%	18.2%	48.5%	5.3%	13.8%	5.5	81.6%	12.4%	6.0%

Table 14 (continued)

Transmission and Drive Characteristics of MY 1975 to MY 2011 Light Duty Vehicles

Trucks

Model Year	Manual	Automatic with Lockup	Automatic without Lockup	CVT	4 Gears or Fewer	5 Gears	6 Gears	7 Gears or More	CVT	Average Number of Gears	Front Wheel Drive	Rear Wheel Drive	Four Wheel Drive
1975	37.1%	-	62.9%	-	100.0%	-	-	-	-	-	-	82.7%	17.3%
1976	34.8%	-	65.2%	-	100.0%	-	-	-	-	-	-	76.8%	23.2%
1977	31.8%	-	68.2%	-	100.0%	-	-	-	-	-	-	76.0%	24.0%
1978	32.2%	-	67.8%	-	99.3%	0.7%	-	-	-	-	-	70.7%	29.3%
1979	35.2%	2.1%	62.7%	-	96.0%	4.0%	-	-	-	3.3	-	81.9%	18.1%
1980	53.1%	24.4%	22.5%	-	89.2%	10.8%	-	-	-	3.5	1.4%	73.5%	25.1%
1981	51.7%	31.0%	17.3%	-	86.0%	14.0%	-	-	-	3.6	1.9%	78.0%	20.1%
1982	46.1%	33.3%	20.6%	-	83.7%	16.3%	-	-	-	3.7	1.7%	78.1%	20.2%
1983	46.3%	36.1%	17.3%	-	81.6%	18.4%	-	-	-	3.9	1.4%	72.5%	26.2%
1984	42.6%	34.7%	22.8%	-	78.5%	21.5%	-	-	-	3.9	5.0%	63.5%	31.6%
1985	37.8%	41.3%	20.8%	-	78.5%	21.5%	-	-	-	3.8	7.3%	61.2%	31.5%
1986	43.1%	41.5%	15.4%	-	69.0%	31.0%	-	-	-	4.0	6.0%	63.3%	30.8%
1987	40.6%	43.8%	15.6%	-	70.1%	29.9%	-	-	-	4.0	7.6%	60.1%	32.3%
1988	35.8%	52.5%	11.7%	-	68.3%	31.7%	-	-	-	4.1	9.2%	56.6%	34.2%
1989	32.9%	56.4%	10.7%	-	70.3%	29.7%	-	-	-	4.1	10.2%	56.9%	32.9%
1990	28.1%	67.6%	4.3%	-	74.1%	25.9%	-	-	-	4.1	15.8%	52.3%	31.9%
1991	31.6%	66.8%	1.6%	-	69.0%	31.0%	-	-	-	4.2	10.3%	52.2%	37.4%
1992	27.5%	71.3%	1.2%	-	74.6%	25.4%	-	-	-	4.2	14.5%	52.0%	33.5%
1993	24.7%	74.2%	1.1%	-	75.9%	24.1%	-	-	-	4.2	16.8%	50.4%	32.8%
1994	23.7%	75.3%	1.0%	-	76.7%	23.3%	-	-	-	4.2	13.8%	47.0%	39.2%
1995	20.6%	78.5%	0.9%	-	79.6%	20.4%	-	-	-	4.2	18.7%	38.2%	43.0%
1996	16.0%	83.0%	1.0%	-	84.0%	16.0%	-	-	-	4.1	21.8%	37.3%	40.9%
1997	14.5%	85.4%	0.1%	-	80.8%	19.2%	-	-	-	4.1	14.7%	37.7%	47.6%
1998	13.9%	85.5%	0.6%	-	81.4%	18.6%	-	-	-	4.2	19.8%	33.9%	46.2%
1999	9.4%	90.2%	0.4%	-	85.5%	14.5%	-	-	-	4.1	17.9%	32.8%	49.2%
2000	8.4%	91.3%	0.3%	-	87.0%	13.0%	-	-	-	4.1	20.4%	32.3%	47.3%
2001	6.6%	93.0%	0.4%	-	83.9%	16.1%	-	-	-	4.2	14.1%	33.9%	52.0%
2002	5.1%	94.6%	0.3%	0.0%	78.6%	21.3%	-	-	0.0%	4.2	15.8%	28.2%	56.0%
2003	4.8%	94.2%	0.3%	0.7%	71.9%	27.4%	-	-	0.7%	4.3	15.1%	31.3%	53.7%
2004	3.7%	95.4%	0.3%	0.6%	63.1%	35.4%	0.8%	-	0.6%	4.4	11.7%	27.7%	60.6%
2005	2.9%	95.2%	-	1.8%	54.4%	41.6%	2.2%	-	1.8%	4.5	19.4%	24.8%	55.8%
2006	3.4%	93.8%	-	2.9%	48.9%	43.4%	4.0%	0.8%	2.9%	4.6	17.5%	25.5%	57.0%
2007	2.6%	94.3%	-	3.1%	46.3%	37.6%	12.0%	1.1%	3.1%	4.7	14.2%	26.4%	59.4%
2008	2.2%	94.9%	-	2.8%	38.1%	37.0%	20.7%	1.3%	2.8%	4.8	15.9%	23.2%	60.9%
2009	2.0%	92.4%	-	5.6%	24.2%	34.4%	34.1%	1.7%	5.6%	5.1	16.0%	20.9%	63.2%
2010	1.8%	92.5%	0.2%	5.5%	16.5%	27.7%	48.3%	2.0%	5.5%	5.4	16.6%	17.6%	65.8%
2011	1.7%	89.9%	2.5%	5.8%	12.2%	19.0%	58.7%	4.3%	5.8%	5.6	14.7%	24.1%	61.3%

Table 14 (continued)

Transmission and Drive Characteristics of MY 1975 to MY 2011 Light Duty Vehicles

Cars and Trucks

Model Year	Manual	Automatic with Lockup	Automatic without Lockup	CVT	4 Gears or Fewer	5 Gears	6 Gears	7 Gears or More	CVT	Average Number of Gears	Front Wheel Drive	Rear Wheel Drive	Four Wheel Drive
1975	23.0%	0.2%	76.8%	-	99.0%	1.0%	-	-	-	-	5.3%	91.4%	3.3%
1976	20.9%	-	79.1%	-	100.0%	-	-	-	-	-	4.6%	90.6%	4.8%
1977	19.8%	-	80.2%	-	100.0%	-	-	-	-	-	5.5%	89.8%	4.7%
1978	22.7%	5.5%	71.9%	-	92.7%	7.3%	-	-	-	-	7.4%	86.0%	6.6%
1979	24.2%	7.3%	68.1%	-	93.8%	6.2%	-	-	-	3.3	9.2%	86.5%	4.3%
1980	34.6%	18.1%	46.8%	-	87.9%	12.1%	-	-	-	3.5	25.0%	70.1%	4.9%
1981	33.6%	33.0%	32.9%	-	85.6%	14.4%	-	-	-	3.5	31.0%	65.0%	4.0%
1982	32.4%	47.8%	19.4%	-	84.4%	15.6%	-	-	-	3.6	37.0%	58.4%	4.6%
1983	30.5%	52.1%	17.0%	-	80.9%	19.1%	-	-	-	3.7	37.0%	54.8%	8.1%
1984	28.4%	52.8%	18.8%	-	81.3%	18.7%	-	-	-	3.7	42.1%	49.8%	8.2%
1985	26.5%	54.5%	19.1%	-	80.7%	19.3%	-	-	-	3.8	47.8%	42.9%	9.3%
1986	29.8%	53.5%	16.7%	-	76.8%	23.2%	-	-	-	3.8	52.6%	38.0%	9.3%
1987	29.1%	55.4%	15.5%	-	76.2%	23.8%	-	-	-	3.9	57.7%	32.8%	9.6%
1988	27.6%	62.2%	10.2%	-	76.8%	23.2%	-	-	-	3.9	60.0%	29.5%	10.5%
1989	24.6%	65.5%	9.9%	0.1%	78.5%	21.4%	0.0%	-	0.1%	3.9	60.2%	29.3%	10.5%
1990	22.2%	71.2%	6.5%	0.0%	79.9%	20.0%	0.1%	-	0.0%	4.0	63.8%	26.1%	10.1%
1991	23.9%	71.6%	4.5%	0.0%	77.3%	22.6%	0.0%	-	0.0%	4.0	59.6%	28.1%	12.3%
1992	20.7%	74.8%	4.5%	0.0%	80.8%	19.2%	0.1%	-	0.0%	4.0	58.4%	30.4%	11.2%
1993	19.8%	76.5%	3.7%	0.0%	80.9%	19.0%	0.1%	-	0.0%	4.0	59.9%	28.8%	11.3%
1994	19.5%	77.6%	3.0%	-	80.8%	19.0%	0.2%	-	-	4.1	55.6%	29.2%	15.2%
1995	17.9%	80.7%	1.4%	-	82.0%	17.7%	0.2%	-	-	4.1	57.6%	26.3%	16.2%
1996	15.2%	83.5%	1.3%	0.0%	84.7%	15.1%	0.2%	-	0.0%	4.1	60.0%	24.3%	15.7%
1997	14.0%	85.5%	0.5%	0.0%	82.4%	17.3%	0.2%	-	0.0%	4.1	55.8%	24.9%	19.3%
1998	12.8%	86.7%	0.5%	0.0%	82.1%	17.7%	0.2%	-	0.0%	4.1	56.4%	23.5%	20.1%
1999	10.1%	89.4%	0.5%	0.0%	84.4%	15.3%	0.3%	-	0.0%	4.1	55.8%	22.9%	21.3%
2000	9.7%	89.5%	0.7%	0.0%	83.8%	15.8%	0.5%	-	0.0%	4.1	55.5%	24.3%	20.2%
2001	9.0%	90.2%	0.6%	0.1%	80.7%	18.5%	0.7%	-	0.1%	4.2	53.8%	24.2%	21.9%
2002	8.2%	91.3%	0.3%	0.2%	77.1%	21.6%	1.1%	-	0.2%	4.2	52.7%	22.3%	25.0%
2003	8.0%	90.8%	0.1%	1.1%	69.2%	28.1%	1.7%	-	1.1%	4.3	50.7%	24.3%	25.0%
2004	6.8%	91.8%	0.3%	1.2%	63.9%	31.8%	3.0%	0.2%	1.2%	4.4	47.7%	22.4%	29.8%
2005	6.2%	91.4%	0.1%	2.3%	56.0%	37.3%	4.1%	0.2%	2.3%	4.5	53.0%	20.2%	26.8%
2006	6.5%	90.6%	0.0%	2.8%	47.7%	39.2%	8.8%	1.4%	2.8%	4.6	51.9%	22.3%	25.8%
2007	5.6%	87.1%	0.0%	7.2%	40.5%	36.1%	14.4%	1.8%	7.2%	4.8	54.3%	19.6%	26.1%
2008	5.2%	86.8%	0.2%	7.9%	38.8%	31.9%	19.4%	2.0%	7.9%	4.8	54.2%	18.5%	27.3%
2009	4.8%	85.5%	0.2%	9.4%	31.3%	32.2%	24.5%	2.6%	9.4%	5.0	62.9%	13.6%	23.5%
2010	3.8%	84.1%	1.2%	10.9%	24.6%	23.5%	38.1%	2.8%	10.9%	5.2	59.5%	13.7%	26.7%
2011	5.1%	81.1%	3.0%	10.8%	13.4%	18.5%	52.4%	4.9%	10.8%	5.6	56.4%	16.8%	26.8%

Table 15

**MY 2011 Technology Usage by Vehicle Type and Size
(Percent of Vehicle Type/Size Strata)**

Vehicle Type	Vehicle Size	Front Wheel Drive	Four Wheel Drive	Manual Trans	Multi-Valve	VVT
Car	Small	69%	8%	19%	93%	91%
Car	Midsize	87%	7%	2%	100%	100%
Car	Large	81%	4%	1%	79%	92%
Car	All	79%	7%	8%	93%	95%
Wagon	Small	86%	13%	13%	100%	92%
Wagon	Midsize	10%	90%	-	100%	100%
Wagon	All	85%	13%	13%	100%	92%
Non-Truck SUV	Midsize	93%	-	2%	98%	98%
Non-Truck SUV	Large	93%	-	-	100%	100%
Non-Truck SUV	All	93%	-	1%	99%	98%
Van	Midsize	94%	5%	-	99%	94%
Van	Large	-	9%	-	-	42%
Van	All	91%	5%	-	96%	92%
Truck SUV	Small	-	100%	23%	-	-
Truck SUV	Midsize	0%	100%	2%	95%	95%
Truck SUV	Large	15%	69%	0%	77%	99%
Truck SUV	All	8%	84%	2%	82%	93%
Pickup	Midsize	-	11%	27%	100%	46%
Pickup	Large	-	50%	1%	39%	90%
Pickup	All	-	48%	2%	41%	88%

Figure 20 shows trends in drive use for the six vehicle classes. Cars and wagons used to be nearly all rear wheel drive, but are now nearly all front wheel drive and four wheel drive. The trend towards increased use of front wheel drive for vans is very similar to that for cars, except it started a few years later. Almost all non-truck SUVs are front wheel drive, while almost all truck SUVs are four wheel drive. Consistent with load-carrying capabilities, nearly all pickup trucks use either rear or four wheel drive, and four wheel drive is approaching 50% of pickup production.

Figure 19

Transmission Production Share by Model Year

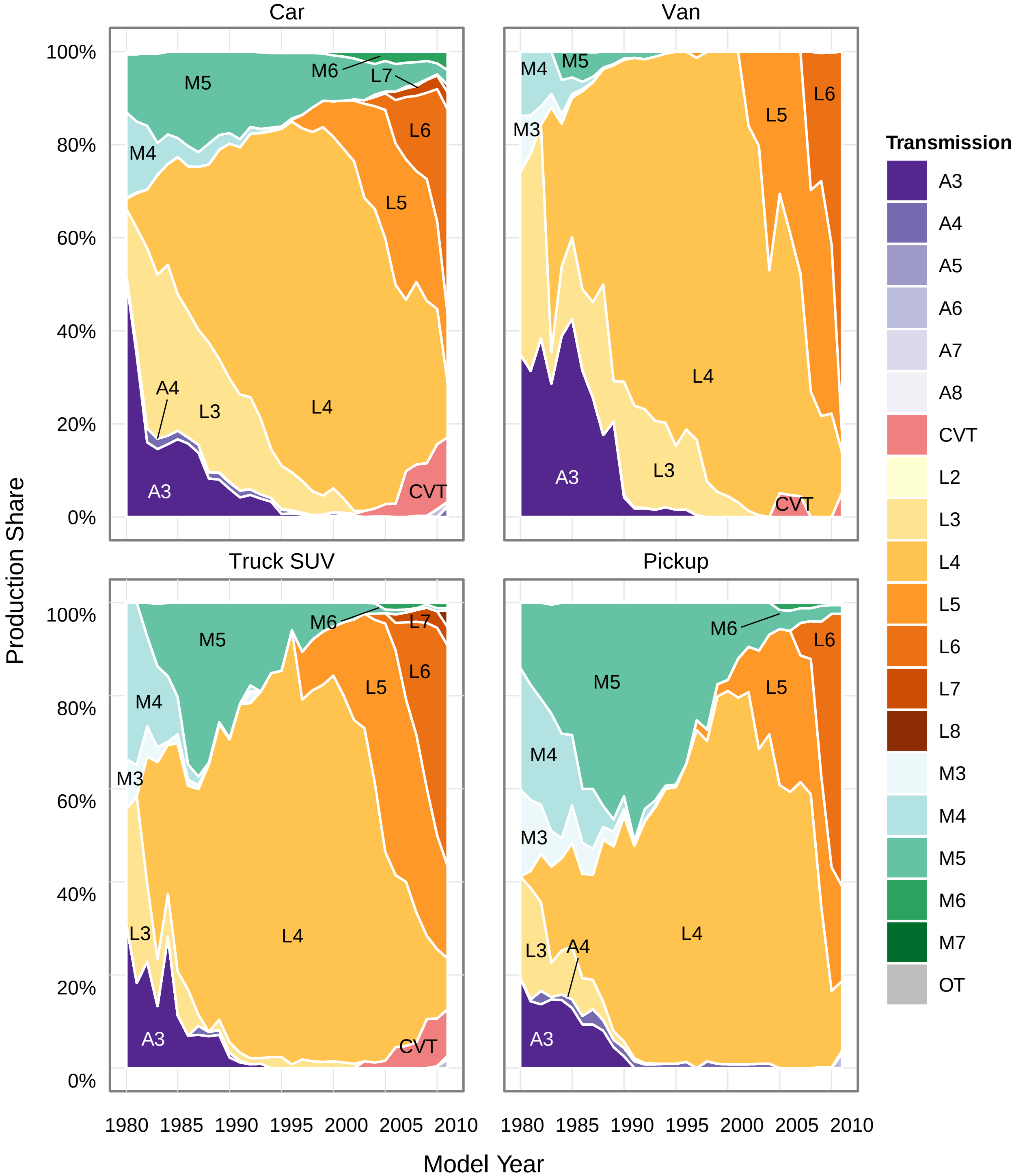


Figure 20

Front, Rear, and Four Wheel Drive Usage - Production Share by Vehicle Type

Table 16 and Figure 21 show production share stratified by number of engine cylinders. Engines with 8, 6, and 4 cylinders have accounted for 97 to 99% of all engines produced since MY 1975. The 8-cylinder engine was dominant in the mid and late 1970s, accounting for over half of production. Subsequently, while production share stratified by number of engine cylinders varied over time, there were two years with notable production shifts. The first major shift was in MY 1980, when 8-cylinder engine production share dropped from 54% to 26%, and 4-cylinder production share increased from 26% to 45%. The 4-cylinder engine continued to lead the market until overtaken by 6-cylinder engines in MY 1992. The second major shift was in MY 2009, when 4-cylinder engines once again became the production leader with 51% (an increase of 13% in a single year), followed by 6-cylinder engines with 35%, and 8-cyinder engines at an all-time low of 12%. This shift in MY 2009 reversed very slightly in MY 2010 and is projected to continue in MY 2011. Figure 22 breaks out the data for engine cylinders by vehicle type. It can be seen that 4-cylinder engines account for nearly 70% of cars and about 25% of truck SUVs, but are used only rarely in pickups and vans. Vans are almost exclusively powered by 6-cylinder engines, and pickups use mostly 8-cylinder engines. Over one-half of all truck SUVs use 6-cylinder engines.

Figure 21

Production Share by Number of Cylinders

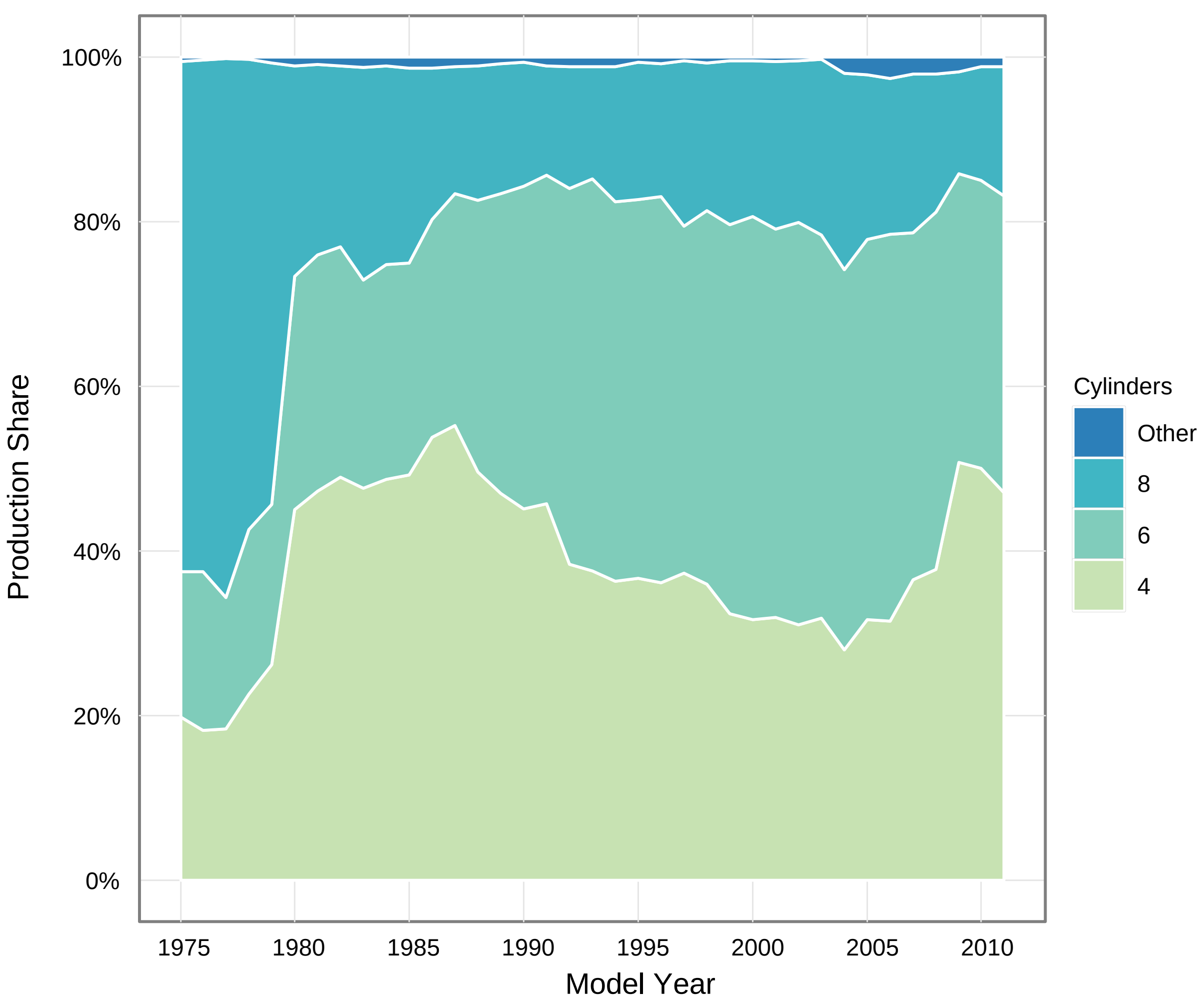


Table 16

Production Share by Number of Cylinders

Model Year	4 Cylinder	6 Cylinder	8 Cylinder	Other
1975	19.8%	17.7%	61.9%	0.6%
1976	18.2%	19.3%	62.2%	0.4%
1977	18.4%	16.0%	65.4%	0.2%
1978	22.6%	20.0%	57.1%	0.3%
1979	26.2%	19.5%	53.6%	0.7%
1980	45.1%	28.3%	25.6%	1.1%
1981	47.3%	28.7%	23.1%	0.9%
1982	49.0%	28.0%	21.9%	1.1%
1983	47.6%	25.3%	25.9%	1.2%
1984	48.7%	26.1%	24.1%	1.1%
1985	49.2%	25.7%	23.7%	1.4%
1986	53.8%	26.5%	18.4%	1.4%
1987	55.3%	28.1%	15.4%	1.2%
1988	49.6%	33.0%	16.3%	1.1%
1989	47.0%	36.4%	15.8%	0.8%
1990	45.1%	39.2%	15.0%	0.7%
1991	45.7%	39.9%	13.2%	1.1%
1992	38.4%	45.6%	14.8%	1.2%
1993	37.6%	47.7%	13.6%	1.2%
1994	36.4%	46.0%	16.5%	1.2%
1995	36.7%	46.0%	16.7%	0.6%
1996	36.2%	46.9%	16.1%	0.9%
1997	37.4%	42.1%	20.1%	0.5%
1998	35.9%	45.4%	17.9%	0.8%
1999	32.4%	47.2%	19.9%	0.4%
2000	31.7%	48.9%	19.0%	0.5%
2001	32.0%	47.1%	20.4%	0.6%
2002	31.1%	48.8%	19.6%	0.5%
2003	31.8%	46.6%	21.3%	0.3%
2004	28.0%	46.1%	23.9%	2.0%
2005	31.7%	46.2%	20.0%	2.1%
2006	31.5%	47.0%	18.9%	2.6%
2007	36.5%	42.1%	19.3%	2.1%
2008	37.7%	43.4%	16.8%	2.1%
2009	51.1%	34.7%	12.3%	1.8%
2010	50.0%	35.0%	13.8%	1.2%
2011	47.0%	36.1%	15.7%	1.2%

Figure 22

Production Share by Cylinder Count and Vehicle Type

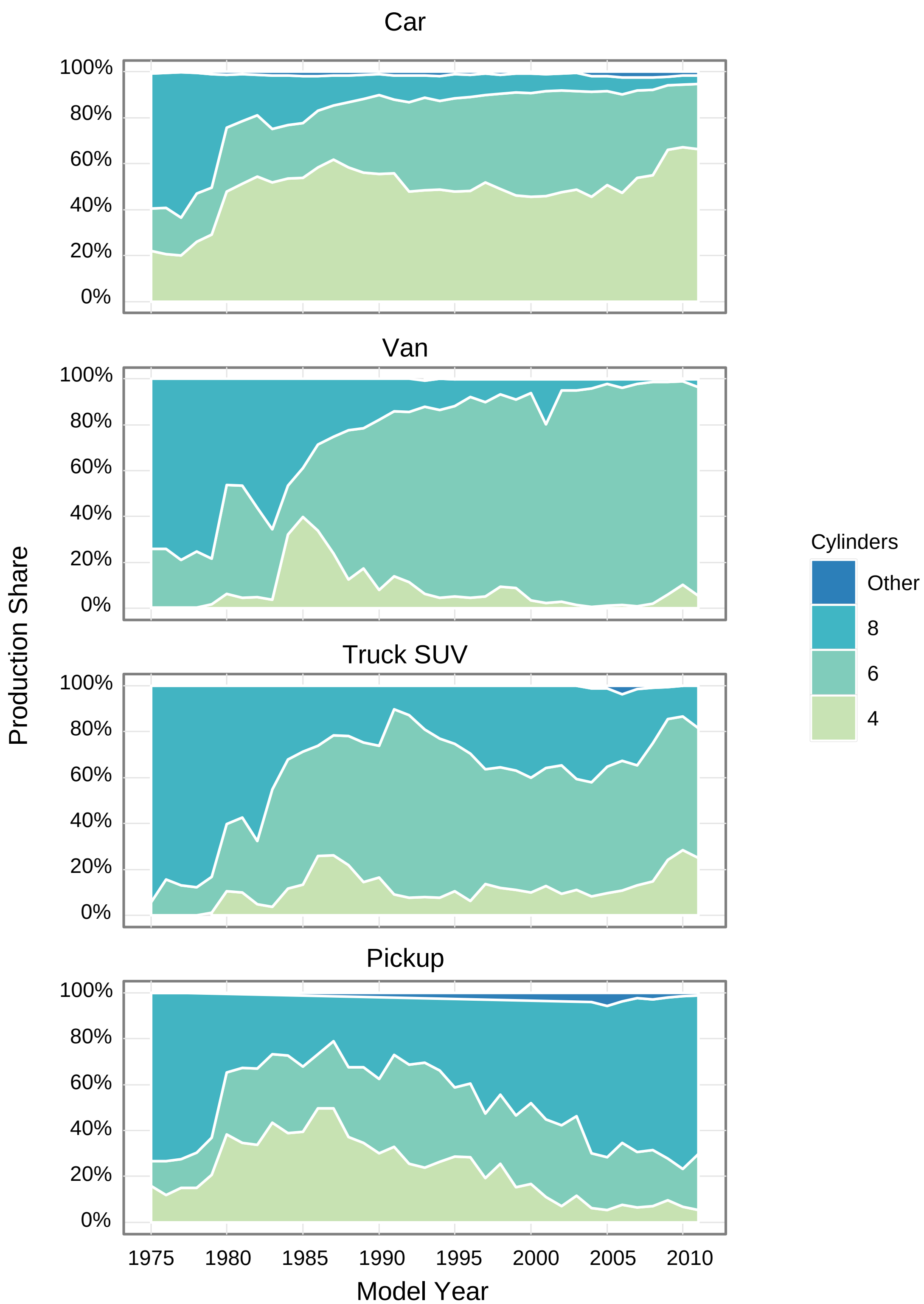


Table 17 and Figure 23 compare engine horsepower (HP), engine displacement (CID), and specific power or horsepower per cubic inch (HP/CID) for cars, vans, truck SUVs, and pickups. For all four vehicle types, significant CID reductions occurred in the late 1970s and early 1980s. Engine displacement has been flat for cars and vans since the mid-1980s and has declined for truck SUVs since the mid-1990s, but has been increasing for two decades for pickups. Average horsepower has increased substantially for all of these vehicle types since MY 1981 (with a small decrease in MY 2009) with the highest increase occurring for pickups whose horsepower is now over 2.5 times what it was then (i.e., 307 versus 115). Light-duty vehicle engines, thus, have also improved in specific power with the highest specific power being for engines used in passenger cars and truck SUVs. The use of cylinder deactivation has been popular in pickup trucks, now used in over one-third of the pickup fleet.

Table 17

MY 2011 Engine Characteristics by Vehicle Type

Vehicle Type	HP	CID	HP/CID	Multi-Valve	VVT	Cylinder Deactivation
Car	198	159	1.25	95%	95%	3%
Van	262	215	1.23	96%	92%	17%
Truck SUV	261	219	1.22	82%	93%	17%
Pickup	307	289	1.08	41%	88%	38%
All	228	191	1.22	85%	94%	11%

Figure 23

Horsepower, CID, and Horsepower per CID

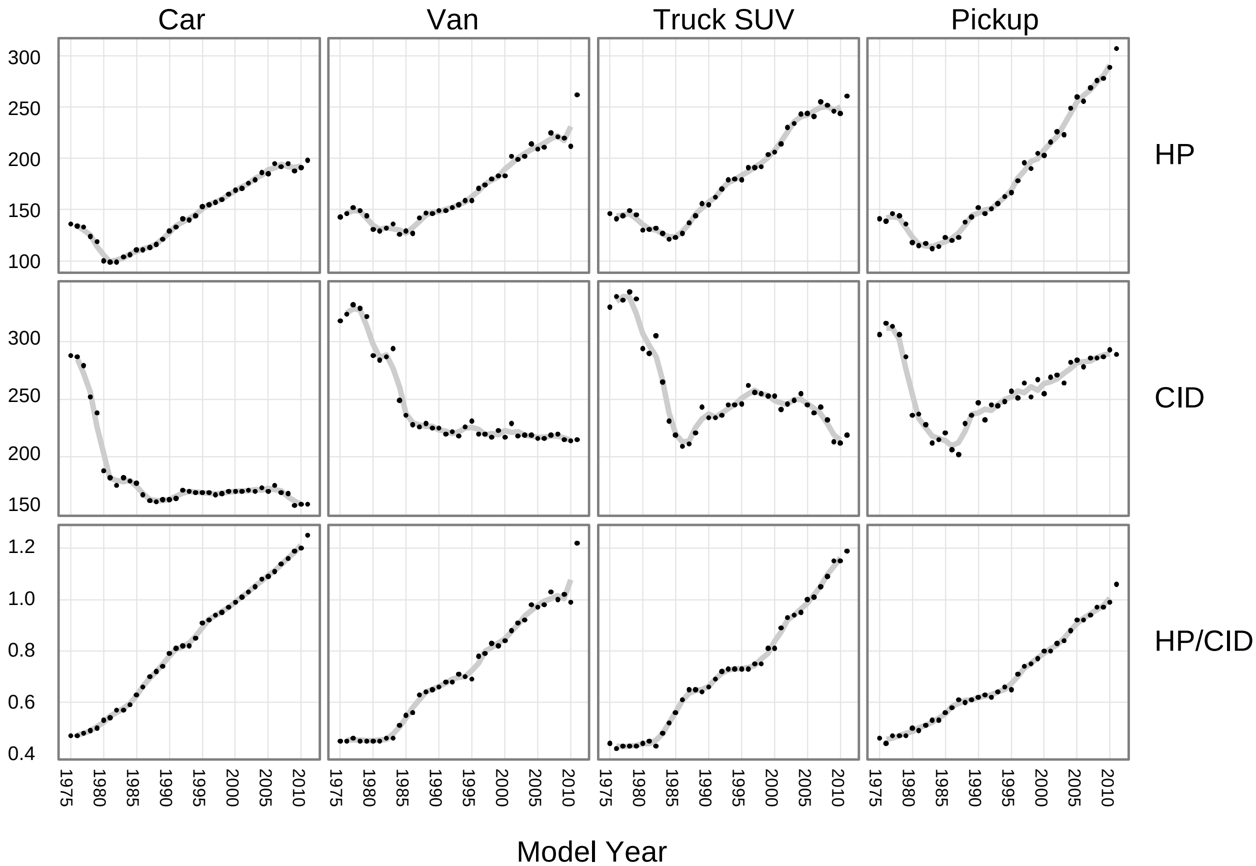


Table 18 compares HP, CID, and HP/CID by vehicle type and number of cylinders for model years 1988 and 2011. Table 18 shows that the increase in horsepower shown for the fleet in Table 13 extends to all vehicle type and cylinder number strata. These increases in horsepower range from 50 to 130%. Because displacement has remained relatively constant, it can be seen that the primary reason for the horsepower increase is increased specific power -- up between 47 and 124% from MY 1988 to 2011.

At the number-of-cylinders level of stratification, model year 2011 cars and truck SUVs generally achieve higher specific power than vans or pickups. One 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 drivability. Engines equipped with four valves per cylinder typically have inherently lower torque rise than two valve engines with lower specific power.

Table 18

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

Vehicle Type	Cylinders	HP 1988	HP 2011	Percent Change	CID 1988	CID 2011	Percent Change	HP/ CID 1988	HP/ CID 2011	Percent Change
Car	4	95	158	66%	118	129	9%	0.805	1.233	53%
Car	6	142	266	87%	194	208	7%	0.743	1.287	73%
Car	8	164	378	130%	301	312	4%	0.543	1.216	124%
Van	4	98	147	50%	145	128	-11%	0.678	1.147	69%
Van	6	149	269	81%	213	216	2%	0.722	1.245	72%
Van	8	168	269	60%	322	311	-4%	0.520	0.866	67%
SUV	4	94	178	89%	121	148	22%	0.775	1.210	56%
SUV	6	148	270	82%	214	213	0%	0.703	1.270	81%
SUV	8	184	349	90%	338	332	-2%	0.544	1.056	94%
Pickup	4	97	156	61%	142	154	9%	0.685	1.007	47%
Pickup	6	142	274	93%	229	231	1%	0.644	1.205	87%
Pickup	8	180	333	85%	329	321	-2%	0.544	1.036	90%

Table 19 shows similar data to those in Table 18, but the stratification is based on vehicle weight. This table clearly shows that, for nearly every case for which a comparison can be made between 1988 and 2011, there were increases in HP, decreases in CID, and substantial increases in specific power ranging from 45 to 181%.

Table 19

Changes in Horsepower and Specific Power by Vehicle Type and Weight

Cars

Weight (lb)	HP 1988	HP 2011	Percent Change	CID 1988	CID 2011	Percent Change	HP/CID 1988	HP/CID 2011	Percent Change
2000	59	70	19%	77	61	-21%	0.770	1.148	49%
2250	73	95	30%	90	81	-10%	0.808	1.170	45%
2500	79	105	33%	100	91	-9%	0.785	1.149	46%
2750	97	115	19%	123	97	-21%	0.804	1.183	47%
3000	114	138	21%	145	112	-23%	0.797	1.243	56%
3500	150	179	19%	212	145	-32%	0.731	1.238	69%
4000	160	249	56%	289	198	-31%	0.569	1.264	122%
4500	145	298	106%	306	232	-24%	0.473	1.302	175%
5000	207	387	87%	408	272	-33%	0.509	1.430	181%
5500	205	504	146%	412	378	-8%	0.498	1.334	168%
6000	205	373	82%	412	308	-25%	0.498	1.183	138%

Vans

Weight (lb)	HP 1988	HP 2011	Percent Change	CID 1988	CID 2011	Percent Change	HP/CID 1988	HP/CID 2011	Percent Change
3500	123	140	14%	166	122	-27%	0.736	1.148	56%
4500	169	269	59%	321	215	-33%	0.528	1.249	137%
5000	156	249	60%	312	236	-24%	0.500	1.082	116%
5500	195	262	34%	347	306	-12%	0.562	0.851	51%
6000	126	279	121%	379	326	-14%	0.332	0.858	158%

Truck SUVs

Weight (lb)	HP 1988	HP 2011	Percent Change	CID 1988	CID 2011	Percent Change	HP/CID 1988	HP/CID 2011	Percent Change
3500	149	173	16%	213	149	-30%	0.709	1.161	64%
4000	135	198	47%	190	166	-13%	0.723	1.203	66%
4500	148	254	72%	309	211	-32%	0.505	1.222	142%
5000	181	292	61%	330	219	-34%	0.545	1.335	145%
5500	200	344	72%	350	276	-21%	0.572	1.281	124%
6000	162	339	109%	368	329	-11%	0.445	1.033	132%

Pickups

Weight (lb)	HP 1988	HP 2011	Percent Change	CID 1988	CID 2011	Percent Change	HP/CID 1988	HP/CID 2011	Percent Change
3500	130	155	19%	184	153	-17%	0.719	1.014	41%
4000	154	211	37%	282	221	-22%	0.555	0.960	73%
4500	174	240	38%	322	242	-25%	0.539	0.994	84%
5000	193	287	49%	342	288	-16%	0.565	1.002	77%
5500	178	330	85%	363	315	-13%	0.495	1.056	113%
6000	140	356	154%	379	286	-25%	0.369	1.286	249%

Figure 24 shows that increases in HP per CID apply to all of the engines, except for a few cases of engines with three valves. Engines with more valves per cylinder deliver higher values of HP per CID. Engines with *only* two valves per cylinder deliver approximately twice as much horsepower per CID than they used to. The increases in HP and HP/CID are due to changes in engine technologies.

Figure 24

HP/CID by Number of Valves per Cylinder

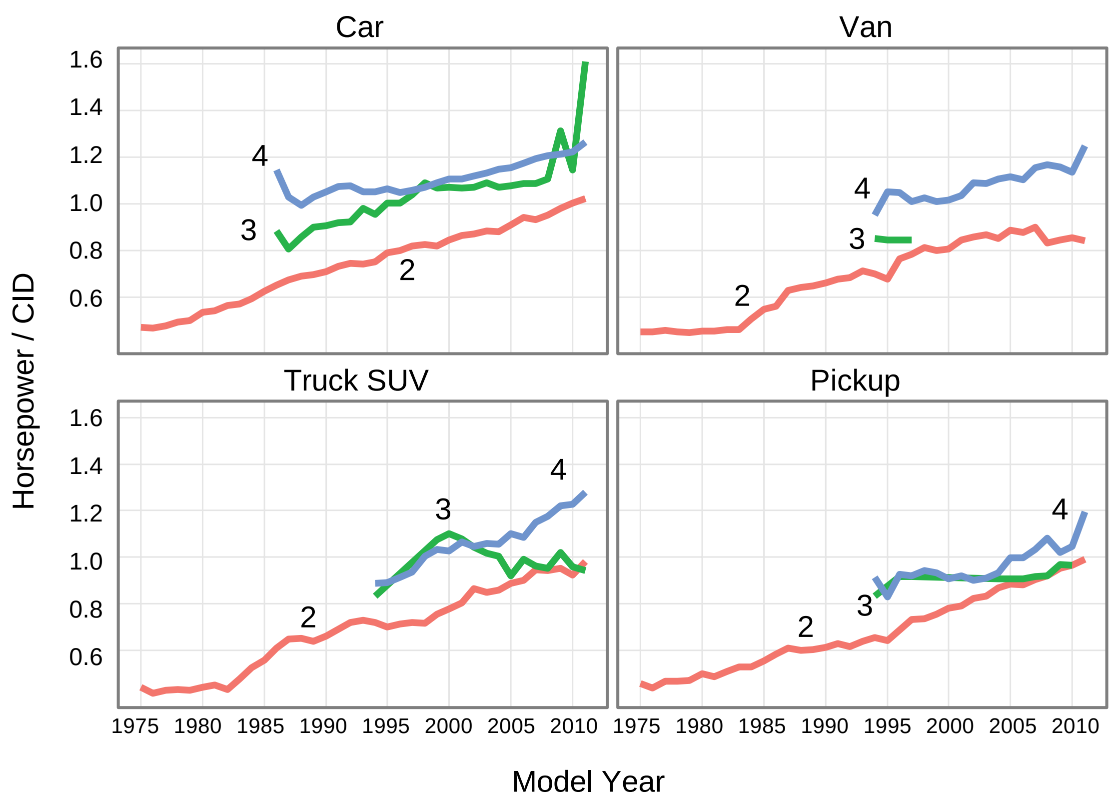


Figure 25 shows that usage of multi-valve engines continues to increase and, as shown in Table 17 for MY 2011, is now 80-90% for cars, vans and SUVs, and about 40% for pickups.

Figure 25

Production Share by Valves per Cylinder

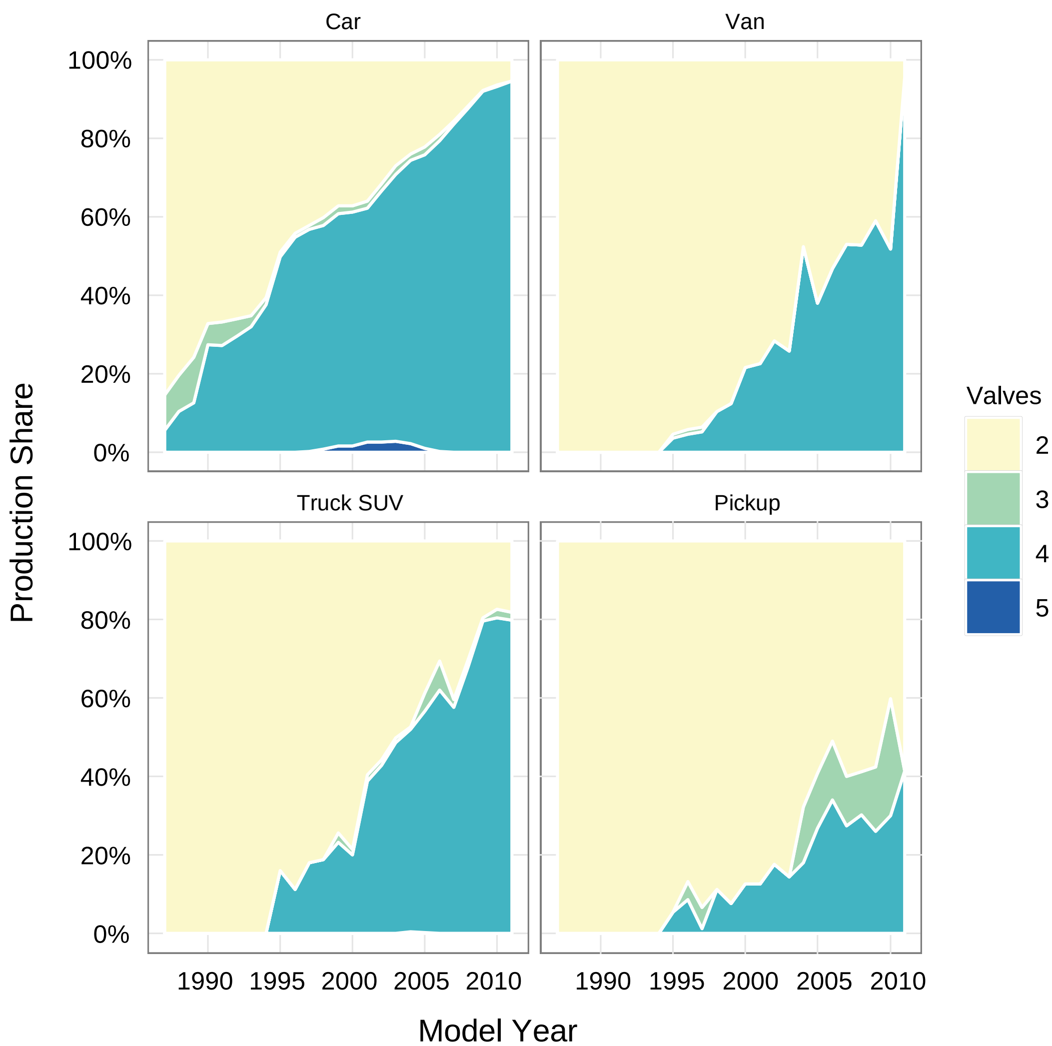


Figure 26 and Table 20 show how the car and truck fleet have evolved from one that consisted almost entirely of carbureted engines in the 1970s and early 1980s, to one which is now almost entirely port fuel injected with variable valve timing.

Figure 26

Production Share by Engine Type

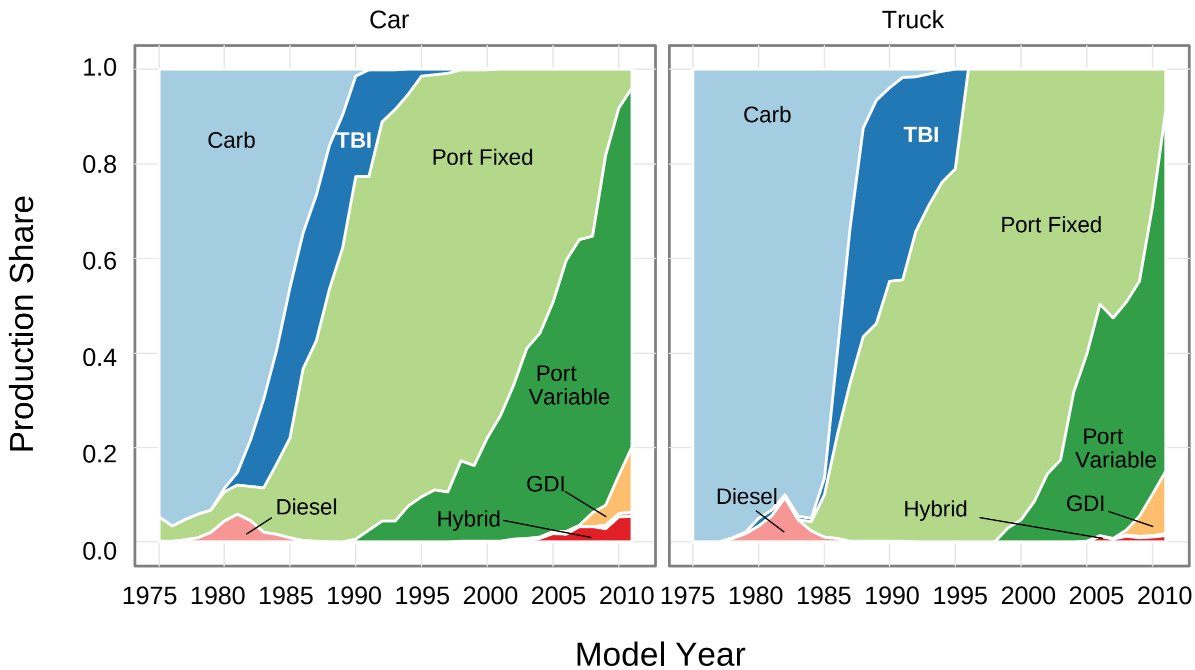


Table 20

Production Share of MY 1988 and MY 2011 Light Vehicles by Engine Type and Valve Timing

Engine Type	Cars 1988	Cars 2011	Vans 1988	Vans 2011	SUVs 1988	SUVs 2011	Pickups 1988	Pickups 2011	All 1988	All 2011
Carb	16%	-	0%	-	18%	-	16%	-	15%	-
TBI	30%	-	43%	-	34%	-	48%	-	34%	-
Port Fixed	54%	4%	57%	8%	48%	6%	35%	12%	51%	6%
Port Variable	-	76%	-	92%	-	70%	-	81%	-	76%
GDI Variable	-	14%	-	-	-	21%	-	7%	-	14%
Diesel	0%	1%	0%	-	0%	1%	0%	-	0%	1%
Hybrid	-	5%	-	-	-	3%	-	0%	-	4%

Table 21 compares horsepower, engine size (CID), specific power (HP/CID), Ton- mpg, and estimated 0-to-60 acceleration time for two selected MY 1988 and five MY 2011 engine types.

Table 21

Comparison of MY 1988 and MY 2011 Cars by Engine Fuel Metering, Number of Valves and Valve Timing

Fuel Metering	Number of Valves	Valve Timing	HP 1988	HP 2011	CID 1988	CID 2011	HP/CID 1988	HP/CID 2011	Ton MPG 1988	Ton MPG 2011	0-to-60 Time 1988	0-to-60 Time 2011
Carb		Fixed	88	-	131	-	0.75	-	37.2	-	14.3	-
TBI	4	Fixed	71	-	91	-	0.78	-	38.1	-	15.0	-
Port	2	Variable	-	232	-	236	-	0.98	-	46.4	-	9.2
Port	4	Variable	-	191	-	154	-	1.23	-	45.4	-	9.7
TBI	2	Fixed	98	-	142	-	0.71	-	36.8	-	13.7	-
GDI	4	Variable	-	246	-	166	-	1.51	-	47.8	-	8.5
Port	2	Fixed	137	306	193	292	0.74	1.05	36.6	39.5	11.9	8.1

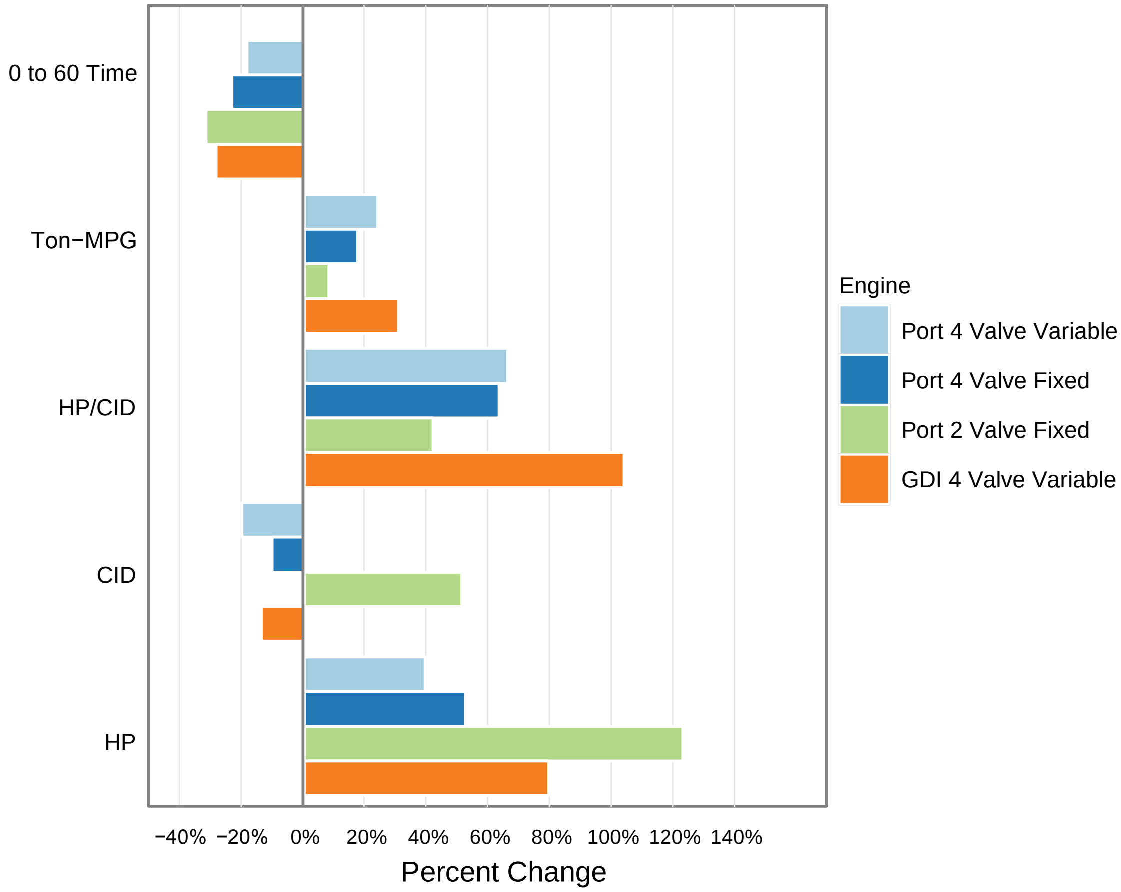
Percent Change over MY 1988 Port Two Valve, Fixed Valve Timing Base Model

Fuel Metering	Number of Valves	Valve Timing	HP 1988	HP 2011	CID 1988	CID 2011	HP/CID 1988	HP/CID 2011	Ton MPG 1988	Ton MPG 2011	0-to-60 Time 1988	0-to-60 Time 2011
Carb	-	Fixed	-35.8%	-	-32.1%	-	1.4%	-	1.6%	-	20.2%	-
TBI	4	Fixed	-48.2%	-	-52.8%	-	5.4%	-	4.1%	-	26.1%	-
Port	2	Variable	-	69.3%	-	22.3%	-	32.4%	-	26.8%	-	-22.7%
Port	4	Variable	-	39.4%	-	-20.2%	-	66.2%	-	24.0%	-	-18.5%
TBI	2	Fixed	-28.5%	-	-26.4%	-	-4.1%	-	0.5%	-	15.1%	-
GDI	4	Variable	-	79.6%	-	-14.0%	-	104.1%	-	30.6%	-	-28.6%
Port	2	Fixed	-	123.4%	-	51.3%	-	41.9%	-	7.9%	-	-31.9%

Because MY 1988 was the peak year for car fuel economy until recently, and because the two valve, fixed valve timing, port injected engine accounted for about half of the car engines built that year, the MY 1988 version of this engine was selected as a baseline engine with its average characteristics compared to four MY 2011 engine configurations. As shown in Figure 27, all of these MY 2011 engine types had substantially higher horsepower than the baseline MY 1988 engine, and substantially higher specific power. Not all of these improvements in engine design for these engine types that occurred between 1988 and 2011 were used to improve fuel economy as indicated by the nominal 20% decrease in 0-to-60 time each achieved. Obtaining increased power to weight in a time when weight is trending upwards implies that horsepower is increasing. Increased horsepower can be obtained by increasing the engine's displacement, the engine's specific power (HP/CID), or both. Increasing specific power has been the primary driver for increases in performance for the past two decades.

Figure 27

Percent Difference in MY 2011 Vehicle Characteristics from MY 1988 Port/2 Valve/Fixed Valve Timing Car Engine



For the current model year fleet, specific power has been studied at an even more detailed level of stratification with both car and truck engines being classified according to: (1) the number of valves per cylinder, (2) the manufacturer's fuel recommendation, (3) the presence or absence of an intake boost device such as a turbocharger or supercharger, and (4) whether or not the engine had fixed or variable valve timing. Higher HP/CID is associated with: (a) more valves per cylinder, (b) higher octane fuel, (c) intake boost, and (d) use of variable valve timing. The technical approaches result in specific power ranges for cars and trucks from about .9 to about 1.9. The relative production fractions in Table 22 are just for each technical option in the table and exclude hybrids.

Rotary engines, which are included in Table 22, present a unique challenge when it comes to determining an engine displacement value that is meaningful in comparison to a standard 4-stroke internal combustion engine. This report uses the displacement as reported by the manufacturers for the one rotary engine on the market for MY 2011. The Mazda RX-8 has a published displacement of 79.3 cubic inches and 232 hp (manual transmission), which results in a HP/CID of 2.9. The HP/CID value in Table 22 for non-boosted, 2 valve fixed timing, premium fuel vehicles appears high due to the inclusion of the Mazda rotary engine. Sales of this category are limited to 0.1% of the fleet.

Table 22 shows the incremental effect, on a production weighted basis, of adding each technical option, but not all of the technical options are production significant. The effect of the use of higher octane fuel cannot be discounted, because roughly 15% of the current car fleet is comprised of vehicles which use engines for which high octane fuel is recommended. By comparison, about 9% of this year's light trucks require premium fuel.

Engine technology which delivers improved specific power thus can be used in many ways ranging from reduced displacement and improved fuel economy at constant (or lower) performance, to increased performance and the same fuel economy at constant displacement.

Table 22

HP/CID and Production Share by Fuel and Engine Technology

MY 2011 Cars

Fuel	Boost	Valve Timing	2 Valve HP / CID	2 Valve Production Fraction	3 Valve HP / CID	3 Valve Production Fraction	4 Valve HP / CID	4 Valve Production Fraction	5 Valve HP / CID	5 Valve Production Fraction	Total Production Fraction
Regular	No Boost	Fixed	0.97	1.2%	-	-	1.19	2.4%	-	-	3.6%
Regular	No Boost	Variable	1.05	4.0%	-	-	1.20	73.9%	-	-	77.9%
Regular	Boost	Fixed	1.69	0.0%	-	-	1.72	0.1%	-	-	0.1%
Regular	Boost	Variable	-	-	-	-	1.78	3.1%	-	-	3.1%
Premium	No Boost	Fixed	1.97	0.1%	-	-	1.11	0.0%	-	-	0.2%
Premium	No Boost	Variable	1.16	0.1%	-	-	1.32	10.0%	1.34	0.0%	10.0%
Premium	Boost	Fixed	1.47	0.1%	1.65	0.0%	-	-	-	-	0.0%
Premium	Boost	Variable	1.22	0.0%	1.52	0.0%	1.73	4.2%	-	-	4.2%
Diesel	Boost		-	-	-	-	1.21	0.8%	-	-	0.8%
Total		-	-	5.4%	-	0.0%	-	94.6%	-	0.0%	100.0%

MY 2011 Trucks

Fuel	Boost	Valve Timing	2 Valve HP / CID	2 Valve Production Fraction	3 Valve HP / CID	3 Valve Production Fraction	4 Valve HP / CID	4 Valve Production Fraction	5 Valve HP / CID	5 Valve Production Fraction	Total Production Fraction
Regular	No Boost	Fixed	0.89	7.0%	-	-	1.07	1.5%	-	-	8.5%
Regular	No Boost	Variable	1.01	24.6%	0.94	1.0%	1.22	53.8%	-	-	79.4%
Regular	Boost	Variable	-	-	-	-	1.68	3.1%	-	-	3.1%
Premium	No Boost	Fixed	-	-	-	-	0.96	0.0%	-	-	0.0%
Premium	No Boost	Variable	-	-	-	-	1.24	6.4%	-	-	6.4%
Premium	Boost	Fixed	-	-	1.51	0.0%	-	-	-	-	0.0%
Premium	Boost	Variable	-	-	-	-	1.70	2.2%	-	-	2.2%
Diesel	Boost		-	-	-	-	1.28	0.3%	-	-	0.3%
Total		-	-	31.6%	-	1.0%	-	67.4%	-	-	100.0%

One engine technology development that began in MY 2005 is the reintroduction of cylinder deactivation, an automotive technology that was used by General Motors in some MY 1981 V-8 engines that could be operated in 8-, 6- and 4-cylinder modes. This approach, which has also been called by a number of names including 'variable displacement', 'displacement on demand', 'active fuel management' and 'multiple displacement', involves allowing the valves of selected cylinders of the engine to remain closed and interrupting the fuel supply to these cylinders when engine power demands are below a predetermined threshold, as typically happens under less demanding driving conditions, such as steady state operation or during idle. Under light load conditions, the engine can thus provide better fuel mileage than would otherwise be achieved. Although frictional and thermodynamic energy losses still occur in the cylinders that are not being used, these losses are more than offset by the increased load and reduced specific fuel consumption of the remaining cylinders. Typically half of the usual number of cylinders is deactivated. Challenges to the engine designer for this type of engine include mode transitions, idle quality, and noise and vibration. For MY 2011, as shown previously in Table 17, it is estimated that about 11% of all vehicles are equipped with cylinder deactivation.

Table 23 compares five examples of individual MY 2011 vehicles with cylinder deactivation to vehicles with similar characteristics. No vehicles are currently offered with and without cylinder deactivation in the same engine, so direct a direct comparison of fuel economy is not available. Table 23 compares vehicles with cylinder deactivation to vehicles that are in the same inertia weight class and have similar displacement, horsepower, transmission, and drive properties. While there are many other factors that affect fuel economy (which are not considered in this comparison), four out of the five vehicles with cylinder deactivation that are included in Table 23 show an increase in fuel economy.

Table 23

Comparison of MY 2010 Vehicles with Engines with Cylinder Deactivation

MY 2011 Cars

Car Class	Model Name	Drive	Trans	Weight (lb)	Engine CID	Engine HP	Lab 55/45	Cyl. Deact.	Pct. HP	Change MPG
Compact Car	ACCORD 2DR COUPE	Front	M6	3500	214	271	26.7	Yes	0%	-4%
Subcompact	ALTIMA COUPE	Front	M6	3500	214	270	27.9	No		
Large Sedan	ACCORD 4DR SEDAN	Front	L5	4000	214	271	31.0	Yes	1%	7%
Midsize Non-Truck SUV	RAV4 2WD	Front	L5	4000	211	269	28.9	No		

MY 2011 Trucks

Car Class	Model Name	Drive	Trans	Weight (lb)	Engine CID	Engine HP	Lab 55/45	Cyl. Deact.	Pct. HP	Change MPG
Midsize Van	ODYSSEY 2WD	Front	L6	4500	214	248	29.0	Yes	-9%	7%
Midsize Van	ENTOURAGE	Front	L6	4500	214	271	26.8	No		
Large SUV	K1500 YUKON DENALI AWD	4WD	L6	6000	378	403	20.6	Yes	0%	12%
Large Pickup	K15 SIERRA 4WD	4WD	L6	6000	378	403	18.2	No		
Large Pickup	Ram 1500 2WD	Rear	L5	5000	348	390	20.5	Yes	19%	5%
Large Pickup	TITAN 2WD	Rear	L5	5000	342	317	19.3	No		

Figure 28 compares historical industry-wide market penetration rates for five mature passenger car technologies, namely fuel injection (summing the values for all of the individual fuel injection technologies in Table 13), front wheel drive (FWD), multi-valve engines (i.e., engines with more than two valves per cylinder), engines with variable valve timing, and lockup transmissions. Figure 28 indicates that, in the past, after the first significant use, it has often taken an additional decade for a new technology to attain an industry-wide car production fraction of 20 to 60%, and often as long as another five or ten years to reach maximum market penetration. It is interesting to note that individual manufacturers, including those with large numbers of vehicle platforms and engine families, have often integrated new technologies much more quickly relative to the industry-wide time frames shown in Figure 28.

Figure 28

Industry-Wide Car Technology Penetration After First Significant Use

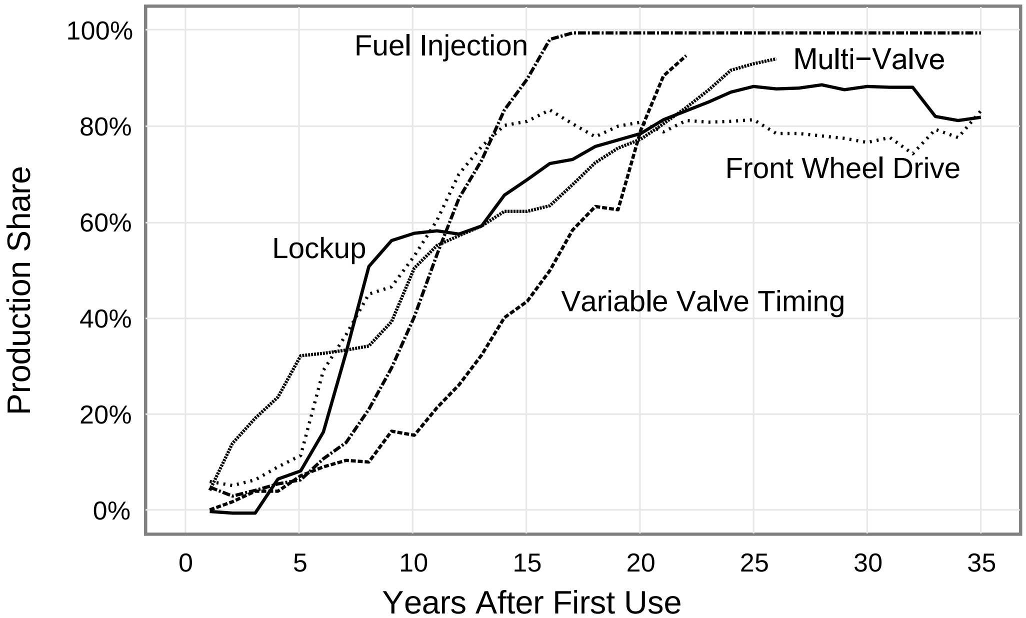


Table 24 compares fuel economy ratings, the ratio of highway to city fuel economy, and ton-mpg of the MY 2011 diesel and hybrid vehicles with those for the average MY 2011 car and truck. All but one of the hybrid vehicles in the table have a lower highway/city ratio than the average car or truck. In addition, there are several cases in the table for which the highway to city ratio is less than 1.0, and these represent cases where a vehicle achieves higher fuel economy in city than in highway driving. This year's diesel cars achieve ton-mpg values that are roughly the same as some of the hybrid cars. For MY 2011, the Toyota Prius has the highest adjusted composite fuel economy value for any hybrid of 49.3 mpg and several diesel vehicles have adjusted composite fuel economy values of 35-36 mpg. The Prius achieves 86 ton-mpg, which is 82% higher than that of the average car.

Most of the vehicles in Table 24 have conventionally powered counterparts. Tables 25 and 26 compare the adjusted composite fuel economy and an estimate of annual fuel usage (assuming 15,000 miles per year) for these vehicles with their conventionally powered (baseline) counterparts. The comparisons in both tables are limited to a basis of model name, drive, weight, transmission, and engine size (CID). Differences in the performance attributes of these vehicles complicate the analysis of the fuel economy improvement potential due to hybridization and dieselization. In particular, hybrid vehicles are sometimes reported to have faster 0-to-60 acceleration times than their conventional counterparts, while vehicles equipped with diesel engines often have higher low-end torque, but slower 0-to-60 times. In addition, some hybrid vehicles use technologies such as cylinder deactivation and CVT transmissions that are not offered in their counterparts.

Fuel economy improvements for the hybrid vehicles in Table 25 vary considerably from 5-10% for the larger, luxury hybrid vehicles to over 40%. Similarly, Table 26 shows fuel economy improvements for diesels range from 15% to 30%.

Table 24

Characteristics of MY 2011 Diesel and Hybrid Vehicles

Diesel Cars

Model Name	Transmission	Weight (lb)	CID (cu in)	Lab 55/45 MPG	Adj City MPG	Adj Hwy MPG	Adj Comp MPG	Ton-MPG	Hwy/ City Ratio
335d	L6	4000	183	36.0	22.7	36.1	28.8	57.6	1.6
A3	L6	3500	120	46.2	29.9	41.6	35.6	62.3	1.4
E 350 BLUETEC	L7	4500	182	34.0	21.8	33.4	27.2	61.1	1.5
GOLF	L6	3500	120	46.2	29.9	41.6	35.6	62.3	1.4
GOLF	M6	3500	120	46.0	29.6	41.7	35.5	62.1	1.4
Jetta	L6	3500	120	46.2	29.9	41.6	35.6	62.3	1.4
Jetta	M6	3500	120	46.0	29.6	41.7	35.5	62.1	1.4
JETTA SPORTWAGEN	L6	3500	120	44.2	28.9	39.5	34.1	59.6	1.4
JETTA SPORTWAGEN	M6	3500	120	46.0	29.6	41.7	35.5	62.1	1.4
Fleetwide Cars		**3589**	**159**	**32.8**	**21.7**	**30.4**	**25.9**	**47.4**	**1.4**

Hybrid Cars

Model Name	Transmission	Weight (lb)	CID (cu in)	Lab 55/45 MPG	Adj City MPG	Adj Hwy MPG	Adj Comp MPG	Ton-MPG	Hwy/ City Ratio
ActiveHybrid 7	L8	5000	269	25.6	17.1	24.1	20.5	51.3	1.4
ActiveHybrid 7L	L8	5000	269	25.6	17.1	24.1	20.5	51.3	1.4
CAMRY HYBRID	CVT	4000	144	45.9	33.4	34.1	33.8	67.6	1.0
CIVIC HYBRID	CVT	3000	79	58.8	40.2	45.3	42.9	64.4	1.1
CR-Z	CVT	3000	92	50.1	34.8	39.1	37.1	55.7	1.1
CR-Z	M6	3000	92	44.9	30.7	36.8	33.9	50.9	1.2
CT 200h	CVT	3500	110	57.5	42.3	40.0	41.0	71.7	0.9
ESCAPE HYBRID FWD	CVT	4000	153	44.1	34.0	30.5	31.9	63.9	0.9
FUSION HYBRID FWD	CVT	4000	153	54.2	41.4	36.4	38.4	76.8	0.9
GS 450h	CVT	4500	211	30.8	21.9	25.3	23.8	53.5	1.2
HS 250h	CVT	4000	144	47.3	35.3	33.6	34.3	68.6	0.9
INSIGHT	CVT	3000	79	57.1	40.1	42.6	41.5	62.2	1.1
LS 600h L	CVT	5500	303	26.9	19.6	21.8	20.8	57.2	1.1
MKZ HYBRID FWD	CVT	4000	153	54.2	41.4	36.4	38.4	76.8	0.9
OPTIMA HYBRID	A6	3500	146	50.6	35.1	39.5	37.5	65.6	1.1
PRIUS	CVT	3500	110	70.8	50.8	48.2	49.3	86.3	0.9
S400 HYBRID	L7	5000	213	27.5	18.6	25.1	21.8	54.6	1.3
SONATA HYBRID	A6	3500	146	52.2	35.4	41.9	38.8	67.9	1.2
TRIBUTE HYBRID 2WD	CVT	4000	153	44.1	34.0	30.5	31.9	63.9	0.9
Fleetwide Cars		**3589**	**159**	**32.8**	**21.7**	**30.4**	**25.9**	**47.4**	**1.4**

Table 24 (continued)

Diesel Trucks

Model Name	Transmission	Weight (lb)	CID (cu in)	Lab 55/45 MPG	Adj City MPG	Adj Hwy MPG	Adj Comp MPG	Ton-MPG	Hwy/City Ratio
GL 350 BLUETEC 4MATIC	L7	6000	182	24.8	16.9	22.7	19.8	59.3	1.3
ML 350 BLUETEC 4MATIC	L7	5000	182	27.1	18.4	24.7	21.5	53.7	1.3
Q7	L8	6000	181	26.4	17.0	26.8	21.5	64.5	1.6
R 350 BLUETEC 4MATIC	L7	5500	182	26.3	17.9	23.9	20.9	57.5	1.3
TOUAREG	L8	5000	181	28.9	18.6	29.0	23.4	58.5	1.6
X5 xDrive35d	L6	5500	183	28.2	18.9	26.1	22.5	61.8	1.4
Fleetwide Trucks		**4905**	**245**	**23.6**	**16.0**	**21.9**	**18.9**	**46.6**	**1.4**

Hybrid Trucks

Model Name	Transmission	Weight (lb)	CID (cu in)	Lab 55/45 MPG	Adj City MPG	Adj Hwy MPG	Adj Comp MPG	Ton-MPG	Hwy/City Ratio
ActiveHybrid X6	L7	6000	269	23.1	16.6	19.4	18.1	54.3	1.2
C15 SIERRA 2WD HYBRID	CVT	6000	366	28.5	20.4	23.6	22.1	66.3	1.2
C15 SILVERADO 2WD HYBRID	CVT	6000	366	28.5	20.4	23.6	22.1	66.3	1.2
C1500 TAHOE 2WD HYBRID	CVT	6000	366	28.5	20.4	23.6	22.1	66.3	1.2
C1500 YUKON 2WD HYBRID	CVT	6000	366	28.5	20.4	23.6	22.1	66.3	1.2
Cayenne S Hybrid	L8	5500	183	28.1	19.9	23.8	21.9	60.3	1.2
ESCALADE 2WD HYBRID	CVT	6000	366	28.5	20.4	23.6	22.1	66.3	1.2
ESCALADE 4WD HYBRID	CVT	6500	366	28.0	20.0	23.3	21.7	70.6	1.2
ESCAPE HYBRID 4WD	CVT	4000	153	39.0	30.4	27.2	28.5	57.0	0.9
HIGHLANDER HYBRID 4WD	CVT	5000	211	38.7	30.1	27.1	28.3	70.7	0.9
K15 SIERRA 4WD HYBRID	CVT	6000	366	28.4	20.3	23.4	22.0	65.9	1.1
K15 SILVERADO 4WD HYBRID	CVT	6000	366	28.4	20.3	23.4	22.0	65.9	1.1
K1500 TAHOE 4WD HYBRID	CVT	6000	366	28.4	20.3	23.4	22.0	65.9	1.1
K1500 YUKON 4WD HYBRID	CVT	6000	366	28.4	20.3	23.4	22.0	65.9	1.1
K1500 YUKON DENALI HYBRID 4WD	CVT	6500	366	28.0	20.0	23.3	21.7	70.6	1.2
ML450 HYBRID 4MATIC	CVT	5500	213	29.6	21.2	24.2	22.8	62.7	1.1
RX 450h	CVT	5000	211	40.4	31.5	27.9	29.4	73.4	0.9
RX 450h AWD	CVT	5000	211	38.6	29.5	27.6	28.4	70.9	0.9
Touareg Hybrid	L8	5500	183	28.2	19.9	23.8	22.0	60.4	1.2
TRIBUTE HYBRID 4WD	CVT	4000	153	39.0	30.4	27.2	28.5	57.0	0.9
Fleetwide Trucks		**4905**	**245**	**23.6**	**16.0**	**21.9**	**18.9**	**46.6**	**1.4**

Table 25

Comparison of MY 2011 Hybrid Vehicles with Their Conventional Counterparts

	Hybrid Version					Baseline					Improvement	
Model Name	Weight (lb)	CID	Trans	Adj Comp MPG	Gal per Year*	Weight (lb)	CID	Trans	Adj Comp MPG	Gal per Year*	Adj Comp MPG	Gal per Year*
ActiveHybrid 7**	5000	269	L8	20.5	731	4500	269	L6	18.0	832	12%	101
ActiveHybrid 7L**	5000	269	L8	20.5	731	5000	269	L6	17.7	846	14%	115
ActiveHybrid X6**	6000	269	L7	18.1	829	5500	269	L8	17.0	883	6%	54
C15 SIERRA 2WD HYBRID	6000	366	CVT	22.1	679	5500	323	L6	17.7	847	20%	168
C15 SILVERADO 2WD HYBRID	6000	366	CVT	22.1	679	5500	323	L6	17.7	847	20%	169
C1500 TAHOE 2WD HYBRID	6000	366	CVT	22.1	679	6000	323	L6	17.9	840	19%	161
C1500 YUKON 2WD HYBRID	6000	366	CVT	22.1	679	6000	323	L6	17.9	840	19%	161
CAMRY HYBRID	4000	144	CVT	33.8	444	3500	152	L6	26.7	562	21%	118
Cayenne S Hybrid	5500	183	L8	21.9	684	5000	293	L8	19.0	788	13%	104
CIVIC HYBRID	3000	79	CVT	42.9	349	3000	110	L5	29.6	506	31%	157
CT 200h**	3500	110	CVT	41.0	366	4000	153	L6	25.5	589	38%	222
ESCALADE 2WD HYBRID	6000	366	CVT	22.1	679	6000	378	L6	17.1	878	23%	199
ESCALADE 4WD HYBRID	6500	366	CVT	21.7	690	6000	378	L6	16.7	897	23%	206
ESCAPE HYBRID 4WD	4000	153	CVT	28.5	526	4000	153	L6	23.0	652	19%	126
ESCAPE HYBRID FWD	4000	153	CVT	31.9	470	4000	153	L6	24.1	623	25%	153
FUSION HYBRID FWD	4000	153	CVT	38.4	391	3500	153	L6	27.6	544	28%	153
GS 450h**	4500	211	CVT	23.8	631	4000	211	L6	22.4	669	6%	38
HIGHLANDER HYBRID 4WD	5000	211	CVT	28.3	530	4500	211	L5	19.5	770	31%	240
HS 250h**	4000	144	CVT	34.3	437	4000	153	L6	25.5	589	26%	152
K15 SIERRA 4WD HYBRID	6000	366	CVT	22.0	683	6000	323	L6	17.7	847	19%	164
K15 SILVERADO 4WD HYBRID	6000	366	CVT	22.0	683	6000	323	L6	17.7	849	20%	166
K1500 TAHOE 4WD HYBRID	6000	366	CVT	22.0	683	6000	323	L6	17.6	850	20%	167
K1500 YUKON 4WD HYBRID	6000	366	CVT	22.0	683	6000	323	L6	17.6	850	20%	167
K1500 YUKON DENALI HYBRID 4WD	6500	366	CVT	21.7	690	6000	378	L6	16.7	897	23%	206
LS 600h L**	5500	303	CVT	20.8	721	5000	281	L8	19.2	781	8%	60
MARINER HYBRID 4WD	4000	153	CVT	28.5	526	4000	153	L6	23.0	652	19%	126
MARINER HYBRID FWD	4000	153	CVT	31.9	470	3500	153	L6	24.1	623	25%	153
MILAN HYBRID FWD	4000	153	CVT	38.4	391	3500	153	L6	27.6	544	28%	153
MKZ HYBRID FWD	4000	153	CVT	38.4	391	4000	214	L6	22.0	681	43%	290
ML450 HYBRID 4MATIC**	5500	213	CVT	22.8	657	5000	213	L7	17.3	867	24%	210
OPTIMA HYBRID	3500	146	A6	37.5	400	3500	146	L6	28.6	524	24%	124
RX 450h**	5000	211	CVT	29.4	511	4500	211	L6	21.3	703	27%	192
RX 450h AWD**	5000	211	CVT	28.4	529	4500	211	L6	21.3	706	25%	177
S400 HYBRID**	5000	213	L7	21.8	687	4500	213	L7	19.2	781	12%	94
SONATA HYBRID	3500	146	A6	38.8	386	3500	146	L6	28.1	533	28%	147
Touareg Hybrid	5500	183	L8	22.0	683	5000	219	L8	19.9	755	9%	72
TRIBUTE HYBRID 2WD	4000	153	CVT	31.9	470	3500	153	L6	24.4	616	24%	146
TRIBUTE HYBRID 4WD	4000	153	CVT	28.5	526	3500	153	L6	23.3	644	18%	118

*Note: Gallons per year calculation is based on all vehicles being driven 15,000 miles.

**Note: Baseline version used for the GS 450h comparison is the GS 350. Baseline vehicle used for the LS 600HL comparison is the LS 460L. Baseline versions used for the Rx 450h and Rx 450h AWD comparison were the Rx 350 and the Rx 350 AWD. Baseline version used for the S400 comparison is the S550 4MATIC

.

Table 26

Comparison of MY 2011 Diesel Vehicles with Their Conventional Counterparts

Model Name	Diesel Weight (lb)	Diesel CID	Diesel Trans	Diesel Adj. Comp. MPG	Diesel Gal. per Year*	Baseline Weight (lb)	Baseline CID	Baseline Trans	Baseline Adj. Comp. MPG	Baseline Gal. per Year*	Improvement: Adj. Comp. MPG	Improvement: Gal. per Year*
335d	4000	183	L6	28.8	520.7	4000	183	L6	23.2	645	19%	124.8
A3	3500	120	L6	35.6	421.3	3500	121	A6	24.6	610	31%	189.0
E 350 BLUETEC	4500	182	L7	27.2	552.1	400	213	L7	20.9	718	23%	166.3
GOLF	3500	120	L6	35.6	421.3	3500	151	L6	26.1	575	27%	153.7
GOLF	3500	120	M6	35.5	422.8	3500	151	M5	25.8	581	27%	158.1
Jetta	3500	120	L6	35.6	421.3	3000	121	L6	25.8	582	28%	160.6
Jetta	3500	120	M6	35.5	422.8	3000	121	M5	27.5	546	23%	123.6
JETTA SPORTWAGEN	3500	120	L6	34.1	440.2	3500	151	L6	26.1	575	23%	134.8
JETTA SPORTWAGEN	3500	120	M6	35.5	422.8	3500	151	M5	25.8	581	27%	158.1
GL 350 BLUETEC 4MATIC	6000	182	L7	19.8	759.2	6000	285	L7	15.1	993	24%	234.2
ML 350 BLUETEC 4MATIC**	5000	182	L7	21.5	697.8	5000	213	L7	17.3	867	20%	169.2
Q7	6000	181	L8	21.5	698.1	6000	183	A8	18.5	813	14%	114.9
R 350 BLUETEC 4MATIC**	5500	182	L7	20.9	716.9	5500	213	L7	17.3	867	17%	150.1
TOUAREG	5000	181	L8	23.4	641.1	5000	219	L8	19.9	755	15%	113.5
X5 xDrive35d**	5500	183	L6	22.5	667.6	5000	183	L8	19.4	773	14%	105.2

*Note: Gallons per year calculation is based on all vehicles being driven 15,000 miles.

**Note: Baseline version used for the R350 Bluetec comparison is the R350 4MATIC. Baseline version used for the GL350 Bluetec comparison is the GL450 4MATIC. Baseline version used for the ML350 Bluetec comparison is the ML350 4MATIC. Baseline version used for the X5 xDrive 35d comparison is the X5 xDrive 30i.

VII. Fuel Economy by Manufacturer and Make

This report groups vehicles by “manufacturer” and “make.” The initial reports in this series examined fuel economy and technology trends for the "Domestic" and "Import" vehicle categories which are part of the corporate average fuel economy (CAFE) program. Over time, 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." More recent reports in this series used “Marketing Groups” to better reflect the financial arrangements and transnational nature of the modern automobile industry.

This report reflects the manufacturer definitions used by the National Highway Traffic Safety Administration (NHTSA) for purposes of implementation of and manufacturer compliance with the CAFE program. Table 27 lists the 13 manufacturers which had production of 100,000 vehicles or more in MY 2009 and/or MY 2010, which together accounted for approximately 99% of total industry-wide production, and for which data are shown in Tables 28 through 32 (industry-wide tables in the rest of this report also include production from those manufacturers that do not meet the 100,000 production threshold).

Make is typically included in the model name and is generally equivalent to the “brand” of the vehicle. Table 27 also lists the 30 makes for which data are shown in Tables 28 and 29. The MY 2010 production threshold for makes to be included in Tables 28 and 29 is 40,000 vehicles, though the Smart was included as well because of the high interest in this make. The Pontiac, Saturn, and Mercury makes no longer exist, but are included since Tables 28 and 29 also provide data for MY 2009 and 2010.

Table 27

Manufacturers and Makes for MY 2009-2011

Manufacturer	Makes Above Threshold	Makes Below Threshold
General Motors	Chevrolet, Cadillac, Buick, GMC, Pontiac, Saturn	Hummer
Ford	Ford, Lincoln, Mercury	Roush, Shelby
Chrysler	Chrysler, Dodge, Jeep, Ram	
Toyota	Toyota, Lexus, Scion	
Honda	Honda, Acura	
Nissan	Nissan, Infiniti	
Hyundai	Hyundai	
Volkswagen	Volkswagen, Audi	Lamborghini, Bentley, Bugatti
Kia	Kia	
Subaru	Subaru	
BMW	BMW, Mini	Rolls Royce
Daimler	Mercedes-Benz, Smart	Maybach
Mazda	Mazda	
Others		Mitsubishi, Volvo, Rover, Suzuki, Porsche, Jaguar, Saab, Ferrari, Maserati, Lotus, Spyker

It is important to note that when a manufacturer or make grouping is changed to reflect a change in the industry's current financial structure, EPA makes the same adjustment for the entire historical database back to 1975. This maintains a consistent manufacturer or make definition over time, which allows a better identification of long-term trends. On the other hand, this also means that the current database does not necessarily reflect actual financial or structural arrangements in the past. For example, the 2010 database no longer accounts for the fact that Chrysler was combined with Daimler for several years, and Tables 28 and 29 show a separate Chrysler Ram make for MY 2008 and 2009, even though Ram did not become a separate make until MY 2010.

Automakers submit vehicle production data, rather than vehicle sales data, in formal end-of-year CAFE compliance reports to EPA. Accordingly, the vehicle production data in this report may differ from sales data reported by press sources. In addition, the vehicle production data presented in this report are tabulated on a model year basis. In years past, manufacturers typically used a more consistent approach for model year designations, i.e., from fall of one year to the fall of the following year. More recently, however, many manufacturers have used a more flexible approach and it is not uncommon to see a new or redesigned model be introduced in the spring or summer, with a new model year designation, rather than the fall. This means that a model year for an individual vehicle can be either shortened or lengthened. Accordingly, year-to-year comparisons can be affected by these model year anomalies, though, of course, these even out over a multi-year period.

Tables 28 and 29 give laboratory and adjusted fuel economy values for cars, trucks, and cars and trucks combined for MY 2009-2011, for the 13 manufacturers and 30 makes shown in Table 27. By including data from both MY 2009 and 2010, with formal end-of-year data for both years, it is possible to identify meaningful changes from year-to-year. Because of the uncertainty associated with the MY 2011 projections, changes from MY 2010 to MY 2011 may be less meaningful.

The relative fuel economy comparisons for manufacturers and makes in Tables 28 and 29 will be similar, of course, since the relative offset between laboratory and adjusted values will be similar across manufacturers and makes. The following discussion will be based on the adjusted composite fuel economy data from Table 29.

In MY 2010, 10 of the 13 highest-selling manufacturers increased fuel economy and the industry reached an all-time high of 22.6 mpg. In terms of manufacturers, Hyundai and Kia had the highest MY 2010 adjusted composite fuel economy of 27.0 mpg, followed by Toyota at 25.4 mpg. Daimler had the lowest MY 2010 adjusted fuel economy for any manufacturer, 18.9 mpg, and was followed by Chrysler at 19.5 mpg and Ford at 20.4 mpg. In terms of improvement from MY 2009 to MY 2010, Kia had the largest improvement of 2.8 mpg, followed by Hyundai at 1.9 mpg and Volkswagen and Mazda at 1.2 mpg.

In terms of makes in MY 2010, the Smart make was the leader at 36.8 mpg. Of course, the Smart Fourtwo is the smallest and lightest car in the U.S. market and has relatively low production. The make with the second-highest fuel economy in MY 2010 was the Mini, which produces a relatively low number of small vehicles, at 29.2 mpg. Of the makes with higher production, Hyundai and Kia had the highest overall fuel economy at 27.0 mpg, followed by Volkswagen at 26.4 mpg.

Preliminary projections suggest that 11 of the 13 manufacturers will improve fuel economy further in MY 2011, though EPA will not have actual data for MY 2011 until later this year. Hyundai, Kia, and Honda are projected to be the overall fuel economy leaders for MY 2011.

Table 30 shows footprint by manufacturer for MY 2009-2011, along with truck production share by manufacturer. GM, Ford, and Chrysler had the largest footprint values in MY 2010 at 51-52 square feet, with most of the other manufacturers having average footprint values in the 44-47 square feet range. Overall footprint increased by 0.3 square feet in MY 2010, with the largest increases for Ford, Nissan, and Toyota. Kia had the largest decrease in footprint, followed by GM and Mazda. Subaru had the highest MY 2010 truck share at 72%, followed by Chrysler at 58%, while Hyundai, Kia, and Volkswagen had the lowest truck shares, all between 8% and 11%. Industry-wide footprint and truck share are projected to grow in MY 2011.

Table 31 (actual MY 2010) and Table 32 (MY 2011 projections) show the adjusted fuel economy values broken out by manufacturer and vehicle size and type. For example, Honda had the highest small car adjusted composite fuel economy in MY 2010 at 30.5 mpg. Of course, these tables rely on the threshold definitions for small/midsize/large vehicle sizes that have been discussed earlier in this report, and a vehicle that just crosses the threshold into the next largest class can be a fuel economy leader in that class, while it may have been a relatively poor performer in the next smaller class.

For a long-term perspective going back to 1975, Figure 29 shows the adjusted fuel economy values (cars, trucks, and both cars and trucks) and truck production shares for each of the 13 highest-selling manufacturers. More information for the historic database stratified by manufacturer can be found in Appendices L through P.

Table 28

Laboratory 55/45 Fuel Economy by Manufacturer and Make for MY 2009--2011

Manufacturer	Make	2009 Cars	2009 Trucks	2009 Cars and Trucks	2010 Cars	2010 Trucks	2010 Cars and Trucks	2011 Cars	2011 Trucks	2011 Cars and Trucks
Kia	**All**	**32.6**	**24.1**	**30.7**	**35.8**	**25.0**	**34.5**	**35.9**	**28.5**	**34.7**
Hyundai	**All**	**32.3**	**24.9**	**31.7**	**34.9**	**29.2**	**34.4**	**35.4**	**28.5**	**34.8**
Toyota	Toyota	36.5	25.7	33.3	39.4	24.1	33.2	38.2	25.0	32.1
Toyota	Lexus	27.8	23.1	26.2	29.1	27.1	28.3	32.1	27.1	30.3
Toyota	Scion	32.5	-	32.5	33.1	-	33.1	36.5	-	36.5
Toyota	**All**	**35.3**	**25.3**	**32.4**	**37.5**	**24.6**	**32.4**	**37.0**	**25.2**	**32.0**
VW	VW	31.7	24.4	31.3	34.0	25.3	33.5	35.1	27.1	34.4
VW	Audi	28.6	22.9	27.3	29.7	24.6	28.0	29.6	26.6	28.6
VW	**All**	**30.8**	**23.5**	**30.0**	**32.8**	**24.8**	**31.7**	**33.2**	**26.7**	**32.0**
Honda	Honda	34.2	26.0	31.7	35.2	26.6	32.2	36.1	27.5	33.4
Honda	Acura	29.2	22.4	26.3	29.1	23.6	27.0	29.9	23.6	26.8
Honda	**All**	**33.7**	**25.5**	**31.1**	**34.5**	**26.2**	**31.5**	**35.5**	**26.8**	**32.6**
Mazda	**All**	**30.2**	**27.1**	**29.3**	**32.0**	**25.9**	**30.9**	**32.6**	**24.5**	**31.7**
Subaru	**All**	**28.9**	**28.4**	**28.7**	**30.2**	**29.6**	**29.7**	**30.3**	**30.5**	**30.4**
Nissan	Nissan	33.3	24.4	30.5	33.6	23.1	29.8	34.3	24.5	31.3
Nissan	Infiniti	26.3	21.8	25.3	26.4	19.8	24.6	27.4	21.0	26.3
Nissan	**All**	**32.5**	**24.2**	**29.9**	**32.7**	**22.8**	**29.3**	**33.2**	**24.2**	**30.7**
BMW	BMW	26.4	22.7	25.6	26.1	23.6	25.5	27.8	25.0	27.2
BMW	Mini	39.2	-	39.2	37.6	-	37.6	39.7	-	39.7
BMW	**All**	**28.4**	**22.7**	**27.3**	**28.5**	**23.6**	**27.6**	**29.5**	**25.0**	**28.7**
GM	Chevrolet	30.7	21.3	25.7	30.8	22.6	27.2	32.4	22.2	26.3
GM	GMC	21.1	21.3	21.3	31.4	22.8	23.7	32.3	22.2	22.7
GM	Buick	30.5	23.8	28.5	26.1	24.0	25.2	27.7	24.3	26.6
GM	Cadillac	23.5	18.9	22.4	25.4	22.6	24.6	25.5	21.7	23.9
GM	Pontiac	29.6	24.8	29.5	32.4	-	32.4	-	-	-
GM	Saturn	30.0	23.9	28.3	27.5	24.5	25.6	-	-	-
GM	**All**	**29.8**	**21.4**	**25.6**	**29.9**	**22.8**	**26.5**	**31.0**	**22.2**	**25.6**
Ford	Ford	30.0	21.9	25.7	30.9	21.6	25.5	31.4	23.0	26.8
Ford	Lincoln	25.1	23.0	24.9	25.6	23.7	25.1	26.4	22.7	25.2
Ford	Mercury	27.1	25.2	26.8	28.7	24.1	27.7	27.3	27.2	27.3
Ford	**All**	**29.1**	**22.0**	**25.7**	**30.3**	**21.7**	**25.6**	**30.9**	**23.0**	**26.7**
Chrysler	Dodge	26.6	22.1	25.9	27.1	23.9	25.8	28.4	23.8	26.3
Chrysler	Chrysler	27.6	24.4	25.4	27.9	24.3	25.7	28.6	25.9	26.9
Chrysler	Jeep	26.0	21.7	22.6	26.7	22.2	23.1	27.8	22.7	23.6
Chrysler	Ram	-	19.5	19.5	-	19.7	19.7	-	19.9	19.9
Chrysler	**All**	**26.7**	**22.0**	**23.9**	**27.2**	**22.6**	**24.4**	**28.4**	**22.8**	**24.5**
Daimler	Mercedes-Benz	24.3	20.8	23.3	24.5	21.4	23.4	25.1	22.0	24.0
Daimler	Smart	49.5	-	49.5	49.1	-	49.1	49.5	-	49.5
Daimler	**All**	**25.6**	**20.8**	**24.3**	**24.7**	**21.4**	**23.6**	**26.4**	**22.0**	**24.9**
Other	**All**	**28.2**	**20.9**	**26.5**	**28.5**	**21.3**	**25.4**	**29.3**	**22.4**	**27.0**
Fleet	**All**	**31.4**	**23.0**	**28.2**	**32.3**	**23.4**	**28.4**	**32.8**	**23.6**	**28.6**

Table 29

Adjusted Composite Fuel Economy by Manufacturer and Make for MY 2009-2011

Manufacturer	Make	2009 Cars	2009 Trucks	2009 Cars and Trucks	2010 Cars	2010 Trucks	2010 Cars and Trucks	2011 Cars	2011 Trucks	2011 Cars and Trucks
Hyundai	**All**	**25.6**	**19.9**	**25.1**	**27.4**	**23.0**	**27.0**	**27.9**	**22.5**	**27.5**
Kia	**All**	**25.6**	**19.3**	**24.2**	**27.9**	**20.0**	**27.0**	**28.1**	**22.5**	**27.2**
Toyota	Toyota	28.5	20.4	26.1	30.4	19.2	25.9	29.5	19.8	25.1
Toyota	Lexus	22.1	18.4	20.9	23.1	21.4	22.4	25.2	21.3	23.8
Toyota	Scion	25.4	-	25.4	25.9	-	25.9	28.3	-	28.3
Toyota	**All**	**27.6**	**20.1**	**25.4**	**29.1**	**19.6**	**25.4**	**28.7**	**20.0**	**25.1**
VW	VW	25.1	19.5	24.8	26.8	20.1	26.4	27.6	21.5	27.1
VW	Audi	22.7	18.2	21.7	23.5	19.5	22.1	23.5	21.1	22.7
VW	**All**	**24.4**	**18.7**	**23.8**	**25.9**	**19.7**	**25.0**	**26.2**	**21.2**	**25.2**
Honda	Honda	27.0	20.8	25.1	27.7	21.3	25.4	28.4	21.9	26.3
Honda	Acura	23.3	17.9	21.0	23.2	18.8	21.5	23.8	18.8	21.3
Honda	**All**	**26.6**	**20.3**	**24.6**	**27.1**	**20.9**	**24.9**	**27.9**	**21.4**	**25.7**
Mazda	**All**	**23.9**	**21.5**	**23.2**	**25.3**	**20.6**	**24.4**	**25.7**	**19.5**	**25.0**
Subaru	**All**	**22.8**	**22.4**	**22.6**	**23.8**	**23.3**	**23.4**	**23.9**	**23.9**	**23.9**
Nissan	Nissan	26.1	19.4	24.0	26.3	18.4	23.5	26.8	19.5	24.6
Nissan	Infiniti	21.1	17.6	20.3	21.1	16.0	19.8	21.9	17.0	21.1
Nissan	**All**	**25.5**	**19.2**	**23.6**	**25.7**	**18.2**	**23.1**	**26.1**	**19.3**	**24.2**
BMW	BMW	21.3	18.3	20.6	21.1	18.9	20.6	22.4	20.0	21.9
BMW	Mini	30.3	-	30.3	29.2	-	29.2	30.6	-	30.6
BMW	**All**	**22.8**	**18.3**	**21.9**	**22.8**	**18.9**	**22.1**	**23.6**	**20.0**	**23.0**
GM	Chevrolet	24.5	17.2	20.7	24.7	18.2	21.8	25.9	17.9	21.1
GM	GMC	17.1	17.2	17.2	25.0	18.4	19.1	25.7	17.9	18.4
GM	Buick	24.3	19.2	22.8	21.1	19.4	20.4	22.4	19.6	21.5
GM	Cadillac	19.1	15.5	18.2	20.5	18.2	19.8	20.6	17.5	19.3
GM	Pontiac	23.5	19.9	23.5	25.5	-	25.5	-	-	-
GM	Saturn	23.9	19.2	22.6	22.0	19.7	20.6	-	-	-
GM	**All**	**23.8**	**17.3**	**20.6**	**23.9**	**18.3**	**21.3**	**24.9**	**17.9**	**20.6**
Ford	Ford	23.9	17.5	20.5	24.4	17.3	20.3	24.9	18.4	21.3
Ford	Lincoln	20.3	18.5	20.1	20.6	18.9	20.2	21.2	18.2	20.2
Ford	Mercury	21.3	20.1	21.1	23.0	19.2	22.1	21.9	21.3	21.9
Ford	**All**	**23.2**	**17.6**	**20.5**	**24.0**	**17.4**	**20.4**	**24.5**	**18.4**	**21.3**
Chrysler	Dodge	21.3	17.8	20.7	21.7	19.3	20.7	22.7	19.2	21.1
Chrysler	Chrysler	22.0	19.6	20.4	22.3	19.7	20.6	23.0	20.9	21.7
Chrysler	Jeep	20.4	17.3	18.0	20.9	17.8	18.4	21.9	18.2	18.9
Chrysler	Ram	-	15.8	15.8	-	16.0	16.0	-	16.1	16.1
Chrysler	**All**	**21.3**	**17.7**	**19.2**	**21.7**	**18.2**	**19.5**	**22.7**	**18.3**	**19.7**
Daimler	Mercedes-Benz	19.6	16.7	18.8	19.7	17.2	18.8	20.2	17.6	19.3
Daimler	Smart	37.1	-	37.1	36.8	-	36.8	37.1	-	37.1
Daimler	**All**	**20.6**	**16.7**	**19.5**	**19.9**	**17.2**	**18.9**	**21.2**	**17.6**	**20.0**
Other	**All**	**22.5**	**16.9**	**21.2**	**22.7**	**17.2**	**20.4**	**23.3**	**18.0**	**21.5**
Fleet	**All**	**24.8**	**18.4**	**22.4**	**25.5**	**18.7**	**22.6**	**25.9**	**18.9**	**22.8**

Table 30

Footprint (sq ft) and Truck Share by Manufacturer for MY 2009—2011*

Manufacturer	2009 Cars	2009 Trucks	2009 Cars and Trucks	2009 Percent Trucks	2010 Cars	2010 Trucks	2010 Cars and Trucks	2010 Percent Trucks	2011 Cars	2011 Trucks	2011 Cars and Trucks	2011 Percent Trucks
Toyota	44.9	51.5	46.4	22.6%	44.3	53.3	47.0	30.0%	44.8	53.5	47.7	33.4%
Ford	46.0	57.6	50.7	40.6%	46.2	58.4	51.9	46.4%	46.3	59.3	52.2	45.2%
GM	46.6	60.0	52.1	41.1%	46.8	58.4	51.6	41.3%	47.0	61.0	54.5	53.4%
Honda	44.8	49.1	45.9	25.9%	44.7	49.3	46.0	29.7%	45.5	50.1	46.8	28.1%
Chrysler	47.8	53.4	50.9	55.7%	48.3	52.7	50.9	57.6%	48.1	53.9	51.8	64.5%
Nissan	45.3	51.4	46.8	24.6%	45.4	53.1	47.5	27.2%	45.0	53.1	46.8	22.5%
Hyundai	45.3	47.0	45.4	7.0%	45.0	46.9	45.2	7.5%	46.6	46.8	46.6	6.7%
VW	43.4	50.5	44.0	8.6%	43.5	48.9	44.1	11.3%	44.4	49.4	45.2	15.7%
Mazda	45.4	46.8	45.8	24.5%	45.0	47.8	45.4	14.8%	44.3	49.7	44.7	8.4%
Subaru	44.4	43.4	43.9	47.6%	44.2	44.1	44.1	71.8%	44.4	44.5	44.5	65.2%
Kia	45.2	50.8	46.2	17.7%	44.3	52.4	45.0	8.8%	44.4	48.3	44.9	13.4%
Daimler	47.7	52.2	48.7	22.8%	47.8	50.7	48.7	32.0%	45.1	50.0	46.6	29.8%
BMW	44.3	51.2	45.4	16.4%	44.9	50.7	45.8	15.7%	45.8	50.9	46.7	16.5%
Other	44.3	49.1	45.2	18.3%	44.8	48.3	46.1	35.5%	45.3	49.1	46.4	28.0%
All	45.5	54.3	48.2	30.8%	45.4	54.1	48.5	35.7%	45.8	55.9	49.6	37.6%

*Note: all footprint values for MY 2011 are preliminary, and are based on different data sources than values for MY 2009-2010.

Table 31

MY 2010 Adjusted Composite Fuel Economy by Vehicle Type and Size for Largest Manufacturers

Vehicle Type/Size	Toyota	Ford	GM	Honda	Chrysler	Nissan	Hyundai	VW	Mazda	Subaru	Kia	Daimler	BMW	All
Cars														
Small	29.8	25.7	24.2	30.5	19.8	23.5	28.7	25.7	26.9	22.7	29.3	20.9	24.1	26.8
Midsize	31.6	25.6	24.0	21.4	25.1	26.8	29.9	23.3	24.4	25.3	26.4	19.9	21.2	26.8
Large	23.7	20.8	22.6	25.4	20.7	19.6	25.5	19.2	-	-	-	16.6	17.8	22.7
All Sizes	30.6	24.7	23.7	27.7	21.9	26.4	28.2	25.5	26.3	24.4	28.7	20.0	22.8	26.1
Wagons														
Small	25.9	-	25.6	30.7	24.3	25.0	26.9	31.3	-	22.5	27.1	-	21.5	26.5
Midsize	-	-	-	-	-	-	-	24.9	-	-	23.1	-	20.0	22.8
All Sizes	25.9	-	25.6	30.7	24.3	25.0	26.9	30.6	-	22.5	27.0	-	20.5	26.4
SUVs (non-truck)														
Small	-	-	-	-	17.5	-	-	-	-	-	-	-	-	17.5
Midsize	22.6	23.7	21.9	23.1	20.8	23.0	24.6	21.4	23.4	-	22.4	19.1	-	22.8
Large	-	20.7	24.3	22.4	20.1	20.2	19.8	-	18.7	-	18.9	-	-	21.8
All Sizes	22.6	22.3	24.3	23.0	20.4	21.8	24.0	21.4	21.8	-	22.4	19.1	-	22.4
All Cars														
Small	29.5	25.7	24.5	30.5	21.7	24.1	28.3	26.3	26.9	22.6	28.4	20.9	24.1	26.8
Midsize	28.8	25.0	24.0	22.6	23.4	26.4	28.2	22.8	24.0	25.3	25.3	19.8	21.2	25.7
Large	23.7	20.8	23.3	25.2	20.5	20.1	25.1	19.2	18.7	-	18.9	16.6	17.8	22.4
All Sizes	29.1	24.0	23.9	27.1	21.7	25.7	27.4	25.9	25.3	23.8	27.9	19.9	22.8	25.5
Vans														
Small	-	-	-	-	-	-	-	-	24.1	-	-	-	-	24.1
Midsize	20.8	23.4	-	20.2	19.7	-	-	-	-	-	19.8	-	-	20.1
Large	-	-	16.2	-	-	-	-	-	-	-	-	-	-	16.2
All Sizes	20.8	23.4	16.2	20.2	19.7	-	-	-	24.1	-	19.8	-	-	20.1
SUVs														
Small	-	-	-	-	17.4	-	-	-	-	-	-	-	-	17.4
Midsize	21.7	21.7	19.5	21.5	18.0	22.0	23.6	20.9	20.3	23.3	20.3	18.0	-	21.2
Large	15.3	17.0	19.4	20.7	18.5	17.5	19.0	19.4	17.8	-	-	16.8	18.9	18.2
All Sizes	21.2	18.4	19.4	21.5	17.8	19.2	23.0	19.7	18.5	23.3	20.3	17.2	18.9	19.7
Pickups														
Midsize	19.1	21.7	20.6	-	-	-	-	-	-	-	-	-	-	19.7
Large	15.9	16.4	17.3	17.6	16.0	16.4	-	-	-	-	-	-	-	16.5
All Sizes	17.3	16.6	17.3	17.6	16.0	16.4	-	-	-	-	-	-	-	16.9
All Trucks														
Small	-	-	-	-	17.4	-	-	-	24.1	-	-	-	-	18.3
Midsize	21.0	22.0	20.5	21.1	19.2	22.0	23.6	20.9	20.3	23.3	20.0	18.0	-	20.8
Large	15.8	16.5	18.3	19.3	16.2	17.0	19.0	19.4	17.8	-	-	16.8	18.9	17.2
All Sizes	19.6	17.4	18.3	20.9	18.2	18.2	23.0	19.7	20.6	23.3	20.0	17.2	18.9	18.7
Fleet														
All Sizes	25.4	20.4	21.3	24.9	19.5	23.1	27.0	25.0	24.4	23.4	27.0	18.9	22.1	22.6

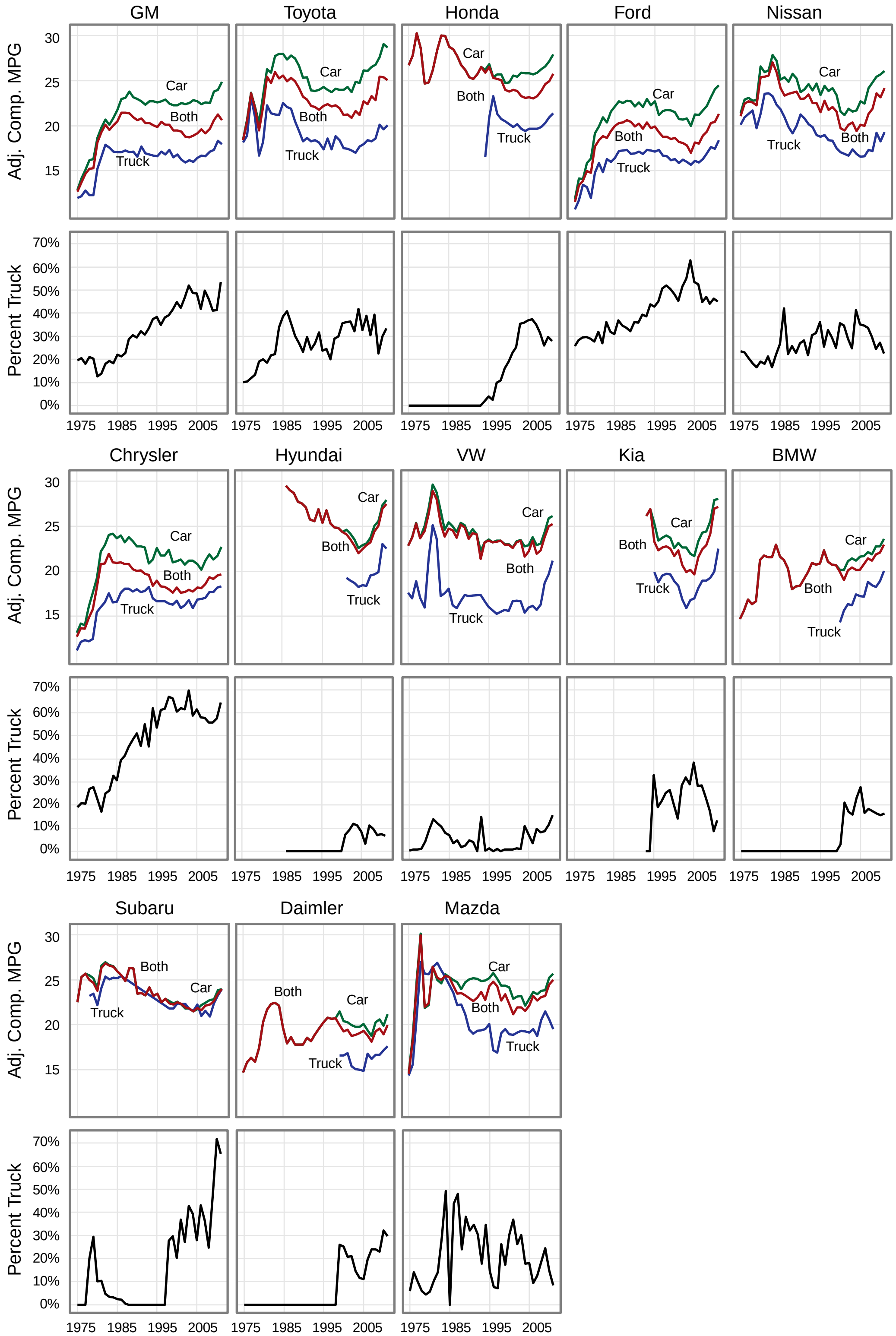
Table 32

MY 2011 Adjusted Composite Fuel Economy by Vehicle Type and Size for Largest Manufacturers

Vehicle Type/Size	Toyota	Ford	GM	Honda	Chrysler	Nissan	Hyundai	VW	Mazda	Subaru	Kia	Daimler	BMW	All
Cars														
Small	30.6	28.0	23.1	31.8	21.2	22.9	28.3	26.0	27.0	22.4	30.3	22.3	24.2	27.1
Midsize	30.8	26.2	26.1	21.5	24.4	27.2	34.4	20.4	24.8	25.5	29.6	20.3	24.2	27.2
Large	24.0	21.0	22.6	27.3	21.6	-	27.3	21.0	-	-	-	18.8	18.5	24.5
All Sizes	30.3	25.6	24.9	28.9	22.8	26.5	29.1	25.6	26.5	24.4	29.8	21.4	23.6	26.5
Wagons														
Small	25.3	-	25.2	31.0	25.1	27.2	26.9	31.1	-	22.7	27.3	-	21.5	26.9
Midsize	-	-	-	-	-	-	-	21.0	-	-	22.8	19.6	-	20.0
All Sizes	25.3	-	25.2	31.0	25.1	27.2	26.9	31.0	-	22.7	27.2	19.6	21.5	26.8
SUVs (non-truck)														
Midsize	23.0	23.5	-	22.6	22.5	23.6	24.1	22.1	23.0	-	24.9	19.2	-	23.2
Large	-	21.4	24.7	22.4	20.4	20.6	19.8	-	20.2	-	18.9	-	-	22.0
All Sizes	23.0	22.4	24.7	22.5	21.4	21.7	23.8	22.1	22.0	-	24.2	19.2	-	22.8
All Cars														
Small	29.9	28.0	23.7	31.6	23.7	25.1	28.0	26.7	27.0	22.6	28.8	22.3	24.1	27.0
Midsize	28.2	25.2	26.1	22.3	23.7	27.0	29.0	21.1	24.1	25.5	28.0	20.0	24.2	26.2
Large	24.0	21.2	23.2	27.0	21.2	20.6	27.1	21.0	20.2	-	18.9	18.8	18.5	23.8
All Sizes	28.7	24.5	24.9	27.9	22.7	26.1	27.9	26.2	25.7	23.9	28.1	21.2	23.6	25.9
Vans														
Midsize	20.8	23.2	-	23.0	20.9	21.5	-	-	-	-	21.3	-	-	21.3
Large	-	13.6	15.5	-	-	-	-	-	-	-	-	-	-	14.8
All Sizes	20.8	20.5	15.5	23.0	20.9	21.5	-	-	-	-	21.3	-	-	20.9
SUVs														
Small	-	-	-	-	17.5	-	-	-	-	-	-	-	-	17.5
Midsize	21.9	21.5	-	21.1	19.4	23.7	22.8	22.1	20.1	23.9	23.3	18.4	-	21.6
Large	15.4	18.4	18.9	21.6	18.4	18.5	19.0	21.1	19.2	-	18.5	17.0	20.0	18.8
All Sizes	21.6	19.5	18.9	21.1	18.3	20.5	22.5	21.2	19.5	23.9	22.8	17.6	20.0	19.9
Pickups														
Midsize	21.9	21.5	21.5	-	-	-	-	-	-	-	-	-	-	21.7
Large	16.9	17.4	17.3	17.6	16.1	16.4	-	-	-	-	-	-	-	17.1
All Sizes	17.5	17.8	17.4	17.6	16.1	16.4	-	-	-	-	-	-	-	17.3
All Trucks														
Small	-	-	-	-	17.5	-	-	-	-	-	-	-		17.5
Midsize	21.6	21.7	21.5	21.6	20.4	22.8	22.8	22.1	20.1	23.9	22.9	18.4	-	21.5
Large	16.7	17.6	17.9	19.7	17.0	17.4	19.0	21.1	19.2	-	18.5	17.0	20.0	17.8
All Sizes	20.0	18.4	17.9	21.4	18.3	19.3	22.5	21.2	19.5	23.9	22.5	17.6	20.0	18.9
Fleet														
All Sizes	25.1	21.3	20.6	25.7	19.7	24.2	27.5	25.2	25.0	23.9	27.2	20.0	23.0	22.8

Figure 29

Manufacturer Adjusted Fuel Economy and Percent Truck by Model Year



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