Chapter 1

ENERGY AND ECONOMICS

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Transportation Accounts for 28% of Total U.S. Energy Consumption

In 2014, the transportation sector used 27 quadrillion Btu of energy, which was 28% of total U.S. energy use. Nearly all of the energy consumed in this sector is petroleum (92%), with small amounts of renewable fuels (5%) and natural gas (3%). With the future use of plug-in hybrids and electric vehicles, transportation will begin to use electric utility resources. The electric utility sector draws on the widest range of sources and uses only a small amount of petroleum (1%). Over the last five years, the energy sources have not changed significantly, although renewable fuel use has grown slightly in each sector.

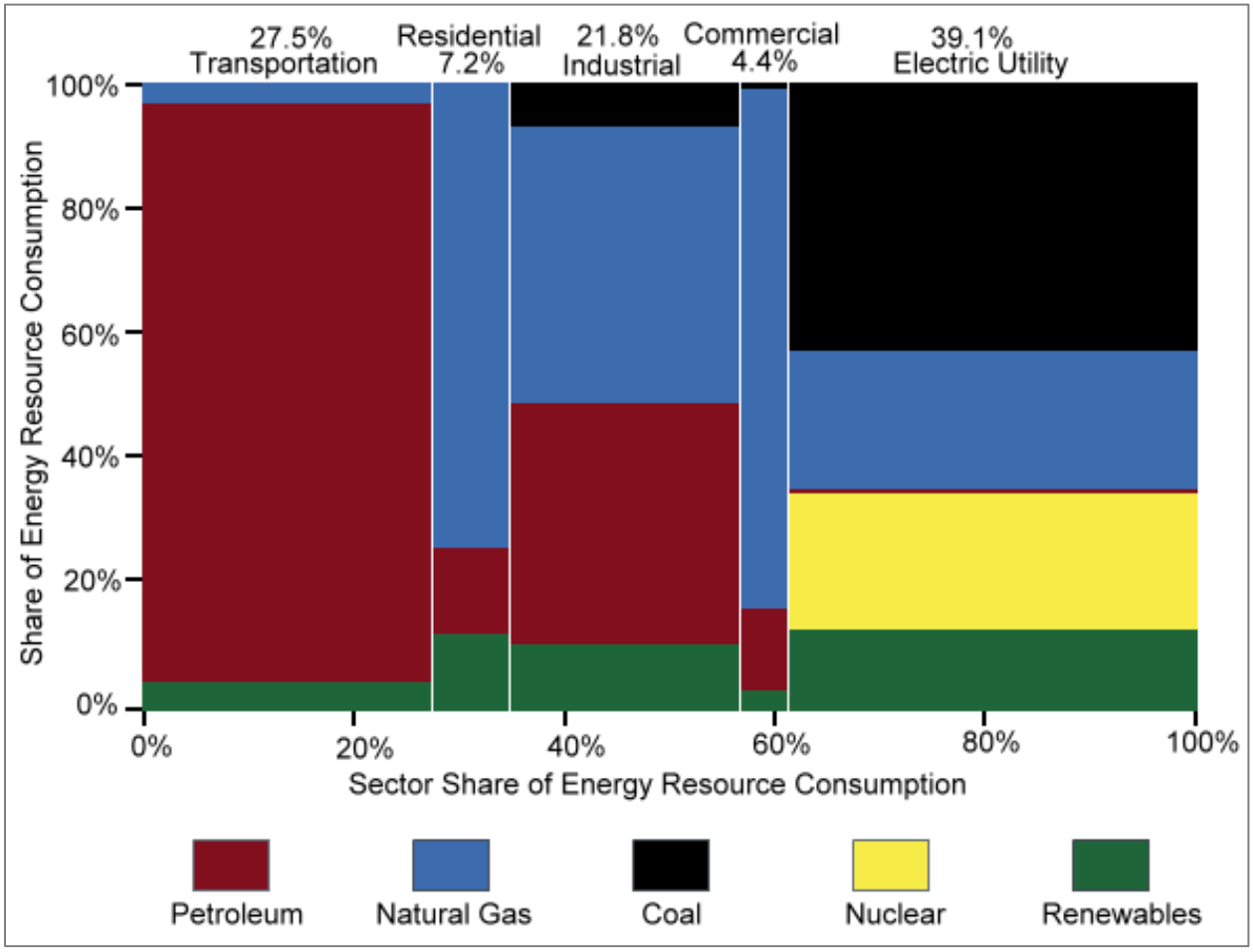


FIGURE 1. U.S. Energy Consumption by Sector and Energy Source, 2014

Source:
Energy Information Administration, *Monthly Energy Review, October 2015*, Tables 2.2, 2.3, 2.4, 2.5, and 2.6. http://www.eia.gov/totalenergy/data/monthly

The Transportation Sector Currently Uses about the Same Amount of Petroleum as Produced by the United States

Petroleum consumption in the transportation sector surpassed U.S. petroleum production for the first time in 1989, creating a gap that must be met with imports of petroleum. By 2015 the gap had disappeared and the United States produced almost the same amount of petroleum as the transportation sector used. Current projections show that conventional sources will more than meet transportation demand in the coming years. Combined with non-petroleum sources, such as ethanol, biomass, and liquids from coal, the production will be 16 million barrels per day in 2040.

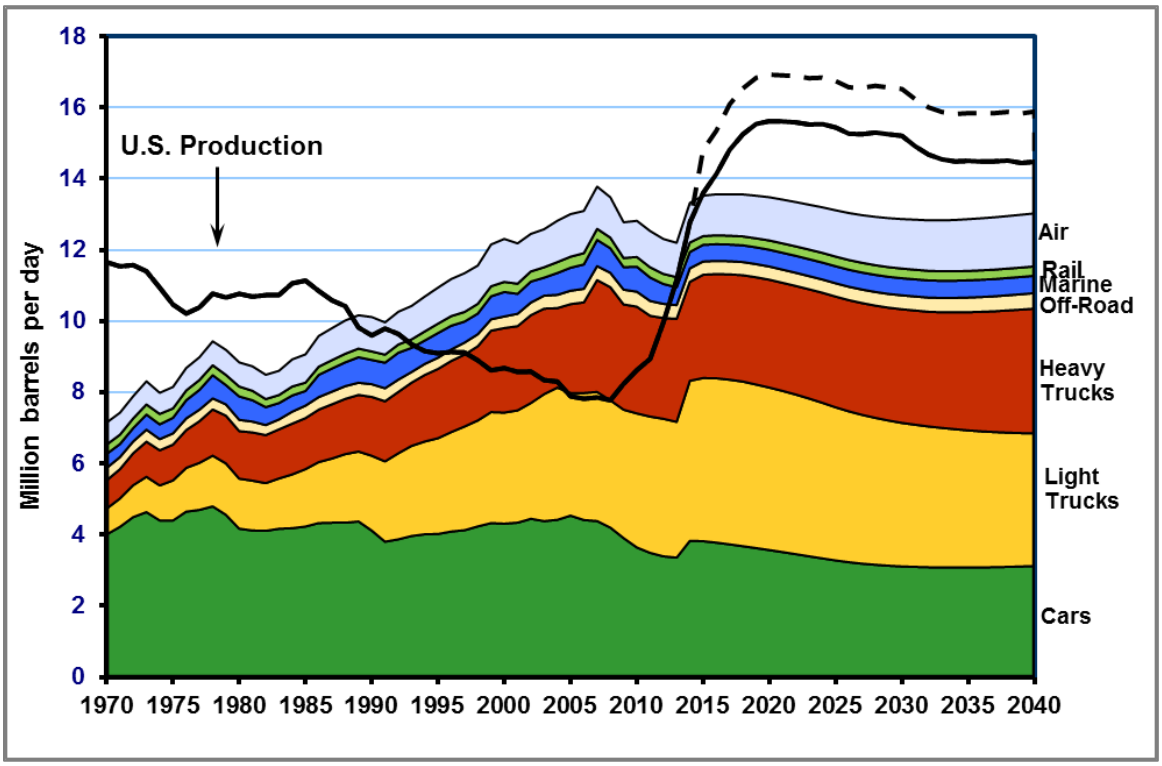


FIGURE 2. Transportation Petroleum Use by Mode and the U.S. Production of Petroleum, 1970-2040

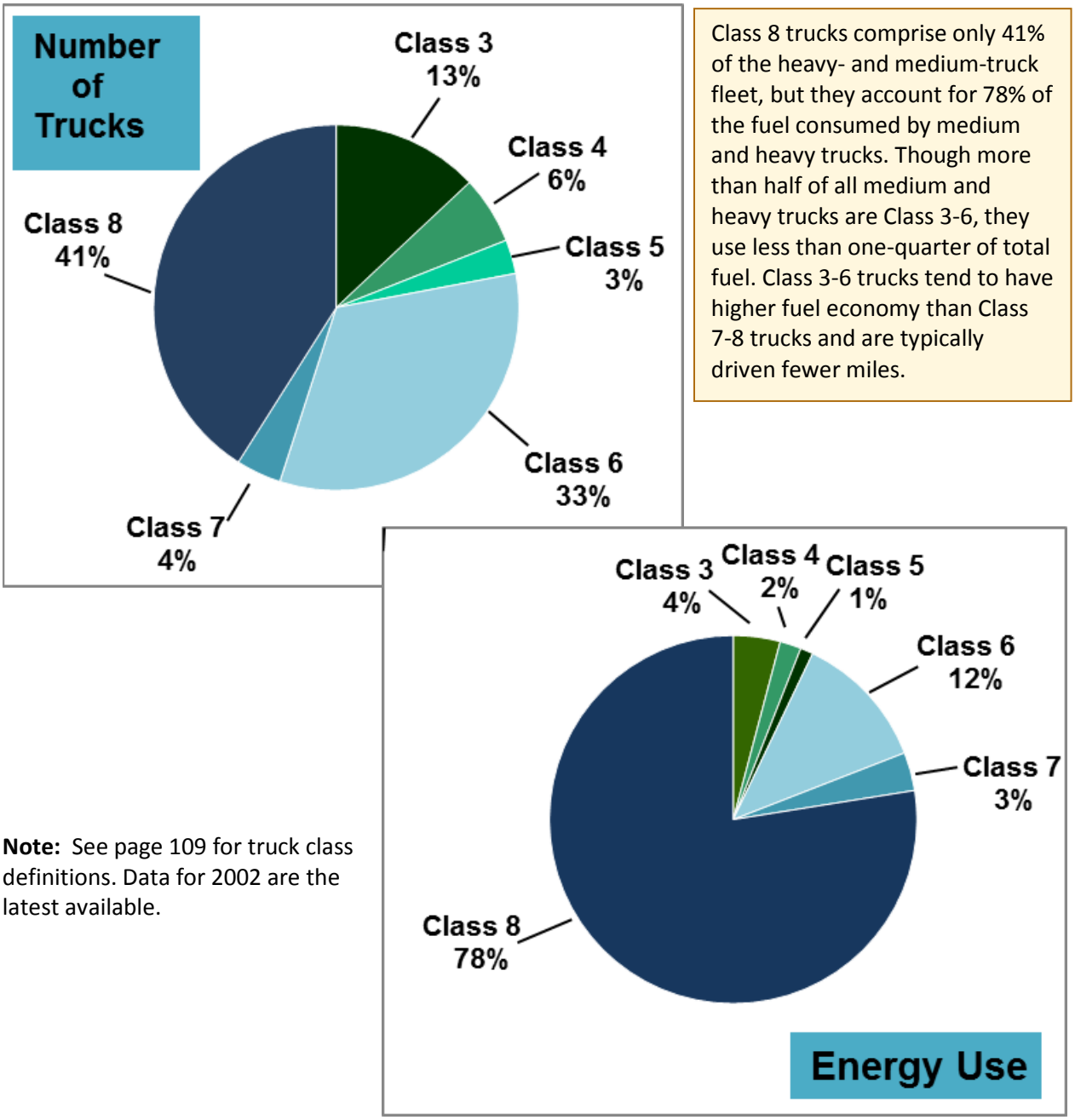
Note: The U.S. production has two lines after 2011. The solid line is conventional sources of petroleum, including crude oil, natural gas plant liquids, and refinery gains. The dashed line adds in other non-petroleum sources, including ethanol, biomass, liquids from coal, other blending components, other hydrocarbons, and ethers. The sharp increase in values between 2013 and 2014 is caused by the data change from historical to projected values. The sharp increase in values for heavy trucks between 2006 and 2007 is the result of a methodology change in the Federal Highway Administration data.

Sources:

1970-2009: Oak Ridge National Laboratory, *Transportation Energy Data Book: Edition 34*, Oak Ridge, TN, 2015. http://cta.ornl.gov/data

2010-2040: Energy Information Administration, *Annual Energy Outlook 2015*, Washington, DC, 2015. http://www.eia.gov/forecasts/aeo/index

Class 8 Trucks Use the Majority of Fuel Consumed by Medium/Heavy Trucks



Class 8 trucks comprise only 41% of the heavy- and medium-truck fleet, but they account for 78% of the fuel consumed by medium and heavy trucks. Though more than half of all medium and heavy trucks are Class 3-6, they use less than one-quarter of total fuel. Class 3-6 trucks tend to have higher fuel economy than Class 7-8 trucks and are typically driven fewer miles.

Note: See page 109 for truck class definitions. Data for 2002 are the latest available.

FIGURE 3. Medium and Heavy Truck Fleet Composition and Energy Usage, 2002

Source:
Oak Ridge National Laboratory, *Transportation Energy Data Book: Edition 34*, Oak Ridge, TN, 2015.
http://cta.ornl.gov/data

Improvements in Fuel Economy for Low-MPG Vehicles Yield the Greatest Fuel Savings

The relationship between gallons used over a given distance and miles per gallon (mpg) is not linear. Thus, an increase in fuel economy by 5 mpg does not translate to a constant fuel savings amount. Trading a low-mpg car or truck for one with just slightly better mpg will save more fuel than trading a high-mpg car or truck for one that is even higher. For example, trading a truck that gets 10 mpg for a new one that gets 15 mpg will save 33 gallons of fuel for every 1,000 miles driven. In contrast, trading a 30-mpg car for a new car that gets 35 mpg will save 5 gallons of fuel for every 1,000 miles driven.

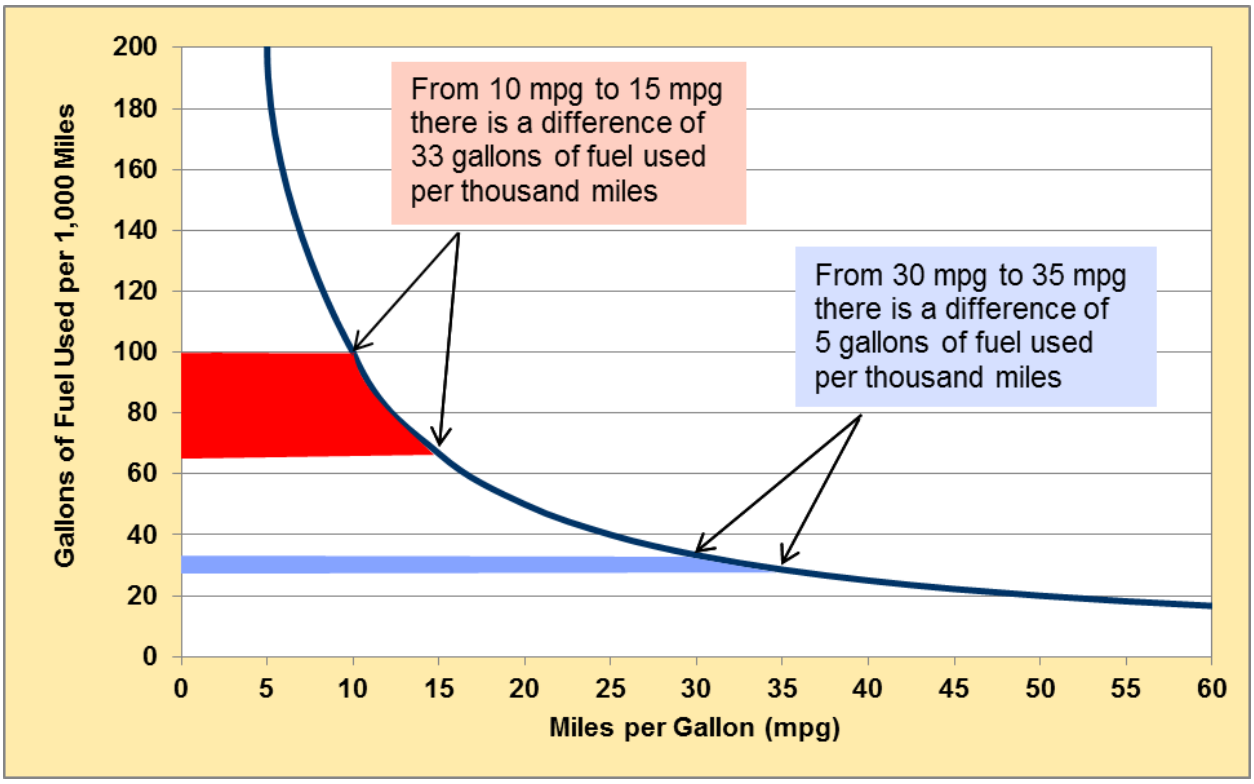


FIGURE 4. Fuel Use versus Fuel Economy

Note: Each category on the horizontal axis shows a five-mile per gallon improvement in fuel economy.

Source:
U.S. Department of Energy, Fuel economy data, http://www.fueleconomy.gov.

Carbon Dioxide Emissions from Transportation Decreased from 2007

Carbon dioxide (CO_2) emissions decreased by 9% from a high of 1,895 million metric tons (mmt) in 2007 to 1,722 mmt in 2013. Improvements in vehicle efficiency and changes in vehicle travel have likely contributed to this decrease. The increased use of ethanol in gasoline may also have played a role in lowering CO_2 emissions.

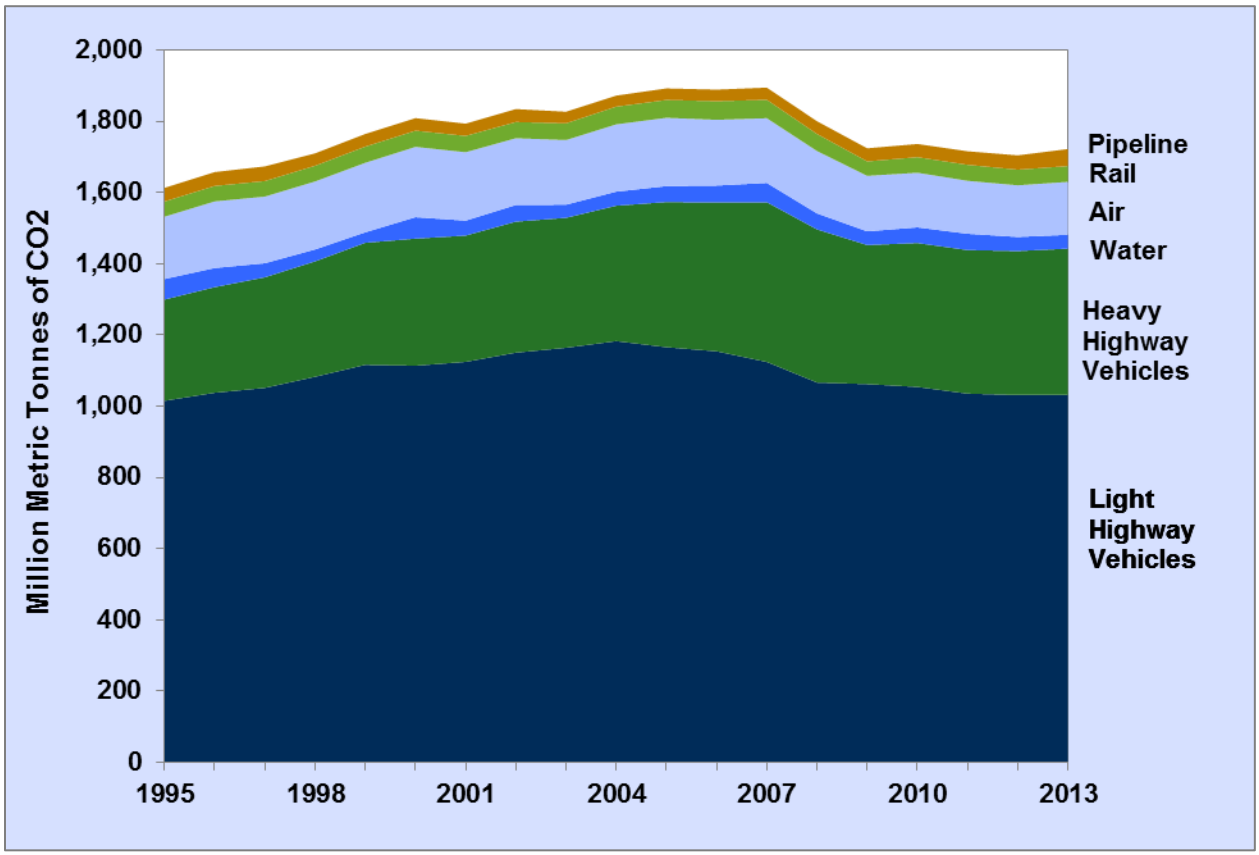


FIGURE 5. Transportation Carbon Dioxide Emissions, 1995-2013

Note: International Bunker Fuels were not included in these calculations.

Source:

U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks*: 1990-2013, Table 3-12, April 2015. http://epa.gov/climatechange/ghgemissions/usinventoryreport.html

Many Cars Pollute Less Despite Increases in Size

As new vehicles become more efficient, the amount of carbon dioxide (CO_2) they produce decreases. Shown below are several examples of model year (MY) 2015 cars that have decreased the amount of CO_2 they produce (in grams per mile) despite the fact that they are the same size or larger (in interior volume) than they were ten years ago. Of the examples, the Ford Taurus had the largest decline in CO_2 emissions in the ten-year period, and the Nissan Sentra had the greatest increase in interior volume while still reducing CO_2 emissions.

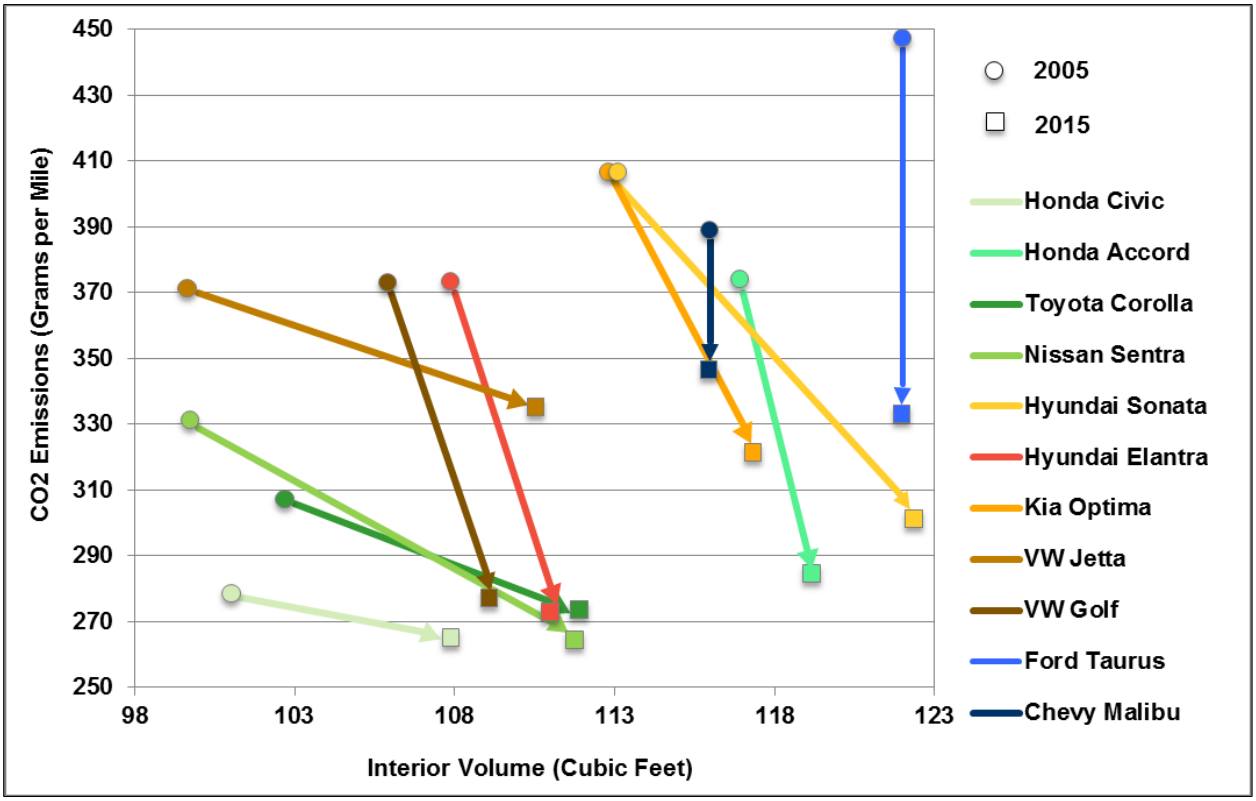


FIGURE 6. Carbon Dioxide Emissions versus Interior Volume for Selected MY 2015 Cars

Source:

U.S. Department of Energy, Fuel economy data, http://www.fueleconomy.gov. Data accessed December 2015.

Newer Cars and Light Trucks Emit Fewer Tons of CO_2 Annually

The carbon footprint measures a vehicle's impact on climate change in tons of carbon dioxide (CO_2) emitted annually. In model year (MY) 2015 the sales-weighted average of CO_2 emitted by new cars was 5.8 metric tons annually per car. For new light trucks, the average was 8.2 metric tons annually per truck.

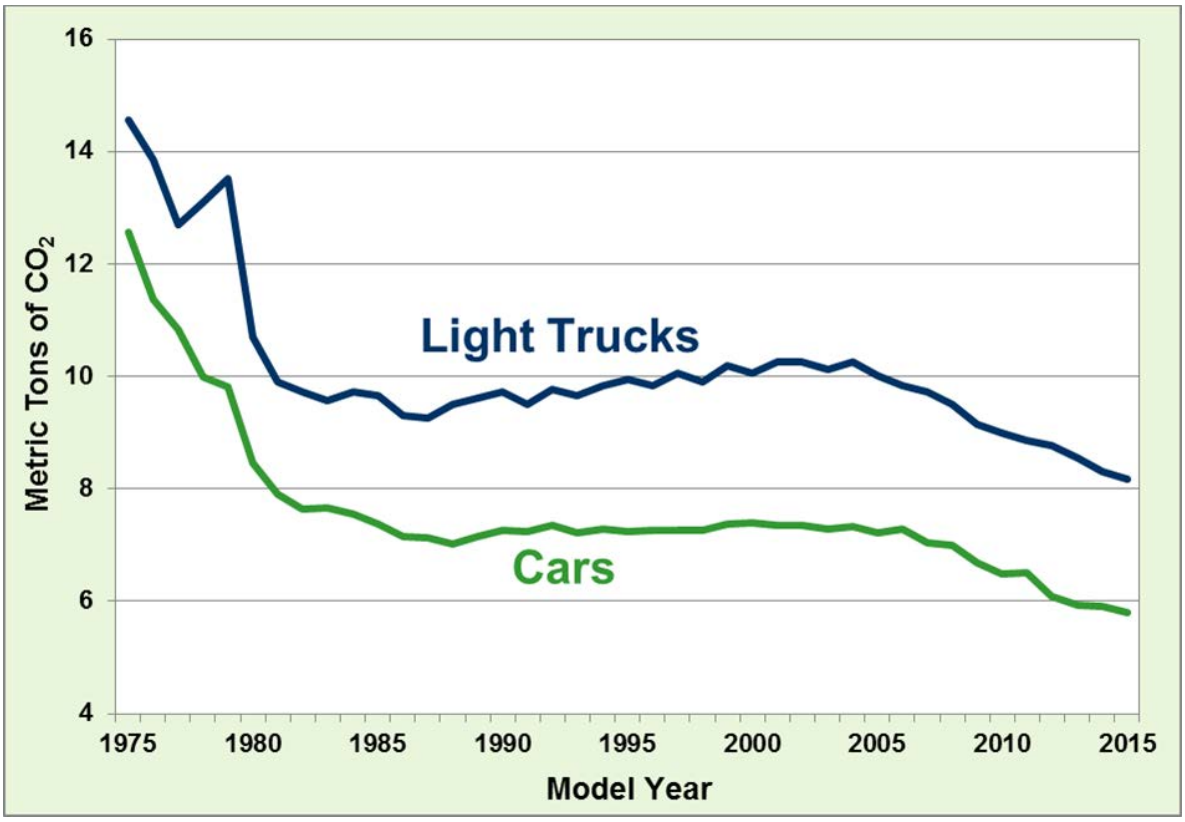


FIGURE 7. Average Carbon Footprint for Cars and Light Trucks Sold, MY 1975-2015

Note: Light trucks include pickups, vans, and 4-wheel drive sport utility vehicles.
Carbon footprint is calculated using results from Argonne National Laboratory's GREET model.

Carbon footprint = $$\left(CO_2 \times LHV \times \frac{AnnualMiles}{CombinedMPG}\right) + \left(CH_4 + N_2O\right) \times AnnualMiles$$

CO_2 = (Tailpipe CO_2 + Upstream Greenhouse Gases) in grams per million Btu
LHV = Lower (or net) Heating Value in million Btu per gallon
CH_4 = Tailpipe CO_2 equivalent methane in grams per mile
N_2O = Tailpipe CO_2 equivalent nitrous oxide in grams per mile

Source:
U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 through 2015*, EPA-420-S-15-001, December 2015. http://www.epa.gov/otaq/fetrends.htm

Total Transportation Pollutants Decline

Due to improvements in fuels and vehicle technologies, the total amount of pollutants emitted from the transportation sector has declined. Since 2002 transportation sector emissions declined for each of the criteria pollutants tracked by the Environmental Protection Agency despite the increased number of highway and nonhighway vehicles and their miles of travel. From 2002 to 2014, carbon monoxide (CO) emissions declined by 51%; nitrogen oxide (NOx) emissions declined by 53%; volatile organic compound (VOC) emissions declined by 44%; and particulate matter emissions less than 10 microns (PM-10) emissions declined 36%.

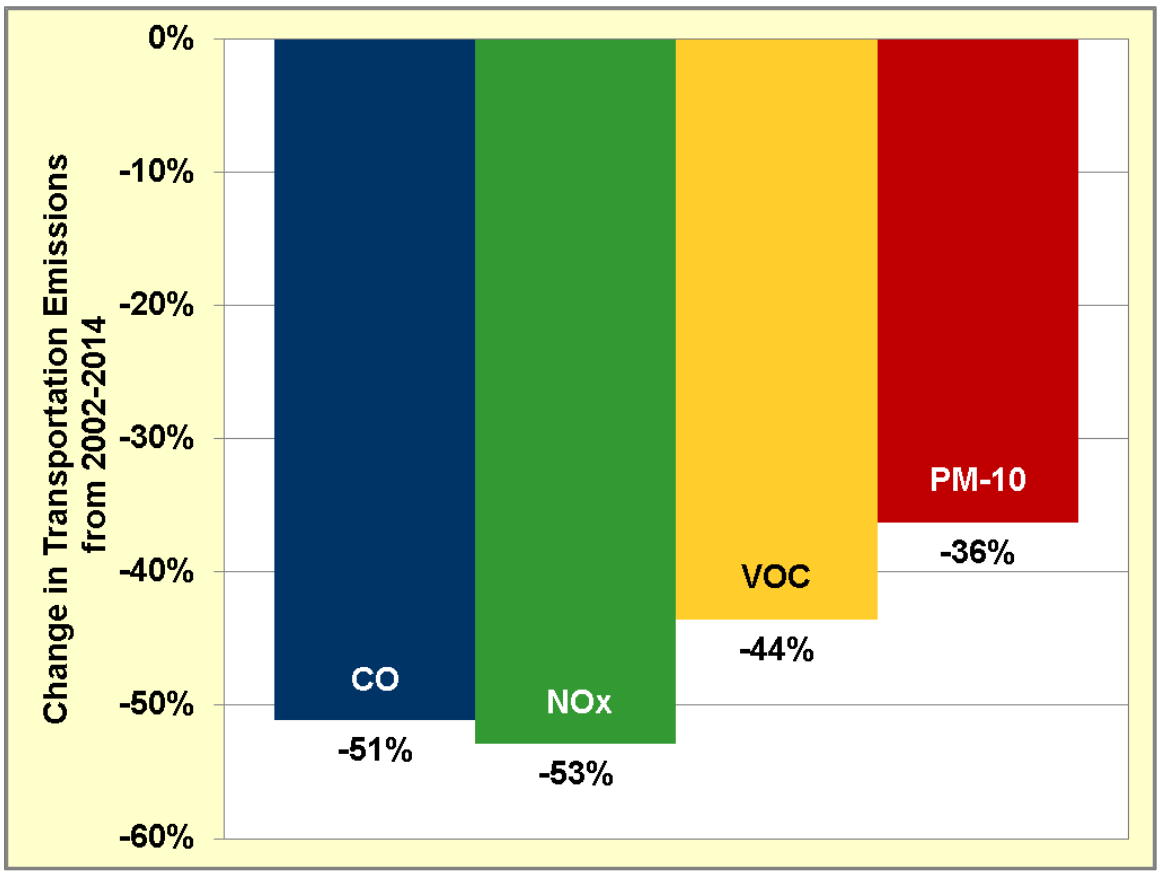


FIGURE 8. Change in Total Transportation Pollutant Emissions from 2002-2014

Note: Includes highway, air, water, rail, and other nonroad vehicles and equipment.

Source:
U.S. Environmental Protection Agency, National Emissions Inventory Air Pollutant Emissions Trends Data. http://www.epa.gov/air-emissions-inventories

Highway Vehicles Responsible for Declining Share of Pollutants

Over 50% of carbon monoxide (CO) emissions from the transportation sector in 2002 were from highway vehicles; by 2014 that fell to 33%. The share of transportation's nitrogen oxide (NOx) emissions from highway vehicles experienced a decline from 43% in 2002 to 36% in 2014. The highway share of volatile organic compound (VOC) emissions declined by 6% during this same period. Highway vehicles contributed less than 5% of all particulate matter (PM) emissions.

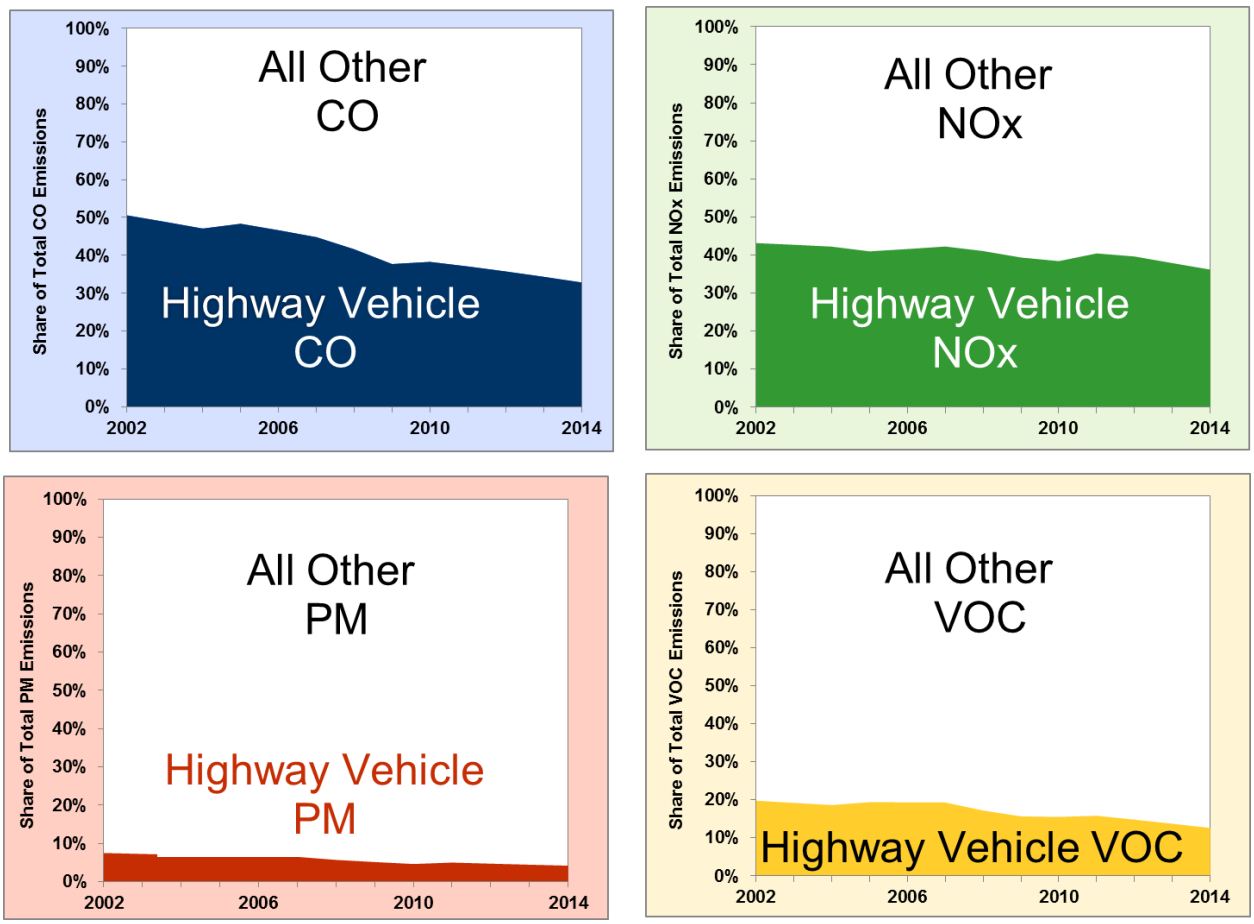


FIGURE 9. Highway and Nonhighway Share of Transportation Pollutant Emissions, 2002-2014

Source:

U.S. Environmental Protection Agency, National Emissions Inventory Air Pollutant Emissions Trends Data. http://www.epa.gov/air-emissions-inventories

Highway Transportation is More Efficient

The number of miles driven on our nation's highways has generally been growing during the past three decades, and energy use has grown with it. However, due to advances in engines, materials, and other vehicle technologies, the amount of fuel used per mile has declined from 1970. The gallons per mile declined by 27% from 1970-1990, but the gallons per mile changed little from the early 1990's to 2014.

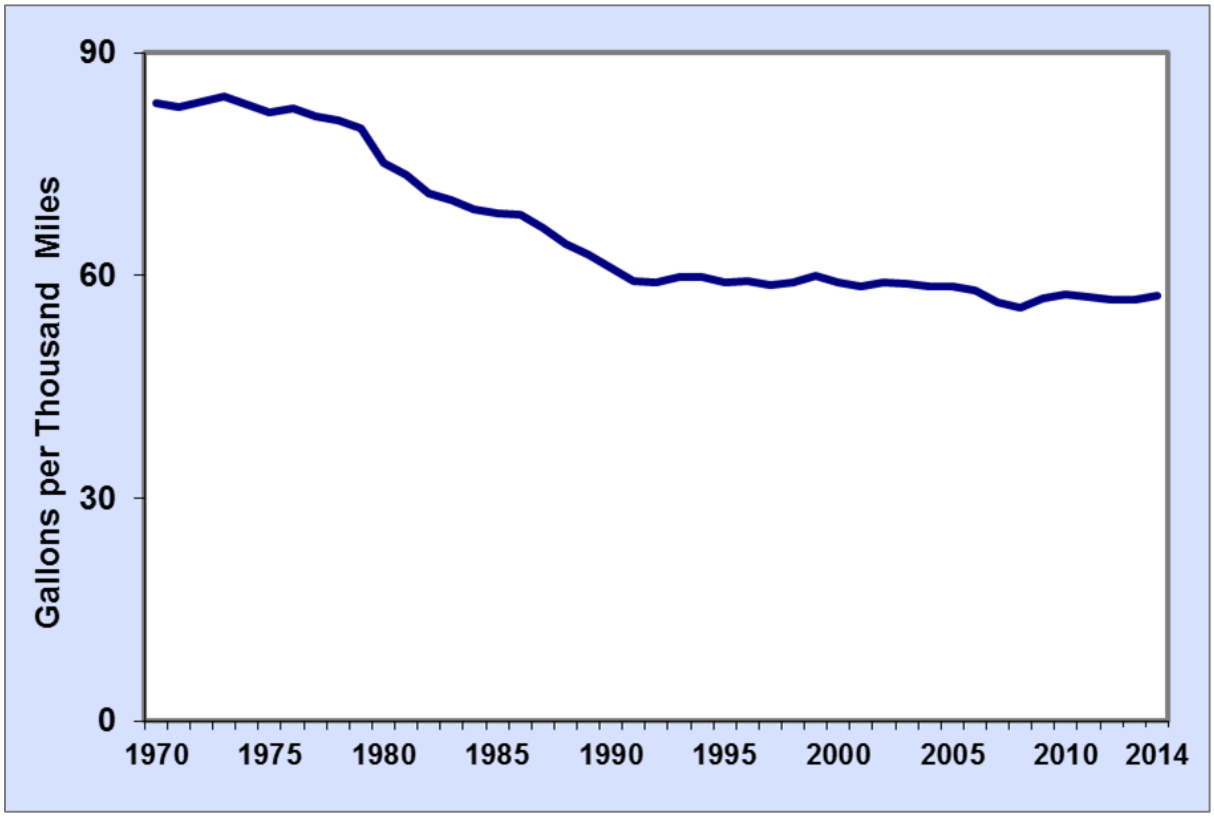


FIGURE 10. Fuel Use per Thousand Miles on the Highways, 1970-2014

Note: Includes travel by cars, light trucks, heavy trucks, buses and motorcycles.

Sources:
Federal Highway Administration, *Highway Statistics 2014*, Table VM-1 and previous annual editions.
http://www.fhwa.dot.gov/policyinformation/statistics/2014

Vehicle Miles and Gross Domestic Product Both Grew in 2015

From 1960 to 1998, the growth in vehicle-miles of travel (VMT) closely followed the growth in the U.S. Gross Domestic Product (GDP). Since 1998, however, the growth in VMT has slowed and not kept up with the growth in GDP. The distance between the two series narrowed in 2015 for the first time since the Great Recession in 2009.

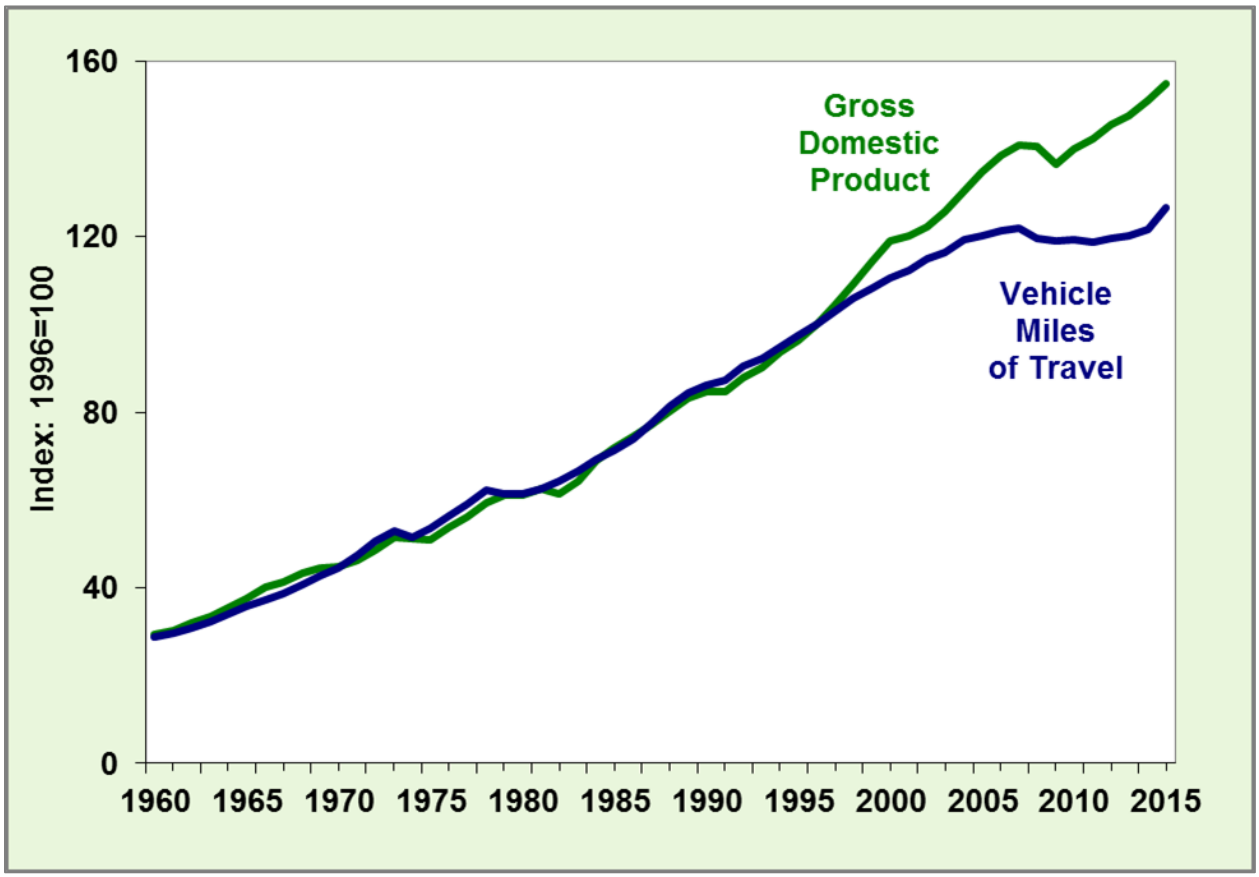


FIGURE 11. Relationship of VMT and GDP, 1960-2015

Sources:

Bureau of Economic Analysis, "Current Dollar and Real Gross Domestic Product."
http://www.bea.gov/national/xls/gdplev.xls

Federal Highway Administration, *Highway Statistics 2014*, Table VM-1 and previous annual editions.
http://www.fhwa.dot.gov/policyinformation/statistics/2014

Federal Highway Administration, *Traffic Volume Trends*, December 2015.
http://www.fhwa.dot.gov/policyinformation/travel_monitoring/15dectvt

Price of Crude Oil Is Affected by World Political and Economic Events

Crude oil prices have been extremely volatile over the past few decades. World events can disrupt the flow of oil to the market or cause uncertainty about future supply or demand for oil, leading to volatility in prices. Supply disruptions caused by political events, such as the Arab Oil Embargo of 1973-74, the Iranian revolution in the late 1970's, and the Persian Gulf War in 1990, were accompanied by major oil price shocks. Excess supply in 2014 caused a decline in crude oil prices.

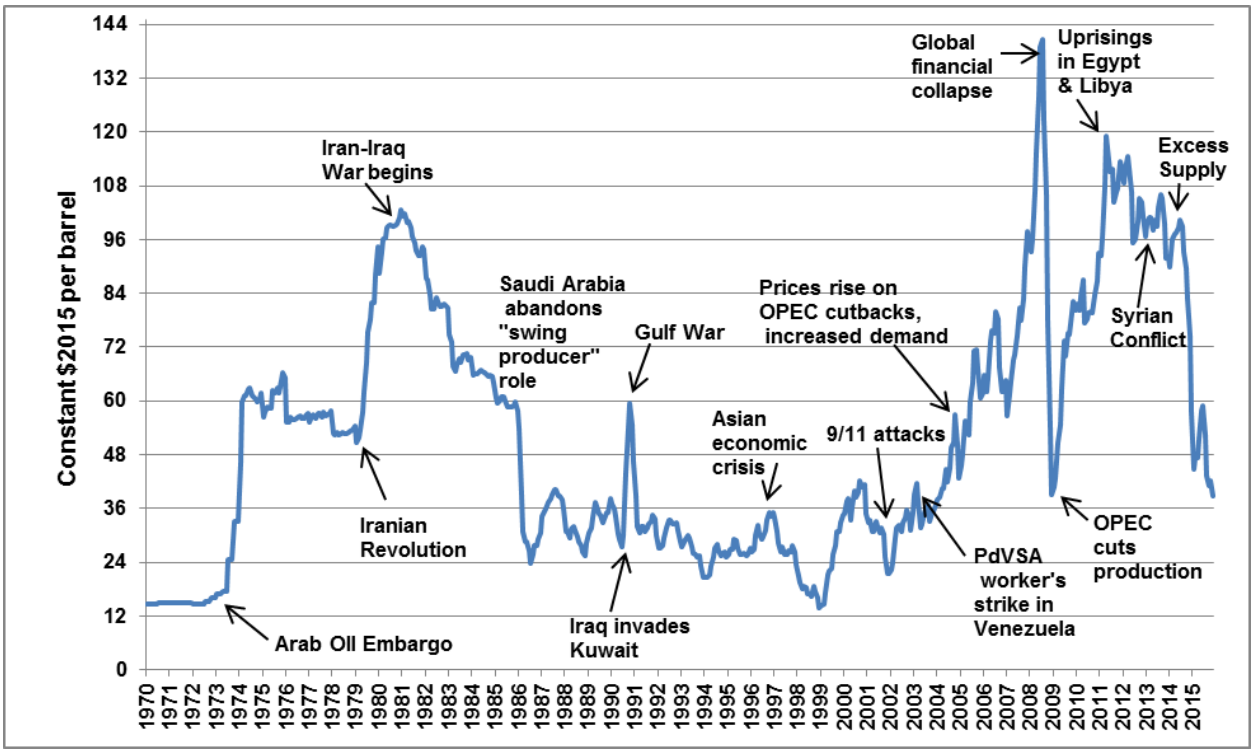


FIGURE 12. World Crude Oil Price and Associated Events, 1970-2015

Notes: Refiner acquisition cost of imported crude oil. OPEC = Organization of the Petroleum Exporting Countries; PdVSA = Petróleos de Venezuela, S.A.

Sources:

Energy Information Administration, "What Drives Crude Oil Prices?" December 31, 2015. http://www.eia.gov/finance/markets/spot_prices.cfm

Pew Center on Global Climate Change, *Reducing Greenhouse Gas Emissions from U.S. Transportation*, January 2011.

Oil Price Shocks Are Often Followed by an Economic Recession

Major oil price shocks have disrupted world energy markets five times in the past 30 years (1973-74, 1979-80, 1990-91, 1999-2000, and 2008). Most of the oil price shocks have been followed by an economic recession in the United States.

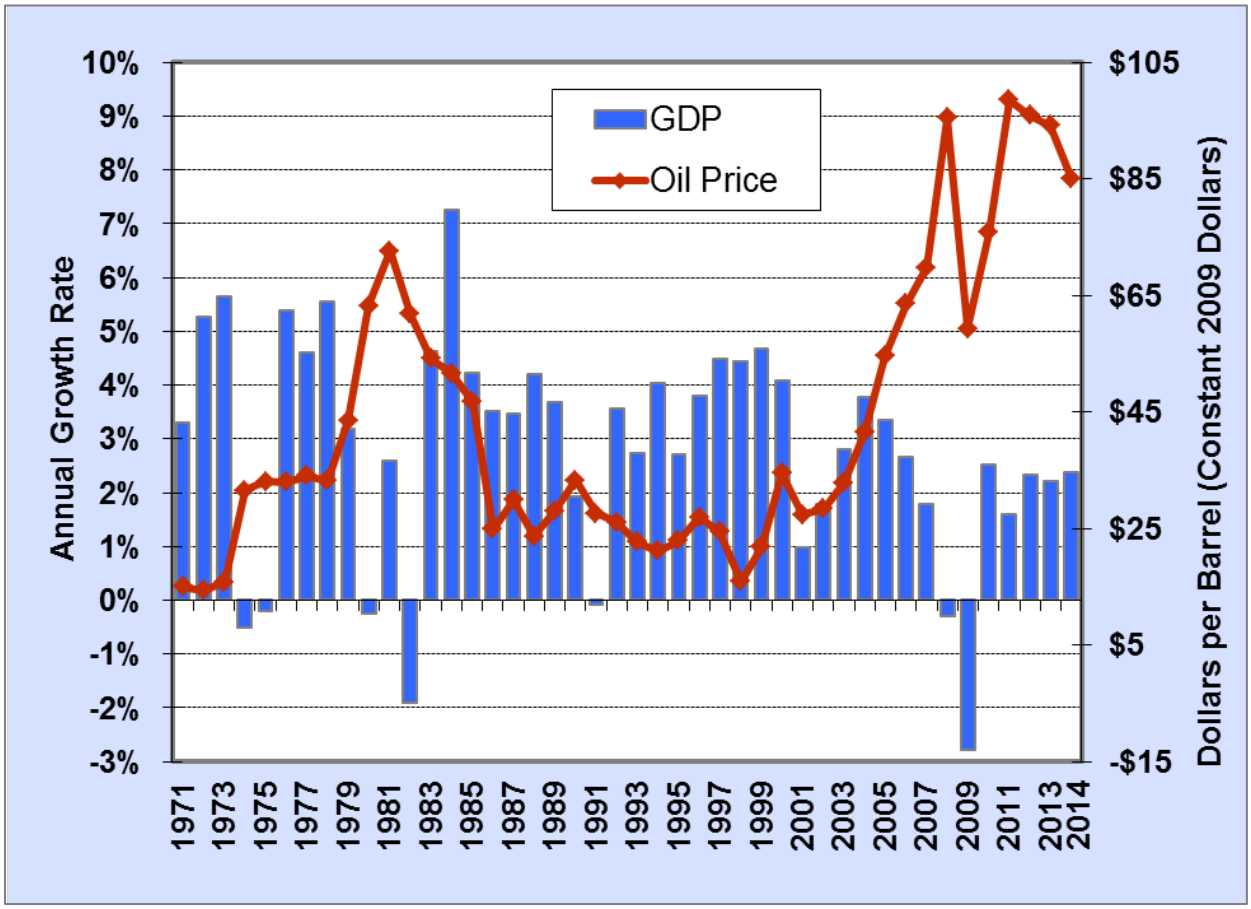


FIGURE 13. The Price of Crude Oil and Economic Growth, 1971-2014

Note: GDP = gross domestic product. Oil price is refiner acquisition cost.

Sources:

Energy Information Administration, *Monthly Energy Review, November 2015*, Table 9.1. http://www.eia.gov/totalenergy/data/monthly

U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts*, Table 1.1.6, December 2015. http://bea.gov/iTable/index_nipa.cfm

ORNL Estimates that 2014 Direct and Indirect Oil Dependence Costs Were $116 Billion

The United States has long recognized the problem of oil dependence and the economic problems that arise from it. Greene, Lee and Hopson define oil dependence as a combination of four factors: (1) a noncompetitive world oil market strongly influenced by the Organization of the Petroleum Exporting Countries (OPEC) cartel, (2) high levels of U.S. imports, (3) the importance of oil to the U.S. economy, and (4) the lack of economical and readily available substitutes for oil. The most recent study shows that the U.S. economy suffered the greatest losses in 2008 when wealth transfer and gross domestic product (GDP) losses (combined) amounted to over half a trillion dollars. However, when comparing oil dependence to the size of the economy, the year 1980 is the highest. Low oil prices in 2009-2010 and 2013-2014 caused total dependence cost to drop; in 2014 the total cost was about $116 billion.

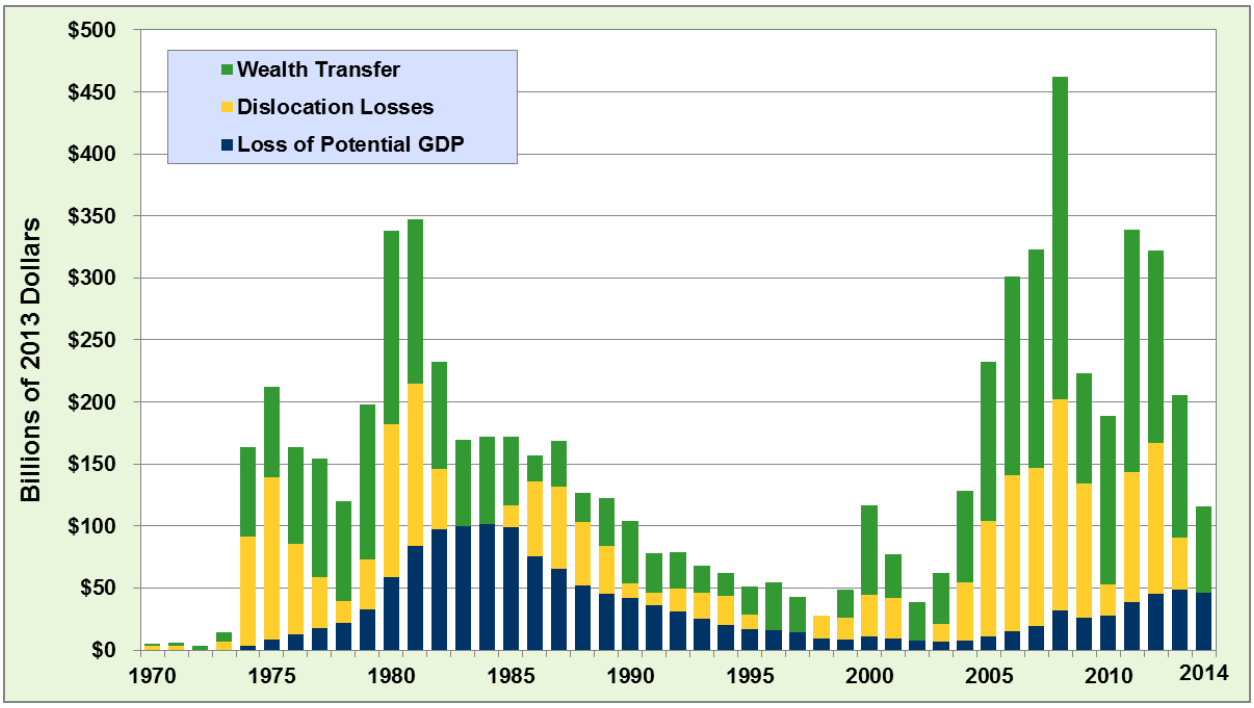


FIGURE 14. Costs of Oil Dependence to the U.S. Economy, 1970-2014

Notes: ***Wealth Transfer*** is the product of total U.S. oil imports and the difference between the actual market price of oil (influenced by market power) and what the price would have been in a competitive market. ***Dislocation Losses*** are temporary reductions in GDP as a result of oil price shocks. ***Loss of Potential GDP*** results because a basic resource used by the economy to produce output has become more expensive. As a consequence, with the same endowment of labor, capital, and other resources, our economy cannot produce quite as much as it could have at a lower oil price.

Source:

Greene, David L., Roderick Lee, and Janet L. Hopson, *OPEC and the Costs to the U.S. Economy of Oil Dependence: 1970-2010*, Oak Ridge National Laboratory Memorandum, 2011, and updates from Changzheng Liu.

Changes in Energy Prices and Vehicle-Miles of Travel Mirror Each Other

The prices of gasoline and diesel fuel affect the transportation sector in many ways. For example, fuel prices can impact the number of miles driven and affect the choices consumers make when purchasing vehicles. The graph below shows a three-month moving average of the percentage change of monthly data from one year to the next (i.e., February 2001 data were compared with February 2000 data). The vehicle travel often mirrors the price of gasoline – when the price of gasoline rises, the vehicle travel declines and when the price of gasoline declines, vehicle travel rises. Still, the price of gasoline is just one of the many factors influencing vehicle travel.

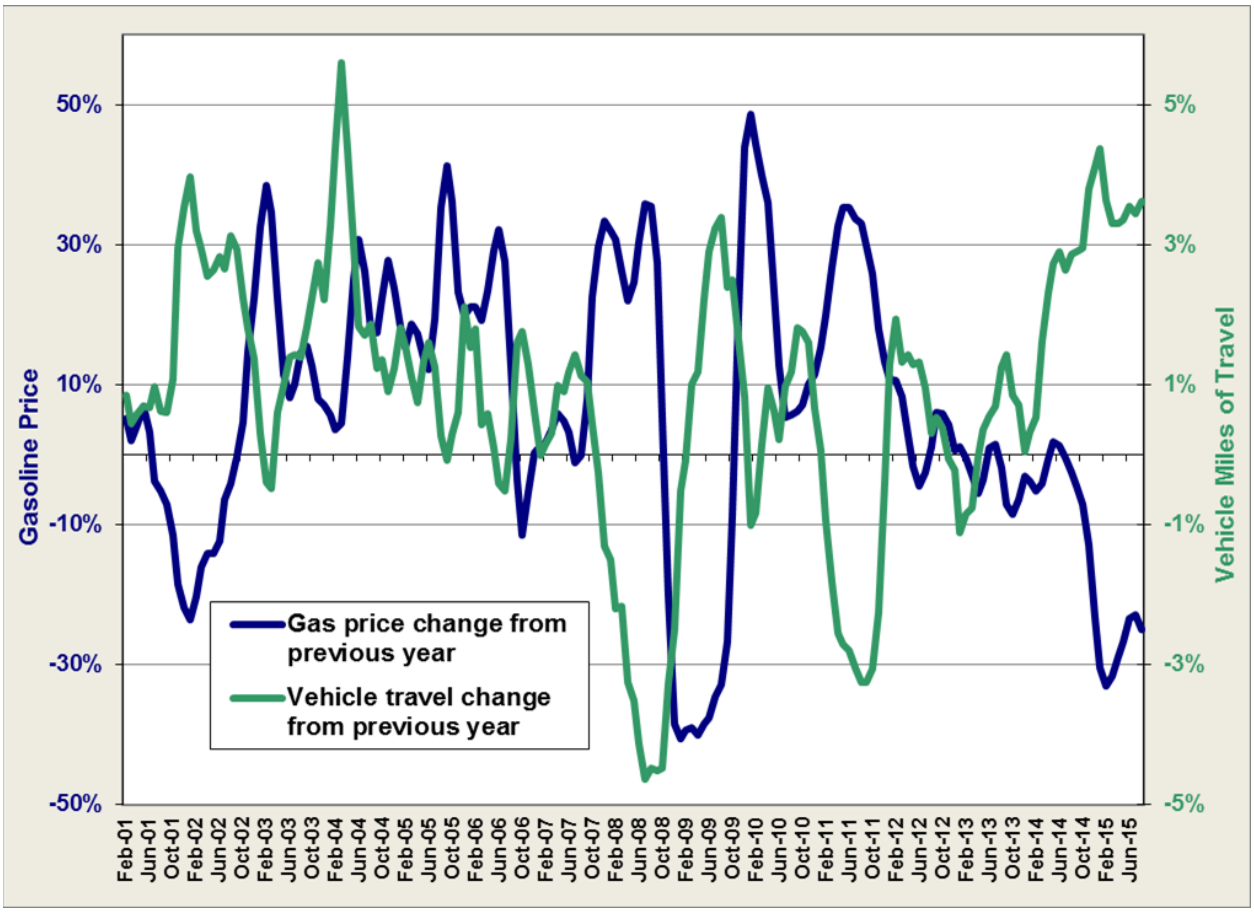


FIGURE 15. Relationship of Vehicle-Miles of Travel and the Price of Gasoline, 2001-2015

Sources:

Federal Highway Administration, *September 2015 Traffic Volume Trends,* and previous monthly editions.
http://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm

Energy Information Administration, *Monthly Energy Review, November 2015*, Table 9.4.
http://www.eia.gov/totalenergy/data/monthly

The Average Price of a New Car Is Just over $25,000

The average price of a new car in 2014 was $25,287, a little lower than the 2013 average (constant 2014 dollars). That price continues to fall from a high of $29,402 in 1999, mainly driven by the high price of import cars. The price of imports peaked in 1998 at $41,676. Until 1981, domestic cars were more expensive than imports.

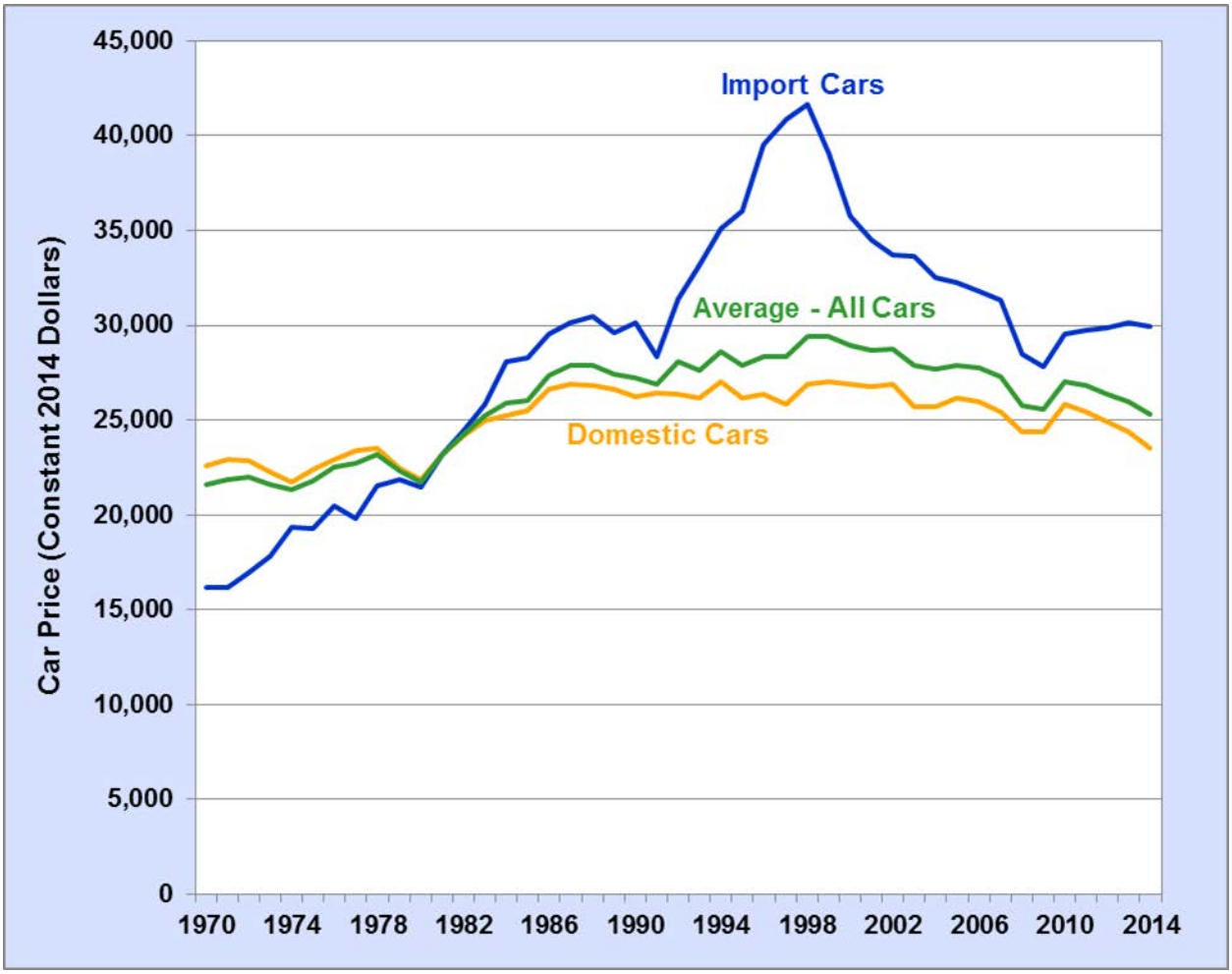


FIGURE 16. Average Price of a New Car, 1970-2014

Note: Data exclude light trucks.

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts*, underlying detail estimates for Motor Vehicle Output, Washington, DC, 2015.

The Highest Selling Light Vehicles of 2014 Were In the $25-$30,000 Price Range

In 2014, there were about 5.6 million light vehicles sold with prices ranging from $25-30,000, which was the category with the highest sales volume. The second highest category was $35-40,000. The 2009 and 2014 sales trends by price are similar, considering that about 10 million light vehicles were sold in 2009 and over 16 million were sold in 2014.

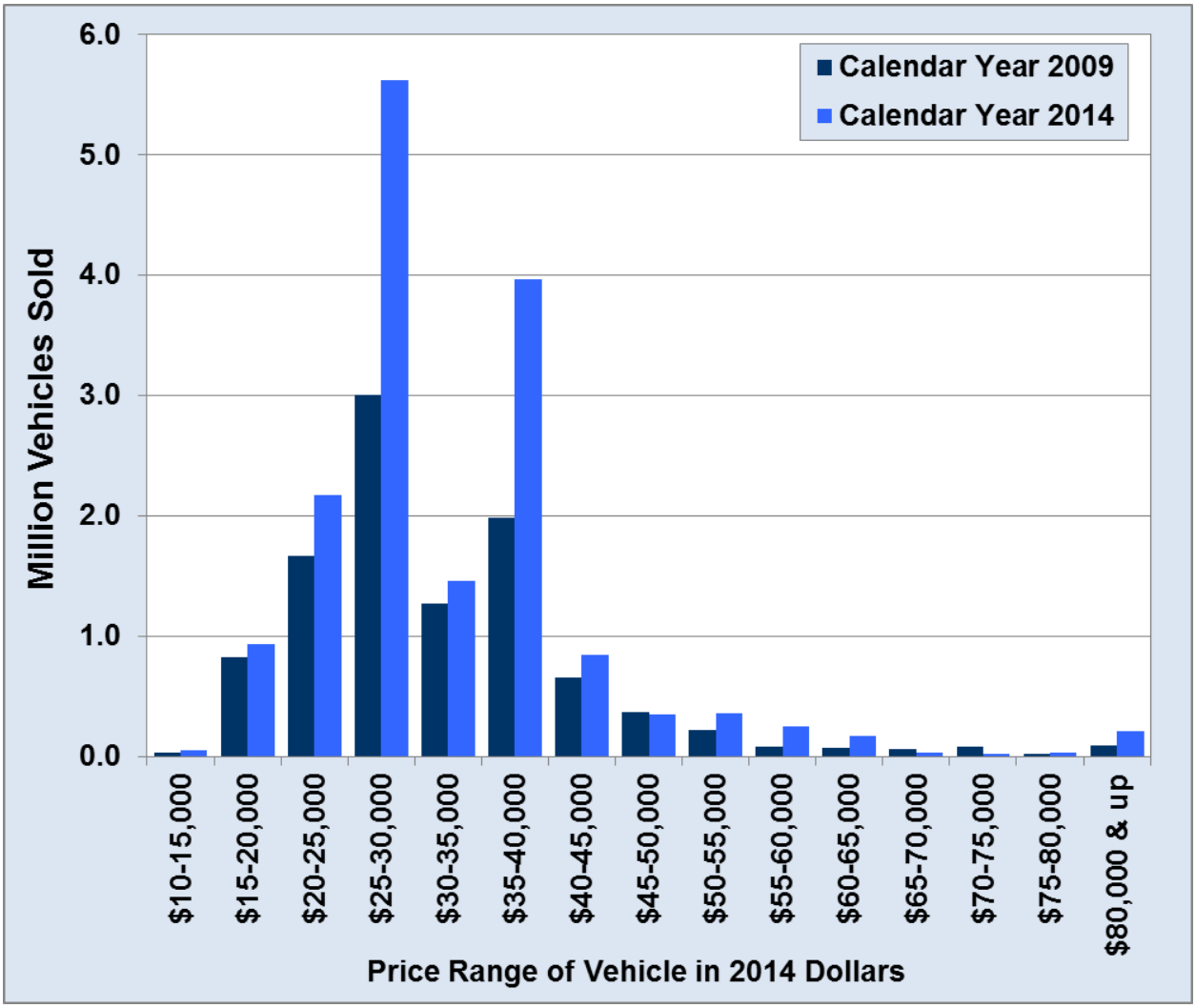


FIGURE 17. Light Vehicle Sales by Price Range, Calendar Years 2009 and 2014

Note: Prices based on Manufacturers Suggested Retail Price (MSRP).

Source:
Provided by Russ Campbell, SRA International, Inc.

Only Thirteen Percent of Survey Respondents Consider Fuel Economy Most Important when Purchasing a Vehicle

A 2015 survey asked a sample of the U.S. population the question "Which one of the following attributes would be MOST important to you in your choice of your next vehicle?" The choices were fuel economy, dependability, low price, quality, and safety. This same question was asked in previous surveys and the results are compared in the graph below. Dependability was chosen most often in nearly every survey after 1980, but fuel economy surpassed it in 2011 and 2012. In 2015, 31% of the survey respondents indicated that dependability would be the most important vehicle attribute while 13% of the survey respondents chose fuel economy—the lowest share since 2005.

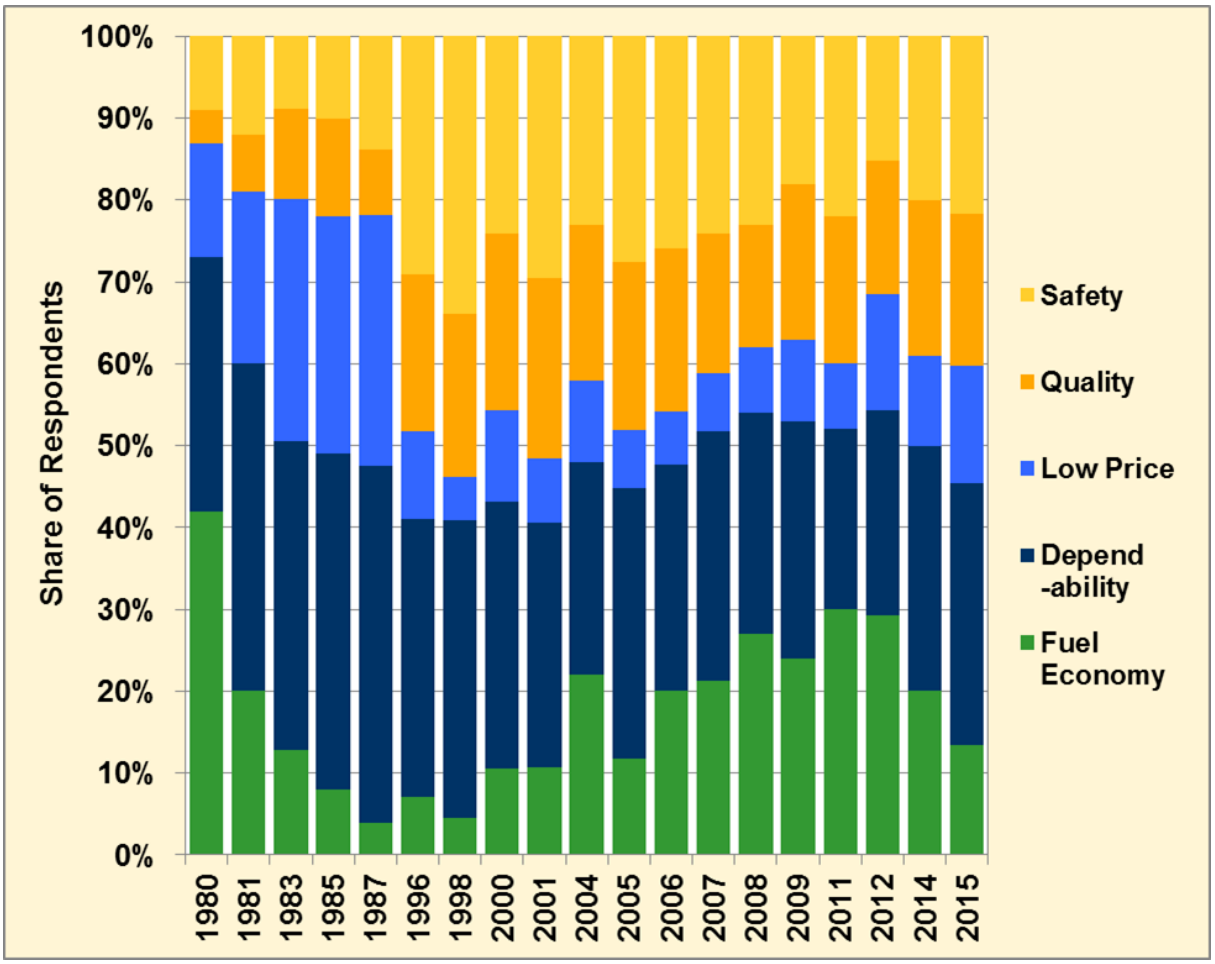


FIGURE 18. Most Important Vehicle Attribute, 1980-2015

Sources:

1980-87: J. D. Power (based on new car buyers). 1998-2015: Opinion Research Corporation International for the National Renewable Energy Laboratory (Sample size ≈ 1,000 in the general population).

Study Finds More than Half of All Age Groups Use the Internet to Find a Car Dealer

According to an AutoTrader-commissioned study of people who purchased vehicles within the past 12 months, the Internet is the source most used when finding a car dealer. However, the study revealed generational differences among vehicle buyers. Millennials were more likely than Baby Boomers or Generation Xers to use a referral from family or friends while Baby Boomers were more likely to rely on prior experience with a dealer, a newspaper or other media sources. Millennials and Generation Xers were more likely to use the Internet.

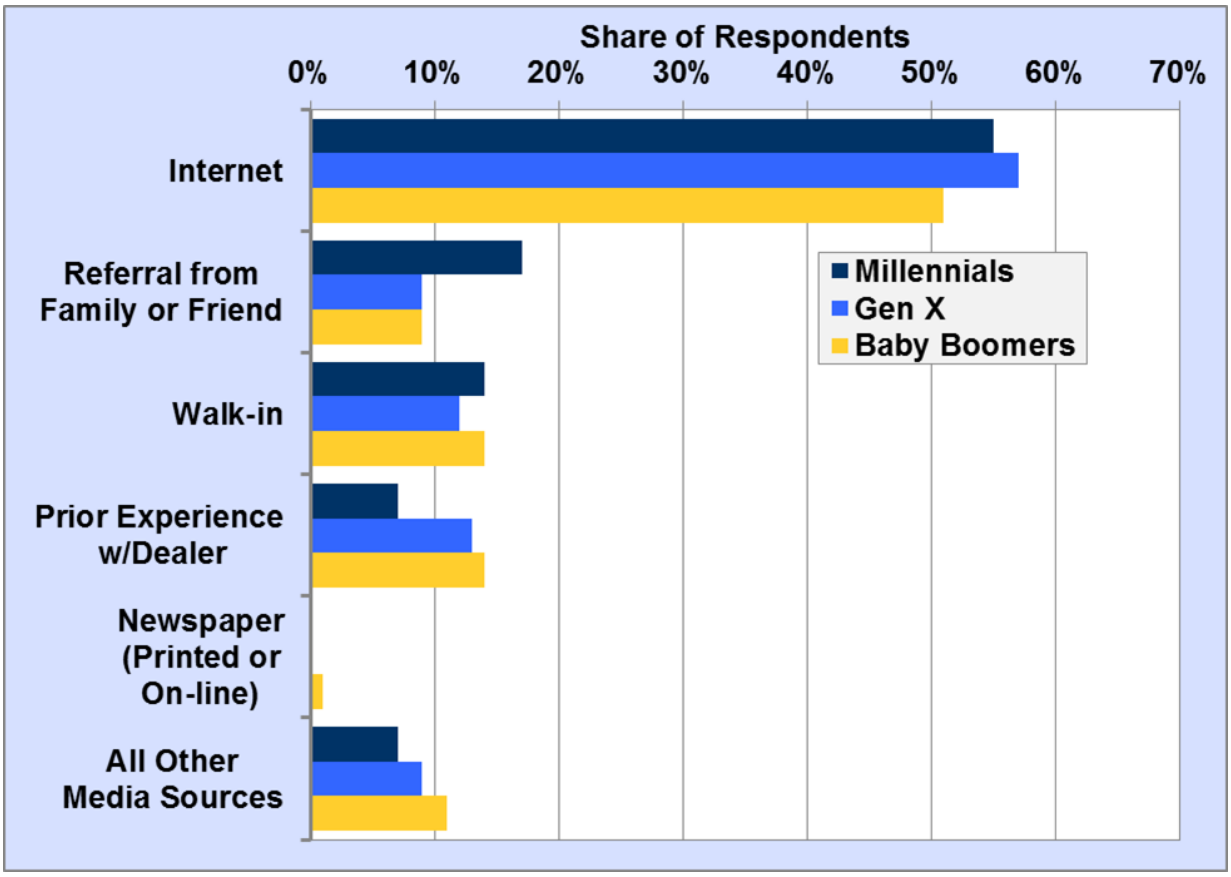


FIGURE 19. Most Influential Sources Leading to a Car Dealer, 2015

Notes: Internet includes on-line news sites. All Other Media Sources include television, direct mailings, outdoor ads, radio, and magazines. Although the original study did not specify exact definitions, Baby Boomers are those born from 1946 to 1964; Generation Xers are those born from 1964 to about 1980; and Millennials are those born from about 1980 to the mid-2000's. Sample size was about 2,300 buyers.

Source:
IHS Automotive/Polk, *2015 Automotive Buyer Influence Study* for AutoTrader.com, 2015.
http://agameautotrader.com/insights/view/2015-automotive-buyer-influence-study-1

Hybrid Vehicles Can Save Money over Time

A selection of hybrid vehicles was paired with a comparably equipped non-hybrid vehicle from the same manufacturer. Price difference was derived from comparably equipped vehicle MSRP (manufacturer's suggested retail price) as shown on the manufacturer's online comparison tools. Annual fuel savings and years to payback were based on 15,000 annual miles and a mix of 55% city and 45% highway driving, and a 2015 national average fuel price of $2.52 per gallon of regular.

TABLE 1. Selected 2015 and 2016 Model Year Hybrid Vehicles Paired with a Comparably Equipped Non-Hybrid Vehicle

Vehicles	EPA MPG	MSRP Difference	Annual Fuel Cost Savings	Years to Payback
2016 Buick LaCrosse eAssist[1]	29	$0	$461	0
2016 Buick LaCrosse	22			
2015 Buick Regal eAssist[1]	29	$0	$378	0
2015 Buick Regal	23			
2016 Lincoln MKZ Hybrid[1]	40	$0	$565	0
2016 Lincoln MKZ FWD	26			
2016 Ford Fusion Hybrid Titanium	42	$310	$615	0.5
2016 Ford Fusion FWD Titanium 4cyl	26			
2015 Toyota Prius Two[2]	50	$1,230	$660	1.9
2015 Toyota Camry LE	28			
2015 Honda Accord Hybrid Touring	47	$1,425	$721	2.0
2015 Honda Accord Touring	26			
2016 Toyota Avalon Hybrid Limited	40	$1,500	$700	2.1
2016 Toyota Avalon Limited	24			
2016 Kia Optima Hybrid	38	$1,105	$395	2.8
2016 Kia Optima EX	28			
2016 Toyota Avalon Hybrid XLE Premium	40	$2,250	$700	3.2
2016 Toyota Avalon XLE Premium	24			
2016 Toyota Avalon Hybrid XLE Plus	40	$2,250	$700	3.2
2016 Toyota Avalon XLE Plus	24			
2016 Ford Fusion Hybrid SE	42	$2,310	$615	3.8
2016 Ford Fusion FWD SE	26			
2016 Lexus ES 300h	40	$2,920	$700	4.2
2016 Lexus ES 350	24			
2015 Toyota Prius Two[2]	50	$2,175	$473	4.6
2015 Toyota Corolla LE Premium	32			
2016 Toyota Prius c One	50	$2,301	$473	4.9
2016 Toyota Yaris 5-Door LE	32			
2016 Ford Fusion Hybrid S	42	$3,075	$615	5.0
2016 Ford Fusion FWD S	26			

[1]Hybrid models shown with an MSRP difference of $0 are available to consumers as a no cost option although performance may not be comparable.

[2]For hybrids with no conventional counterpart, a different model was chosen from the same manufacturer if it appeared to be reasonably similar.

Note: The hybrid models shown have a payback period of 5 years or less based on the assumptions above. Hybrid models available in multiple trim levels are shown only once. No two vehicles from the same manufacturer will be exactly comparable but every effort was made to match the vehicles closely in terms of amenities and utility.

Source:
U.S. Department of Energy, Fuel economy data, http://www.fueleconomy.gov. Data accessed January 2016.

Alternatives to Traditional Car Ownership

Car-sharing programs provide one alternative to car ownership. Typically, car-sharing programs have membership requirements and hourly rates. These programs may have a common vehicle fleet owned by the company or share members' vehicles. Ride-summoning programs are also used as an alternative to car ownership. Ford is experimenting with lease-sharing and lease-swapping programs.

Types of Car-Sharing	Example Companies
Fleet vehicles provided by the company can be rented by the hour.	Enterprise CarShare ZipCar, car2go
Fleet vehicles owned by members can be rented by other members.	FlightCar RelayRides
Share a leased vehicle with friends or family	Ford Credit Link
Swap your leased vehicle with another temporarily (sedan for a mini-van or truck)	Ford Car Swap

Ride-Summoning:
Uber and Lyft are the leading ride-summoning companies. Members use a mobile app to request transportation from a background-checked driver.

TABLE 2. Local/Regional Car-Sharing Programs

Organization	City / Region	URL
BlueIndy	Indianapolis, IN	https://www.blue-indy.com/
Capital CarShare	Albany, NY	http://www.capitalcarshare.org/
Car to Go	Aspen, CO	http://www.cartogo.com/
CarShare Vermont	Burlington, VT	http://www.carsharevt.org/
CityCarshare	San Francisco Bay Area, CA	http://www.citycarshare.org/
Dancing Rabbit Vehicle Cooperative	Rutledge, MO	http://www.dancingrabbit.org/drvc/
e-GO CarShare	Boulder, CO	http://carshare.org/
eThos Electric Carshare	Golden, CO	http://ethoscarshare.com/
Ford Car Swap	(Experiment) Dearborn, MI	https://media.ford.com/content/fordmedia/fna/us/en/news/2015/01/06/mobility-experiment-car-swap-dearborn.html
Ford Credit Link	(Experiment) Austin, TX	https://fordcreditlink.com/#/
FunRide	San Luis Obispo, CA	http://myfunride.com/
HOURCAR	Minneapolis, MN	http://www.hourcar.org/
Ithaca Carshare	Ithaca, NY	http://www.ithacacarshare.org/
Maven (GM)	Manhattan, NY & Ann Arbor, MI	https://www.mavendrive.com/
Missoula Urban Demonstration Project Truck Share Program	Missoula, MT	http://www.mudproject.org/
Scoot	San Francisco, CA	http://www.scootnetworks.com/
Smart Commuter Option Of Today (SCOOT)	Kitsap County, WA	http://www.kitsaptransit.com/scoot
Zero Emission Vehicle Network Enabled Transport (ZEV-NET)	(Research) University of California, Irvine, CA	http://www.zevnet.org/

Note: List may not be all-inclusive.

Source:
University of California, Berkeley, Transportation Sustainability Research Center, "Carsharing," website accessed March 18, 2016, and additional research by Oak Ridge National Laboratory staff. http://tsrc.berkeley.edu/carsharing

Car-Sharing and Ride-Summoning Available across the Nation

TABLE 3. National Car-Sharing and Ride-Summoning Companies by State of Operation

State of Operation	Car-Sharing Company-Owned Vehicles				Car-Sharing Member-Owned Vehicles			Ride-Summoning	
	Enterprise CarShare	ZipCar	UHaul CarShare	Car2Go	Getaround	FlightCar	Turo	Uber	Lyft
Alabama	●	●	●				●	●	
Alaska							●		
Arizona	●	●	●				●	●	●
Arkansas		●					●	●	
California	●	●	●	●	●	●	●	●	●
Colorado	●	●	●	●		●	●	●	●
Connecticut	●	●					●	●	
Delaware		●					●	●	●
Dist. of Columbia	●	●		●	●	●	●	●	●
Florida	●	●	●	●			●	●	●
Georgia	●	●					●	●	●
Hawaii	●	●					●	●	●
Idaho	●	●					●	●	●
Illinois	●	●	●		●		●	●	●
Indiana	●	●	●				●	●	●
Iowa	●	●	●				●	●	
Kansas	●	●					●	●	
Kentucky	●	●	●				●	●	●
Louisiana	●	●					●	●	
Maine		●	●				●	●	
Maryland		●					●	●	●
Massachusetts	●	●	●			●	●	●	●
Michigan	●	●	●				●	●	●
Minnesota	●	●		●			●	●	●
Mississippi		●					●	●	
Missouri	●	●					●	●	
Montana							●	●	
Nebraska	●	●	●				●	●	●
Nevada		●					●	●	●
New Hampshire		●					●	●	
New Jersey	●	●				●	●	●	●
New Mexico	●	●					●	●	
New York	●	●	●	●				●	●
North Carolina	●	●	●				●	●	●
North Dakota							●	●	
Ohio	●	●	●	●			●	●	●
Oklahoma	●	●					●	●	●
Oregon	●	●	●	●	●		●	●	●
Pennsylvania	●	●	●				●	●	●
Rhode Island		●					●	●	●
South Carolina	●	●					●	●	
South Dakota							●		
Tennessee	●	●					●	●	●
Texas	●	●		●		●	●	●	●
Utah	●						●	●	●
Vermont		●	●				●	●	
Virginia	●	●		●			●	●	●
Washington		●		●		●	●	●	●
West Virginia	●	●					●		
Wisconsin	●	●	●				●	●	●
Wyoming							●		
Total locations	**36**	**45**	**20**	**11**	**4**	**5**	**50**	**47**	**32**

Note: Turo, formerly RelayRides, cannot operate in the state of New York due to insurance laws.

Source:
Company websites, research by Oak Ridge National Laboratory, March 2016.

There Were Nearly 1.2 Million Carshare Members and 17,000 Carshare Vehicles in 2015

Data from 23 active car-sharing programs in the United States show that car-sharing membership and vehicles increased from 2004 to 2014, but declined slightly in 2015. This decline may be attributable to the closure of some car-share operations and growing competition from ride-summoning companies and bike-sharing operations.

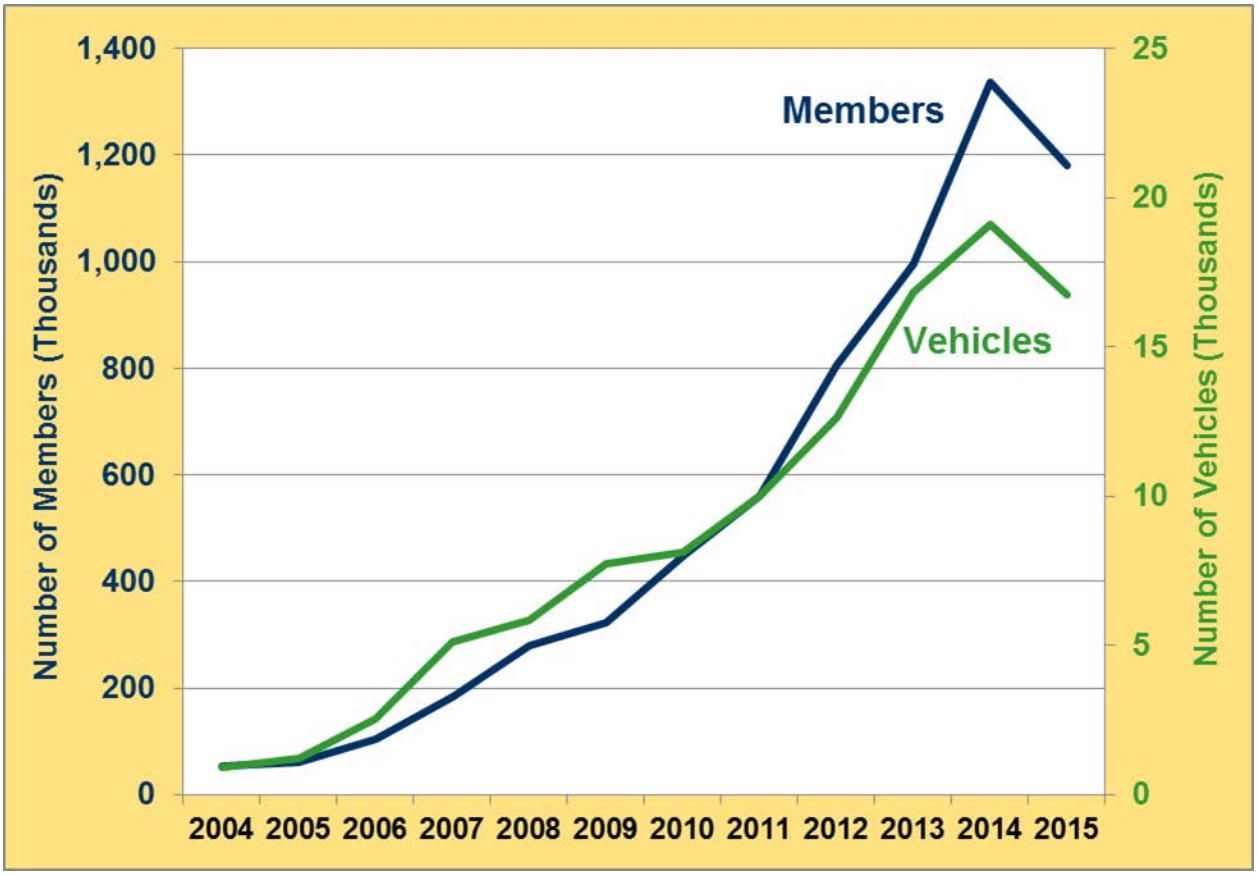


FIGURE 20. Number of Car-Sharing Members and Vehicles, 2004-2015

Source:

University of California, Berkeley, Transportation Sustainability Research Center, *Innovative Mobility Carsharing Outlook, Summer 2015*. http://tsrc.berkeley.edu/node/923

Almost 17% of Household Expenditures Are for Transportation

Except for housing, transportation was the largest single expenditure for the average American household in 2014. Of the transportation expenditures, vehicle purchases and gas and oil were the two largest single expenditures. In 1984, transportation was closer to 20% of all household expenditures and the share has generally fluctuated between 16% and 20% over time. In 2009, however, the transportation share reached a low of 15.6%.

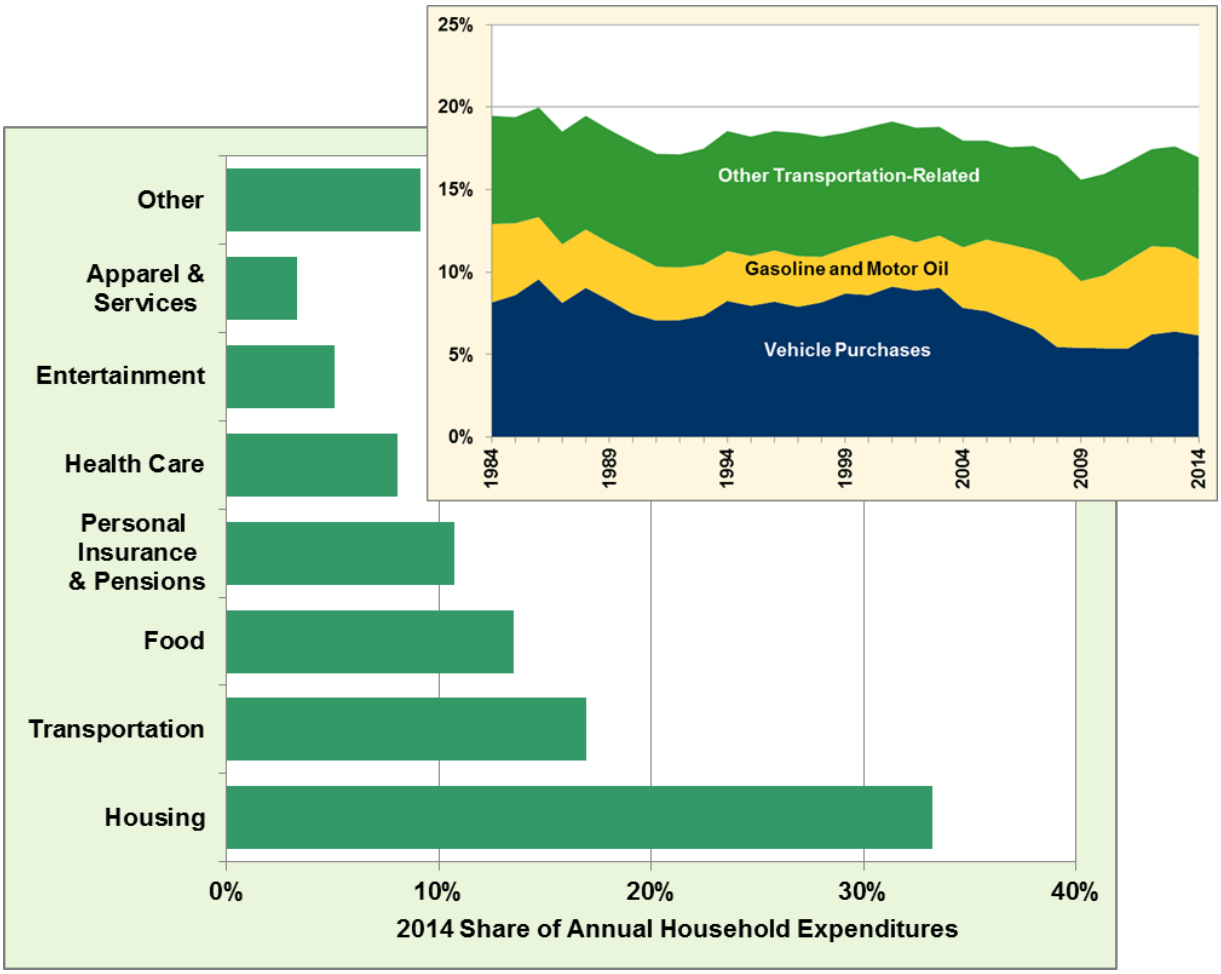


FIGURE 21. Share of Household Expenditures by Category, 2014, and Transportation Share of Household Expenditures, 1984-2014

Note: For additional details on the methodology of the Consumer Expenditure Survey, see http://www.bls.gov/cex.

Sources:

U.S. Department of Labor, *Consumer Expenditure Survey 2015*, Table 1202, Washington, DC, 2015, and multiyear survey tables. http://www.bls.gov/cex/

The Transportation Industry Employs Over 10 Million People

The transportation industry employs a wide variety of people in many different fields. From the manufacture of vehicles and parts to travel reservation services, 10.3 million people are employed in transportation-related jobs. These transportation-related jobs account for 7.5% of the total non-farm employment. Retail sales of motor vehicles and parts, which include dealerships, retail parts stores, and more, accounts for the most employees. Truck transportation, which includes truck drivers, is the category with the second highest number of employees.

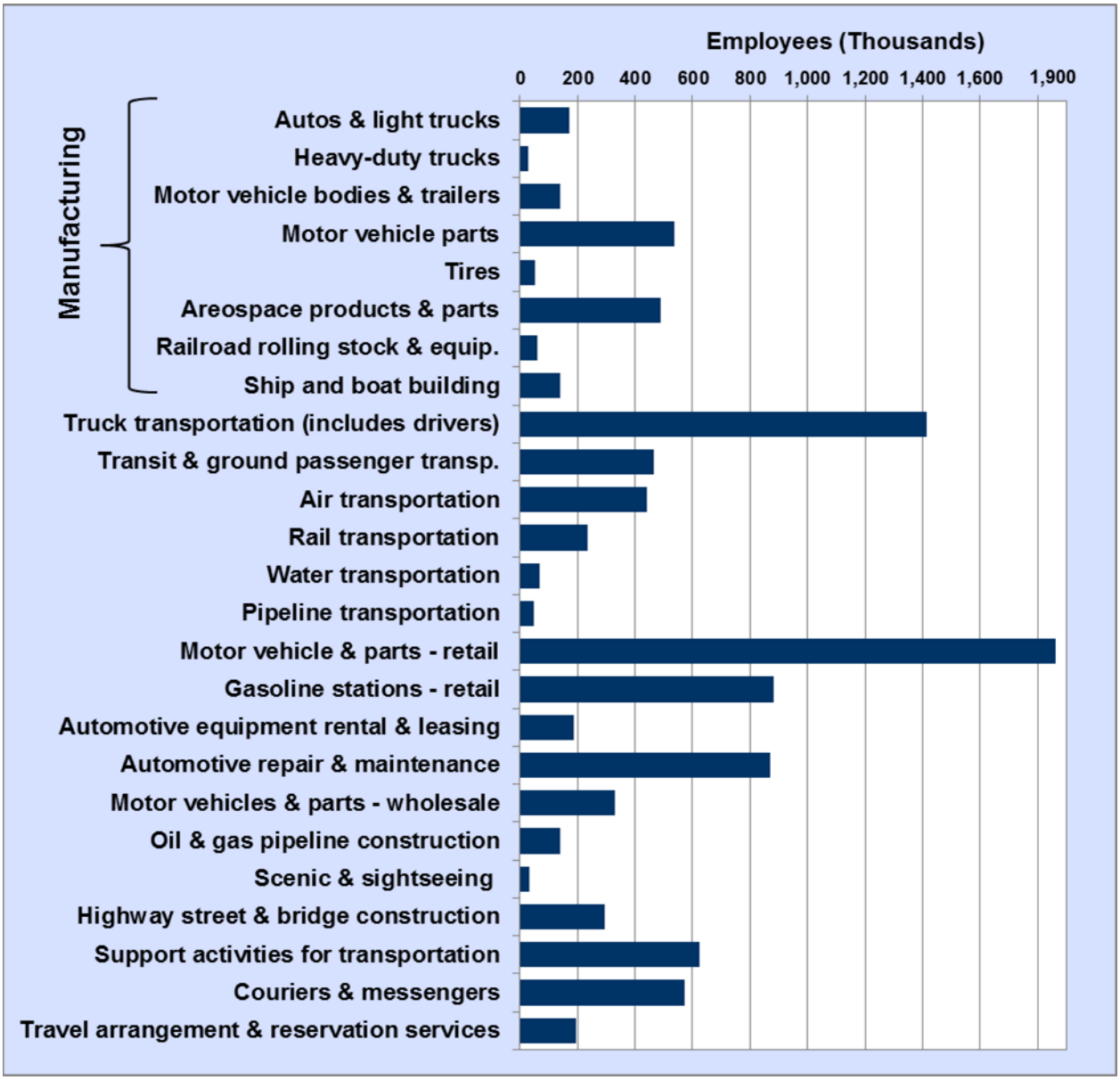
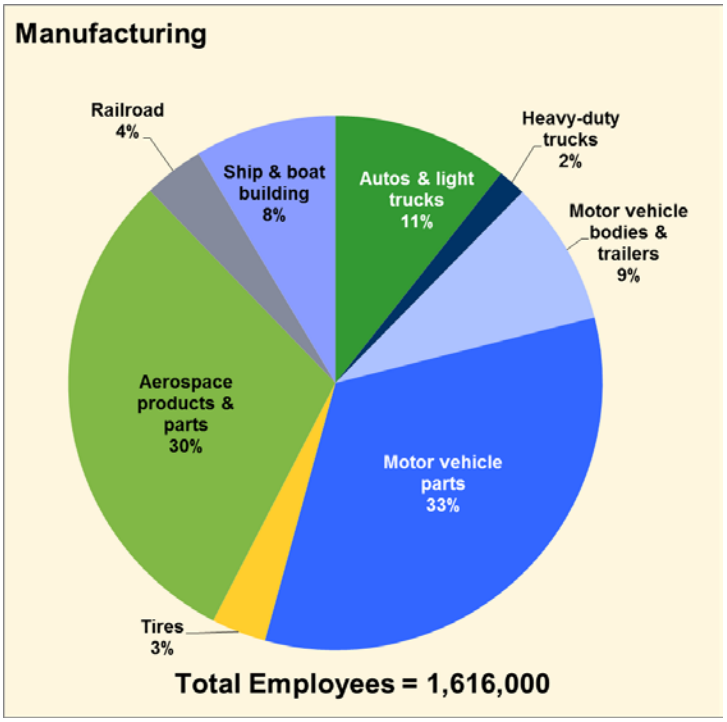


FIGURE 22. Transportation-Related Employment, 2014

Source:
Bureau of Labor Statistics, website Query System. http://www.bls.gov/data/

Americans Employed in Transportation Have Diverse Jobs—From Aerospace Manufacturing to Trucking



The manufacture of vehicles and parts (left) employs over 1.6 million people. The highway mode – vehicles, parts, and tires – accounts for more than half of all transportation manufacturing employees; aerospace products (e.g., airplanes) and their parts account for almost one-third.

When looking at jobs related to the movement of people and goods (right), the trucking industry is responsible for more than half of the 2.7 million employees. Transit and ground transportation, which includes bus drivers and other transit and ground transportation employees, makes up 17% of the total. Air transportation, which includes everything from pilots to airport workers, is 17% of the total.

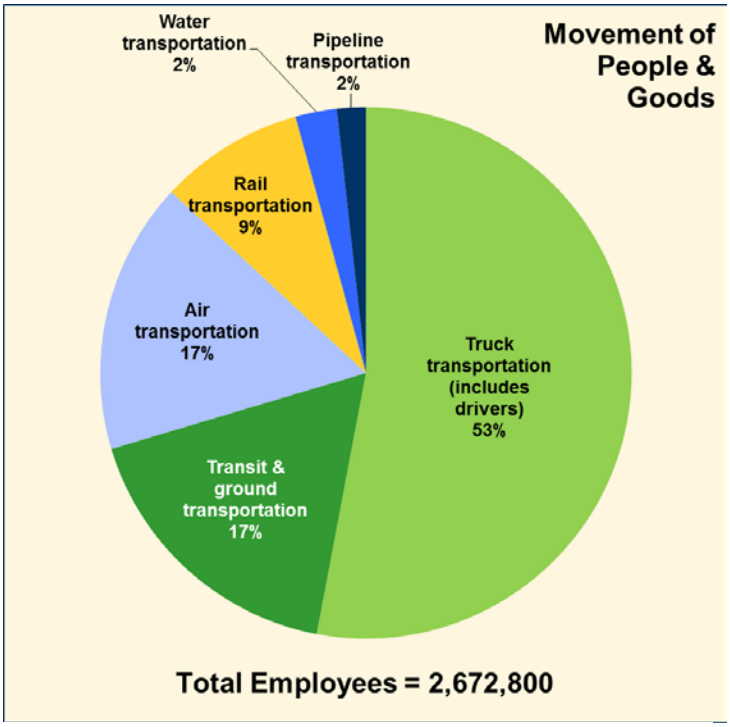


FIGURE 23. Transportation Manufacturing-Related and Mode-Related Employment, 2014

Source:
Bureau of Labor Statistics, website Query System. http://www.bls.gov/ces/cesnaics.htm

The Automotive Industry Spent $109 Billion on Research and Development in 2015

The automotive industry accounted for 16% of all corporate research and development (R&D) in the United States in 2015, totaling $109 billion. Computing & electronics and healthcare were the only two industries where companies spent more on R&D than the automotive industry.

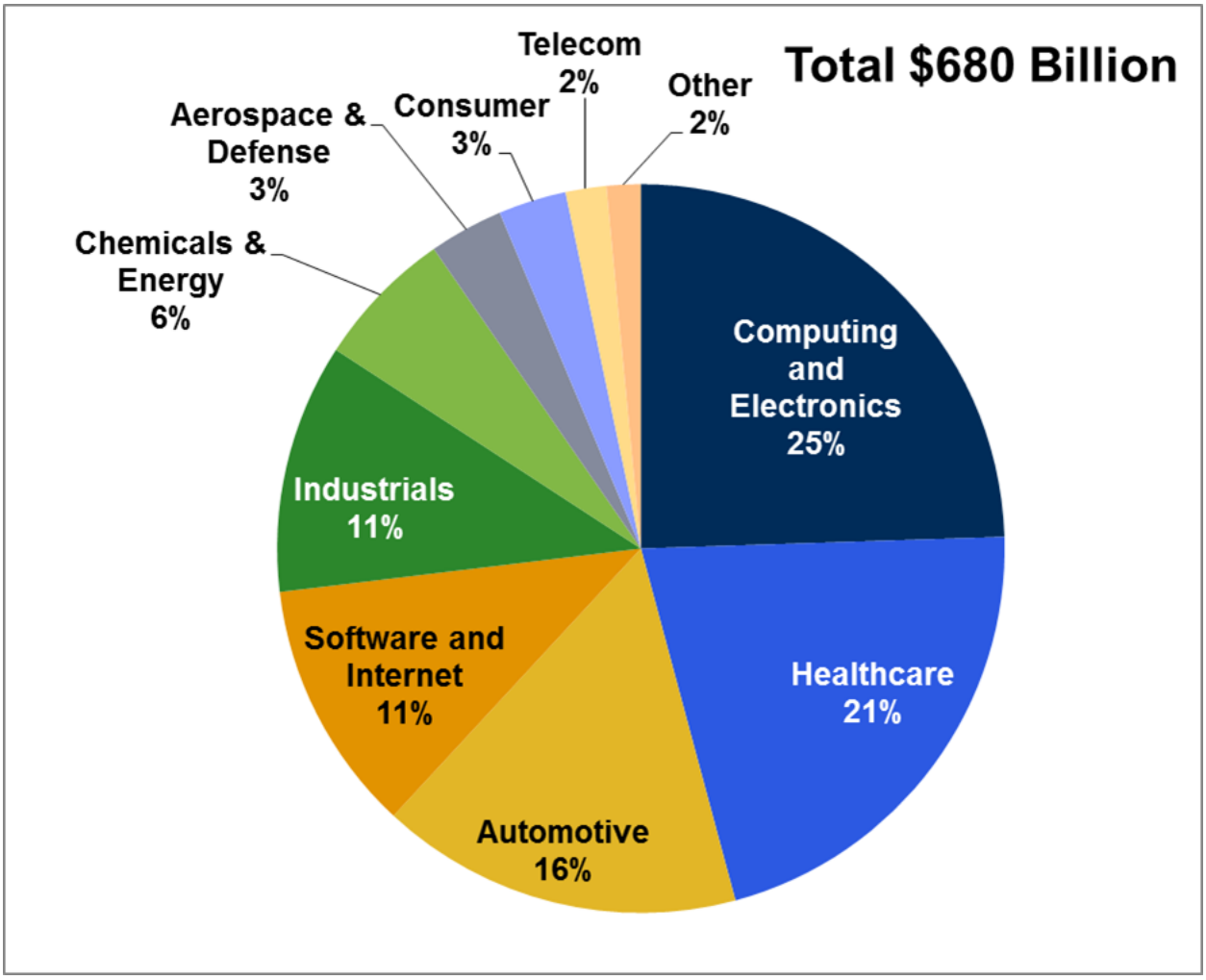


FIGURE 24. Research and Development Spending by Industry, 2015

Source:
PriceWaterhouseCoopers, *The 2015 Global Innovation 1000: Innovation's New World Order*, http://www.strategyand.pwc.com/reports/2015-global-innovation-1000-media-report

VW Tops the List of Automotive Research and Development Expenditures in 2015

Of the top ten companies that spent funds on automotive research and development (R&D), VW is the only company with more than $10 billion of expenditures in 2015. The rest of the companies spent between $3.4 billion (FCA) and 9.2 billion (Toyota) on automotive R&D. Each of the top ten companies is an automotive manufacturer with the exception of Denso, a Tier 1 automotive supplier.

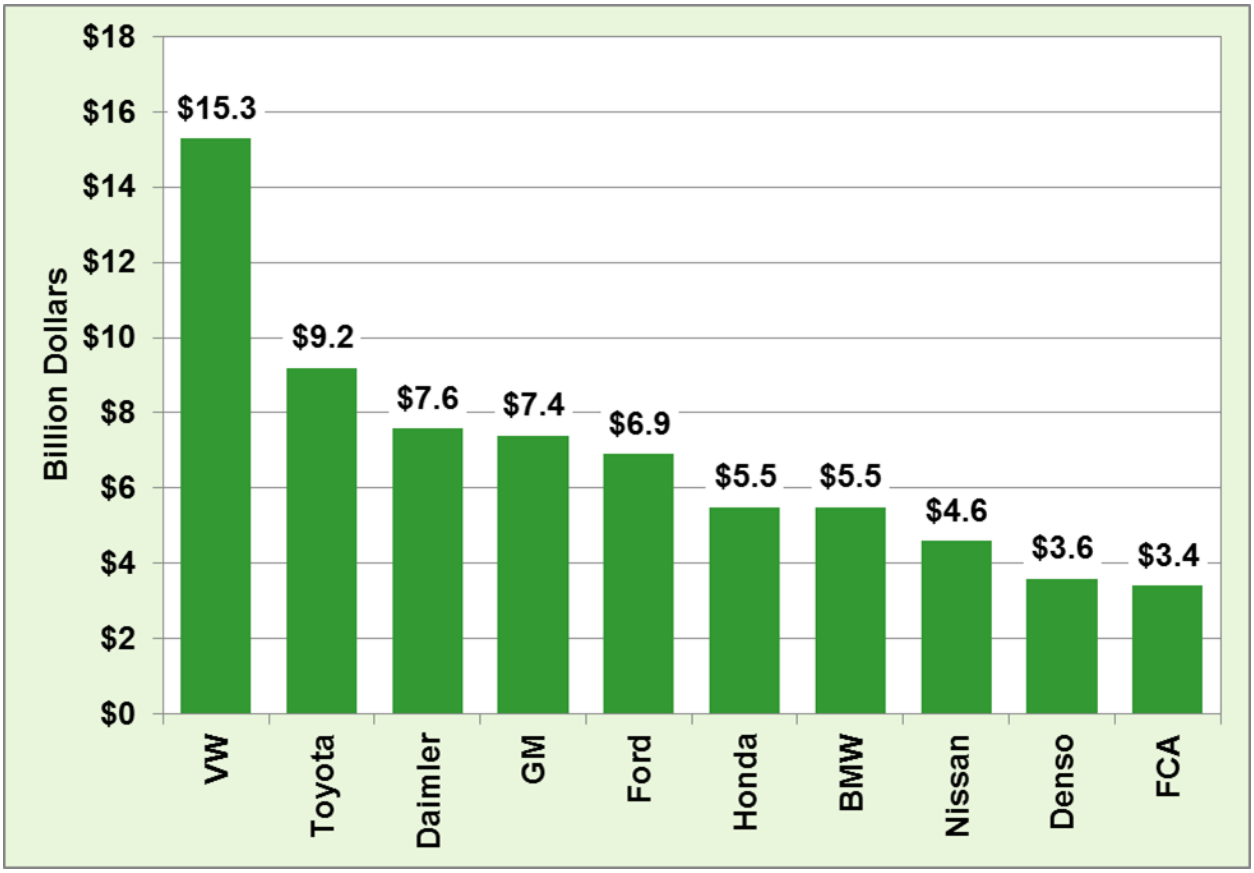


FIGURE 25. Top Ten Companies Investing in Automotive Research and Development, 2015

Source:
Crain Communications, *Automotive News*, February 22, 2016, p. 14.
Original source: PriceWaterhouseCoopers, *The 2015 Global Innovation 1000: Innovation's New World Order*.

Manufacturers' Stock Prices Have Their Ups and Downs

Weekly stock prices are shown on the graph below. Nearly all of the manufacturers show a sharp decline in late 2008 as a result of the economic recession. Most manufacturers have now recovered from the decline and their current stock prices are higher than 2006 levels. Volkswagen (VW) stock experienced a "wild ride" of ups and downs in late October 2008 due to Porsche's increased holdings in VW. Tesla (TES) stock remained consistently under $40 per share until 2015 when it skyrocketed to $280 per share. Fiat Chrysler Automobiles (FCA) stock began trading in October 2014. General Motors (GM) is shown twice – once before bankruptcy (GM-Old) and after the initial public stock offering in late 2010 (GM-New).

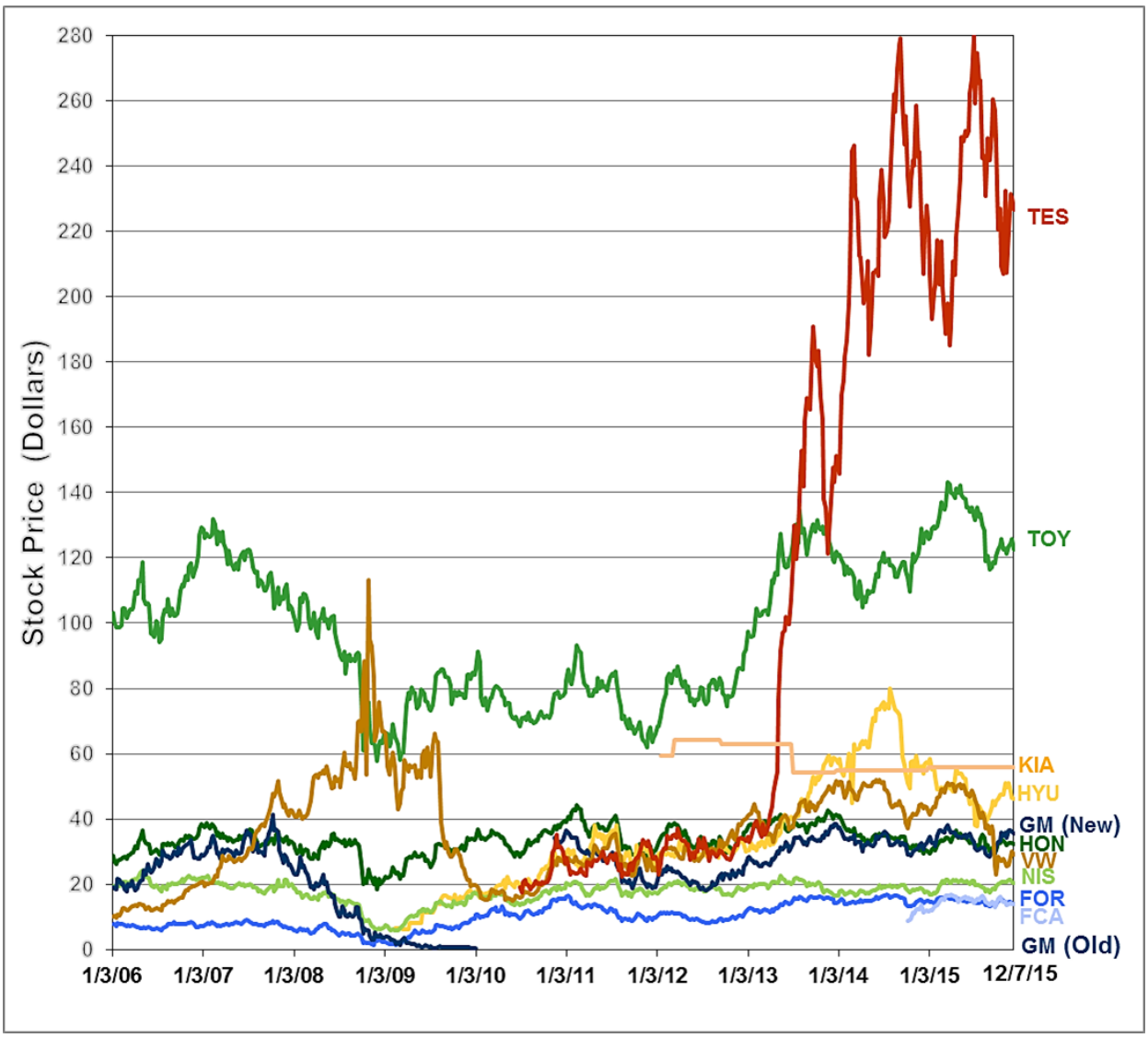


FIGURE 26. Stock Price by Manufacturer, 2006-2015

Source:
Yahoo Finance. http://www.yahoofinance.com

American Full-Size Pickups Top the Most Profitable Vehicles List

Max Warburton and others at Bernstein Research in London developed estimates in 2011 for the vehicles which have made the most money for their companies from the 1990's to 2011. They discovered three categories of vehicles that topped the list: American full-size pickups; German luxury cars; and Japanese mid-size sedans. These vehicles combined high prices, large sales volume and long production periods that spread development costs over a long period. Full-size pickups have a very wide range of extra cost options relative to other vehicle types which contributes to their high ranking on the list.

TABLE 4. List of Twelve Most Profitable Vehicles since the 1990's

Rank	Vehicle Model	Share of Manufacturers' Light Vehicles Sold, 2014	Share of Total Light Vehicles Sold, 2014
1	Ford F series	30%	4%
2	GM Full-Size Pickups	29%	5%
3	Dodge Ram	41%	3%
4	Mercedes S Class	7%	0%
5	BMW 5 Series/X5	25%	1%
6	BMW 3 Series	25%	1%
7	Mercedes E Class	19%	0%
8	Lexus RX SUV	35%	1%
9	Jeep Grand Cherokee	27%	1%
10	Honda Accord	28%	2%
11	Porsche 911	22%	0%
12	Toyota Camry	21%	3%

Note: List compiled in 2011.

Source:

Crain Communications, *Automotive News*, "Cash Cows: The Most Profitable Vehicles Ever," November 21, 2011. http://www.autonews.com/apps/pbcs.dll/article?AID=/20111121/RETAIL07/311219969/1254.

Ward's Automotive Group. http://wardsauto.com