Transportation Energy Data Book
Edition 38

Stacy C. Davis and Robert G. Boundy



OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE US DEPARTMENT OF ENERGY

Transportation Energy Data Book
Quick Facts

Petroleum

- In 2018 the U.S. produced more than 15 million barrels of petroleum per day (mmbd), or 16.3% of the world's 94 mmbd.
- The U.S. consumed 20.5 mmbd, or 21% of the world's 100 mmbd in 2018.
- Net imports of petroleum to the U.S. in 2018 were over 2 mmbd, which was 11% of U.S. petroleum.
- U.S. transportation petroleum use was 69% of total U.S. petroleum use in 2018.
- In 2018, U.S. transportation petroleum use was 93% of total U.S. petroleum production.
- Petroleum comprised 92% of U.S. transportation energy use in 2018.
- Cars and light trucks accounted for 63% of U.S. transportation petroleum use in 2017.
- Medium trucks (Class 3-6) accounted for 4% of U.S. transportation petroleum use in 2017.
- Heavy trucks (Class 7-8) and buses accounted for 19% of U.S. transportation petroleum use in 2017.
- Nonhighway modes accounted for the rest of U.S. transportation petroleum use in 2017 (14%).

Energy

- In 2018 U.S. transportation energy use accounted for about 28% of total U.S. energy use.
- Cars and light trucks accounted for 58% of U.S. transportation energy use in 2017.
- Medium trucks accounted for 5% of U.S. transportation energy use in 2017.
- Heavy trucks and buses accounted for 19% of U.S. transportation energy use in 2017.
- Nonhighway modes accounted for the rest of U.S. transportation energy use in 2017 (18%).

Light Vehicle Characteristics

- In 2017 there were 111 million cars and 138 million light trucks in the U.S. (249 million total light vehicles).
- Light vehicles accounted for 90% of the 3.2 trillion vehicle miles driven in the U.S. in 2017.
- U.S. cars:
  - 5,304,000 cars were sold in 2018 which was 31% of new light vehicle sales.
  - In 2018 the average age of a U.S. car was 11.9 years.
  - In 2017 the average fuel economy for the U.S. car fleet (all cars on the road) was 27.3 mpg.
- U.S. light trucks:
  - 11,609,000 light trucks were sold in 2018 which was 69% of new light vehicle sales.
  - In 2018 the average age of a U.S. light truck was 11.7 years.
  - In 2017 the average fuel economy for the U.S. light truck fleet (all light trucks on the road) was 19.7 mpg.
- The average U.S. household vehicle travels 11,200 miles per year (2017 NHTS).

Heavy Truck Characteristics

- 12,229,000 heavy trucks were registered in the U.S. in 2017.
- Heavy trucks and buses accounted for 10% of the 3.2 trillion vehicle miles driven in 2017.
- In 2002 (the last time a survey was conducted), heavy trucks accounted for 80% of medium and heavy truck fuel use.

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Energy and Transportation Science Division

TRANSPORTATION ENERGY DATA BOOK: EDITION 38

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Users of the *Transportation Energy Data Book* are encouraged to comment on errors, omissions, emphases, and organization of this report to one of the persons listed below. Requests for additional data or information on an existing table should be referred to Ms. Stacy Davis, Oak Ridge National Laboratory.

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Spreadsheets of the tables in the *Transportation Energy Data Book* include data for years not presented in the published document.

Spreadsheets can be found on the web at:
tedb.ornl.gov

Find useful data and information in other products from the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Office.

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This book would not be possible without the leadership, guidance, and vision of Phil Patterson, who began this book in the 1970's. We hope to continue this report into the future with the same level of excellence. The authors and the transportation research community will be forever grateful for his efforts.

ABSTRACT

The *Transportation Energy Data Book: Edition 38* is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Office. Designed for use as a desk-top reference, the Data Book represents an assembly and display of statistics and information that characterize transportation activity and presents data on other factors that influence transportation energy use. The purpose of this document is to present relevant statistical data in the form of tables and graphs. The latest edition of the Data Book is available via the Internet (tedb.ornl.gov).

This edition of the Data Book has 13 chapters which focus on various aspects of the transportation industry. Chapter 1 focuses on petroleum; Chapter 2 – energy; Chapter 3 – highway vehicles; Chapter 4 – light vehicles; Chapter 5 – heavy vehicles; Chapter 6 – alternative fuel vehicles; Chapter 7 – transit and other shared mobility; Chapter 8 – fleet vehicles; Chapter 9 – household vehicles; Chapter 10 – nonhighway modes; Chapter 11 – transportation and the economy; Chapter 12 – greenhouse gas emissions; and Chapter 13 – criteria pollutant emissions. The sources used represent the latest available data. There are also two appendices which include detailed source information for some tables and measures of conversion. A glossary of terms is also included for the reader's convenience.

INTRODUCTION

In January 1976, the Transportation Energy Conservation (TEC) Division of the Energy Research and Development Administration contracted with Oak Ridge National Laboratory (ORNL) to prepare a Transportation Energy Conservation Data Book to be used by TEC staff in their evaluation of current and proposed conservation strategies. The major purposes of the Data Book were to draw together, under one cover, transportation data from diverse sources, to resolve data conflicts and inconsistencies, and to produce a comprehensive document. The first edition of the TEC Data Book was published in October 1976. With the passage of the Department of Energy (DOE) Organization Act, the work being conducted by the former Transportation Energy Conservation Division fell under the purview of the DOE's Office of Transportation Programs. This work continues today in the Vehicle Technologies Office.

Policymakers and analysts need to be well-informed about activity in the transportation sector. The organization and scope of the data book reflect the need for different kinds of information. For this reason, Edition 38 updates much of the same type of data that is found in previous editions.

In any attempt to compile a comprehensive set of statistics on transportation activity, numerous instances of inadequacies and inaccuracies in the basic data are encountered. Where such problems occur, estimates are developed by ORNL. To minimize the misuse of these statistics, an appendix (Appendix A) is included to document the estimation procedures. The attempt is to provide sufficient information for the conscientious user to evaluate the estimates and to form their own opinions as to their utility. Clearly, the accuracy of the estimates cannot exceed the accuracy of the primary data, an accuracy which in most instances is unknown. In cases where data accuracy is known or substantial errors are strongly suspected in the data, the reader is alerted. In all cases it should be recognized that the estimates are not precise.

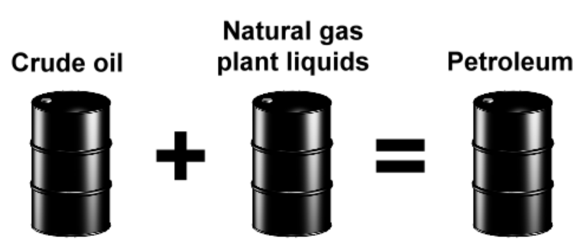
The majority of the statistics contained in the data book are taken directly from published sources, although these data may be reformatted for presentation by ORNL. Consequently, neither ORNL nor DOE endorses the validity of these data.

Chapter 1
Petroleum

Summary Statistics from Tables/Figures in this Chapter

Source			
Table 1.3	World Petroleum Production, 2018 (million barrels per day)		93.99
	U.S. Production (million barrels per day)		15.31
	U.S. Share		16.3%
Table 1.4	World Petroleum Consumption, 2018 (million barrels per day)		99.98
	U.S. Consumption (million barrels per day)		20.45
	U.S. Share		20.5%
Figure 1.4	Average Refinery Yield, 2017	OECD[a] Europe	OECD[a] Americas
	Gasoline	*19.9%*	*41.1%*
	Diesel oil	*29.9%*	*28.4%*
	Residual fuel	*8.2%*	*4.2%*
	Kerosene	*15.5%*	*8.8%*
	Other (includes naptha and LPG)	*26.5%*	*17.5%*
Table 1.12	U.S. transportation petroleum use as a percent of U.S. petroleum production, 2018		92.6%
Table 1.12	Net imports as a percentage of U.S. petroleum consumption, 2018		11.4%
Table 1.13	Transportation share of U.S. petroleum consumption, 2018		69.2%
Table 1.16	Highway share of transportation petroleum consumption, 2017		85.9%
Table 1.16	Light vehicle share of transportation petroleum consumption, 2017		62.5%

In this document, petroleum is defined as crude oil (including lease condensate) and natural gas plant liquids.



[a] Organization for Economic Co-operation and Development.

As new technologies appear, and new areas are explored, the amount of proved reserves of crude oil and natural gas has grown. Although the reserves of natural gas in the United States were 120% higher in 2018 than in 1980, the U.S. share of world natural gas reserves is lower.

Table 1.1
Proved Reserves of Crude Oil and Natural Gas, 1980–2018

	Crude Oil Reserves (billion barrels)		U.S. Share of Crude Oil	Natural Gas Reserves (trillion cubic feet)		U.S. Share of Natural Gas
Year	World	United States	Reserves	World	United States	Reserves
1980	641.8	31.2	4.9%	2,585.7	201.0	7.8%
1981	651.1	31.3	4.8%	2,647.8	199.0	7.5%
1982	669.8	31.0	4.6%	2,920.5	201.7	6.9%
1983	665.5	29.5	4.4%	3,031.9	201.5	6.6%
1984	667.3	29.3	4.4%	3,201.6	200.2	6.3%
1985	701.2	30.0	4.3%	3,401.2	197.5	5.8%
1986	698.5	29.9	4.3%	3,483.6	193.4	5.6%
1987	698.5	28.3	4.1%	3,641.1	191.6	5.3%
1988	889.3	28.7	3.2%	3,789.0	187.2	4.9%
1989	907.9	28.2	3.1%	3,921.6	168.0	4.3%
1990	1,001.8	27.9	2.8%	3,980.7	167.1	4.2%
1991	1,000.1	27.6	2.8%	4,215.4	169.3	4.0%
1992	933.2	25.9	2.8%	2,626.5	167.1	6.4%
1993	940.1	25.0	2.7%	2,941.5	165.0	5.6%
1994	942.3	24.1	2.6%	3,016.2	162.4	5.4%
1995	943.1	23.6	2.5%	3,004.2	163.8	5.5%
1996	951.8	23.5	2.5%	2,958.0	165.1	5.6%
1997	1,021.4	23.3	2.3%	4,946.8	166.5	3.4%
1998	1,023.4	23.9	2.3%	5,087.3	167.2	3.3%
1999	1,034.1	22.4	2.2%	5,141.7	164.0	3.2%
2000	1,018.2	23.2	2.3%	5,149.7	167.4	3.3%
2001	1,029.6	23.5	2.3%	5,288.6	177.4	3.4%
2002	1,033.4	23.8	2.3%	5,457.3	183.5	3.4%
2003	1,214.5	24.0	2.0%	5,505.1	186.9	3.4%
2004	1,266.2	23.1	1.8%	6,078.7	189.0	3.1%
2005	1,278.4	22.6	1.8%	6,044.6	192.5	3.2%
2006	1,289.2	23.0	1.8%	6,124.2	204.4	3.3%
2007	1,319.9	22.3	1.7%	6,190.5	211.1	3.4%
2008	1,328.5	22.8	1.7%	6,213.3	237.7	3.8%
2009	1,336.4	20.6	1.5%	6,261.9	244.7	3.9%
2010	1,356.7	22.3	1.6%	6,637.8	272.5	4.1%
2011	1,475.0	25.2	1.7%	6,707.8	304.6	4.5%
2012	1,523.4	29.0	1.9%	6,808.9	334.1	4.9%
2013	1,643.9	33.4	2.0%	6,844.9	308.0	4.5%
2014	1,650.6	36.5	2.2%	6,972.2	338.3	4.9%
2015	1,657.9	39.9	2.4%	6,950.5	368.7	5.3%
2016	1,650.6	35.2	2.1%	6,878.7	307.7	4.5%
2017	1,645.7	35.2	2.1%	6,922.9	322.2	4.7%
2018	1,661.4	42.0	2.5%	7,124.4	438.5	6.2%
			Average annual percentage change			
1980-2018	2.5%	0.8%		2.7%	2.1%	
2008-2018	2.3%	6.3%		1.4%	6.3%	

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Statistics*, April 2019. (Additional resources: www.eia.doe.gov)

In 2018, the Organization of Petroleum Exporting Countries (OPEC) accounted for 40.9% of world oil production. World and U.S. crude oil production reached all-time highs in 2018.

Table 1.2
World Crude Oil Production, 1960–2018[a]
(million barrels per day)

Year	United States	U.S. share	Total OPEC[b]	OPEC share	Total non-OPEC	World
1960	7.04	33.5%	8.70	41.4%	12.29	20.99
1965	7.80	25.7%	14.35	47.3%	15.98	30.33
1970	9.64	21.0%	23.30	50.8%	22.59	45.89
1975	8.37	15.9%	25.61	48.5%	27.22	52.83
1980	8.60	14.4%	25.15	42.2%	34.41	59.56
1985	8.97	16.6%	15.36	28.5%	38.61	53.97
1990	7.36	12.2%	22.53	37.2%	37.97	60.50
1991	7.42	12.3%	22.48	37.4%	37.65	60.13
1992	7.17	11.9%	23.78	39.6%	36.32	60.10
1993	6.85	11.4%	24.55	40.8%	35.62	60.17
1994	6.66	10.9%	24.97	40.8%	36.20	61.17
1995	6.56	10.5%	25.62	41.0%	36.82	62.43
1996	6.46	10.1%	26.08	40.9%	37.74	63.82
1997	6.45	9.8%	27.40	41.6%	38.41	65.81
1998	6.25	9.3%	28.35	42.3%	38.68	67.03
1999	5.88	8.9%	27.24	41.3%	38.73	65.97
2000	5.82	8.5%	28.96	42.3%	39.56	68.53
2001	5.80	8.5%	28.11	41.3%	40.03	68.13
2002	5.74	8.5%	26.47	39.3%	40.82	67.29
2003	5.65	8.1%	27.87	40.1%	41.60	69.46
2004	5.44	7.5%	30.37	41.8%	42.22	72.60
2005	5.18	7.0%	31.80	43.0%	42.07	73.87
2006	5.09	6.9%	31.49	42.8%	42.13	73.62
2007	5.07	6.9%	31.15	42.5%	42.18	73.33
2008	5.00	6.7%	32.55	43.8%	41.75	74.30
2009	5.35	7.3%	30.79	42.1%	42.33	73.12
2010	5.48	7.3%	31.60	42.2%	43.29	74.89
2011	5.65	7.5%	31.58	42.2%	43.33	74.91
2012	6.50	8.5%	32.82	43.0%	43.56	76.38
2013	7.47	9.8%	31.75	41.5%	44.69	76.45
2014	8.76	11.2%	31.80	40.6%	46.56	78.36
2015	9.43	11.7%	33.07	41.0%	47.68	80.76
2016	8.83	10.9%	34.12	42.2%	46.72	80.84
2017	9.35	11.5%	33.97	41.9%	47.13	81.09
2018	10.96	13.2%	33.91	40.9%	48.97	82.88
			Average annual percentage change			
1960-2018	0.8%		2.4%		2.4%	2.4%
1970-2018	0.3%		0.8%		1.6%	1.2%
2008-2018	8.2%		0.4%		1.6%	1.1%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2019. (Additional resources: www.eia.doe.gov)

[a] Includes lease condensate. Excludes natural gas plant liquids.
[b] See Glossary for membership.

This table shows petroleum production, which includes both crude oil and natural gas plant liquids. Because other liquids and processing gain are not included, the world total is often smaller than world petroleum consumption (Table 1.4). The United States was responsible for 16.3% of the world's petroleum production in 2018 and 13.2% of the world's crude oil production (Table 1.2).

Table 1.3
World Petroleum Production, 1973–2018[a]
(million barrels per day)

Year	United States	U.S. share	Total OPEC[b]	OPEC share	Total non-OPEC	Non-OPEC share	World
1973	10.95	18.7%	29.60	50.6%	28.87	49.4%	58.46
1975	10.01	18.0%	25.98	46.7%	29.64	53.3%	55.62
1980	10.17	16.2%	25.81	41.0%	37.15	59.0%	62.95
1985	10.58	18.3%	16.16	28.0%	41.58	72.0%	57.74
1990	8.91	13.7%	23.70	36.4%	41.32	63.6%	65.02
1991	9.08	14.0%	23.65	36.5%	41.14	63.5%	64.79
1992	8.87	13.7%	25.02	38.6%	39.76	61.4%	64.77
1993	8.58	13.2%	25.86	39.7%	39.19	60.3%	65.05
1994	8.39	12.6%	26.57	39.9%	39.98	60.1%	66.55
1995	8.32	12.2%	27.25	40.1%	40.75	59.9%	68.01
1996	8.29	11.9%	27.72	39.9%	41.80	60.1%	69.52
1997	8.27	11.5%	29.12	40.6%	42.53	59.4%	71.65
1998	8.01	11.0%	30.14	41.3%	42.89	58.7%	73.04
1999	7.73	10.7%	29.07	40.3%	43.08	59.7%	72.15
2000	7.73	10.3%	30.85	41.2%	44.05	58.8%	74.90
2001	7.67	10.3%	30.19	40.4%	44.63	59.6%	74.83
2002	7.62	10.3%	28.65	38.7%	45.45	61.3%	74.10
2003	7.37	9.6%	30.14	39.4%	46.38	60.6%	76.52
2004	7.25	9.0%	33.04	41.2%	47.09	58.8%	80.12
2005	6.90	8.4%	34.79	42.6%	46.94	57.4%	81.73
2006	6.82	8.4%	34.53	42.3%	47.11	57.7%	81.64
2007	6.86	8.4%	34.34	42.1%	47.21	57.9%	81.55
2008	6.78	8.2%	35.73	43.3%	46.79	56.7%	82.52
2009	7.26	8.9%	33.98	41.7%	47.50	58.3%	81.48
2010	7.55	9.0%	34.83	41.7%	48.71	58.3%	83.54
2011	7.87	9.4%	34.81	41.6%	48.96	58.4%	83.77
2012	8.91	10.4%	36.16	42.2%	49.44	57.8%	85.61
2013	10.07	11.7%	35.05	40.8%	50.80	59.2%	85.85
2014	11.77	13.3%	35.05	39.7%	53.15	60.3%	88.20
2015	12.77	14.1%	36.28	39.9%	54.60	60.1%	90.88
2016	12.34	13.5%	37.34	41.0%	53.81	59.0%	91.15
2017	13.13	14.3%	37.24	40.6%	54.47	59.4%	91.70
2018	15.31	16.3%	37.17	39.5%	56.82	60.5%	93.99
			Average annual percentage change				
1973-2018	0.7%		0.5%		1.5%		1.1%
2008-2018	8.5%		0.4%		2.0%		1.3%

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Statistics* website, April 2019. (Additional resources: www.eia.doe.gov)

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[a] Includes natural gas plant liquids, crude oil and lease condensate. Does not account for all inputs or refinery processing gain.

[b] Organization of Petroleum Exporting Countries. See Glossary for membership.

During the 1980s and 1990s, the United States accounted for about one-quarter of the world's petroleum consumption, but from 2000 to 2012 that share had been decreasing. In 2018 the United States accounted for only 20.5%. World petroleum consumption decreased in 2008 but has continued to increase thereafter. Non-OECD consumption has continued to increase.

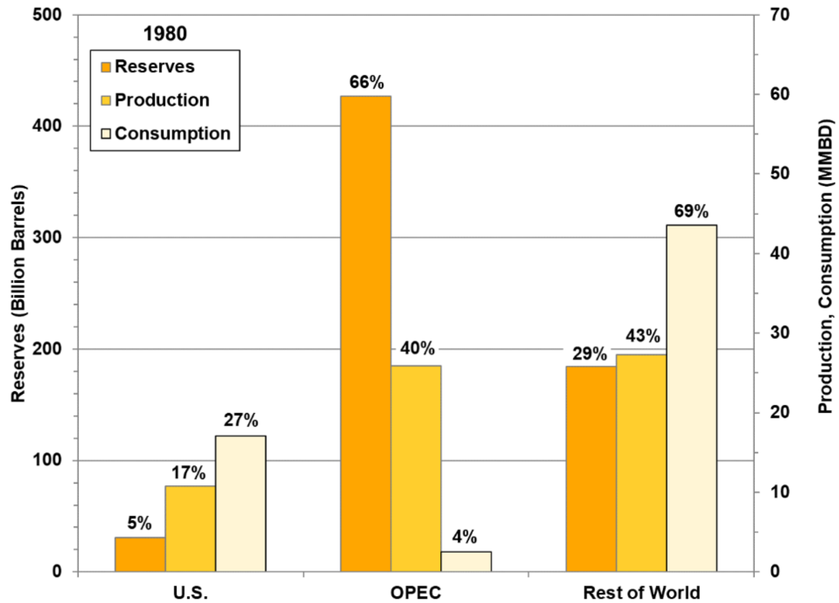
Table 1.4
World Petroleum Consumption, 1960–2018
(million barrels per day)

Year	United States	U.S. share	Total OECD[a]	Total non-OECD	World
1960	9.80	45.9%	15.78	5.56	21.34
1965	11.51	37.0%	22.81	8.33	31.14
1970	14.70	31.4%	34.69	12.12	46.81
1975	16.32	29.0%	39.23	16.97	56.20
1980	17.06	27.0%	41.87	21.24	63.11
1985	15.73	26.2%	37.70	22.39	60.08
1986	16.28	26.3%	38.80	23.02	61.82
1987	16.67	26.4%	39.59	23.51	63.11
1988	17.28	26.6%	40.92	24.05	64.98
1989	17.33	26.2%	41.63	24.46	66.09
1990	16.99	25.5%	41.76	24.77	66.54
1991	16.71	24.9%	42.17	24.96	67.14
1992	17.03	25.3%	43.19	24.05	67.24
1993	17.24	25.5%	43.68	23.82	67.50
1994	17.72	25.7%	44.98	23.94	68.93
1995	17.72	25.3%	45.43	24.65	70.08
1996	18.31	25.6%	46.56	25.10	71.65
1997	18.62	25.4%	47.30	26.08	73.38
1998	18.92	25.6%	47.48	26.55	74.03
1999	19.52	25.8%	48.41	27.29	75.70
2000	19.70	25.6%	48.45	28.53	76.98
2001	19.65	25.3%	48.51	29.16	77.67
2002	19.76	25.2%	48.48	29.88	78.36
2003	20.03	25.0%	49.20	30.81	80.01
2004	20.73	24.9%	50.03	33.12	83.16
2005	20.80	24.6%	50.39	34.21	84.60
2006	20.69	24.2%	50.20	35.46	85.66
2007	20.68	23.9%	50.08	36.43	86.51
2008	19.50	22.8%	48.27	37.21	85.48
2009	18.77	21.9%	46.29	39.25	85.54
2010	19.18	21.6%	46.82	41.87	88.69
2011	18.89	21.1%	46.28	43.20	89.49
2012	18.49	20.4%	45.85	44.98	90.83
2013	18.97	20.6%	45.89	46.37	92.26
2014	19.10	20.3%	45.61	48.26	93.87
2015	19.53	20.4%	46.36	49.50	95.86
2016	19.69	20.3%	46.79	50.14	96.93
2017	19.96	20.3%	47.23	51.22	98.46
2018	20.45	20.5%	47.54	52.44	99.98
		Average annual percentage change			
1960-2018	1.3%	-1.4%	1.9%	3.9%	2.7%
1970-2018	0.7%	-0.9%	0.7%	3.1%	1.6%
2008-2018	0.5%	-0.9%	-0.1%	3.1%	1.4%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2019. (Additional resources: www.eia.doe.gov)

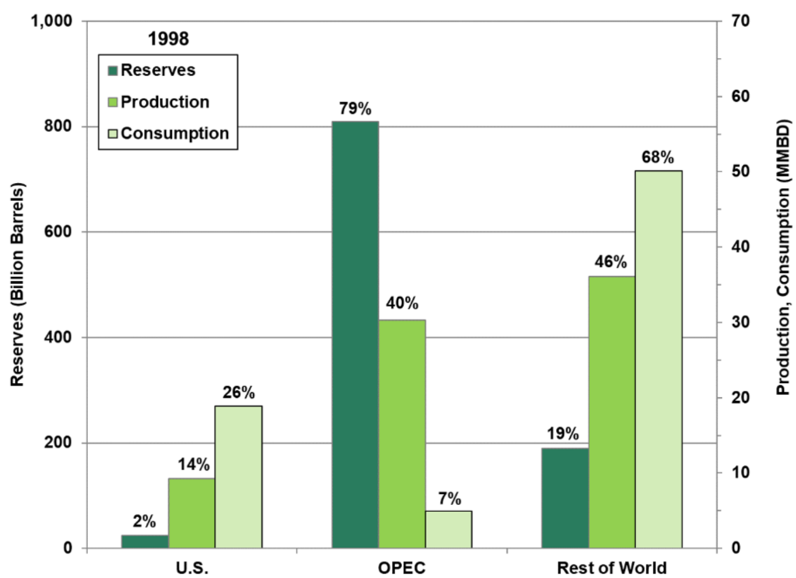
[a] Organization for Economic Cooperation and Development. See Glossary for membership.

Figure 1.1. World Oil Reserves, Production, and Consumption, 1980



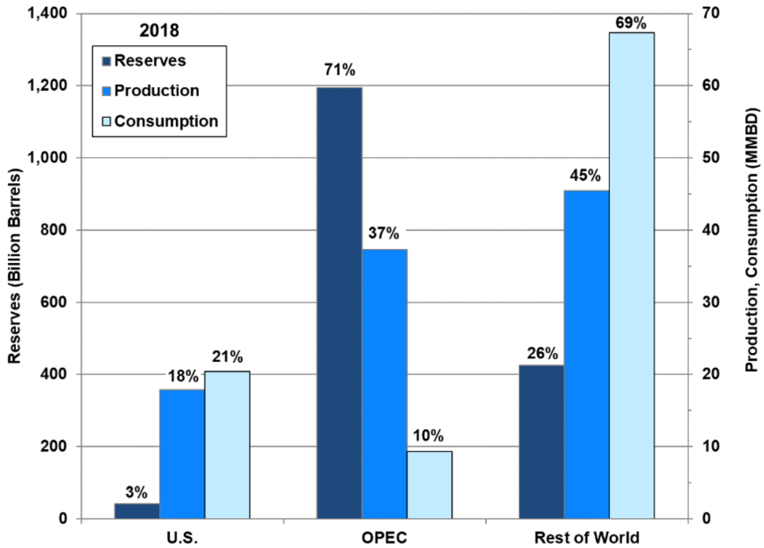
Source:
See Table 1.5.

Figure 1.2. World Oil Reserves, Production, and Consumption, 1998



Source:
See Table 1.5.

Figure 1.3. World Oil Reserves, Production, and Consumption, 2018



Source:
See Table 1.5.

Table 1.5
World Oil Reserves, Production, and Consumption, 1980, 1998 and 2018

	Crude oil reserves (billion barrels)	Reserve share	Petroleum production (million barrels per day)	Production share	Petroleum consumption (million barrels per day)	Consumption share
				1980		
United States	31.0	5%	10.8	17%	17.1	27%
OPEC	426.7	66%	25.9	40%	2.5	4%
Rest of world	184.1	29%	27.3	43%	43.5	69%
				1998		
United States	24.0	2%	9.3	14%	18.9	26%
OPEC	809.9	79%	30.3	40%	5.0	7%
Rest of world	189.5	19%	36.1	48%	50.1	68%
				2018		
United States	42.0	3%	17.9	18%	20.5	21%
OPEC	1,194.2	72%	37.3	37%	9.3	10%
Rest of world	425.1	26%	45.5	45%	67.3	69%

Note: Consumption for OPEC and Rest of World in 2018 are actually 2016 consumption, which are the latest available. Total consumption is higher than total production due to refinery gains including alcohol and liquid products produced from coal and other sources. See Glossary for OPEC countries.

Sources:
Energy Information Administration, *International Energy Statistics*, June 2019. (Additional resources: www.eia.doe.gov)

The share of petroleum imported to the United States can be calculated using total imports or net imports. Net imports, which are the preferred data, rose to over 50% of U.S. petroleum consumption for the first time in 1998, while total imports reached 50% for the first time in 1993. OPEC share of net imports has been below 50% since 1993. Due to rising petroleum exports, net imports have decreased substantially over the last five years, while total imports remained fairly constant.

Table 1.6
U.S. Petroleum Imports, 1960–2018
(million barrels per day)

Year	Net OPEC[a] imports	Net OPEC[a] share	Net imports	Net imports as a share of U.S. consumption	Total imports
1960	1.23	68.0%	1.61	16.5%	1.81
1965	1.44	58.3%	2.28	19.8%	2.47
1970	1.29	37.8%	3.16	21.5%	3.42
1975	3.60	59.5%	5.85	35.8%	6.06
1980	4.30	62.2%	6.36	37.3%	6.91
1985	1.83	36.1%	4.29	27.3%	5.07
1990	4.30	53.6%	7.16	42.2%	8.02
1991	4.09	53.7%	6.63	39.6%	7.63
1992	4.09	51.9%	6.94	40.7%	7.89
1993	4.27	49.6%	7.62	44.2%	8.62
1994	4.25	47.2%	8.05	45.5%	9.00
1995	4.00	45.3%	7.89	44.5%	8.83
1996	4.21	44.4%	8.50	46.4%	9.48
1997	4.57	45.0%	9.16	49.2%	10.16
1998	4.91	45.8%	9.76	51.6%	10.71
1999	4.95	45.6%	9.91	50.8%	10.85
2000	5.20	45.4%	10.42	52.9%	11.46
2001	5.53	46.6%	10.90	55.5%	11.87
2002	4.61	39.9%	10.55	53.4%	11.53
2003	5.16	42.1%	11.24	56.1%	12.26
2004	5.70	43.4%	12.10	58.4%	13.15
2005	5.59	40.7%	12.55	60.3%	13.71
2006	5.52	40.2%	12.39	59.9%	13.71
2007	5.98	44.4%	12.04	58.2%	13.47
2008	5.95	46.1%	11.11	57.0%	12.92
2009	4.78	40.9%	9.67	51.5%	11.69
2010	4.91	41.6%	9.44	49.2%	11.79
2011	4.56	39.8%	8.45	44.8%	11.44
2012	4.27	40.3%	7.39	40.0%	10.60
2013	3.72	37.7%	6.24	32.9%	9.86
2014	3.24	35.0%	5.07	26.5%	9.24
2015	2.89	30.6%	4.71	24.1%	9.45
2016	3.45	34.3%	4.79	24.4%	10.06
2017	3.37	33.2%	3.77	18.9%	10.14
2018	2.89	29.1%	2.34	11.4%	9.93
		Average annual percentage change			
1960-2018	1.5%		0.6%		3.0%
1970-2018	1.7%		-0.6%		2.2%
2008-2018	-7.0%		-14.4%		-2.6%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review,* Washington, DC, March 2019, Table 3.3a. (Additional resources: www.eia.gov)

[a] Organization of Petroleum Exporting Countries. See Glossary for membership.

More than half of the oil imported to the United States in 2018 was from the western hemisphere. Canada, Mexico, and Venezuela provided most of the oil from the western hemisphere, along with small amounts from Brazil, Columbia, Ecuador, and the U.S. Virgin Islands (these countries are not listed separately).

Table 1.7
Imported Crude Oil by Country of Origin, 1960–2018
(million barrels per day)

Year	Saudi Arabia	Venezuela	Nigeria	Other OPEC[a] countries	Canada	Mexico	Russia	Other non-OPEC countries	Total imports
1960	0.08	0.91	0.00	0.24	0.12	0.02	[b]	0.45	1.81
1965	0.16	0.99	0.00	0.29	0.32	0.05	[b]	0.66	2.47
1970	0.03	0.99	0.00	0.27	0.77	0.04	0.00	1.31	3.42
1973	0.49	1.13	0.46	0.91	1.32	0.02	0.03	1.90	6.26
1975	0.71	0.70	0.76	1.42	0.85	0.07	0.01	1.52	6.06
1980	1.26	0.48	0.86	1.70	0.45	0.53	0.00	1.62	6.91
1985	0.17	0.60	0.29	0.76	0.77	0.82	0.01	1.64	5.07
1990	1.34	1.02	0.80	1.13	0.93	0.76	0.04	1.99	8.02
1991	1.80	1.03	0.70	0.55	1.03	0.81	0.03	1.67	7.63
1992	1.72	1.17	0.68	0.52	1.07	0.83	0.02	1.88	7.89
1993	1.41	1.30	0.74	0.82	1.18	0.92	0.05	2.19	8.62
1994	1.40	1.33	0.64	0.87	1.27	0.98	0.03	2.46	9.00
1995	1.34	1.48	0.63	0.55	1.33	1.07	0.02	2.41	8.83
1996	1.36	1.68	0.62	0.56	1.42	1.24	0.03	2.57	9.48
1997	1.41	1.77	0.70	0.69	1.56	1.39	0.01	2.63	10.16
1998	1.49	1.72	0.70	1.00	1.60	1.35	0.02	2.83	10.71
1999	1.48	1.49	0.66	1.33	1.54	1.32	0.09	2.95	10.85
2000	1.57	1.55	0.90	1.19	1.81	1.37	0.07	3.00	11.46
2001	1.66	1.55	0.89	1.43	1.83	1.44	0.09	2.98	11.87
2002	1.55	1.40	0.62	1.03	1.97	1.55	0.21	3.20	11.53
2003	1.77	1.38	0.87	1.14	2.07	1.62	0.25	3.15	12.26
2004	1.56	1.55	1.14	1.45	2.14	1.66	0.30	3.34	13.15
2005	1.54	1.53	1.17	1.36	2.18	1.66	0.41	3.87	13.71
2006	1.46	1.42	1.11	1.52	2.35	1.71	0.37	3.76	13.71
2007	1.48	1.36	1.13	2.00	2.45	1.53	0.41	3.09	13.47
2008	1.53	1.19	0.99	2.25	2.49	1.30	0.47	2.70	12.92
2009	1.00	1.06	0.81	1.90	2.48	1.21	0.56	2.66	11.69
2010	1.10	0.99	1.02	1.80	2.54	1.28	0.61	2.46	11.79
2011	1.19	0.95	0.82	1.59	2.73	1.21	0.62	2.32	11.44
2012	1.37	0.96	0.44	1.51	2.95	1.03	0.48	1.87	10.60
2013	1.33	0.81	0.28	1.30	3.14	0.92	0.46	1.62	9.86
2014	1.17	0.79	0.09	1.19	3.39	0.84	0.33	1.44	9.24
2015	1.06	0.83	0.08	0.93	3.76	0.76	0.37	1.66	9.45
2016	1.11	0.80	0.24	1.31	3.78	0.67	0.44	1.72	10.06
2017	0.96	0.67	0.33	1.40	4.05	0.68	0.39	1.65	10.14
2018	0.90	0.59	0.19	1.21	4.28	0.72	0.38	1.67	9.93
				Average annual percentage change					
1960-2018	4.2%	-0.8%	[b]	2.8%	6.3%	6.8%	[b]	2.3%	3.0%
1970-2018	7.4%	-1.1%	[b]	3.1%	3.6%	6.1%	10.6%	0.5%	2.2%
2008-2018	-5.2%	-6.8%	-15.2%	-6.0%	5.5%	-5.8%	-2.1%	-4.7%	-2.6%

Sources:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, Washington, DC, March 2019, Tables 3.3c and 3.3d. (Additional resources: www.eia.gov)

[a] Organization of Petroleum Exporting Countries. See Glossary for membership.
[b] Data are not available.

The Strategic Petroleum Reserve (SPR) began in October 1977 as a result of the 1975 Energy Policy and Conservation Act. Its purpose is to provide protection against oil supply disruptions. The U.S. consumed 20.5 million barrels per day in 2018. At that rate of consumption, the SPR supply would last 32 days if used exclusively and continuously.

Table 1.8
Crude Oil Supplies, 1973-2018

Year	Strategic Petroleum Reserve	Other crude oil stocks[a]	Total crude oil stocks	U.S. petroleum consumption	Number of days the SPR would supply the U.S.[b]
	(million barrels)			(million barrels per day)	
1973	[c]	242.5	242.5	17.3	[c]
1980	107.8	358.2	466.0	17.1	6
1985	493.3	320.9	814.2	15.7	31
1990	585.7	322.7	908.4	17.0	34
1991	568.5	324.6	893.1	16.7	34
1992	574.7	318.1	892.9	17.0	34
1993	587.1	335.4	922.5	17.2	34
1994	591.7	337.2	928.9	17.7	33
1995	591.6	303.3	895.0	17.7	33
1996	565.8	283.9	849.7	18.3	31
1997	563.4	304.7	868.1	18.6	30
1998	571.4	323.5	894.9	18.9	30
1999	567.2	284.5	851.7	19.5	29
2000	540.7	285.5	826.2	19.7	27
2001	550.2	312.0	862.2	19.6	28
2002	599.1	277.6	876.7	19.8	30
2003	638.4	268.9	907.3	20.0	32
2004	675.6	285.7	961.3	20.7	33
2005	684.5	307.7	992.2	20.8	33
2006	688.6	295.8	984.4	20.7	33
2007	696.9	268.4	964.3	20.7	34
2008	701.8	308.2	1,010.1	19.5	36
2009	726.6	307.1	1,033.8	18.8	39
2010	726.5	312.1	1,038.6	19.2	38
2011	696.0	308.2	1,004.2	18.9	37
2012	695.3	337.8	1,033.1	18.5	38
2013	696.0	327.2	1,023.2	19.0	37
2014	691.0	360.9	1,051.8	19.1	36
2015	695.1	449.2	1,144.3	19.5	36
2016	695.1	484.6	1,179.7	19.7	35
2017	662.8	421.6	1,084.5	20.0	33
2018	649.1	441.8	1,090.9	20.5	32
			Average annual percentage change		
1973-2018	[c]	1.3%	3.4%	0.4%	[c]
2008-2018	-0.8%	3.7%	0.8%	0.5%	-1.3%

Sources:

U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, Washington, DC, March 2019, Tables 3.1 and 3.4. (Additional resources: www.eia.gov)

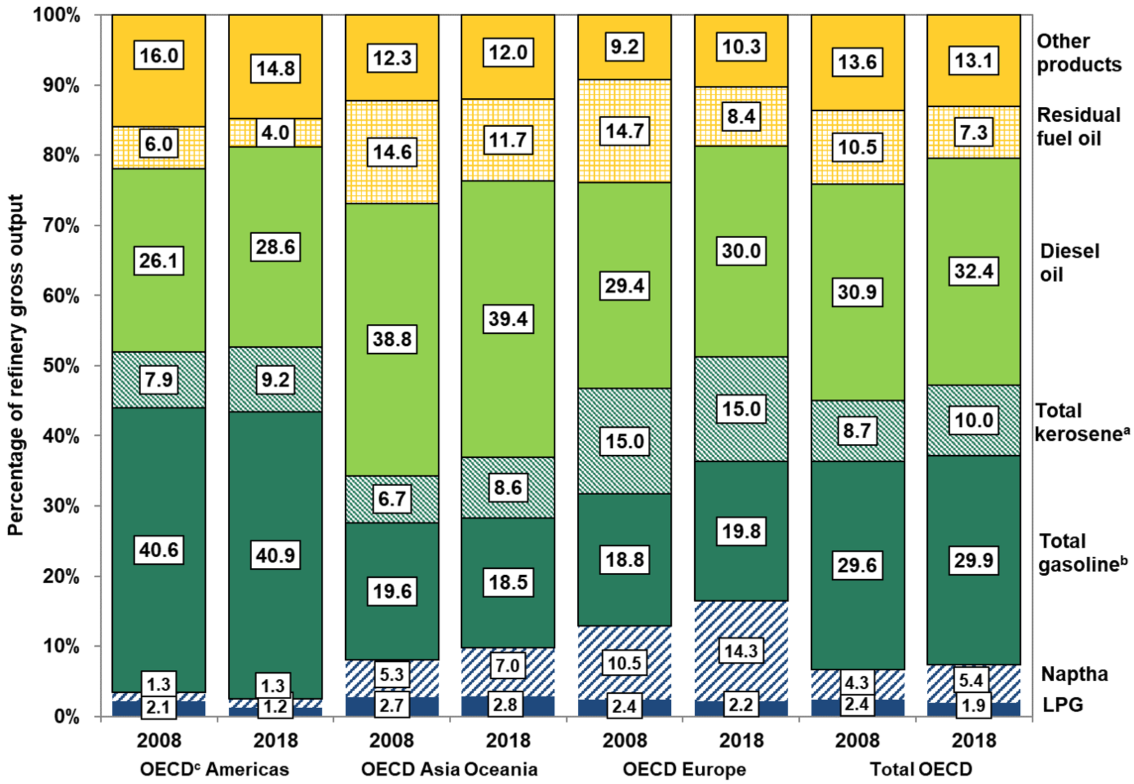
[a] Other crude oil stocks include stocks held by petroleum companies, as well as stocks of Alaskan crude oil in transit.

[b] Strategic Petroleum Reserves divided by U.S. consumption per day. This would only hold true if the SPR were the only oil used for that many days.

[c] Not applicable.

Other parts of the world refine crude oil to produce more diesel fuel and less gasoline than the OECD Americas. The OECD Asia Oceania countries produce the lowest share of gasoline and highest share of diesel in 2018.

Figure 1.4. Refinery Gross Output by World Region, 2008 and 2018



Source:
International Energy Agency, *Monthly Oil Survey*, March 2019 and *Monthly Oil Statistics*, March 2009. (Additional resources: www.iea.org)

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[a] Includes jet kerosene and other kerosene.
[b] Includes motor gasoline, jet gasoline, and aviation gasoline.
[c] Organization for Economic Cooperation and Development. See Glossary for membership.

Oxygenate refinery input increased significantly in 1995, most certainly due to the Clean Air Act Amendments of 1990 which mandated the sale of reformulated gasoline in certain areas beginning in January 1995. The use of MTBE has declined over the last 15 years due to many states banning the additive. The other hydrocarbons and liquids category includes unfinished oils, motor gasoline blending components and aviation gasoline blending components.

Table 1.9
U.S. Refinery Input of Crude Oil and Petroleum Products, 1987–2017
(thousand barrels)

			Oxygenates			Other	
Year	Crude oil	Natural gas liquids	Fuel ethanol	MTBE[a]	Other oxygenates[b]	hydrocarbons and liquids	Total input to refineries
1987	4,691,783	280,889	[c]	[c]	[d]	132,720	5,105,392
1990	4,894,379	170,589	[c]	[c]	[d]	260,108	5,325,076
1991	4,855,016	172,306	[c]	[c]	[d]	280,265	5,307,587
1992	4,908,603	171,701	[c]	[c]	[d]	272,676	5,352,980
1993	4,968,641	179,213	3,351	49,393	1,866	280,074	5,482,538
1994	5,061,111	169,868	3,620	52,937	1,918	193,808	5,483,262
1995	5,100,317	172,026	9,055	79,396	4,122	190,411	5,555,327
1996	5,195,265	164,552	11,156	79,407	3,570	214,282	5,668,232
1997	5,351,466	151,769	11,803	86,240	4,246	201,268	5,806,792
1998	5,434,383	146,921	11,722	89,362	4,038	206,135	5,892,561
1999	5,403,450	135,756	13,735	94,784	4,147	225,779	5,877,651
2000	5,514,395	138,921	15,268	90,288	4,005	201,135	5,964,012
2001	5,521,637	156,479	16,929	87,116	4,544	192,632	5,979,337
2002	5,455,530	155,429	26,320	90,291	2,338	224,567	5,955,475
2003	5,585,875	152,763	55,626	67,592	1,937	163,459	6,027,252
2004	5,663,861	154,356	74,095	47,600	940	194,203	6,135,055
2005	5,555,332	161,037	84,088	39,751	612	295,064	6,135,884
2006	5,563,354	182,924	117,198	11,580	57	322,989	6,198,102
2007	5,532,097	184,383	136,603	1,610	0	349,807	6,204,500
2008	5,361,287	177,559	190,084	480	0	548,843	6,277,893
2009	5,232,656	177,194	240,955	90	0	518,998	6,169,893
2010	5,374,094	161,479	285,883	901	0	523,015	6,345,372
2011	5,404,347	178,884	297,266	1,154	0	541,059	6,422,710
2012	5,489,516	186,270	304,155	806	0	425,946	6,406,693
2013	5,589,006	181,112	310,568	915	0	495,476	6,577,077
2014	5,784,637	186,601	317,171	719	1	490,213	6,779,342
2015	5,908,550	188,722	325,858	830	0	446,744	6,870,704
2016	5,924,395	196,281	334,767	1,062	0	483,229	6,939,734
2017	6,055,241	206,629	335,023	[d]	[d]	406,266	7,003,159
			Average annual percentage change				
1987-2017	0.9%	-1.0%	[d]	[d]	[d]	3.8%	1.1%
2007-2017	0.9%	1.1%	9.4%	[d]	[d]	1.5%	1.2%

Source:
U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual 2017, Vol. 1*, 2018, Table 16, and annual. (Additional resources: www.eia.doe.gov)

[a] Methyl tertiary butyl ether (MTBE).
[b] Includes methanol and other oxygenates.
[c] Reported in “Other hydrocarbons and liquids” category in this year.
[d] Data are not available.

When crude oil and other hydrocarbons are processed into products that are, on average, less dense than the input, a processing volume gain occurs. Due to this gain, the product yield from a barrel of crude oil is more than 100%. For the last 20 years, the processing volume gain has been about 5-7%.

Table 1.10
U.S. Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978–2018
(percentage)

Year	Motor gasoline	Distillate fuel oil	Jet fuel	Liquefied petroleum gas	Other[a]	Total[b]
1978	44.1	21.4	6.6	2.3	29.6	104.0
1980	44.5	19.7	7.4	2.4	30.0	104.0
1985	45.6	21.6	9.6	3.1	24.6	104.5
1986	45.7	21.2	9.8	3.2	24.8	104.7
1987	46.4	20.5	10.0	3.4	24.5	104.8
1988	46.0	20.8	10.0	3.6	24.4	104.8
1989	45.7	20.8	10.1	4.0	24.2	104.8
1990	45.6	20.9	10.7	3.6	24.1	104.9
1991	45.7	21.3	10.3	3.8	24.1	105.2
1992	46.0	21.2	9.9	4.3	24.0	105.4
1993	46.1	21.9	9.2	4.1	23.3	104.6
1994	45.5	22.3	9.8	4.2	23.2	105.0
1995	46.4	21.8	9.7	4.5	22.8	105.2
1996	45.7	22.7	10.4	4.5	22.4	105.7
1997	45.7	22.5	10.3	4.6	22.4	105.5
1998	46.2	22.3	9.9	4.4	22.9	105.7
1999	46.5	22.3	10.2	4.5	22.4	105.9
2000	46.2	23.1	10.3	4.5	22.0	106.1
2001	46.2	23.8	9.8	4.3	21.6	105.7
2002	47.3	23.2	9.8	4.3	21.5	106.1
2003	46.9	23.7	9.5	4.2	22.1	106.4
2004	46.8	23.9	9.7	4.0	22.2	106.6
2005	46.2	25.0	9.8	3.6	21.6	106.2
2006	45.8	25.4	9.3	3.9	21.7	106.1
2007	45.5	26.1	9.1	4.1	21.5	106.3
2008	44.2	27.8	9.7	4.1	20.7	106.5
2009	46.6	26.6	9.2	4.1	20.1	106.6
2010	46.3	27.2	9.2	4.3	20.1	107.1
2011	45.6	28.6	9.3	4.0	19.5	107.0
2012	45.7	28.7	9.4	4.0	19.0	106.8
2013	45.7	29.1	9.4	3.9	18.9	107.0
2014	45.7	29.5	9.4	4.0	17.9	106.5
2015	46.0	29.5	9.6	3.7	17.6	106.4
2016	47.0	28.4	9.8	3.8	17.6	106.6
2017	46.5	29.0	9.9	3.7	17.4	106.5
2018	46.2	29.2	10.3	3.6	17.2	106.5

Source:
Department of Energy, Energy Information Administration, *Petroleum Supply Navigator*, June 2019. (Additional resources: www.eia.doe.gov)

[a] Includes aviation gasoline (0.1%), kerosene (0.0%), residual fuel oil (2.5%), naphtha and other oils for petrochemical feedstock use (1.2%), other oils for petrochemical feedstock use (0.6%), special naphthas (0.2%), lubricants (1.1%), petroleum coke (5.2%) asphalt and road oil (1.9%), still gas (4.0%), and miscellaneous products (0.5%).

[b] Products sum to greater than 100% due to processing gain. The processing gain for years 1978 to 1980 is assumed to be 4 percent.

Domestic petroleum production increased in 2009 for the first time in 20 years and reached an all-time high of 15 mmbd in 2018. Most of the petroleum imported by the United States is in the form of crude oil. Exports were at an all-time high in 2018 as well, partly due to a lift of crude oil export restrictions in December 2015.

Table 1.11
United States Petroleum Production, Imports, and Exports, 1950–2018
(million barrels per day)

	Domestic production			Total imports			Exports		
	Crude oil	Natural gas plant liquids	Total[a]	Crude oil	Petroleum products	Total	Crude oil	Petroleum products	Total
1950	5.41	0.50	5.91	0.49	0.36	0.85	0.10	0.21	0.31
1955	6.81	0.77	7.58	0.78	0.47	1.25	0.03	0.34	0.37
1960	7.05	0.93	7.98	1.02	0.80	1.82	0.01	0.19	0.20
1965	7.80	1.21	9.01	1.24	1.23	2.47	0.00	0.18	0.19
1970	9.64	1.66	11.30	1.32	2.10	3.42	0.01	0.25	0.26
1975	8.38	1.63	10.01	4.11	1.95	6.06	0.01	0.20	0.21
1980	8.60	1.57	10.17	5.26	1.65	6.91	0.29	0.26	0.54
1985	8.97	1.61	10.58	3.20	1.87	5.07	0.20	0.58	0.78
1990	7.36	1.56	8.91	5.89	2.12	8.02	0.11	0.75	0.86
1995	6.56	1.76	8.32	7.23	1.61	8.83	0.09	0.85	0.95
1996	6.46	1.83	8.29	7.51	1.97	9.48	0.11	0.87	0.98
1997	6.45	1.82	8.27	8.23	1.94	10.16	0.11	0.90	1.00
1998	6.25	1.76	8.01	8.71	2.00	10.71	0.11	0.83	0.94
1999	5.88	1.85	7.73	8.73	2.12	10.85	0.12	0.82	0.94
2000	5.82	1.91	7.73	9.07	2.39	11.46	0.05	0.99	1.04
2001	5.80	1.87	7.67	9.33	2.54	11.87	0.02	0.95	0.97
2002	5.74	1.88	7.62	9.14	2.39	11.53	0.01	0.97	0.98
2003	5.65	1.72	7.37	9.66	2.60	12.26	0.01	1.01	1.03
2004	5.44	1.81	7.25	10.09	3.06	13.15	0.03	1.02	1.05
2005	5.18	1.72	6.90	10.13	3.59	13.71	0.03	1.13	1.16
2006	5.09	1.74	6.82	10.12	3.59	13.71	0.02	1.29	1.32
2007	5.07	1.78	6.86	10.03	3.44	13.47	0.03	1.41	1.43
2008	5.00	1.78	6.78	9.78	3.13	12.92	0.03	1.77	1.80
2009	5.35	1.91	7.26	9.01	2.68	11.69	0.04	1.98	2.02
2010	5.48	2.07	7.55	9.21	2.58	11.79	0.04	2.31	2.35
2011	5.64	2.22	7.86	8.94	2.50	11.44	0.05	2.94	2.99
2012	6.50	2.41	8.90	8.53	2.07	10.60	0.07	3.14	3.20
2013	7.47	2.61	10.07	7.73	2.13	9.86	0.13	3.49	3.62
2014	8.76	3.01	11.77	7.34	1.90	9.24	0.35	3.82	4.18
2015	9.43	3.34	12.77	7.36	2.09	9.45	0.47	4.27	4.74
2016	8.83	3.51	12.34	7.85	2.20	10.06	0.59	4.67	5.26
2017	9.35	3.78	13.13	7.97	2.18	10.14	1.16	5.22	6.38
2018	10.95	4.35	15.30	7.76	2.17	9.93	2.00	5.58	7.59
Average annual percentage change									
1950-2018	1.0%	3.2%	1.4%	4.2%	2.7%	3.7%	4.6%	4.9%	4.8%
1970-2018	0.3%	2.0%	0.6%	3.8%	0.1%	2.2%	10.9%	6.7%	7.3%
2008-2018	8.2%	9.3%	8.5%	-2.3%	-3.6%	-2.6%	53.0%	12.2%	15.5%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, Washington, DC, March 2019, Tables 3.1, 3.3b, and 3.3e. (Additional resources: www.eia.gov)

[a] Total domestic production includes crude oil, natural gas plant liquids and small amounts of other liquids.

U.S. petroleum production has been mainly increasing and petroleum imports decreasing from 2008 to 2018. Net imports of petroleum in 2018 were at the lowest level since 1970. In 2016, domestic production declined slightly, but rose to over 15 mmbd in 2018.

Table 1.12
Petroleum Production and Transportation Petroleum Consumption in Context, 1950–2018

	Domestic petroleum production[a]	Net petroleum imports	Transportation petroleum consumption	U.S. petroleum consumption	World petroleum consumption	Net imports as a share of U.S. consumption	U.S. petroleum consumption as a share of world consumption	Transportation petroleum use as a share of domestic production
	(million barrels per day)							
1950	5.91	0.55	3.36	6.46	[b]	8.4%	[b]	56.8%
1955	7.58	0.88	4.46	8.46	[b]	10.4%	[b]	58.8%
1960	7.99	1.62	5.15	9.82	21.34	16.5%	46.0%	64.5%
1965	9.01	2.28	6.04	11.51	31.14	19.8%	37.0%	67.0%
1970	11.30	3.16	7.78	14.70	46.81	21.5%	31.4%	68.9%
1975	10.01	5.85	8.92	16.32	56.20	35.8%	29.0%	89.4%
1980	10.17	6.36	9.55	17.06	63.11	37.3%	27.0%	93.9%
1985	10.58	4.29	9.84	15.73	58.18	27.3%	26.2%	93.0%
1990	8.91	7.16	10.99	16.99	66.66	42.2%	25.5%	123.2%
1995	8.32	7.89	11.67	17.72	69.86	44.5%	25.2%	140.2%
1996	8.29	8.50	11.92	18.31	71.91	46.4%	25.5%	143.7%
1997	8.27	9.16	12.10	18.62	73.13	49.2%	25.3%	146.3%
1998	8.01	9.76	12.42	18.92	73.95	51.6%	25.5%	155.0%
1999	7.73	9.91	12.76	19.52	75.60	50.8%	25.7%	165.1%
2000	7.73	10.42	13.01	19.70	77.15	52.9%	25.6%	168.3%
2001	7.67	10.90	12.94	19.65	77.92	55.5%	25.3%	168.7%
2002	7.62	10.55	13.21	19.76	78.65	53.4%	25.2%	173.2%
2003	7.37	11.24	13.29	20.03	80.27	56.1%	25.0%	180.3%
2004	7.25	12.10	13.72	20.73	83.41	58.4%	25.0%	189.2%
2005	6.90	12.55	13.96	20.80	84.65	60.3%	24.6%	202.3%
2006	6.82	12.39	14.18	20.69	85.85	59.9%	24.2%	207.7%
2007	6.86	12.04	14.29	20.68	87.26	58.2%	23.8%	208.4%
2008	6.78	11.11	13.62	19.50	86.82	57.0%	22.7%	200.8%
2009	7.26	9.67	13.30	18.77	85.86	51.5%	22.1%	183.2%
2010	7.55	9.44	13.50	19.18	88.69	49.2%	21.5%	178.8%
2011	7.87	8.45	13.29	18.89	89.49	44.7%	21.0%	168.9%
2012	8.91	7.39	13.02	18.49	90.83	40.0%	20.3%	146.1%
2013	10.07	6.24	13.25	18.97	92.26	32.9%	32.9%	131.6%
2014	11.77	5.07	13.46	19.10	93.87	26.5%	26.5%	114.3%
2015	12.77	4.71	13.65	19.53	95.86	24.1%	24.1%	106.9%
2016	12.34	4.79	13.89	19.69	96.93	24.4%	24.4%	112.6%
2017	13.13	3.77	14.02	19.96	98.46	18.9%	18.9%	106.7%
2018	15.30	2.34	14.16	20.45	99.94	11.4%	11.4%	92.6%
	Average annual percentage change							
1950-2018	1.4%	2.2%	2.1%	1.7%	[b]			
1970-2018	0.6%	-0.6%	1.3%	0.7%	0.02			
2008-2018	8.5%	-14.4%	0.4%	0.5%	0.01			

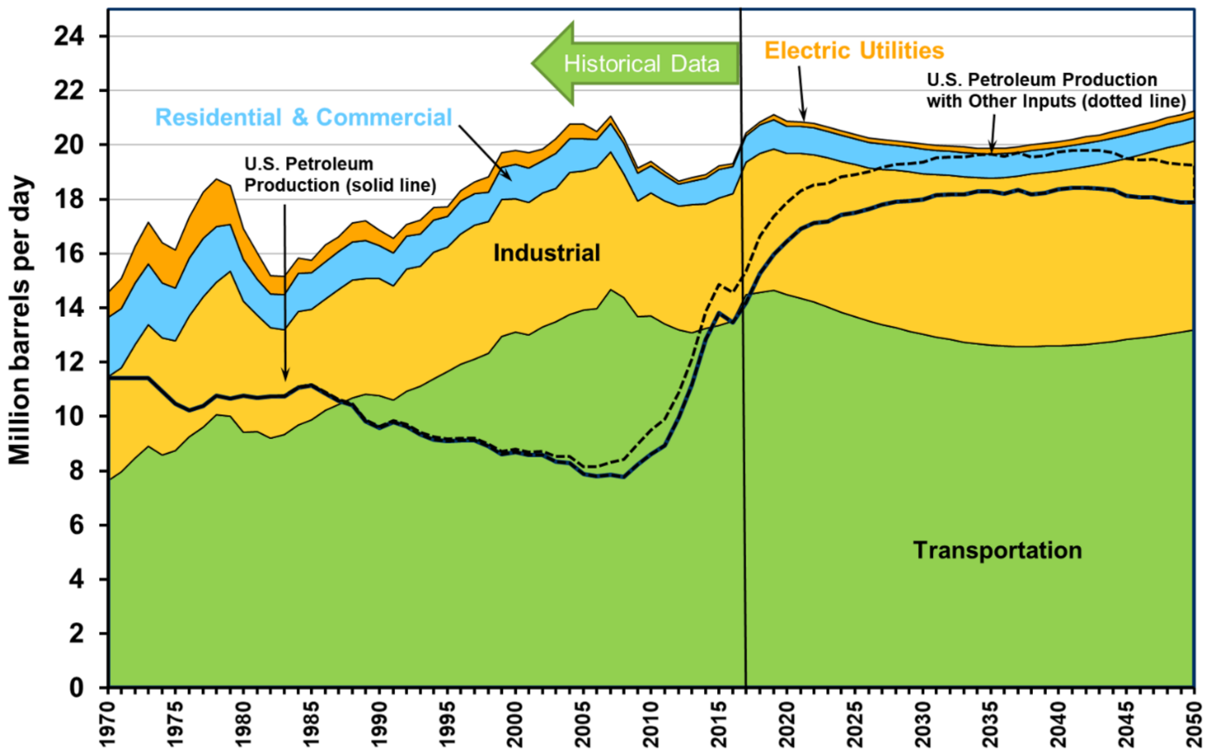
Sources:

U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, Washington, DC, March 2018, Tables 2.5, 3.1, and 11.2. (Pre-1973 data from the *Annual Energy Review*). (Additional resources: www.eia.doe.gov)

[a] Total domestic production includes crude oil, natural gas plant liquids and small amounts of other liquids.
[b] Data are not available.

Before 1989 the U.S. produced enough petroleum to meet the needs of the transportation sector but was still short of meeting the petroleum needs of all the sectors, including industrial, residential and commercial, and electric utilities. In 1970 the gap between what the U.S. produced and what was consumed was 3.2 million barrels per day and in 2007, the gap was 12.8 million barrels per day. By 2050, the gap is expected to be only 2.0 million barrels per day if petroleum and other inputs are included or 3.4 million barrels per day if only conventional petroleum is used.

Figure 1.5. United States Petroleum Production and Consumption – All Sectors, 1970–2050



Notes: "Total U.S. Petroleum Production" includes crude oil, natural gas plant liquids, and refinery gains. It does not include dry natural gas.

"Total U.S. Petroleum Production" is for all uses.

"Total U.S. Petroleum Production with Other Inputs" also includes non-petroleum sources such as ethanol, biomass, liquids from coal, other blending components, other hydrocarbons, and ethers which were domestically produced.

The change from historical values to projected values is between 2017 and 2018.

The sharp increase in the value for heavy trucks between 2006 and 2007 is the result of the Federal Highway Administration's methodology change.

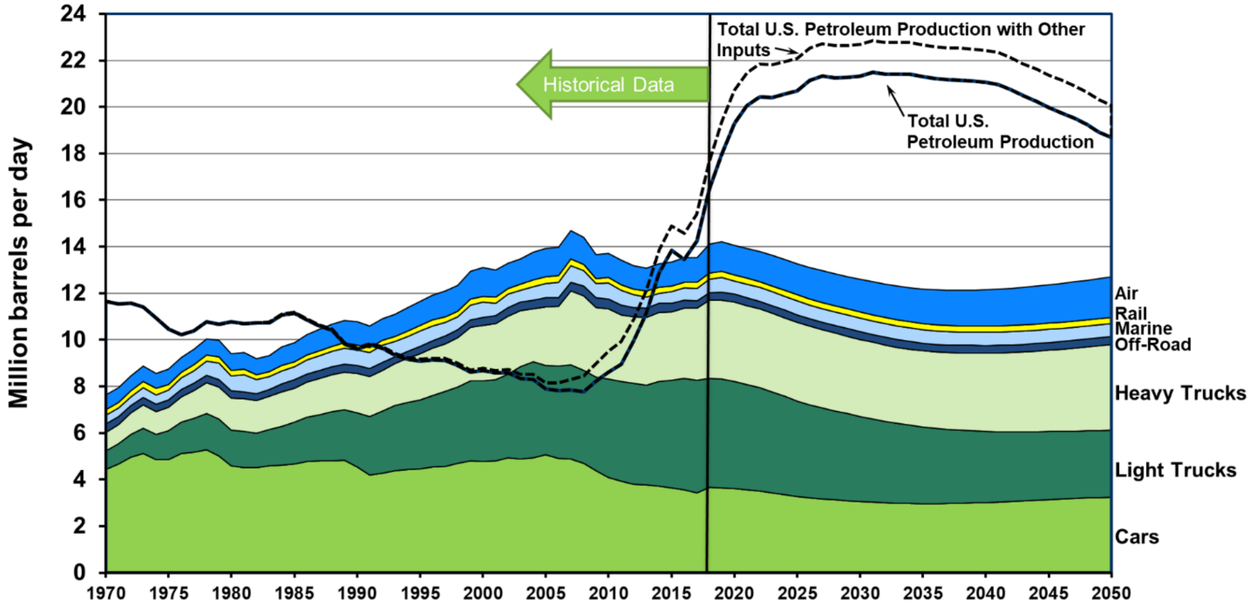
Sources:

Historical transportation petroleum use – See Tables 1.14 and 1.15. Historical petroleum use for other sectors – See Table 1.13. Historical U.S. petroleum production – Energy Information Administration, *Monthly Energy Review May 2019*, Table 3.1. Historical other inputs - Energy Information Administration, *Monthly Energy Review May 2019*, Tables 10.3 and 10.4. Forecasted petroleum use and petroleum production – Energy Information Administration, *2019 Annual Energy Outlook*, January 2019, reference case tables 7, 11, and 36.

In 1989, for the first time, petroleum consumption for transportation surpassed total U.S. petroleum production, which was declining. These contrasting trends in production and consumption created a gap that was met with foreign imports of petroleum. In 2009, however, the U.S. production of petroleum (for all uses including, but not limited to, transportation) began to increase substantially because of new hydraulic fracturing and oil extraction technology. In 2015, total production exceeded all transportation sector petroleum consumption. With other inputs included, such as ethanol, domestic production has exceeded transportation consumption since 2014. Transportation accounts for about 70% of all U.S. petroleum consumption.

The Energy Information Administration expects petroleum production to be greater than transportation consumption through 2050. Including non-petroleum sources such as ethanol, the production will exceed transportation demand by approximately seven million barrels per day in 2050.

Figure 1.6. United States Petroleum Production and Transportation Consumption, 1970–2050



Notes: "Total U.S. Petroleum Production" includes crude oil, natural gas plant liquids, and refinery gains. It does not include dry natural gas.

"Total U.S. Petroleum Production" is for all uses, including but not limited to transportation.

"Total U.S. Petroleum Production with Other Inputs" also includes non-petroleum sources such as ethanol, biomass, liquids from coal, other blending components, other hydrocarbons, and ethers which were domestically produced.

The change from historical values to projected values is between 2017 and 2018.

The sharp increase in the value for heavy trucks between 2006 and 2007 is the result of the Federal Highway Administration's methodology change.

Sources:

Historical transportation petroleum use – See Tables 1.14 and 1.15. Historical U.S. petroleum production – Energy Information Administration, *Monthly Energy Review May 2019*, Table 3.1. Historical other inputs - Energy Information Administration, *Monthly Energy Review May 2019*, Tables 10.3 and 10.4. Forecasted petroleum use and petroleum production – Energy Information Administration, *2019 Annual Energy Outlook*, January 2019, reference case tables 7, 11, and 36.

Transportation accounted for about 70% of the U.S. petroleum use from 2008 to 2018. Total petroleum consumption reached more than 20 million barrels per day from 2003 to 2007 but was below that level until 2018.

Table 1.13
Consumption of Petroleum by End-Use Sector, 1950–2018
(million barrels per day)

Year	Transportation	Percentage	Residential	Commercial	Industrial	Electric utilities	Total
1950	3.36	52.0%	0.66	0.41	1.82	0.21	6.46
1955	4.46	52.7%	0.89	0.52	2.39	0.21	8.46
1960	5.14	52.4%	1.12	0.59	2.71	0.24	9.80
1965	6.04	52.4%	1.24	0.67	3.25	0.32	11.51
1970	7.78	52.9%	1.42	0.76	3.81	0.93	14.70
1975	8.95	54.8%	1.29	0.65	4.04	1.39	16.32
1980	9.55	56.0%	0.89	0.63	4.84	1.15	17.06
1985	9.84	62.6%	0.81	0.53	4.07	0.48	15.73
1986	10.19	62.6%	0.80	0.57	4.09	0.64	16.28
1987	10.50	63.0%	0.85	0.55	4.21	0.55	16.67
1988	10.85	62.8%	0.87	0.54	4.35	0.68	17.28
1989	10.94	63.1%	0.88	0.51	4.25	0.75	17.33
1990	10.89	64.1%	0.74	0.49	4.30	0.57	16.99
1991	10.76	64.4%	0.74	0.46	4.22	0.53	16.71
1992	10.88	63.9%	0.75	0.44	4.52	0.43	17.03
1993	11.12	64.5%	0.77	0.41	4.44	0.49	17.24
1994	11.42	64.4%	0.76	0.41	4.67	0.47	17.72
1995	11.67	65.8%	0.74	0.38	4.59	0.33	17.72
1996	11.92	65.1%	0.81	0.40	4.82	0.36	18.31
1997	12.10	65.0%	0.78	0.38	4.95	0.41	18.62
1998	12.42	65.7%	0.72	0.36	4.84	0.58	18.92
1999	12.76	65.4%	0.82	0.37	5.03	0.53	19.52
2000	13.01	66.0%	0.87	0.41	4.90	0.51	19.70
2001	12.94	65.8%	0.85	0.41	4.89	0.56	19.65
2002	13.21	66.8%	0.82	0.38	4.93	0.43	19.76
2003	13.29	66.3%	0.86	0.43	4.92	0.53	20.03
2004	13.72	66.2%	0.84	0.42	5.22	0.53	20.73
2005	13.96	67.1%	0.81	0.39	5.10	0.55	20.80
2006	14.18	68.5%	0.69	0.34	5.19	0.29	20.69
2007	14.29	69.1%	0.71	0.34	5.06	0.29	20.68
2008	13.62	69.9%	0.76	0.35	4.56	0.21	19.50
2009	13.30	70.8%	0.68	0.35	4.27	0.17	18.77
2010	13.50	70.4%	0.66	0.34	4.51	0.17	19.18
2011	13.29	70.4%	0.61	0.34	4.51	0.14	18.89
2012	13.02	70.4%	0.51	0.30	4.56	0.10	18.49
2013	13.25	69.9%	0.57	0.30	4.72	0.12	18.97
2014	13.46	70.5%	0.61	0.32	4.58	0.14	19.10
2015	13.65	69.9%	0.58	0.48	4.69	0.13	19.53
2016	13.89	70.5%	0.52	0.47	4.70	0.11	19.69
2017	14.02	70.2%	0.52	0.46	4.85	0.10	19.96
2018	14.16	69.2%	0.57	0.48	5.13	0.11	20.45
		Average annual percentage change					
1950-2018	2.1%		-0.2%	0.2%	1.5%	-0.9%	1.7%
1970-2018	1.3%		-1.9%	-1.0%	0.6%	-4.3%	0.7%
2008-2018	0.4%		-2.8%	3.2%	1.2%	-6.0%	0.5%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review,* Washington, DC, March 2019, Tables 3.7a–3.7c. (Additional resources: www.eia.doe.gov)

Cars and light trucks use most of the petroleum in the transportation sector. Light trucks include pick-ups, minivans, sport-utility vehicles, and vans. See Table 2.9 for highway energy use in trillion Btu.

Table 1.14
Highway Transportation Petroleum Consumption by Mode, 1970–2017[a]
(thousand barrels per day)

Year	Cars	Light trucks	Light vehicle subtotal	Motor-cycles	Buses	Class 3-6 trucks	Class 7-8 trucks	Heavy Trucks subtotal	Highway subtotal	Total transportation[b]
1970	4,424	803	5,227	4	62	140	598	738	6,031	7,301
1975	4,836	1,245	6,081	7	58	181	771	952	7,099	8,435
1980	4,565	1,552	6,117	13	68	247	1,055	1,302	7,500	9,092
1981	4,508	1,546	6,054	14	69	253	1,077	1,329	7,466	9,154
1982	4,509	1,481	5,989	13	71	253	1,077	1,330	7,403	8,929
1983	4,587	1,562	6,149	11	72	257	1,097	1,354	7,586	9,062
1984	4,609	1,670	6,280	11	69	266	1,132	1,398	7,758	9,351
1985	4,665	1,785	6,450	12	72	265	1,131	1,396	7,930	9,526
1986	4,773	1,897	6,670	12	76	271	1,155	1,426	8,184	9,882
1987	4,782	1,996	6,778	12	77	279	1,190	1,469	8,336	10,099
1988	4,784	2,130	6,914	13	80	284	1,211	1,495	8,503	10,328
1989	4,821	2,170	6,992	14	79	291	1,242	1,534	8,618	10,490
1990	4,538	2,323	6,861	12	78	304	1,294	1,597	8,549	10,414
1991	4,196	2,493	6,688	12	83	310	1,320	1,630	8,413	10,236
1992	4,268	2,670	6,938	12	87	315	1,345	1,660	8,698	10,574
1993	4,374	2,795	7,169	13	86	325	1,386	1,711	8,979	10,811
1994	4,428	2,878	7,305	13	86	343	1,463	1,806	9,211	11,082
1995	4,440	2,975	7,415	13	87	357	1,523	1,881	9,396	11,340
1996	4,515	3,089	7,604	13	88	367	1,564	1,931	9,636	11,595
1997	4,559	3,222	7,781	13	91	370	1,579	1,949	9,834	11,769
1998	4,677	3,292	7,969	13	93	382	1,630	2,012	10,086	12,004
1999	4,780	3,448	8,228	14	96	420	1,792	2,212	10,550	12,637
2000	4,766	3,453	8,219	14	98	437	1,861	2,298	10,630	12,787
2001	4,798	3,491	8,290	13	93	436	1,859	2,295	10,690	12,656
2002	4,923	3,602	8,525	12	91	456	1,944	2,401	11,029	12,938
2003	4,866	3,963	8,829	12	90	443	1,890	2,334	11,265	13,118
2004	4,919	4,137	9,055	13	92	411	1,752	2,162	11,323	13,384
2005	5,050	3,840	8,890	12	93	461	1,965	2,426	11,422	13,553
2006	4,893	3,959	8,852	14	94	470	2,006	2,476 [c]	11,436	13,596
2007	4,852	4,034	8,885	31	92	585	2,495	3,080	12,089	14,286
2008	4,664	3,992	8,656 [c]	32	95	591	2,521	3,112	11,895	13,977
2009	4,344	4,033	8,376	31	95	549	2,341	2,890	11,392	13,248
2010	4,060	4,220	8,280	28	90	558	2,379	2,937	11,335	13,282
2011	3,891	4,291	8,182	28	92	525	2,240	2,766	11,068	12,988
2012	3,777	4,331	8,108	32	95	525	2,238	2,763	10,998	12,777
2013	3,737	4,276	8,013	31	97	537	2,288	2,824	10,965	12,673
2014	3,684	4,502	8,185	30	98	545	2,325	2,871	11,184	12,852
2015	3,602	4,627	8,229	29	100	542	2,311	2,853	11,210	12,955
2016	3,539	4,769	8,308	30	102	556	2,372	2,928	11,368	13,169
2017	3,410	4,816	8,226	30	105	570	2,429	2,998	11,359	13,198
				Average annual percentage change						
1970-2017	-0.6%	3.9%	1.0%	4.4%	1.1%	3.0%	3.0%	3.0%	1.4%	1.3%
2007-2017	-3.5%	1.8%	-0.8%	-0.4%	1.2%	-0.3%	-0.3%	-0.3%	-0.6%	-0.8%

Source:
See Appendix A, Section 2.1 Highway Energy Use.

[a] Each gallon of petroleum product was assumed to equal one gallon of crude oil. The oil used to produce electricity is also estimated. See Appendix A, Section 2.4 for details.

[b] Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g., snowmobiles).

[c] Due to changes in the FHWA fuel use methodology, motorcycle, bus, and heavy truck data are not comparable with data before the year 2007. Car and light truck data changed after 2008; see Appendix A, Section 7, Car/Light Truck Shares.

Although 18% of transportation energy use is for nonhighway modes, only 14% of transportation petroleum use is for nonhighway. This is because some nonhighway modes, such as pipelines and transit rail, use electricity. An estimate for the petroleum used to make electricity is included in the data. See Table 2.10 for nonhighway transportation energy use in trillion Btu.

Table 1.15
Nonhighway Transportation Petroleum Consumption by Mode, 1970–2017[a]
(thousand barrels per day)

Year	Air	Water	Pipeline	Rail	Nonhighway subtotal	Total transportation[b]
1970	625	381	14	250	1,270	7,301
1975	651	423	16	246	1,336	8,435
1980	697	625	11	259	1,592	9,092
1985	814	564	4	214	1,596	9,526
1986	884	601	6	207	1,698	9,882
1987	920	626	5	211	1,763	10,099
1988	958	644	6	217	1,825	10,328
1989	960	688	6	218	1,872	10,490
1990	991	655	5	214	1,865	10,414
1991	928	690	4	201	1,823	10,236
1992	942	724	3	207	1,876	10,574
1993	961	653	4	213	1,831	10,811
1994	1,004	635	4	229	1,871	11,082
1995	1,036	668	2	238	1,944	11,340
1996	1,068	644	3	244	1,959	11,595
1997	1,113	574	3	245	1,935	11,769
1998	1,102	566	4	246	1,918	12,004
1999	1,202	626	4	255	2,086	12,637
2000	1,236	663	3	254	2,156	12,787
2001	1,161	546	4	255	1,966	12,656
2002	1,079	572	3	256	1,910	12,938
2003	1,094	494	3	262	1,855	13,118
2004	1,188	593	3	276	2,064	13,384
2005	1,226	623	3	279	2,133	13,553
2006	1,216	657	2	285	2,163	13,596
2007	1,215	704	2	276	2,202	14,286
2008	1,160	657	1	265	2,091	13,977
2009	1,029	604	1	221	1,864	13,248
2010	1,040	665	1	240	1,959	13,282
2011	1,044	623	1	253	1,935	12,988
2012	1,006	525	1	247	1,797	12,777
2013	987	467	1	253	1,727	12,673
2014	997	405	1	265	1,689	12,852
2015	1,025	465	1	254	1,765	12,955
2016	1,054	512	1	234	1,820	13,169
2017	1,080	517	1	242	1,858	13,198
			Average annual percentage change			
1970-2017	1.2%	0.7%	-6.3%	-0.1%	0.8%	1.3%
2007-2017	-1.2%	-3.0%	-9.3%	-1.3%	-1.7%	-0.8%

Source:
See Appendix A, Section 2.3. Nonhighway Energy Use.

[a] Each gallon of petroleum product was assumed to equal one gallon of crude oil. The oil used to produce electricity is also estimated. See Appendix A, Section 2.3 Nonhighway Energy Use for details.

[b] Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g., snowmobiles).

Highway vehicles were responsible for 85.9% of all transportation petroleum use in 2017. See Table 2.8 for transportation energy use in trillion Btu.

Table 1.16
Transportation Petroleum Use by Mode, 2016–2017[a]

	Thousand barrels per day		Percentage of total[b]		Percentage of total U.S. petroleum consumption[b]	
	2016	2017	2016	2017	2016	2017
HIGHWAY	**11,368.1**	**11,358.6**	**86.3%**	**86.1%**	**57.7%**	**56.9%**
Light vehicles	**8,337.9**	**8,255.8**	**63.3%**	**62.6%**	**42.4%**	**41.4%**
Cars	3,538.7	3,409.5	26.9%	25.8%	18.0%	17.1%
Light trucks[c]	4,768.9	4,816.4	36.2%	36.5%	24.2%	24.1%
Motorcycles	30.4	29.9	0.2%	0.2%	0.2%	0.1%
Buses	101.7	104.6	0.8%	0.8%	0.5%	0.5%
Transit	43.9	43.6	0.3%	0.3%	0.2%	0.2%
Intercity	16.6	17.5	0.1%	0.1%	0.1%	0.1%
School	41.2	43.4	0.3%	0.3%	0.2%	0.2%
Medium/heavy trucks	**2,928.4**	**2,998.3**	**22.2%**	**22.7%**	**14.9%**	**15.0%**
Class 3-6	556.4	569.7	4.2%	4.3%	2.8%	2.9%
Class 7-8	2,372.0	2,428.6	18.0%	18.4%	12.0%	12.2%
NONHIGHWAY	**1,800.7**	**1,839.4**	**13.7%**	**13.9%**	**9.1%**	**9.2%**
Air	**1,054.1**	**1,079.8**	**8.0%**	**8.2%**	**5.4%**	**5.4%**
General aviation	106.9	113.8	0.8%	0.9%	0.5%	0.6%
Domestic air carriers	741.9	755.9	5.6%	5.7%	3.8%	3.8%
International air carriers	205.3	210.1	1.6%	1.6%	1.0%	1.1%
Water	**512.0**	**517.3**	**3.9%**	**3.9%**	**2.6%**	**2.6%**
Freight	405.3	409.6	3.1%	3.1%	2.1%	2.1%
Recreational	106.7	107.7	0.8%	0.8%	0.5%	0.5%
Pipeline	**0.7**	**0.7**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Rail	**233.9**	**241.6**	**1.8%**	**1.8%**	**1.2%**	**1.2%**
Freight (Class I)	223.0	230.7	1.7%	1.7%	1.1%	1.2%
Passenger	10.9	10.9	0.1%	0.1%	0.1%	0.1%
Transit	0.1	0.1	0.0%	0.0%	0.0%	0.0%
Commuter	6.8	6.8	0.1%	0.1%	0.0%	0.0%
Intercity	3.9	3.9	0.0%	0.0%	0.0%	0.0%
HWY & NONHWY TOTAL[d]	**13,168.8**	**13,198.0**	**100.0%**	**100.0%**	**66.9%**	**66.1%**
Off-Highway[e]	**1,008.0**	**1,013.6**				

Source:
See Appendix A, Section 2. Energy Use Sources.

[a] Each gallon of petroleum product was assumed to equal one gallon of crude oil. The oil used to produce electricity is also estimated. See Appendix A, Section 2.4 for details.
[b] Percentages may not sum to totals due to rounding.
[c] Two-axle, four-tire trucks.
[d] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).
[e] Includes equipment that does not travel on roads, such as equipment from agriculture, construction, and airports.

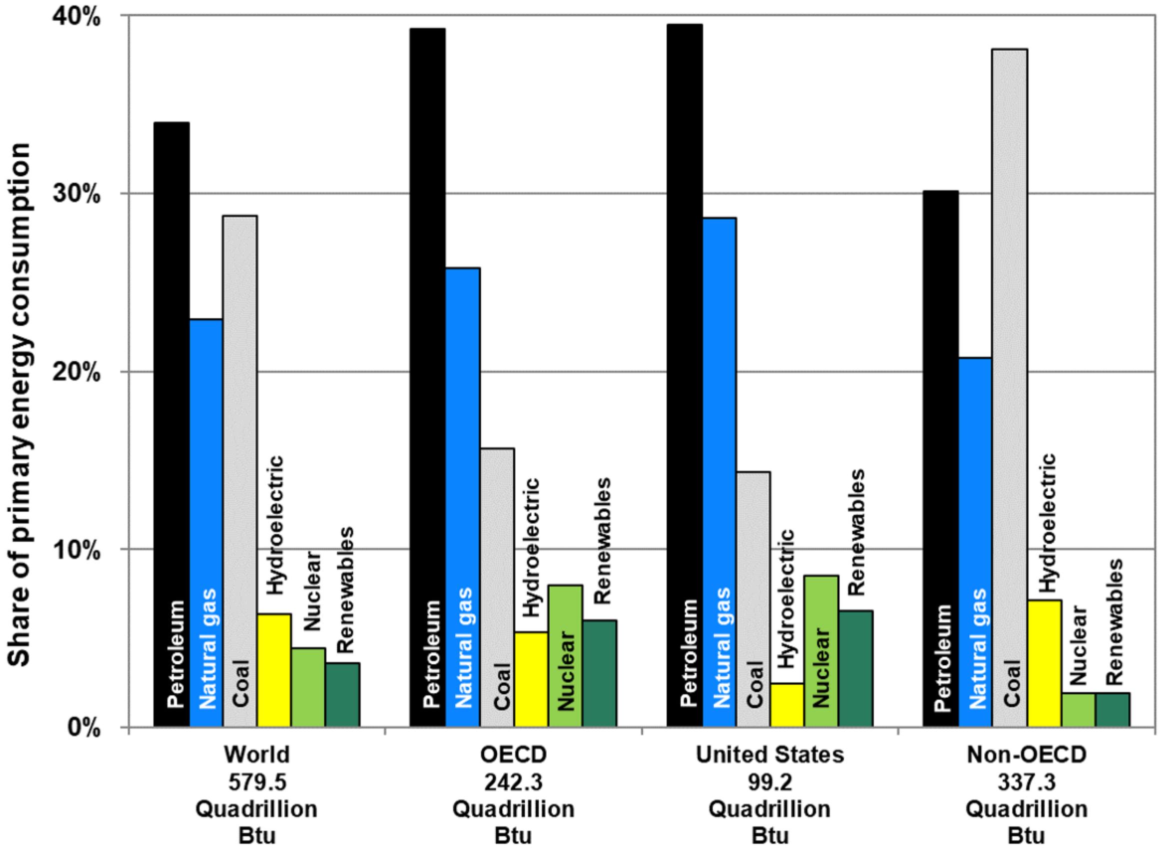
Chapter 2
Energy

Summary Statistics from Tables in this Chapter

Source			
Table 2.1	Transportation share of U.S. energy consumption, 2017		28.8%
Table 2.2	Petroleum share of transportation energy consumption, 2017		91.9%
Table 2.6	Fuel ethanol consumption, 2018 (million gallons)		14,382.0
	Biodiesel consumption, 2018 (million gallons)		1,895.9
Table 2.8	Transportation energy use by mode, 2017	(trillion Btu)	(transportation energy share)
	Cars	*6,339*	*23.8%*
	Light trucks	*8,963*	*33.7%*
	Medium/heavy trucks	*6,289*	*23.6%*
	Buses	*220*	*0.8%*
	Total Highway	*21,869*	*82.1%*
	Air	*2,231*	*8.4%*
	Water	*1,167*	*4.4%*
	Pipeline	*825*	*3.1%*
	Rail	*537*	*2.0%*

Petroleum accounted for 34% of the world's energy use in 2016. Although petroleum and natural gas are the dominant energy sources for OECD countries, the non-OECD countries rely on coal and petroleum. The U.S. shares of primary energy sources are similar to the OECD countries as a whole, but with a lesser reliance on hydroelectric and renewables and a greater reliance on natural gas.

Figure 2.1. World Consumption of Primary Energy, 2016



Note: The United States data are shown separately but are also included in the OECD data.

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Statistics,* June 2019. (Additional resources: www.eia.doe.gov)

Total energy use was over 101 quads in 2018 with transportation using 28%. The Energy Information Administration includes renewable energy in the appropriate sectors.

Table 2.1
U. S. Consumption of Total Energy by End-Use Sector, 1950–2018
(quadrillion Btu)

Year	Transportation	Percentage transportation of total	Industrial	Commercial	Residential	Total[a]
1950	8.5	24.5%	16.2	3.9	6.0	34.6
1955	9.6	23.8%	19.5	3.9	7.3	40.2
1960	10.6	23.5%	20.8	4.6	9.0	45.1
1965	12.4	23.0%	25.1	5.8	10.6	54.0
1970	16.1	23.7%	29.6	8.3	13.8	67.8
1975	18.2	25.4%	29.4	9.5	14.8	72.0
1980	19.7	25.2%	32.0	10.6	15.8	78.1
1985	20.1	26.3%	28.8	11.5	16.0	76.4
1990	22.4	26.5%	31.8	13.3	16.9	84.5
1991	22.1	26.2%	31.4	13.5	17.4	84.4
1992	22.4	26.1%	32.6	13.4	17.4	85.8
1993	22.7	26.0%	32.6	13.8	18.2	87.3
1994	23.3	26.2%	33.5	14.1	18.1	89.0
1995	23.8	26.2%	34.0	14.7	18.5	91.0
1996	24.4	26.0%	34.9	15.2	19.5	94.0
1997	24.7	26.1%	35.2	15.7	19.0	94.6
1998	25.2	26.8%	34.8	16.0	19.0	95.0
1999	25.9	26.8%	34.8	16.4	19.6	96.6
2000	26.5	26.8%	34.7	17.2	20.4	98.8
2001	26.2	27.3%	32.7	17.1	20.0	96.1
2002	26.8	27.5%	32.7	17.3	20.8	97.6
2003	26.9	27.5%	32.6	17.3	21.1	97.9
2004	27.8	27.8%	33.5	17.7	21.1	100.1
2005	28.3	28.2%	32.4	17.9	21.6	100.2
2006	28.7	28.9%	32.4	17.7	20.7	99.5
2007	28.8	28.5%	32.4	18.3	21.5	101.0
2008	27.4	27.7%	31.3	18.4	21.7	98.8
2009	26.6	28.3%	28.5	17.9	21.1	94.0
2010	27.0	27.6%	30.7	18.1	21.9	97.6
2011	26.6	27.4%	31.0	18.0	21.4	96.9
2012	26.1	27.7%	31.1	17.4	19.9	94.5
2013	26.6	27.4%	31.6	17.9	21.1	97.2
2014	26.9	27.3%	31.8	18.3	21.4	98.4
2015	27.2	27.9%	31.5	18.2	20.6	97.5
2016	27.8	28.5%	31.5	18.0	20.2	97.4
2017	28.0	28.6%	32.0	17.9	19.9	97.8
2018	28.4	28.0%	32.6	18.6	21.7	101.3
		Average annual percentage change				
1950-2018	1.8%		1.0%	2.3%	1.9%	1.6%
1970-2018	1.2%		0.2%	1.7%	0.9%	0.8%
2008-2018	0.3%		0.4%	0.1%	0.0%	0.2%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review,* March 2019, Washington, DC, Table 2.1. (Additional resources: www.eia.doe.gov)

[a] Electrical energy losses have been distributed among the sectors. Renewable energy consumption is included in the appropriate sectors.

In transportation, the alcohol fuels blended into gasoline to make gasohol (10% ethanol or less) are counted under "renewables" and are not in with petroleum. The petroleum category, however, still contains other blending agents that are not actually petroleum but are not broken out into a separate category.

Table 2.2
Distribution of Energy Consumption by Source and Sector, 1973 and 2018
(percentage)

Energy source	Transportation 1973	Transportation 2018	Residential 1973	Residential 2018	Commercial 1973	Commercial 2018
Petroleum[a]	95.8	91.6	18.8	4.4	16.8	4.6
Natural gas[b]	4.0	3.1	33.4	23.8	27.8	19.4
Coal	0.0	0.0	0.6	0.0	1.7	0.1
Renewable	0.0	5.0	2.4	3.6	0.1	1.5
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0
Electricity[c]	0.2	0.3	44.8	68.2	53.6	74.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Energy source	Industrial 1973	Industrial 2018	Electric utilities 1973	Electric utilities 2018
Petroleum[a]	27.9	27.2	17.8	0.6
Natural gas[b]	31.8	31.8	19.0	28.6
Coal	12.4	3.7	44.0	31.6
Renewable	3.7	7.9	14.4	16.8
Nuclear	0.0	0.0	4.6	22.0
Electricity[c]	24.2	29.4	0.2	0.4
Total	100.0	100.0	100.0	100.0

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2019, Washington, DC, Tables 2.2, 2.3, 2.4, 2.5, and 2.6. (Additional resources: www.eia.doe.gov)

[a] In transportation, the petroleum category contains some blending agents which are not petroleum.
[b] Includes supplemental gaseous fuels. Transportation sector includes pipeline fuel and natural gas vehicle use.
[c] Includes electrical system energy losses.

Total transportation energy consumption was 28.4 quads in 2018. Petroleum has accounted for more than 90% of transportation energy consumption since the mid-1950's. Renewables, including ethanol and biodiesel, were 5% of the total in 2018.

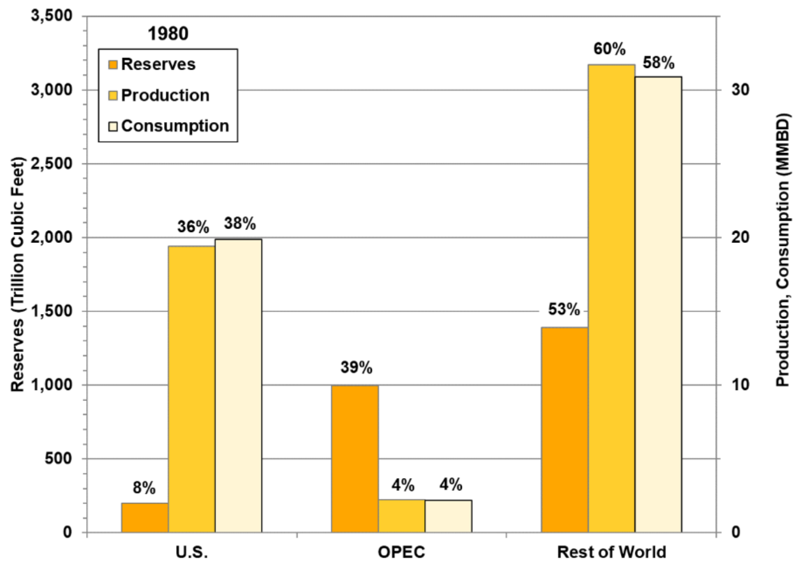
Table 2.3
Distribution of Transportation Energy Consumption by Source, 1950–2018

Year	Petroleum[a]	Natural gas[b]	Coal	Renewables	Electricity[c]	Total (trillion Btu)
1950	78.8%	1.5%	18.4%	0.0%	1.3%	8,492.5
1955	92.1%	2.7%	4.4%	0.0%	0.8%	9,550.2
1960	95.6%	3.4%	0.7%	0.0%	0.3%	10,595.9
1965	95.4%	4.2%	0.1%	0.0%	0.3%	12,432.5
1970	95.1%	4.6%	0.0%	0.0%	0.2%	16,098.2
1975	96.5%	3.3%	0.0%	0.0%	0.2%	18,245.0
1980	96.5%	3.3%	0.0%	0.0%	0.2%	19,696.7
1985	96.9%	2.6%	0.0%	0.2%	0.2%	20,087.9
1986	97.1%	2.4%	0.0%	0.3%	0.2%	20,788.8
1987	97.0%	2.5%	0.0%	0.3%	0.2%	21,468.9
1988	96.6%	2.8%	0.0%	0.3%	0.2%	22,317.7
1989	96.6%	2.9%	0.0%	0.3%	0.2%	22,477.9
1990	96.5%	3.0%	0.0%	0.3%	0.2%	22,419.0
1991	96.6%	2.8%	0.0%	0.3%	0.2%	22,118.0
1992	96.7%	2.7%	0.0%	0.4%	0.2%	22,415.1
1993	96.5%	2.8%	0.0%	0.4%	0.2%	22,670.8
1994	96.3%	3.0%	0.0%	0.4%	0.2%	23,318.7
1995	96.3%	3.0%	0.0%	0.5%	0.2%	23,811.9
1996	96.4%	3.0%	0.0%	0.3%	0.2%	24,419.3
1997	96.2%	3.2%	0.0%	0.4%	0.2%	24,722.6
1998	96.7%	2.6%	0.0%	0.4%	0.2%	25,224.5
1999	96.7%	2.6%	0.0%	0.5%	0.2%	25,916.0
2000	96.7%	2.5%	0.0%	0.5%	0.2%	26,515.5
2001	96.7%	2.5%	0.0%	0.5%	0.2%	26,242.1
2002	96.5%	2.6%	0.0%	0.6%	0.2%	26,807.8
2003	96.5%	2.3%	0.0%	0.9%	0.2%	26,881.1
2004	96.5%	2.2%	0.0%	1.0%	0.3%	27,826.5
2005	96.3%	2.2%	0.0%	1.2%	0.3%	28,260.8
2006	95.9%	2.2%	0.0%	1.7%	0.3%	28,696.9
2007	95.3%	2.3%	0.0%	2.1%	0.3%	28,815.2
2008	94.2%	2.5%	0.0%	3.0%	0.3%	27,421.6
2009	93.5%	2.7%	0.0%	3.5%	0.3%	26,588.9
2010	93.0%	2.7%	0.0%	4.0%	0.3%	26,980.1
2011	92.6%	2.8%	0.0%	4.4%	0.3%	26,601.1
2012	92.3%	3.0%	0.0%	4.4%	0.3%	26,129.1
2013	91.5%	3.3%	0.0%	4.8%	0.3%	26,614.2
2014	92.0%	2.8%	0.0%	4.8%	0.3%	26,870.9
2015	92.1%	2.7%	0.0%	4.9%	0.3%	27,240.9
2016	91.8%	2.7%	0.0%	5.2%	0.3%	27,788.2
2017	91.7%	2.9%	0.0%	5.1%	0.3%	28,017.4
2018	91.7%	3.1%	0.0%	5.0%	0.3%	28,393.3

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2019, Washington, DC, Table 2.5. (Additional resources: www.eia.doe.gov)

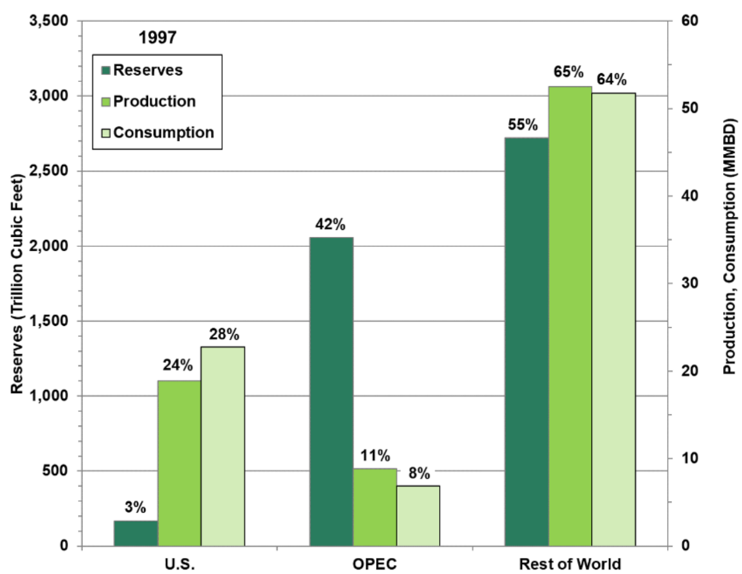
[a] In transportation, the petroleum category contains some blending agents which are not petroleum.
[b] Includes supplemental gaseous fuels. Transportation sector includes pipeline fuel and natural gas vehicle use.
[c] Includes electrical system energy losses.

Figure 2.2. World Natural Gas Reserves, Production, and Consumption, 1980



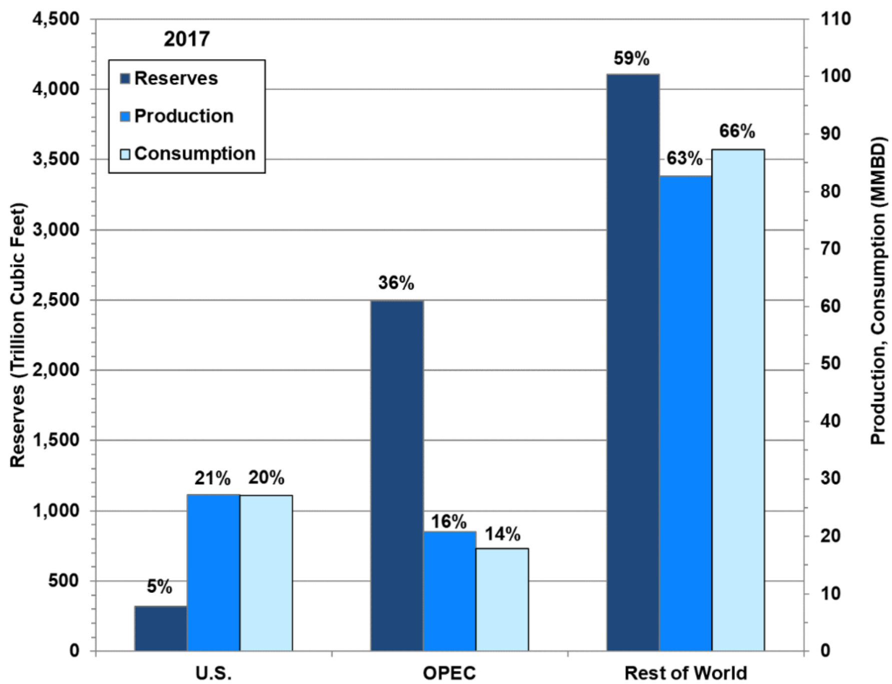
Source:
See Table 2.4.

Figure 2.3. World Natural Gas Reserves, Production, and Consumption, 1997



Source:
See Table 2.4.

Figure 2.4. World Natural Gas Reserves, Production, and Consumption, 2017



Source:
See Table 2.4.

Table 2.4
World Natural Gas Reserves, Production, and Consumption, 1980, 1997, and 2017
(trillion cubic feet)

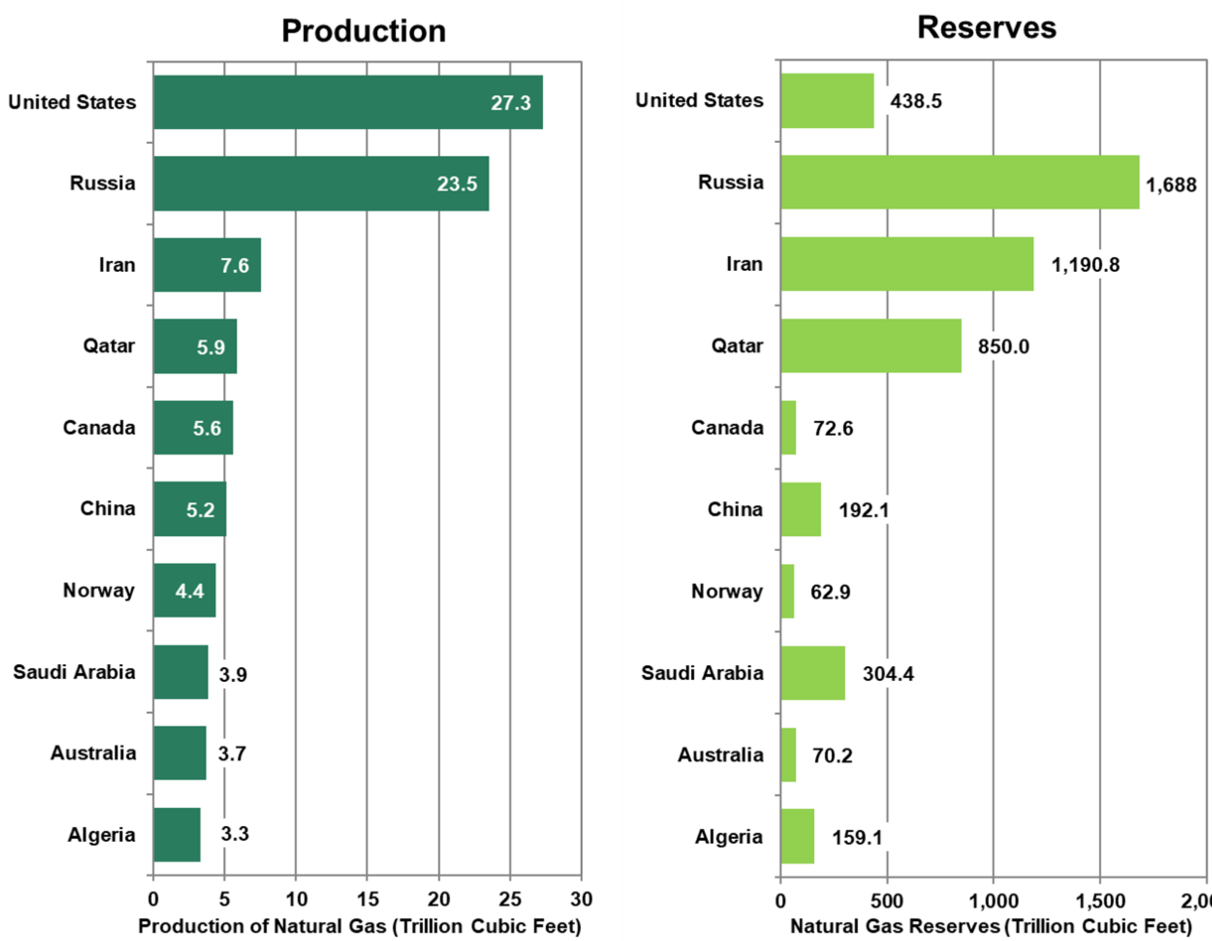
	Natural gas reserves	Reserve share	Natural gas production	Production share	Natural gas consumption	Consumption share
			1980			
United States	199.0	8%	19.4	36%	19.9	38%
OPEC	997.1	39%	2.3	4%	2.2	4%
Rest of world	1,389.6	54%	31.7	59%	30.9	58%
			1997			
United States	166.5	3%	18.9	24%	22.7	28%
OPEC	2,057.6	42%	8.9	11%	6.9	8%
Rest of world	2,722.7	55%	52.5	65%	51.7	64%
			2017			
United States	322.2	5%	27.3	21%	27.1	20%
OPEC	2,492.8	36%	20.8	16%	17.9	14%
Rest of world	4,107.8	59%	82.6	63%	87.3	66%

Note: Production data are dry gas production. OPEC production and consumption are 2015 data. See Glossary for OPEC countries.

Source:
Energy Information Administration, *International Energy Statistics*, and *International Energy Outlook*, July 2019. (Additional resources: www.eia.doe.gov)

In 2017, the United States and Russia were by far the top natural gas producing countries with more than triple that of any other country. Although the United States produced more than Russia, Russia has almost four times more reserves.

Figure 2.5. Natural Gas Production and Reserves for the Top Ten Natural Gas Producing Countries, 2017



Source:
U.S. Central Intelligence Agency, *The World Factbook*, June 2019. (Additional resources: www.cia.gov/library/publications/the-world-factbook)

The Energy Information Administration no longer publishes national data on alternative use. They do publish fuel use data for four types of alternative fuel vehicle fleets at www.eia.gov/renewable/afv.

Table 2.5
Alternative Fuel and Oxygenate Consumption, 2005–2011
(thousand gasoline–equivalent gallons)

	2005	2006	2007	2008	2009	2010	2011
Alternative fuel							
Liquefied petroleum gas	188,171	173,130	152,360	147,784	129,631	126,354	124,457
Compressed natural gas	166,878	172,011	178,585	189,358	199,513	210,007	220,247
Liquefied natural gas	22,409	23,474	24,594	25,554	25,652	26,072	26,242
E85[a]	38,074	44,041	54,091	62,464	71,213	90,323	137,165
Electricity[b]	5,219	5,104	5,037	5,050	4,956	4,847	7,635
Hydrogen	25	41	66	117	140	152	174
Biodiesel	91,649	267,623	367,764	324,329	334,809	270,170	910,968
Other	2	2	2	2	2	0	0
Subtotal	**512,427**	**685,426**	**782,479**	**754,658**	**756,916**	**727,925**	**1,426,888**
Oxygenates							
MTBE[c]	1,654,500	435,000	0	0	0	0	0
Ethanol in gasohol	2,756,663	3,729,168	4,694,304	6,442,781	7,343,133	8,527,431	8,563,841
Total	**4,923,590**	**4,849,594**	**5,476,783**	**7,197,439**	**8,099,342**	**9,255,356**	**9,990,729**

Note: These are the latest data available from the Energy Information Administration. See text box for additional information.

Source:
U.S. Department of Energy, Energy Information Administration, Alternative Fuel Vehicle Data website, May 2013, www.eia.doe.gov/renewable. (Additional resources: www.eia.doe.gov)

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[a] Consumption includes gasoline portion of the mixture.
[b] Vehicle consumption only; does not include power plant inputs.
[c] Methyl Tertiary Butyl Ether. This category includes a very small amount of other ethers, primarily Tertiary Amyl Methyl Ether (TAME) and Ethyl Tertiary Butyl Ether (ETBE).

Ethanol is an oxygenate blended with gasoline in amounts up to 10% to be used in conventional vehicles and is blended in higher amounts up to 85% for use in flex-fuel vehicles. The production of ethanol grew to over 16 billion gallons in 2018, with consumption reaching over 14 billion gallons. Beginning in 2010, the United States began exporting more fuel ethanol than it imports. Biodiesel is a renewable fuel typically made from vegetable oils or animal fats. It can be burned in standard diesel engines and is often blended with petroleum diesel. In 2018, about 1.9 billion gallons of biodiesel were consumed.

Table 2.6
Fuel Ethanol and Biodiesel Production, Net Imports, and Consumption, 1981–2018
(million gallons)

	Fuel ethanol			Biodiesel		
Year	Production	Net imports	Consumption	Production	Net imports	Consumption
1981	83.1	[a]	83.1	[a]	[a]	[a]
1985	617.1	[a]	617.1	[a]	[a]	[a]
1990	747.7	[a]	747.7	[a]	[a]	[a]
1991	866.3	[a]	866.3	[a]	[a]	[a]
1992	985.0	[a]	985.0	[a]	[a]	[a]
1993	1,154.3	10.2	1,151.0	[a]	[a]	[a]
1994	1,288.9	11.7	1,288.9	[a]	[a]	[a]
1995	1,357.7	16.3	1,382.6	[a]	[a]	[a]
1996	973.5	13.1	991.7	[a]	[a]	[a]
1997	1,288.3	3.6	1,255.8	[a]	[a]	[a]
1998	1,405.0	2.8	1,387.6	[a]	[a]	[a]
1999	1,465.0	3.7	1,442.7	[a]	[a]	[a]
2000	1,622.3	4.9	1,653.4	[a]	[a]	[a]
2001	1,765.2	13.2	1,740.7	8.6	1.7	10.3
2002	2,140.2	12.9	2,073.1	10.5	5.9	16.4
2003	2,804.4	12.3	2,826.0	14.2	(0.7)	13.5
2004	3,404.4	148.8	3,552.2	28.0	(1.1)	26.8
2005	3,904.4	135.8	4,058.6	90.8	0.0	90.8
2006	4,884.3	731.1	5,481.2	250.4	10.5	260.9
2007	6,521.0	439.2	6,885.7	489.8	(136.1)	353.7
2008	9,308.8	529.6	9,683.4	678.1	(374.6)	303.6
2009	10,937.8	198.2	11,036.6	515.8	(194.9)	321.8
2010	13,297.9	(382.8)	12,858.5	343.4	(85.0)	260.1
2011	13,929.1	(1,023.3)	12,893.3	967.5	(38.1)	886.2
2012	13,218.0	(247.4)	12,881.9	990.7	(92.5)	899.0
2013	13,292.7	(242.0)	13,215.6	1,359.5	146.0	1,428.8
2014	14,312.8	(771.6)	13,444.0	1,279.0	109.4	1,416.9
2015	14,807.2	(740.5)	13,946.7	1,263.3	246.9	1,494.2
2016	15,413.2	(1,134.1)	14,356.3	1,567.7	620.8	2,085.4
2017	15,936.3	(1,313.2)	14,485.1	1,595.7	300.1	1,985.3
2018	16,060.8	(1,666.6)	14,382.0	1,831.9	61.3	1,895.9
	Average annual percentage change					
1981-2018	15.3%	[a]	14.9%	[a]	[a]	[a]
2008-2018	5.6%	[a]	4.0%	10.4%	[a]	20.1%

Note: Net imports are total imports minus exports.

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, Washington, DC, March 2019, Table 10.3. (Additional resources: www.eia.doe.gov)

[a] Data are not available.

As data about alternative fuel use become available, an attempt is made to incorporate them into this table. Sometimes assumptions must be made in order to use the data. Please see Appendix A for a description of the methodology used to develop these data. See Table 1.16 for transportation petroleum use in thousand barrels per day.

Table 2.7
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 2017[a]
(trillion Btu)

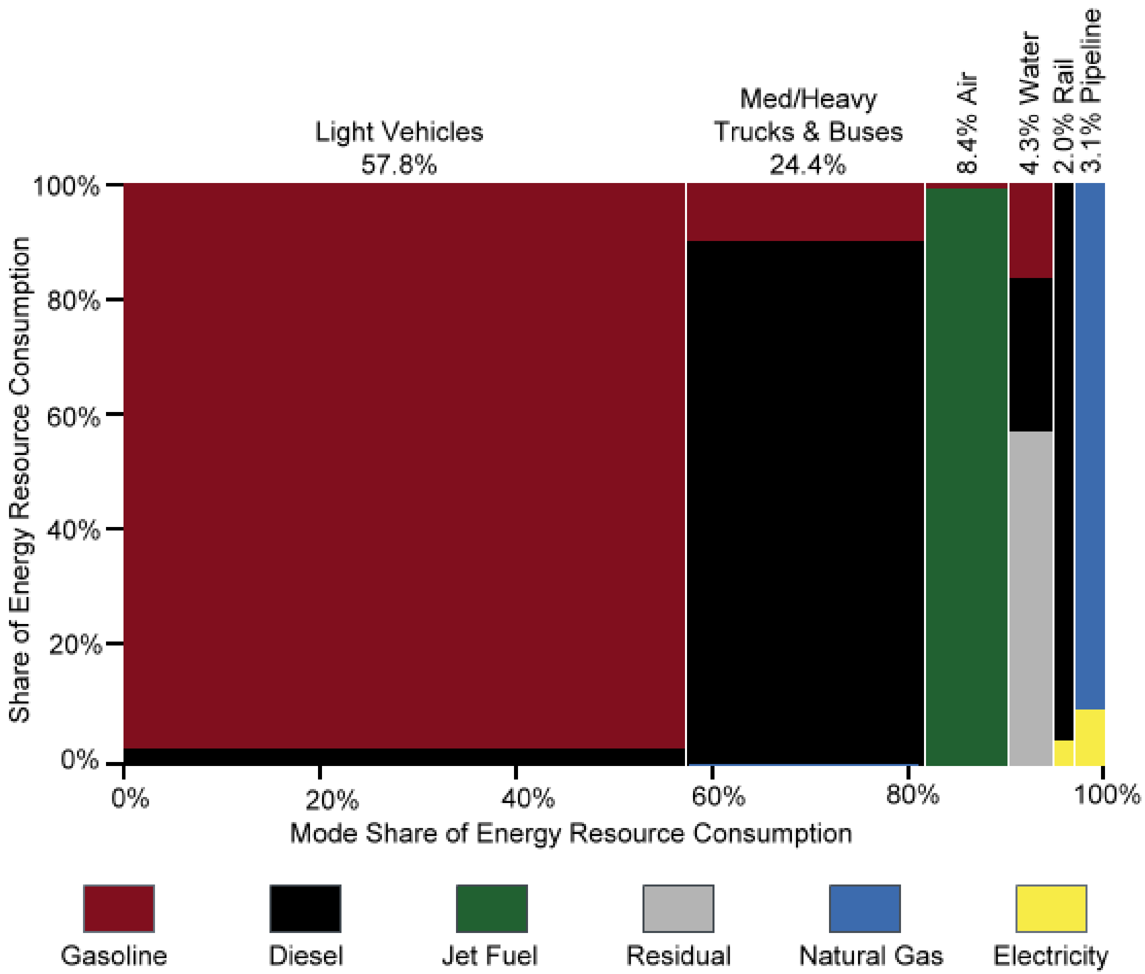
	Gasoline	Diesel fuel	Liquefied petroleum gas	Jet fuel	Residual fuel oil	Natural gas	Electricity[b]	Total[c]
HIGHWAY	**15,495.3**	**6,266.5**	**75.5**	**-**	**-**	**24.6**	**6.8**	**21,868.7**
Light vehicles	**14,853.3**	**445.9**	**53.9**	**-**	**-**	**-**	**6.6**	**15,359.8**
Cars	6,297.2	36.2					5.8	6,339.3
Light trucks[d]	8,498.8	409.6	53.9				0.8	8,963.2
Motorcycles	57.3							57.3
Buses	**9.9**	**185.0**	**0.6**	**-**	**-**	**24.6**	**0.2**	**220.3**
Transit	1.6	64.6	0.6			24.6	0.2	91.6
Intercity		37.3						37.3
School	8.3	83.1						91.4
Medium/heavy trucks	**632.0**	**5,635.6**	**21.0**	**-**	**-**	**-**	**-**	**6,288.6**
Class 3-6 trucks	581.4	789.0	20.8					1,391.2
Class 7-8 trucks	50.6	4,846.6	0.2					4,897.4
NONHIGHWAY	**214.8**	**818.5**	**-**	**2,208.2**	**669.5**	**743.9**	**104.7**	**4,723.2**
Air	**22.6**	**-**	**-**	**2,208.2**	**-**	**-**	**-**	**2,230.8**
General aviation	22.6			209.1				231.7
Domestic air carriers				1,564.3				1,564.3
International air carriers[e]				434.8				434.8
Water	**170.4**	**290.5**	**-**	**-**	**669.5**	**-**	**-**	**1,130.4**
Freight		250.7			669.5			920.2
Recreational	170.4	39.9						210.3
Pipeline	**-**	**-**	**-**	**-**	**-**	**743.9**	**81.1**	**825.0**
Rail	**-**	**513.3**	**-**	**-**	**-**	**-**	**23.6**	**536.9**
Freight (Class I)		490.5						490.5
Passenger		22.8					23.6	46.4
Transit							15.9	15.9
Commuter		14.5					6.1	20.5
Intercity		8.3					1.7	10.0
TOTAL HWY & NONHWY[c]	**15,688.3**	**7,070.4**	**75.5**	**2,208.2**	**669.5**	**768.4**	**111.6**	**26,591.9**

Source:
See Appendix A, Section 2. Energy Use Sources.

[a] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).
[b] Only end-use energy was counted for electricity. See Appendix C for this table with electricity generation and distribution losses included.
[c] Totals may not sum due to rounding.
[d] Two-axle, four-tire trucks.
[e] One half of fuel used by domestic carriers in international operation.

The gasoline and diesel used in highway modes accounted for the majority of transportation energy use (82.1%) and nearly all highway use in 2017.

Figure 2.6. Domestic Consumption of Transportation Energy Use by Mode and Fuel Type, 2017[a]



Note: Residual fuel oil is heavier oil which can be used in vessel bunkering.

Source:
See Table 2.7 or Appendix A, Section 2. Energy Use Sources.

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[a] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles). Only end-use energy was counted for electricity. See Appendix C for this figure with electricity generation and distribution losses included.

Nonhighway modes were responsible for 17.8% of all transportation energy use in 2017. See Table 1.16 for transportation energy use in thousand barrels per day.

Table 2.8
Transportation Energy Use by Mode, 2016–2017[a]

	Trillion Btu		Percentage of total based on Btus	
	2016	2017	2016	2017
HIGHWAY	**21,873.9**	**21,868.7**	**82.6%**	**82.2%**
Light vehicles	**15,525.3**	**15,359.8**	**58.6%**	**57.8%**
Cars	6,577.2	6,339.3	24.8%	23.8%
Light trucks[b]	8,889.8	8,963.2	33.6%	33.7%
Motorcycles	58.2	57.3	0.2%	0.2%
Buses	**206.5**	**220.3**	**0.8%**	**0.8%**
Transit	84.4	91.6	0.3%	0.3%
Intercity	35.4	37.3	0.1%	0.1%
School	86.8	91.4	0.3%	0.3%
Medium/heavy trucks	**6,142.1**	**6,288.6**	**23.2%**	**23.6%**
Class 3-6 trucks	1,358.8	1,391.2	5.1%	5.2%
Class 7-8 trucks	4,783.3	4,897.4	18.1%	18.4%
NONHIGHWAY	**4,613.5**	**4,723.2**	**17.4%**	**17.8%**
Air	**2,178.1**	**2,230.8**	**8.2%**	**8.4%**
General aviation	217.8	231.7	0.8%	0.9%
Domestic air carriers	1,535.4	1,564.3	5.8%	5.9%
International air	424.9	434.8	1.6%	1.6%
Water	**1,115.4**	**1,130.4**	**4.2%**	**4.3%**
Freight	907.1	920.2	3.4%	3.5%
Recreational	208.3	210.3	0.8%	0.8%
Pipeline	**799.8**	**825.0**	**3.0%**	**3.1%**
Rail	**520.2**	**536.9**	**2.0%**	**2.0%**
Freight (Class I)	474.2	490.5	1.8%	1.8%
Passenger	46.0	46.4	0.2%	0.2%
Transit	15.9	15.9	0.1%	0.1%
Commuter	20.0	20.5	0.1%	0.1%
Intercity	10.1	10.0	0.0%	0.0%
HWY & NONHWY TOTAL	**26,487.4**	**26,591.9**	**100.0%**	**100.0%**
Off-highway[c]	**1,895.5**	**1,980.8**		

Source:
See Appendix A, Section 2. Energy Use Sources.

[a] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles). Only end-use energy was counted for electricity. See Appendix C for this table with electricity generation and distribution losses included.

[b] Two-axle, four-tire trucks.

[c] Includes equipment that does not travel on roads, such as equipment from agriculture, construction, and airports.

Light trucks include pick-ups, minivans, sport-utility vehicles, and vans. See Table 1.14 for highway petroleum use in thousand barrels per day.

Table 2.9
Highway Transportation Energy Consumption by Mode, 1970–2017
(trillion Btu)

Year	Cars	Light trucks	Light vehicles subtotal	Motor-cycles	Buses	Class 3-6 trucks	Class 7-8 trucks	Heavy trucks subtotal	Highway subtotal	Total transportation[a]
1970	8,479	1,539	10,018	7	129	333	1,220	1,553	11,707	15,192
1975	9,298	2,384	11,682	14	124	430	1,574	2,003	13,823	17,204
1980	8,800	2,975	11,775	26	143	929	1,757	2,686	14,630	18,760
1981	8,693	2,963	11,656	27	145	1,065	1,659	2,724	14,552	18,558
1982	8,673	2,837	11,510	25	151	1,182	1,525	2,707	14,393	18,055
1983	8,802	2,990	11,792	22	152	1,121	1,649	2,770	14,736	18,188
1984	8,837	3,197	12,034	22	146	1,072	1,801	2,873	15,075	18,773
1985	8,932	3,413	12,345	23	153	986	1,897	2,883	15,404	19,017
1986	9,138	3,629	12,767	23	160	920	2,038	2,958	15,908	20,086
1987	9,157	3,819	12,976	24	164	858	2,203	3,061	16,225	20,578
1988	9,158	4,078	13,236	25	169	860	2,257	3,118	16,548	21,131
1989	9,232	4,156	13,388	26	169	869	2,330	3,199	16,782	21,487
1990	8,688	4,451	13,139	24	167	891	2,442	3,334	16,664	21,383
1991	8,029	4,774	12,803	23	177	895	2,507	3,402	16,405	20,985
1992	8,169	5,117	13,286	24	184	897	2,570	3,468	16,962	21,646
1993	8,368	5,356	13,724	25	183	906	2,671	3,577	17,509	22,125
1994	8,470	5,515	13,985	26	183	936	2,842	3,778	17,972	22,729
1995	8,489	5,695	14,184	25	184	954	2,983	3,937	18,330	23,263
1996	8,634	5,917	14,551	24	186	958	3,088	4,045	18,806	23,773
1997	8,710	6,169	14,879	25	192	945	3,141	4,086	19,182	24,126
1998	8,936	6,303	15,239	26	196	967	3,251	4,218	19,679	24,461
1999	9,134	6,602	15,736	26	203	1,054	3,584	4,638	20,603	25,760
2000	9,100	6,607	15,707	26	209	1,085	3,734	4,819	20,761	26,071
2001	9,161	6,678	15,839	24	196	1,074	3,738	4,813	20,872	25,741
2002	9,391	6,883	16,274	24	192	1,114	3,921	5,035	21,525	26,329
2003	9,255	7,551	16,806	24	190	1,083	3,812	4,895	21,915	26,509
2004	9,331	7,861	17,192	25	194	1,003	3,532	4,535	21,946	26,965
2005	9,579	7,296	16,875	24	196	1,126	3,963	5,088	22,183	27,373
2006	9,316	7,550	16,866	28	199	1,149	4,045	5,193 [b]	22,286	27,546
2007	9,221	7,679	16,900	59	195	1,429	5,031	6,460	23,615	29,004
2008	8,831	7,572	16,404	61	200	1,444	5,083	6,527	23,192	28,365
2009	8,209	7,635	15,843	60	200	1,341	4,720	6,061	22,165	26,878
2010	7,657	7,971	15,628	53	190	1,363	4,797	6,160	22,032	26,949
2011	7,336	8,104	15,440	53	195	1,283	4,517	5,801	21,489	26,357
2012	7,121	8,180	15,300	61	200	1,282	4,512	5,794	21,356	25,966
2013	7,047	8,077	15,124	58	204	1,310	4,613	5,924	21,310	25,868
2014	6,951	8,506	15,454	57	206	1,332	4,689	6,022	21,742	25,949
2015	6,716	8,654	15,370	56	210	1,324	4,660	5,984	21,619	26,084
2016	6,577	8,890	15,467	58	214	1,359	4,783	6,142	21,881	26,485
2017	6,339	8,963	15,302	57	220	1,391	4,897	6,289	21,869	26,592
						Average annual percentage change				
1970-2017	-0.6%	3.8%	0.9%	4.6%	1.1%	3.1%	3.0%	3.0%	1.3%	1.2%
2007-2017	-3.7%	1.6%	-1.0%	-0.4%	1.3%	-0.3%	-0.3%	-0.3%	-0.8%	-0.9%

Note: Totals may not add due to rounding.

Source:
See Appendix A, Section 2.1 Highway Energy Use.

[a] Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g., snowmobiles). Only end-use energy was counted for electricity. See Appendix C for this table with electricity generation and distribution losses included.

[b] Due to changes in the FHWA fuel use methodology, motorcycle, bus, and heavy truck data are not comparable with data before the year 2007. Car and light truck data changed after 2008; see Appendix A for car/light truck shares.

About 18% of transportation energy use is for nonhighway modes. Air travel accounts for 47% of nonhighway energy use. See Table 1.15 for nonhighway petroleum use in thousand barrels per day.

Table 2.10
Nonhighway Transportation Energy Consumption by Mode, 1970–2017
(trillion Btu)

Year	Air	Water	Pipeline	Rail	Nonhighway subtotal	Total transportation[a]
1970	1,287	836	826	537	3,486	15,192
1975	1,234	927	680	540	3,381	17,204
1980	1,434	1,393	734	570	4,130	18,760
1985	1,677	871	597	468	3,613	19,017
1986	1,823	1,323	578	454	4,178	20,086
1987	1,899	1,378	613	464	4,354	20,578
1988	1,978	1,417	712	476	4,583	21,131
1989	1,981	1,516	729	478	4,705	21,487
1990	2,046	1,442	760	471	4,719	21,383
1991	1,916	1,523	699	442	4,580	20,985
1992	1,945	1,599	685	455	4,684	21,646
1993	1,986	1,437	723	469	4,615	22,125
1994	2,075	1,394	787	502	4,758	22,729
1995	2,141	1,468	803	523	4,935	23,263
1996	2,206	1,411	814	536	4,967	23,773
1997	2,300	1,250	856	537	4,943	24,126
1998	2,275	1,232	735	540	4,782	24,461
1999	2,483	1,370	745	560	5,156	25,760
2000	2,554	1,455	742	559	5,309	26,071
2001	2,397	1,187	724	561	4,869	25,741
2002	2,229	1,246	768	563	4,807	26,329
2003	2,260	1,071	689	575	4,597	26,509
2004	2,456	1,293	662	607	5,024	26,965
2005	2,532	1,363	681	613	5,194	27,373
2006	2,511	1,442	681	626	5,269	27,546
2007	2,509	1,550	720	610	5,399	29,004
2008	2,396	1,444	748	586	5,190	28,365
2009	2,127	1,323	771	492	4,731	26,878
2010	2,149	1,460	775	533	4,942	26,949
2011	2,157	1,362	790	560	4,900	26,357
2012	2,077	1,148	835	549	4,644	25,966
2013	2,037	1,017	942	562	4,596	25,868
2014	2,060	876	803	587	4,367	25,949
2015	2,118	1,005	780	563	4,505	26,084
2016	2,178	1,116	789	520	4,642	26,485
2017	2,231	1,130	825	537	4,760	26,592
			Average annual percentage change			
1970-2017	1.2%	0.7%	0.0%	0.0%	0.7%	1.2%
2007-2017	-1.2%	-2.9%	1.4%	-1.3%	-1.3%	-0.9%

Note: Totals may not add due to rounding.

Source:
See Appendix A, Section 2.3 Nonhighway Energy Use.

[a] Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g., snowmobiles). Only end-use energy was counted for electricity. See Appendix C for this table with electricity generation and distribution losses included.

The Environmental Protection Agency's MOVES model estimates fuel use for different types of nonroad equipment and off-highway vehicles. MOVES nonroad base data were updated in model 2014b. Most of these vehicles/ equipment use diesel fuel. Recreational equipment, such as off-highway motorcycles, snowmobiles, and all-terrain vehicles, are mainly fueled by gasoline.

Table 2.11
Off-Highway Transportation-Related Fuel Consumption, 2017
(trillion Btu)

	Gasoline	Diesel	LPG	CNG	Total
Agricultural equipment *Tractors, mowers, combines, balers, and other farm equipment which has utility in its movement.*	8.3	525.0	0.0	1.5	534.8
Airport ground equipment	0.3	9.6	0.2	[a]	10.1
Construction and mining equipment *Pavers, rollers, drill rigs, graders, backhoes, excavators, cranes, mining equipment*	20.1	841.3	2.3	0.0	863.7
Industrial equipment *Forklifts, terminal tractors, sweeper/scrubbers*	27.9	190.4	211.0	15.6	445.0
Logging equipment *Feller/buncher/skidder*	1.1	18.4	[a]	[a]	19.5
Railroad maintenance equipment	0.2	3.1	-	[a]	3.3
Recreational equipment *Off-road motorcycles, snowmobiles, all-terrain vehicles, golf carts, specialty vehicles*	103.2	1.2	0.1	[a]	104.5
Total	161.0	1,589.0	213.6	17.1	1,980.8

Source:
Environmental Protection Agency, MOVES2014b model, www.epa.gov/otaq/models/moves.

[a] There is no equipment listed for this fuel type.

The Federal Highway Administration (FHWA) cautions that data from 1993 on may not be directly comparable to earlier years. Some states have improved reporting procedures in recent years, and the estimation procedures were revised in 1994. The FHWA no longer publishes separate estimates of gasohol or ethanol used in gasohol.

Table 2.12
Highway Usage of Gasoline and Diesel, 1973–2017
(billion gallons)

Year	Total gasoline and gasohol	Diesel[a]	Percent diesel	Total highway fuel use
1973	100.6	9.8	8.9%	110.5
1975	99.4	9.6	8.8%	109.0
1980	101.2	13.8	12.0%	115.0
1985	103.6	17.8	14.6%	121.3
1986	106.8	18.4	14.7%	125.2
1987	108.7	19.0	14.9%	127.7
1988	109.8	20.1	15.5%	129.9
1989	110.6	21.2	16.1%	131.9
1990	110.2	21.4	16.3%	131.6
1991	107.9	20.7	16.1%	128.6
1992	111.0	22.0	16.5%	132.9
1993	113.7	23.5	17.1%	137.2
1994	115.0	25.1	17.9%	140.1
1995	117.1	26.2	18.3%	143.3
1996	119.5	27.2	18.5%	146.7
1997	120.9	29.4	19.6%	150.3
1998	124.7	30.2	19.5%	154.9
1999	128.7	31.9	19.9%	160.7
2000	128.9	33.4	20.6%	162.3
2001	129.7	33.4	20.5%	163.1
2002	133.0	34.8	20.7%	167.8
2003	134.1	35.5	20.9%	169.6
2004	136.5	37.4	21.5%	173.9
2005	135.2	39.1	22.4%	174.3
2006	134.8	40.1	22.9%	174.9
2007	135.4	40.7	23.1%	176.1
2008	132.2	38.6	22.6%	170.8
2009	132.9	35.3	21.0%	168.1
2010	133.1	36.6	21.6%	169.7
2011	131.5	37.1	22.0%	168.6
2012	130.9	37.4	22.2%	168.3
2013	131.3	38.4	22.6%	169.7
2014	136.5	39.7	22.5%	176.2
2015	132.2	40.5	23.5%	172.9
2016	136.3	41.6	23.4%	177.9
2017	135.3	42.7	24.0%	177.9
		Average annual percentage change		
1973–2017	0.7%	3.4%		1.1%
2007–2017	0.0%	0.5%		0.1%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2017*, Washington, DC, 2019, Table MF-27 and annual. (Additional resources: www.fhwa.dot.gov)

[a] Consists primarily of diesel fuel, with small quantities of other fuels, such as liquefied petroleum gas and E85.

Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences among the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes. These values are averages, and there is a great deal of variability even within a mode.

Table 2.13
Passenger Travel and Energy Use, 2017[a]

	Number of vehicles (thousands)	Vehicle-miles (millions)	Passenger-miles (millions)	Load factor (persons/vehicle)	Energy intensities		Energy use (trillion Btu)
					(Btu per vehicle-mile)	(Btu per passenger-mile)	
Cars	111,177.0	1,424,302	2,195,206	1.5	4,451	2,888	6,339.3
Personal trucks	121,202.8	1,214,523	2,210,432	1.8	6,067	3,334	7,368.6
Motorcycles	8,715.2	20,149	23,978	1.2	2,844	2,390	57.3
Demand response[b]	69.4	1,705	2,031	1.2	15,619	13,109	26.6
Buses	[c]	[c]	[c]	[c]	[c]	[c]	213.8
Transit	72.9	2,513	20,209	8.0	36,468	4,535	91.6
Intercity[d]	[c]	[c]	[c]	[c]	[c]	[c]	35.4
School[d]	702.3	[c]	[c]	[c]	[c]	[c]	86.8
Air	[c]	[c]	[c]	[c]	[c]	[c]	1,872.2
Certificated route[e]	[c]	5,848	685,977	117.3	280,416	2,391	1,640.0
General aviation	211.8	[c]	[c]	[c]	[c]	[c]	232.2
Recreational boats	12,396.7	[c]	[c]	[c]	[c]	[c]	210.3
Rail	20.6	1,518	39,116	25.8	30,578	1,187	46.4
Intercity (Amtrak)	0.4	316	6,563	20.8	31,644	1,524	10.0
Transit	12.8	823.6	20,169	24.5	19,297	788	15.9
Commuter	7.3	378	12,384	32.7	54,251	1,657	20.5

Source:
See Appendix A, Section 3. Passenger Travel and Energy Use.

[a] Only end-use energy was counted for electricity. See Appendix C for this table with electricity generation and distribution losses included.

[b] Demand response data are for 2015. Includes passenger cars, vans, and small buses operating in response to calls from passengers to the transit operator who dispatches the vehicles.

[c] Data are not available.

[d] Energy use is estimated.

[e] Only domestic service and domestic energy use are shown on this table. These energy intensities may be inflated because all energy use is attributed to passengers–cargo energy use is not taken into account.

Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences among the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes. These values are averages, and there is a great deal of variability even within a mode.

Table 2.14
Energy Intensities of Highway Passenger Modes, 1970–2017

	Cars		Light trucks[b]		Transit Buses[c]	
Year	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per vehicle-mile)	(Btu per passenger-mile)
1970	9,250	4,868	12,479	6,568	31,796	2,472
1975	8,993	4,733	11,879	6,496	33,748	2,814
1980	7,916	4,279	10,224	5,548	36,553	2,813
1985	7,164	4,110	8,730	4,737	38,876	3,423
1986	7,194	4,197	8,560	4,718	37,889	3,545
1987	6,959	4,128	8,359	4,681	36,247	3,594
1988	6,683	4,033	8,119	4,621	36,673	3,706
1989	6,589	4,046	7,746	4,481	36,754	3,732
1990	6,169	3,856	7,746	4,557	37,374	3,794
1991	5,912	3,695	7,351	4,376	37,732	3,877
1992	5,956	3,723	7,239	4,361	40,243	4,310
1993	6,087	3,804	7,182	4,379	39,043	4,262
1994	6,024	3,765	7,212	4,452	36,932	4,225
1995	5,902	3,689	7,208	4,505	36,936	4,271
1996	5,874	3,683	7,247	4,473	37,238	4,315
1997	5,797	3,646	7,251	4,421	38,622	4,407
1998	5,767	3,638	7,260	4,373	41,062	4,374
1999	5,821	3,684	7,327	4,361	40,351	4,320
2000	5,687	3,611	7,158	4,211	41,466	4,506
2001	5,626	3,583	7,080	4,116	38,320	4,123
2002	5,662	3,612	7,125	4,101	37,340	4,110
2003	5,535	3,537	7,673	4,374	36,900	4,191
2004	5,489	3,513	7,653	4,320	37,665	4,342
2005	5,607	3,594	7,009	3,919	37,244	4,229
2006	5,511	3,538	6,974	3,862	39,397	4,297
2007	5,513	3,546	6,904	3,787	39,748	4,352
2008	5,466	3,520	6,830	3,712	39,726	4,328
2009	5,239	3,380	7,159	3,895	39,073	4,233
2010	5,117	3,304	6,919	3,769	35,858	4,107
2011	5,032	3,252	6,795	3,706	37,648	4,232
2012	4,950	3,201	6,675	3,645	37,037	4,023
2013	4,874	3,155	6,557	3,585	37,273	4,052
2014	4,797	3,107	6,631	3,630	35,237	3,810
2015	4,646	3,012	6,486	3,555	36,322	4,059
2016	4,526	2,936	6,366	3,494	36,826	4,283
2017	4,451	2,890	6,168	3,389	36,468	4,535
			Average annual percentage change			
1970-2017	-1.5%	-1.1%	-1.5%	-1.4%	0.3%	1.3%
2007-2017	-2.1%	-2.0%	-1.1%	-1.1%	-0.9%	0.4%

Source:
See Appendix A, Section 4. Highway Passenger Mode Energy Intensities.

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[a] Only end-use energy was counted for electricity. See Appendix C for this table with electricity generation and distribution losses included.

[b] All two-axle, four-tire trucks.

[c] Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transportation Association (APTA).

Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences between the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes.

Table 2.15
Energy Intensities of Nonhighway Passenger Modes, 1970–2017[a]

Year	Air: Certificated air carriers[b] (Btu per passenger-mile)	Rail: Intercity Amtrak (Btu per passenger-mile)	Rail: Rail transit (Btu per passenger-mile)	Rail: Commuter rail (Btu per passenger-mile)
1970	10,115	[c]	712	[c]
1975	7,625	3,311	866	[c]
1980	5,561	2,859	763	[c]
1981	5,774	2,414	855	[c]
1982	5,412	2,551	891	[c]
1983	5,133	2,359	931	[c]
1984	5,298	2,417	1,002	1,798
1985	5,053	2,237	927	1,720
1986	5,011	2,037	1,004	1,720
1987	4,827	1,989	1,003	1,628
1988	4,861	1,967	1,014	1,666
1989	4,844	2,082	960	1,622
1990	4,797	2,052	998	1,622
1991	4,602	2,011	1,074	1,601
1992	4,455	2,117	1,041	1,565
1993	4,490	2,142	1,113	1,782
1994	4,407	1,917	1,102	1,605
1995	4,349	2,071	1,102	1,580
1996	4,199	2,194	996	1,541
1997	4,173	2,289	943	1,630
1998	3,987	2,246	931	1,612
1999	4,108	2,362	919	1,670
2000	3,960	2,651	923	1,542
2001	3,943	2,690	925	1,533
2002	3,718	2,537	948	1,542
2003	3,614	2,145	936	1,542
2004	3,505	2,068	907	1,536
2005	3,346	2,025	919	1,658
2006	3,250	1,948	893	1,539
2007	3,153	1,824	851	1,543
2008	3,055	1,745	832	1,579
2009	2,901	1,773	830	1,714
2010	2,825	1,668	832	1,753
2011	2,772	1,628	812	1,681
2012	2,633	1,561	791	1,703
2013	2,568	1,608	793	1,676
2014	2,506	1,629	786	1,638
2015	2,477	1,589	777	1,661
2016	2,449	1,551	761	1,705
2017	2,415	1,524	788	1,657
		Average annual percentage change[d]		
1970-2017	-3.0%	-1.8%	0.2%	-0.2%
2007-2017	-2.6%	-1.8%	-0.8%	0.7%

Source:
See Appendix A, Section 5. Nonhighway Passenger Mode Energy Intensities.

[a] Only end-use energy was counted for electricity. See Appendix C for this table with electricity generation and distribution losses included.

[b] These data differ from the data on Table 2.13 because they include half of international services. These energy intensities may be inflated because all energy use is attributed to passengers–cargo energy use is not taken into account.

[c] Data are not available.

[d] Average annual percentage calculated to earliest year possible.

Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences between the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes.

Table 2.15
Energy Intensities of Nonhighway Passenger Modes, 1970–2017[a]

	Air	Rail		
Year	Certificated air carriers[b] (Btu per passenger-mile)	Intercity Amtrak (Btu per passenger-mile)	Rail transit (Btu per passenger-mile)	Commuter rail (Btu per passenger-mile)
1970	10,115	c	712	c
1975	7,625	3,311	866	c
1980	5,561	2,859	763	c
1981	5,774	2,414	855	c
1982	5,412	2,551	891	c
1983	5,133	2,359	931	c
1984	5,298	2,417	1,002	1,798
1985	5,053	2,237	927	1,720
1986	5,011	2,037	1,004	1,720
1987	4,827	1,989	1,003	1,628
1988	4,861	1,967	1,014	1,666
1989	4,844	2,082	960	1,622
1990	4,797	2,052	998	1,622
1991	4,602	2,011	1,074	1,601
1992	4,455	2,117	1,041	1,565
1993	4,490	2,142	1,113	1,782
1994	4,407	1,917	1,102	1,605
1995	4,349	2,071	1,102	1,580
1996	4,199	2,194	996	1,541
1997	4,173	2,289	943	1,630
1998	3,987	2,246	931	1,612
1999	4,108	2,362	919	1,670
2000	3,960	2,651	923	1,542
2001	3,943	2,690	925	1,533
2002	3,718	2,537	948	1,542
2003	3,614	2,145	936	1,542
2004	3,505	2,068	907	1,536
2005	3,346	2,025	919	1,658
2006	3,250	1,948	893	1,539
2007	3,153	1,824	851	1,543
2008	3,055	1,745	832	1,579
2009	2,901	1,773	830	1,714
2010	2,825	1,668	832	1,753
2011	2,772	1,628	812	1,681
2012	2,633	1,561	791	1,703
2013	2,568	1,608	793	1,676
2014	2,506	1,629	786	1,638
2015	2,477	1,589	777	1,661
2016	2,449	1,551	761	1,705
2017	2,415	1,524	788	1,657
		Average annual percentage change[d]		
1970-2017	-3.0%	-1.8%	0.2%	-0.2%
2007-2017	-2.6%	-1.8%	-0.8%	0.7%

Source:
See Appendix A, Section 5. Nonhighway Passenger Mode Energy Intensities.

[a] Only end-use energy was counted for electricity. See Appendix C for this table with electricity generation and distribution losses included.

[b] These data differ from the data on Table 2.13 because they include half of international services. These energy intensities may be inflated because all energy use is attributed to passengers–cargo energy use is not taken into account.

[c] Data are not available.

[d] Average annual percentage calculated to earliest year possible.

Chapter 3
All Highway Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 3.2	U.S. share of world car registrations, 2017	12.2%
Table 3.3	U.S. share of world truck & bus registrations, 2017	42.7%
Table 3.4	Number of U.S. cars, 2017 (thousands)	111,177
Table 3.4	Number of U.S. trucks, 2017 (thousands)	149,301
Table 3.8	Vehicle miles traveled, 2017 (million miles)	3,212,347
	Cars	*44.3%*
	Two-axle, four-tire trucks	*45.2%*
	Combination trucks	*5.6%*
	Other single-unit trucks	*3.6%*
	Motorcycles	*0.6%*
	Buses	*0.5%*
Table 3.11	Average age of vehicles, 2018	
	Cars (years)	*11.9*
	Light trucks (years)	*11.7*
	All light vehicles (years)	*11.8*

The top countries producing the world's cars and trucks have changed over the last 17 years. In 2017, China was the largest producer of cars and trucks. In 2000, Japan produced the most cars and the United States produced the most trucks (includes light trucks).

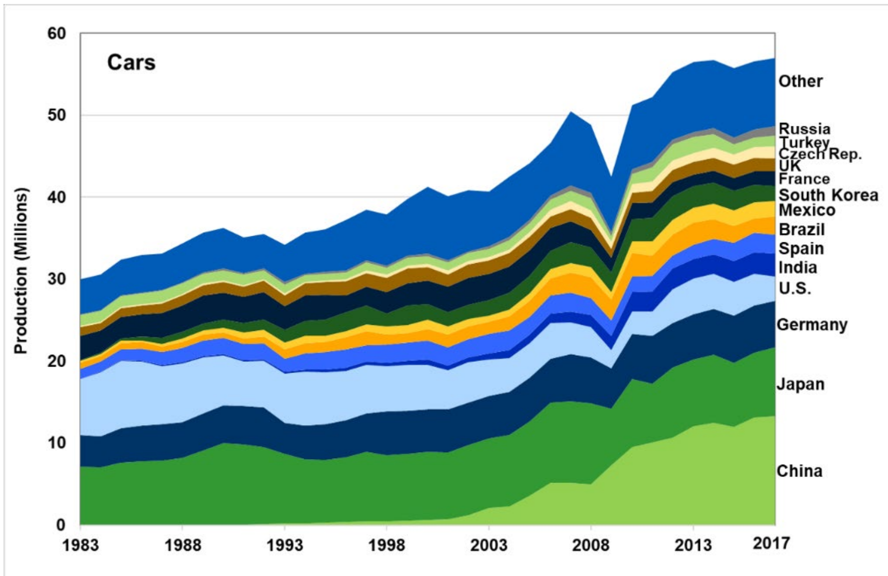
Table 3.1
World Production of Cars and Trucks, 2000 and 2017
(thousands)

Cars	2000	2017	Percent change 2000-2017
China	605	13,333	2105%
Japan	8,363	8,348	0%
Germany	5,132	5,646	10%
U.S.	5,542	3,033	-45%
India	605	2,751	355%
Spain	2,366	2,291	-3%
Brazil	1,362	2,271	67%
Mexico	1,130	1,900	68%
South Korea	1,881	1,810	-4%
France	2,880	1,748	-39%
UK	1,641	1,626	-1%
Czech Republic	428	1,414	230%
Russia	969	1,348	39%
Turkey	297	1,121	277%
All Other Countries	8,026	8,373	4%
Total World	41,229	57,012	38%
Trucks[a]	**2000**	**2017**	**Percent change 2000-2017**
China	1,464	15,683	971%
U.S.	7,263	8,157	12%
South Korea	513	2,305	349%
Mexico	792	2,169	174%
India	283	2,032	617%
Canada	1,411	1,443	2%
Japan	1,781	1,342	-25%
Thailand	315	1,170	271%
All Other Countries	3,893	6,030	55%
Total World	17,717	39,161	121%

Source:
Ward's Communications, www.wardsauto.com.

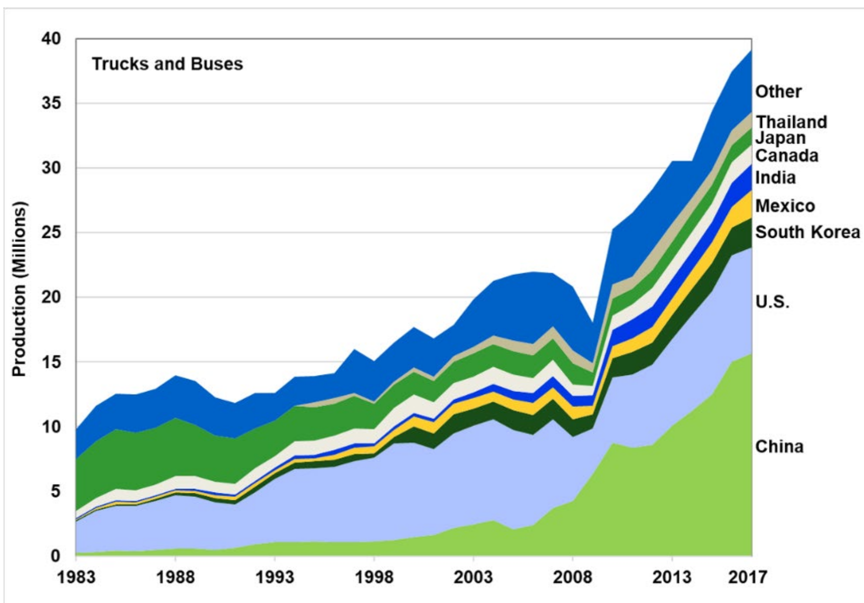
[a] Includes light trucks, heavy trucks, and buses.

Figure 3.1. World Car Production, 1983–2017[a]



Source:
See Table 3.1.

Figure 3.2. World Truck and Bus Production, 1983–2017[a]



Source:
See Table 3.1.

[a] The sharp decrease in 2009 coincides with the recession. Note that the scales of the two figures differ.

Use caution comparing historical data because of disconnects in data series and definitional differences among countries. The United States uses light trucks (SUVs, minivans, pickups) for personal travel which are not counted as cars in this table. China's light trucks were not counted in this table until 2014, when a reclassification of vehicle types added them as cars. The U.S. share of world cars continues to decline. The growth in the World total comes mainly from developing countries, like China, Indonesia, India, and South Korea.

Table 3.2
Car Registrations for Selected Countries, 1960–2017
(thousands)

Country	1960	1970	1980	1990	2000	2005	2010	2015	2017	Average annual percentage change 1990-2017
Argentina	474	1,482	3,112	4,284	5,060	5,340	7,605	10,403	10,690	3.4%
Brazil	[a]	[a]	[a]	12,127	15,393	18,370	25,541	35,471	36,190	4.1%
Canada[b]	4,104	6,602	10,256	12,622	16,832	18,124	20,121	22,068	22,678	2.2%
China[c]	[a]	[a]	351	1,897	3,750	8,900	34,430	146,800	184,644	18.5%
France	4,950	11,860	18,440	23,550	28,060	30,100	31,300	32,000	32,614	1.2%
Germany[d]	4,856	14,376	23,236	35,512	43,772	46,090	42,302	45,071	46,475	1.0%
India	[a]	[a]	[a]	2,300	5,150	7,654	13,300	28,836	35,890	10.7%
Indonesia	[a]	[a]	[a]	1,200	[a]	3,850	8,891	13,846	14,160	9.6%
Japan	457	8,779	23,660	34,924	52,437	57,091	58,347	60,987	61,803	2.1%
Malaysia	[a]	[a]	[a]	1,811	4,213	6,402	9,115	11,279	12,900	7.5%
Pakistan	[a]	[a]	[a]	738	375	411	1,726	2,807	3,020	5.4%
Russia	[a]	[a]	[a]	[a]	20,353	25,285	34,350	41,000	46,747	5.0%
South Korea	[a]	[a]	[a]	2,075	8,084	11,122	13,632	16,562	18,035	8.3%
United Kingdom	5,650	11,802	15,438	22,528	27,185	30,652	31,258	33,542	34,686	1.6%
United States	61,671	89,244	121,601	143,550	127,721	132,909	129,053	122,322	124,141	-0.5%
U.S. percentage of world	62.7%	46.1%	38.0%	32.3%	23.3%	21.5%	17.8%	13.1%	12.2%	
World total	98,305	193,479	320,390	444,900	548,558	617,914	723,567	931,260	1,015,643	3.1%

Source:
Ward's Communications, www.wardsauto.com.

[a] Data are not available.
[b] Data from 2000 and later are not comparable to prior data. Canada reclassified autos and trucks prior to 2000.
[c] Light trucks were reclassified into the car category in 2014.
[d] Data for 1990 and prior include West Germany only. Kraftwagen are included with automobiles.
[e] Data for earliest year available.

Use caution comparing historical data because of disconnects in data series and definitional differences among countries. The United States totals include SUVs, minivans, and light trucks, many of which are used for personal travel. Thus, countries that only use trucks for freight movement will not be comparable to the United States. China's light trucks were included in this table until a reclassification in 2014.

Table 3.3
Truck and Bus Registrations for Selected Countries, 1960–2017
(thousands)

Country	1960	1970	1980	1990	2000	2005	2010	2015	2017	Average annual percentage change 1990-2017
Argentina	392	788	1,217	1,501	1,554	1,730	2,511	3,305	3,419	3.1%
Brazil	[a]	[a]	[a]	936	3,917	4,653	6,524	7,272	7,408	8.0%
Canada[b]	1,056	1,481	2,955	3,931	739	786	933	1,147	1,168	-4.4%
China[c]	[a]	[a]	1,480	4,314	9,650	21,750	43,590	25,200	30,956	7.6%
France	1,650	1,850	2,550	4,910	5,733	6,198	6,444	6,652	6,770	1.2%
Germany[d]	786	1,228	1,617	2,764	3,534	3,133	2,960	3,356	3,618	1.0%
India	[a]	[a]	[a]	2,050	2,390	4,145	9,500	15,675	10,630	6.3%
Indonesia	[a]	[a]	[a]	1,391	2,373	2,950	6,938	9,238	9,458	7.4%
Japan	896	8,803	14,197	22,773	20,211	16,734	15,512	14,503	14,555	-1.6%
Malaysia	[a]	[a]	[a]	616	1,030	1,323	1,138	1,335	1,475	3.3%
Pakistan	[a]	[a]	[a]	172	385	414	538	678	714	5.4%
Russia	[a]	[a]	[a]	7,200	5,041	5,705	6,304	8,000	6,214	-0.5%
South Korea	[a]	[a]	[a]	1,320	3,956	4,275	4,310	4,428	4,494	4.6%
United Kingdom	1,534	1,769	1,920	3,774	3,361	3,943	4,220	4,677	4,989	1.0%
United States	12,186	19,175	34,195	45,106	85,579	104,788	119,179	141,872	151,878	4.6%
U.S. percentage of world	42.6%	36.2%	37.7%	32.7%	42.1%	42.6%	38.5%	42.7%	42.7%	
World total	28,583	52,899	90,592	138,082	203,272	245,798	309,395	332,434	356,044	3.6%

Source:
Ward's Communications, www.wardsauto.com.

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[a] Data are not available.
[b] Data from 2000 and later are not comparable to prior data. Canada reclassified autos and trucks prior to 2000.
[c] Light trucks were reclassified into the car category in 2014.
[d] Data for 1990 and prior include West Germany only. Kraftwagen are included with automobiles.

VEHICLES IN USE

Both the Federal Highway Administration (FHWA) and IHS Automotive report figures on the car and truck population each year. The two estimates, however, differ by as much as 11.2% (1981). The differences can be attributed to several factors:

- The FHWA data include all vehicles which have been registered at any time throughout the calendar year. Therefore, the data include vehicles which were retired during the year and may double count vehicles which have been registered in different states or the same states to different owners. IHS Automotive data include only those vehicles which are registered on July 1 of the given year and would not include vehicles registered after that date.
- The classification of mini-vans, station wagons on truck chassis, and utility vehicles as cars or trucks causes important differences in the two estimates. IHS Automotive data included passenger vans in the car count until 1980; since 1980 all vans have been counted as trucks.
- Starting in 1993, the FHWA reclassified some minivans and sport utility vehicles into the truck category which were previously included with cars. This change produced a dramatic change in the individual percentage differences of cars and trucks. The difference in total vehicles has been less than 5% each year since 1990 and does not appear to be significantly affected by the FHWA reclassifications. Beginning with 2009, the FHWA discontinued the car/2-axle, 4-tire truck designations on Table VM-1. The data since 2009 come from Tables MV-1 and MV-9.
- The FHWA data include all non-military Federal vehicles, while IHS Automotive data include only those Federal vehicles which are registered within a state. Federal vehicles are not required to have State registrations, and, according to the General Services Administration, most Federal vehicles are not registered.
- In 2012 both IHS Automotive and FHWA changed their methodologies for the car/light truck split which created a significant decrease in the number of cars reported and a corresponding increase in the number of light trucks.

In the early 1980's, researchers had to make a conscious choice of which data series to use, since they differed by as much as 11%. In 2005 the two sources differed by less than 1%. Both sources changed their methodologies for the car/light truck split causing significant decreases to the number of cars in 2012.

Table 3.4
U.S. Cars and Trucks in Use, 1970–2017
(thousands)

	Cars			Trucks			Total		
Year	FHWA	IHS Automotive	Percentage difference	FHWA	IHS Automotive	Percentage difference	FHWA	IHS Automotive	Percentage difference
1970	89,243	80,448	10.9%	18,797	17,688	6.3%	108,040	98,136	10.1%
1975	106,706	95,241	12.0%	25,781	24,813	3.9%	132,487	120,054	10.4%
1980	121,601	104,564	16.3%	33,667	35,268	-4.5%	155,267	139,832	11.0%
1985	127,885	114,662	11.5%	43,210	42,387	1.9%	171,095	157,049	8.9%
1986	130,004	117,268	10.9%	45,103	44,826	0.6%	175,106	162,094	8.0%
1987	131,482	119,849	9.7%	46,826	47,344	-1.1%	178,308	167,193	6.6%
1988	133,836	121,519	10.1%	49,941	50,221	-0.6%	183,777	171,740	7.0%
1989	134,559	122,758	9.6%	52,172	53,202	-1.9%	186,731	175,960	6.1%
1990	133,700	123,276	8.5%	54,470	56,023	-2.8%	188,171	179,299	4.9%
1991	128,300	123,268	4.1%	59,206	58,179	1.8%	187,505	181,447	3.3%
1992	126,581	120,347	5.2%	63,136	61,172	3.2%	189,717	181,519	4.5%
1993	127,327	121,055	5.2%	66,082	65,260	1.3%	193,409	186,315	3.8%
1994	127,883	121,997	4.8%	69,491	66,717	4.2%	197,375	188,714	4.6%
1995	128,387	123,242	4.2%	72,458	70,199	3.2%	200,845	193,441	3.8%
1996	129,728	124,613	4.1%	75,940	73,681	3.1%	205,669	198,294	3.7%
1997	129,749	124,673	4.1%	77,307	76,398	1.2%	207,056	201,071	3.0%
1998	131,839	125,966	4.7%	79,062	79,077	0.0%	210,901	205,043	2.9%
1999	132,432	126,869	4.4%	83,148	82,640	0.6%	215,580	209,509	2.9%
2000	133,621	127,721	4.6%	87,108	85,579	1.8%	220,729	213,300	3.5%
2001	137,633	128,714	6.9%	92,045	87,969	4.6%	229,678	216,683	6.0%
2002	135,921	129,907	4.6%	92,939	91,120	2.0%	228,860	221,027	3.5%
2003	135,670	131,072	3.5%	94,944	94,810	0.1%	230,614	225,882	2.1%
2004	136,431	132,469	3.0%	100,016	99,698	0.3%	236,447	232,167	1.8%
2005	136,568	132,909	2.8%	103,819	105,475	-1.6%	240,387	238,384	0.8%
2006	135,400	135,047	0.3%	107,944	109,596	-1.5%	243,344	244,643	-0.5%
2007	135,933	135,222	0.5%	110,498	113,479	-2.6%	246,431	248,701	-0.9%
2008	137,080	135,882	0.9%	110,242	113,931	-3.2%	247,322	249,813	-1.0%
2009	134,880	132,500	1.8%	110,561	116,472	-5.1%	245,441	248,972	-1.4%
2010	130,892	129,053	1.4%	110,322	119,179	-7.4%	241,214	248,232	-2.8%
2011	125,657	127,577	-1.5%	118,483	121,355	-2.4%	244,140	248,932	-1.9%
2012	111,290	120,902	-8.0%	133,130	130,595	1.9%	244,420	251,497	-2.8%
2013	113,676	120,214	-5.4%	132,931	132,501	0.3%	246,607	252,715	-2.4%
2014	113,899	120,984	-5.9%	137,531	137,043	0.4%	251,430	258,027	-2.6%
2015	112,864	122,322	-7.7%	141,256	141,872	-0.4%	254,120	264,194	-3.8%
2016	112,961	123,553	-8.6%	146,182	147,014	-0.6%	259,144	270,566	-4.2%
2017	111,177	124,141	-10.4%	149,301	151,838	-1.7%	260,478	275,979	-5.6%

Source:

FHWA - U.S. Department of Transportation, Federal Highway Administration, 1970-2008, *Highway Statistics 2008* and earlier, Washington, DC, 2009, Table VM-1 and annual. 2009-2017 data from Tables MV-1 and MV-9, *Highway Statistics 2017*. (Additional resources: www.fhwa.dot.gov)

IHS Automotive - IHS Automotive, Detroit, Michigan. Used with permission. FURTHER REPRODUCTION PROHIBITED. (Additional resources: https://www.ihs.com/industry/automotive.html)

Table 3.5
New Retail Vehicle Sales, 1970–2018
(thousands)

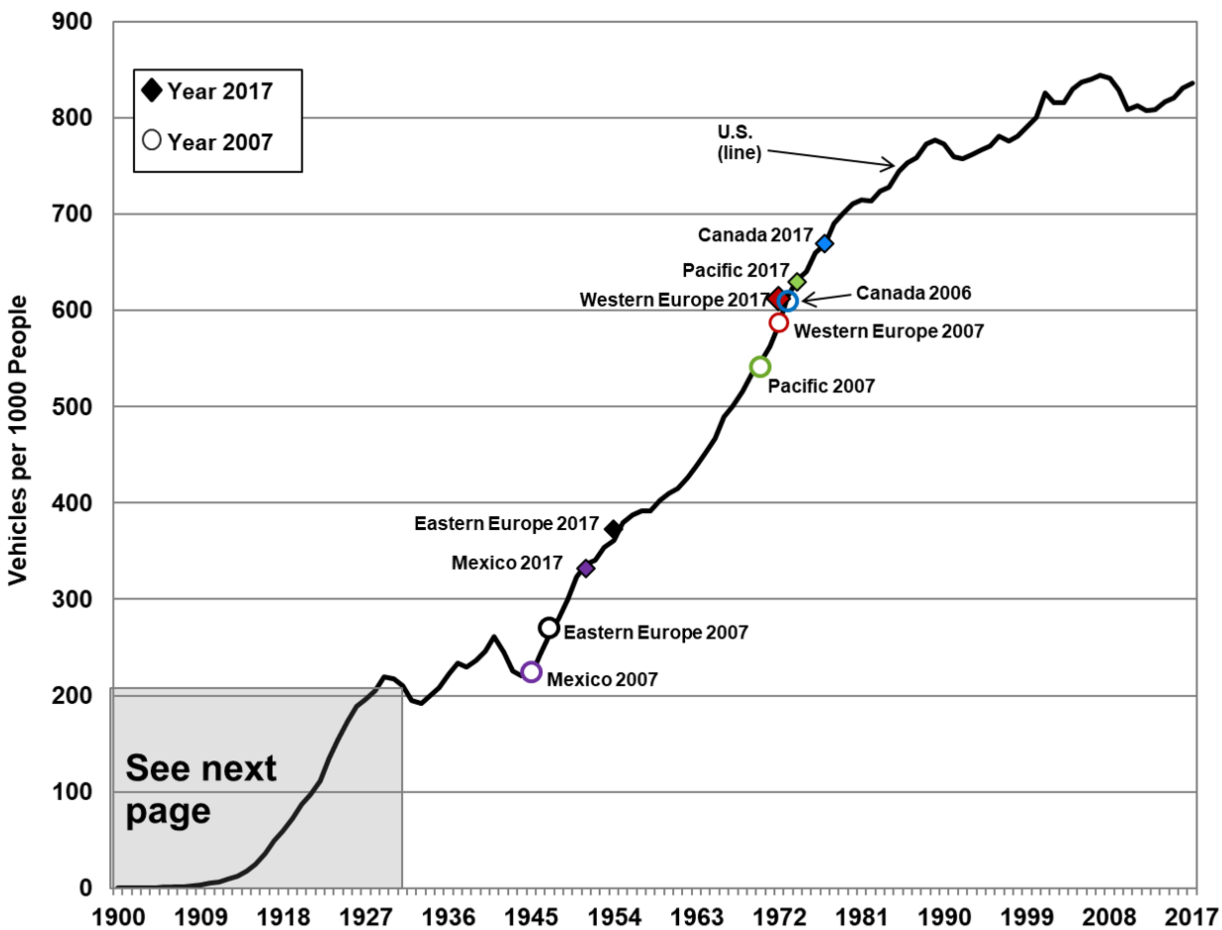
Calendar Year	Cars	Light Trucks[a]	Subtotal Light Vehicles	Heavy Trucks	Total Vehicle Sales
1970	8,399	1,457	9,856	334	10,190
1975	8,486	2,053	10,539	298	10,837
1976	9,957	2,719	12,676	324	13,000
1977	11,004	3,109	14,113	376	14,489
1978	11,107	3,474	14,581	441	15,022
1979	10,512	2,845	13,357	391	13,748
1980	8,949	1,960	10,909	271	11,180
1981	8,488	1,746	10,234	226	10,460
1982	7,956	2,063	10,019	184	10,203
1983	9,148	2,521	11,669	189	11,858
1984	10,324	3,255	13,579	282	13,861
1985	10,979	3,688	14,667	295	14,962
1986	11,404	4,594	15,998	277	16,275
1987	10,187	4,610	14,797	302	15,099
1988	10,544	4,800	15,344	348	15,692
1989	9,776	4,610	14,386	330	14,716
1990	9,301	4,548	13,849	297	14,146
1991	8,185	4,122	12,307	242	12,549
1992	8,213	4,629	12,842	276	13,118
1993	8,518	5,351	13,869	330	14,199
1994	8,991	6,033	15,024	387	15,411
1995	8,620	6,053	14,673	428	15,101
1996	8,479	6,519	14,998	411	15,409
1997	8,217	6,797	15,014	430	15,444
1998	8,085	7,299	15,384	526	15,910
1999	8,638	8,073	16,711	641	17,352
2000	8,778	8,386	17,164	579	17,743
2001	8,352	8,598	16,950	452	17,402
2002	8,042	8,633	16,675	402	17,077
2003	7,556	8,938	16,494	420	16,914
2004	7,483	9,254	16,737	538	17,275
2005	7,660	9,114	16,774	664	17,438
2006	7,762	8,574	16,336	694	17,030
2007	7,562	8,305	15,867	537	16,404
2008	6,769	6,246	13,015	432	13,447
2009	5,402	4,834	10,236	312	10,548
2010	5,636	5,758	11,394	378	11,772
2011	6,093	6,449	12,542	500	13,042
2012	7,245	6,975	14,220	569	14,789
2013	7,586	7,693	15,279	606	15,884
2014	7,708	8,484	16,192	671	16,862
2015	7,517	9,578	17,095	732	17,827
2016	6,873	10,296	17,169	697	17,866
2017	6,080	10,738	16,818	732	17,551
2018	5,304	11,609	16,913	789	17,701
			Average annual percentage change		
1970-2018	-0.9%	4.4%	1.1%	1.8%	1.2%
2008-2018	-2.4%	6.4%	2.7%	6.2%	2.8%

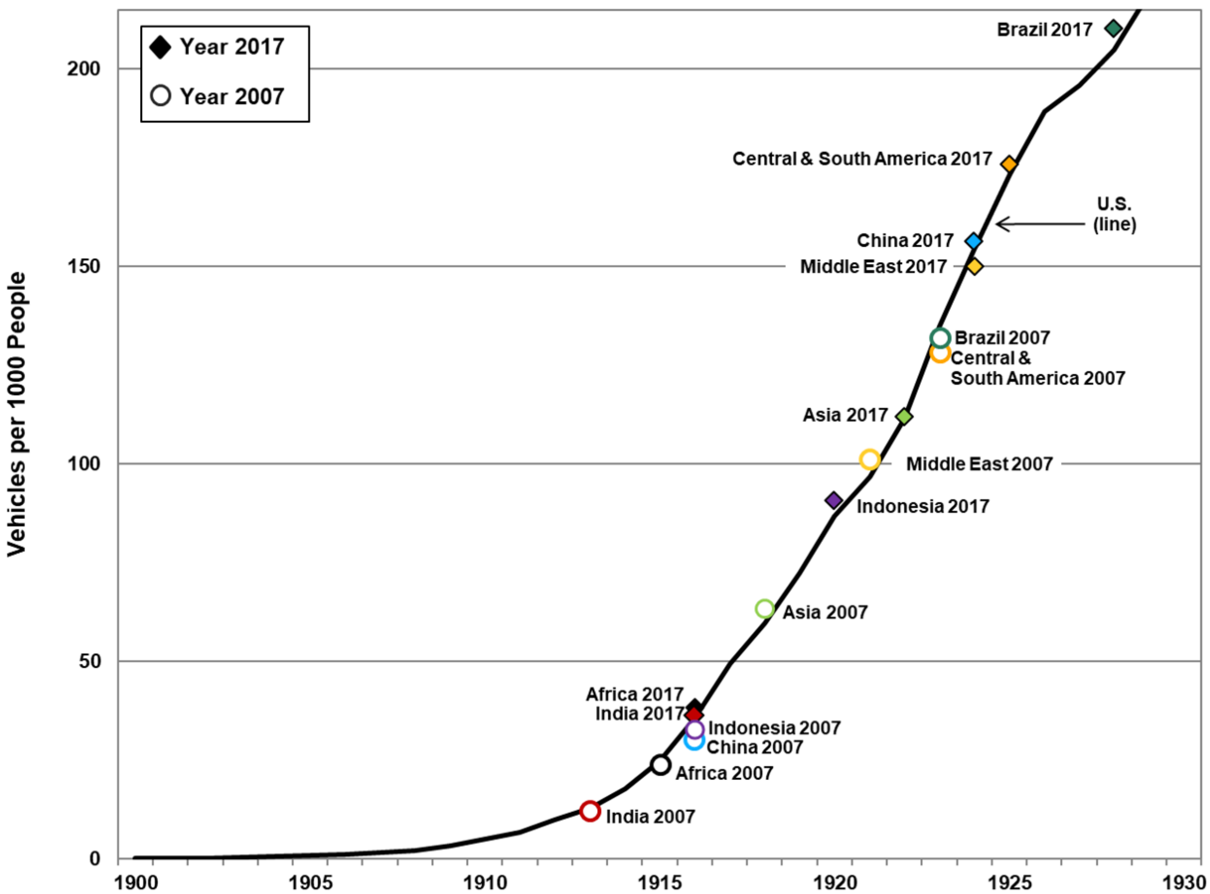
Source:
Ward's Communications, www.wardsauto.com.

[a] Includes light trucks of 10,000 lb. gross vehicle weight and less.

The graphs below show the number of motor vehicles per thousand people for various countries. The data for the United States are displayed in the line which goes from 1900 to 2017. The points labeled on that line show data for the other countries/regions around the world and how their vehicles per thousand people compare to the United States at two different points in time, 2006 and 2017. For instance, the graph shows that in 2007, Eastern Europe's vehicles per thousand people was about where the United States was in 1947, but by 2017 it is about where the United States was in 1954. The lower part of the graph (1900-1930) is shown enlarged on the facing page.

Figure 3.3. Vehicles per Thousand People: U.S. (Over Time) Compared to Other Countries (in 2007 and 2017)





Source:
See Tables 3.5 and 3.6.

Though some countries are listed separately in this table, those countries are also included in the regional total. For instance, China is listed separately, but is also included in the Asia, Far East region.

Table 3.6
Vehicles per Thousand People in Selected Countries/Regions, 2007 and 2017

	Vehicles per 1,000 people	
Country/Region	2007	2017
Africa	24.0	38.4
Asia, Far East	63.4	112.0
Asia, Middle East	101.4	149.9
Brazil	132.0	210.3
Canada	609.4	669.4
Central & South America	128.3	176.0
China	30.3	156.3
Europe, East	270.8	373.3
Europe, West	587.5	611.9
India	12.3	36.3
Indonesia	32.8	90.6
Mexico	224.3	629.7
Pacific	541.1	331.6
United States	844.5	831.2

Sources:
2017 population – U.S. Census Bureau, Population Division, International Data Base (IDB) World, July 15, 2019. (Additional resources: www.census.gov/population/international)
2017 vehicles – United States: See Table 3.6. All other countries: Ward's Communications, www.wardsauto.com.
2007 data – Oak Ridge National Laboratory, *Transportation Energy Data Book: Edition 28*, ORNL-6984, 2009.

The number of vehicles per thousand people in the United States has grown tremendously since 1900. After a peak in 2007 at 844.5, the number declined but began rising in 2012. By 2017 there were 836.6 vehicles per thousand people in the United States.

Table 3.7
Vehicles per Thousand People in the United States, 1900–2017

Year	U.S. vehicles per 1,000 people	Year	U.S. vehicles per 1,000 people	Year	U.S. vehicles per 1,000 people	Year	U.S. vehicles per 1,000 people	Year	U.S. vehicles per 1,000 people
1900	0.1	1924	154.4	1948	280.2	1972	585.6	1996	781.2
1901	0.2	1925	173.3	1949	299.6	1973	615.2	1997	776.0
1902	0.3	1926	189.1	1950	323.7	1974	632.3	1998	781.2
1903	0.4	1927	195.8	1951	337.1	1975	640.1	1999	790.1
1904	0.7	1928	204.9	1952	340.6	1976	659.5	2000	800.3
1905	0.9	1929	219.3	1953	353.7	1977	669.0	2001	825.8
1906	1.3	1930	217.3	1954	361.4	1978	690.2	2002	815.7
1907	1.7	1931	210.4	1955	379.8	1979	700.4	2003	816.1
1908	2.2	1932	195.4	1956	387.6	1980	710.7	2004	829.9
1909	3.5	1933	192.4	1957	392.1	1981	715.2	2005	837.3
1910	5.1	1934	199.9	1958	392.2	1982	714.0	2006	840.7
1911	6.8	1935	208.6	1959	402.8	1983	724.3	2007	844.5
1912	9.9	1936	222.6	1960	410.4	1984	728.2	2008	841.6
1913	12.9	1937	233.3	1961	415.1	1985	744.5	2009	828.7
1914	17.8	1938	229.7	1962	426.1	1986	753.3	2010	808.4
1915	24.8	1939	236.9	1963	438.8	1987	758.6	2011	812.5
1916	35.5	1940	245.6	1964	451.6	1988	772.9	2012	807.8
1917	49.6	1941	261.6	1965	466.9	1989	777.0	2013	809.1
1918	59.7	1942	244.7	1966	489.3	1990	773.4	2014	817.1
1919	72.5	1943	225.9	1967	500.7	1991	760.2	2015	821.1
1920	86.8	1944	220.2	1968	516.5	1992	758.0	2016	831.2
1921	96.7	1945	221.8	1969	533.4	1993	761.9	2017	836.6
1922	111.5	1946	243.1	1970	545.4	1994	766.9		
1923	134.9	1947	262.6	1971	562.5	1995	771.0		

Sources:

Population – U.S. Census Bureau, Population Division, International Data Base (IDB) World, July 2019. (Additional resources: www.census.gov/programs-surveys/international-programs.html)

Vehicles – U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2017,* Washington, DC, 2019.

Total vehicle-miles traveled increased each year from 2011 to 2017. The trend of using two-axle, four-tire trucks, such as pickups, vans, and sport-utility vehicles, for personal travel is evident in these data; two-axle, four-tire trucks account for 33% more travel in 2017 than in 1970, and cars account for 38% less travel in that time period.

Table 3.8
Shares of Highway Vehicle-Miles Traveled by Vehicle Type, 1970–2017

Year	Cars	Motorcycles	Two-axle, four-tire trucks	Other single-unit trucks	Combination trucks	Buses	Total vehicle-miles traveled (million miles)
1970	82.6%	0.3%	11.1%	2.4%	3.2%	0.4%	1,109,724
1975	77.9%	0.4%	15.1%	2.6%	3.5%	0.5%	1,327,664
1980	72.8%	0.7%	19.0%	2.6%	4.5%	0.4%	1,527,295
1985	70.2%	0.5%	22.0%	2.6%	4.4%	0.3%	1,774,826
1986	69.2%	0.5%	23.1%	2.5%	4.4%	0.3%	1,834,872
1987	68.5%	0.5%	23.8%	2.5%	4.5%	0.3%	1,921,204
1988	67.6%	0.5%	24.8%	2.4%	4.4%	0.3%	2,025,962
1989	66.8%	0.5%	25.6%	2.4%	4.4%	0.3%	2,096,487
1990	65.7%	0.4%	26.8%	2.4%	4.4%	0.3%	2,144,362
1991	62.5%	0.4%	29.9%	2.4%	4.4%	0.3%	2,172,050
1992	61.0%	0.4%	31.5%	2.4%	4.4%	0.3%	2,247,151
1993	59.9%	0.4%	32.5%	2.5%	4.5%	0.3%	2,296,378
1994	59.6%	0.4%	32.4%	2.6%	4.6%	0.3%	2,357,588
1995	59.4%	0.4%	32.6%	2.6%	4.8%	0.3%	2,422,696
1996	59.1%	0.4%	32.8%	2.6%	4.8%	0.3%	2,485,848
1997	58.7%	0.4%	33.2%	2.6%	4.9%	0.3%	2,561,695
1998	58.9%	0.4%	33.0%	2.6%	4.9%	0.3%	2,631,522
1999	58.3%	0.4%	33.5%	2.6%	4.9%	0.3%	2,691,056
2000	58.3%	0.4%	33.6%	2.6%	4.9%	0.3%	2,746,925
2001	58.2%	0.3%	33.7%	2.6%	4.9%	0.3%	2,797,287
2002	58.1%	0.3%	33.8%	2.7%	4.9%	0.2%	2,855,508
2003	57.8%	0.3%	34.0%	2.7%	4.8%	0.2%	2,890,412
2004	57.3%	0.3%	34.6%	2.6%	4.8%	0.2%	2,964,788
2005	57.1%	0.3%	34.8%	2.6%	4.8%	0.2%	2,989,430
2006	56.1%	0.4%	35.9%	2.7%	4.7%	0.2%	3,014,369 [a]
2007	55.2%	0.4%	36.7%	2.7%	4.8%	0.2%	3,032,399
2008	54.3%	0.5%	37.3%	2.8%	4.8%	0.2%	2,973,509
2009	53.0%	0.7%	36.1%	4.1%	5.7%	0.5%	2,956,764
2010	50.4%	0.6%	38.8%	3.7%	5.9%	0.5%	2,967,266
2011	49.4%	0.6%	40.4%	3.5%	5.6%	0.5%	2,950,402
2012	48.4%	0.7%	41.3%	3.6%	5.5%	0.5%	2,969,433
2013	48.4%	0.7%	41.2%	3.6%	5.6%	0.5%	2,988,280
2014	47.5%	0.7%	42.1%	3.6%	5.6%	0.5%	3,025,656
2015	46.7%	0.6%	43.1%	3.5%	5.5%	0.5%	3,095,373
2016	45.8%	0.6%	44.0%	3.6%	5.5%	0.5%	3,174,408
2017	44.3%	0.6%	45.2%	3.6%	5.6%	0.5%	3,212,347
			Average annual percentage change				
1970–2017							2.3%
2007–2017							0.6%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2017*, Washington, DC, 2019, Table VM-1 and annual. (Additional resources: www.fhwa.dot.gov). 2009-2017 cars and 2-axle 4-tire trucks – see Section 7 in Appendix A.

[a] Due to FHWA methodology changes, data from 2007-on are not comparable with previous data.

In 1970 only 2.9% of the car population was 15 years old or older; by 2013 that number rose to nearly 20%.

Table 3.9
Cars in Operation by Age, 1970, 2000, and 2013

	1970			2000			2013		
Age (years)	Vehicles (thousands)	Percentage[a]	Cumulative percentage[a]	Vehicles (thousands)	Percentage[a]	Cumulative percentage[a]	Vehicles (thousands)	Percentage[a]	Cumulative percentage[a]
Under 1[b]	6,288	7.8%	7.8%	6,665	5.2%	5.2%	9,287	7.1%	7.1%
1	9,299	11.6%	19.4%	8,177	6.4%	11.6%	7,700	5.9%	13.1%
2	8,816	11.0%	30.3%	7,655	6.0%	17.6%	5,957	4.6%	17.6%
3	7,878	9.8%	40.1%	7,906	6.2%	23.8%	6,159	4.7%	22.4%
4	8,538	10.6%	50.8%	7,413	5.8%	29.6%	5,484	4.2%	26.6%
5	8,506	10.6%	61.3%	8,675	6.8%	36.4%	7,226	5.6%	32.1%
6	7,116	8.8%	70.2%	7,628	6.0%	42.4%	7,896	6.1%	38.2%
7	6,268	7.8%	78.0%	7,650	6.0%	48.4%	7,706	5.9%	44.1%
8	5,058	6.3%	84.3%	7,021	5.5%	53.9%	7,843	6.0%	50.2%
9	3,267	4.1%	88.3%	7,109	5.6%	59.4%	6,924	5.3%	55.5%
10	2,776	3.5%	91.8%	7,071	5.5%	65.0%	7,237	5.6%	61.1%
11	1,692	2.1%	93.9%	7,338	5.7%	70.7%	7,167	5.5%	66.6%
12	799	1.0%	94.9%	6,876	5.4%	76.1%	6,660	5.1%	71.7%
13	996	1.2%	96.1%	6,084	4.8%	80.9%	6,889	5.3%	77.0%
14	794	1.0%	97.1%	5,334	4.2%	85.0%	5,487	4.2%	81.2%
15 and older	2,336	2.9%	100.0%	19,119	15.0%	100.0%	24,457	18.8%	100.0%
Subtotal	**80,427**	**100.0%**		**127,721**	**100.0%**		**130,078**	**100.0%**	
Age not given	**22**			**0**			**0**		
Total	**80,449**			**121,721**			**130,078**		

Source:
IHS Automotive, Detroit, MI. Used with permission. **FURTHER REPRODUCTION PROHIBITED.**

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[a] Percentages may not sum to totals due to rounding.

[b] Includes cars which were sold prior to July 1, 1970, and similarly, sold prior to July 1, 2000. For 2013, cars sold prior to December 31, 2013 were included.

The number of trucks in the United States has grown significantly since 1970, some of it due to the use of light trucks (pickups, vans, sport utility vehicles) as personal passenger vehicles. Those light trucks, as well as medium and heavy trucks, are included in the data. In 1970 about 15% of trucks were age 15 or older; by 2013, that increased to 20.8%.

Table 3.10
Trucks in Operation by Age, 1970, 2000, and 2013

	1970			2000			2013		
Age (years)	Vehicles (thousands)	Percentage[a]	Cumulative percentage[a]	Vehicles (thousands)	Percentage[a]	Cumulative percentage[a]	Vehicles (thousands)	Percentage[a]	Cumulative percentage[a]
Under 1[b]	1,262	7.1%	7.1%	6,439	7.5%	7.5%	8,097	6.5%	6.5%
1	1,881	10.6%	17.8%	7,726	9.0%	16.6%	6,391	5.1%	11.6%
2	1,536	8.7%	26.5%	6,630	7.7%	24.3%	6,417	5.2%	16.8%
3	1,428	8.1%	34.6%	6,313	7.4%	31.7%	4,972	4.0%	20.8%
4	1,483	8.4%	43.0%	5,300	6.2%	37.9%	3,991	3.2%	24.0%
5	1,339	7.6%	50.5%	5,818	6.8%	44.7%	6,927	5.6%	29.5%
6	1,154	6.5%	57.1%	5,206	6.1%	50.8%	7,587	6.1%	35.6%
7	975	5.5%	62.6%	4,335	5.1%	55.8%	7,580	6.1%	41.7%
8	826	4.7%	67.3%	3,547	4.1%	60.0%	7,585	6.1%	47.8%
9	621	3.5%	70.8%	3,411	4.0%	63.9%	7,978	6.4%	54.2%
10	658	3.7%	74.5%	3,258	3.8%	67.8%	7,201	5.8%	60.0%
11	583	3.3%	77.8%	3,665	4.3%	72.0%	6,850	5.5%	65.5%
12	383	2.2%	80.0%	3,421	4.0%	76.0%	6,163	4.9%	70.4%
13	417	2.4%	82.3%	2,860	3.3%	79.4%	5,673	4.6%	75.0%
14	414	2.3%	84.7%	2,812	3.3%	82.7%	5,217	4.2%	79.2%
15 and older	2,710	15.3%	100.0%	14,838	17.3%	100.0%	25,917	20.8%	100.0%
Subtotal	**17,670**	**100.0%**		**85,579**	**100.0%**		**124,545**	**100.0%**	
Age note given	**15**			**0**			**0**		
Total	**17,685**			**85,579**			**124,545**		

Source:
IHS Automotive, Detroit, MI. Used with permission. **FURTHER REPRODUCTION PROHIBITED.**

[a] Percentages may not sum to totals due to rounding.

[b] Includes trucks which were sold prior to July 1, 1970, and similarly, sold prior to July 1, 2000. For 2013, trucks sold prior to December 31, 2013 were included.

The average age of cars and light trucks has grown to a record level in 2018—11.8 years. Light trucks, which include pickups, vans, and sport utility vehicles, had a lower average age than cars in 2018.

Table 3.11
U.S. Average Vehicle Age, 1970–2018

Calendar Year	Passenger cars	Light trucks	All light vehicles
1970	5.6	7.3	[a]
1975	6.0	6.9	[a]
1980	6.6	7.1	[a]
1985	7.6	8.1	[a]
1990	7.8	8.0	[a]
1991	7.9	8.1	[a]
1992	8.1	8.4	[a]
1993	8.3	8.6	[a]
1994	8.4	8.4	[a]
1995	8.4	8.3	8.4
1996	8.5	8.3	8.5
1997	8.7	8.5	8.6
1998	8.9	8.5	8.8
1999	9.1	8.5	8.8
2000	9.1	8.4	8.9
2001	9.3	8.4	8.9 [b]
2002	9.8	9.4	9.6
2003	9.9	9.0	9.7
2004	10.0	9.5	9.8
2005	10.1	9.5	9.8
2006	10.2	9.5	9.9
2007	10.3	9.6	10.0
2008	10.4	9.8	10.1
2009	10.5	10.1	10.3
2010	10.8	10.5	10.6
2011	11.1	10.8	10.9
2012	11.3	11.1	11.2
2013	11.4	11.3	11.4
2014	11.4	11.4	11.4
2015	11.5	11.5	11.5
2016	11.6	11.6	11.6
2017	[a]	[a]	[a]
2018	11.9	11.7	11.8

Source:
IHS Automotive, Detroit, MI. Used with permission. **FURTHER REPRODUCTION PROHIBITED**. (Additional resources: https://www.ihs.com/industry/automotive.html)

[a] Data are not available.
[b] In 2013, IHS Automotive published a data series showing vehicle age from 2002-2013. These data did not match the previous data published in earlier releases and, therefore, are not comparable.

The Environmental Protection Agency estimated the annual vehicle miles of travel for cars and light trucks up to 30 years old for the mid-term evaluation of the Light Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards. The "Total" row represents the number of miles a car or light truck would travel if it is in operation for 30 years. Typical lifetime miles from a 2006 study by the National Highway Traffic Safety Administration (NHTSA) are shown below the total.

Table 3.12
Annual Mileage for Cars and Light Trucks by Vehicle Age

Vehicle age (years)	Estimated annual vehicle miles of travel for cars	Estimated annual vehicle miles of travel for light trucks
0	13,843	15,962
1	13,580	15,670
2	13,296	15,320
3	12,992	15,098
4	12,672	14,528
5	12,337	14,081
6	11,989	13,548
7	11,630	13,112
8	11,262	12,544
9	10,887	12,078
10	10,509	11,595
11	10,129	11,131
12	9,748	10,641
13	9,370	10,153
14	8,997	9,691
15	8,629	9,239
16	8,270	8,797
17	7,922	8,383
18	7,586	8,009
19	7,265	7,666
20	6,962	7,358
21	6,679	7,089
22	6,416	6,862
23	6,177	6,684
24	5,963	6,556
25	5,778	6,481
26	5,623	6,466
27	5,499	6,466
28	5,410	6,466
29	5,358	6,466
30	5,358	6,466
Total	**278,134**	**310,610**
NHTSA 2006 study – typical lifetime miles	152,137	179,954

Sources:

U.S. Environmental Protection Agency, *Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025*, EPA-420-D-16-900, July 2016. (Additional resources: https://www.epa.gov/regulations-emissions-vehicles-and-engines/midterm-evaluation-light-duty-vehicle-greenhouse-gas-ghg#TAR)

U.S. Department of Transportation, National Highway Traffic Safety Administration, *Vehicle Survivability and Travel Mileage Schedules*, January 2006.

The Environmental Protection Agency estimated the survival rates for cars and light trucks for the mid-term evaluation of the Light Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards.

Table 3.13
Survival Rates for Cars and Light Trucks by Vehicle Age

Vehicle age (years)	Estimated survival rate for cars	Estimated survival rate for light trucks
0	1.000	1.000
1	0.997	0.991
2	0.994	0.982
3	0.991	0.973
4	0.984	0.960
5	0.974	0.941
6	0.961	0.919
7	0.942	0.891
8	0.920	0.859
9	0.893	0.823
10	0.862	0.784
11	0.826	0.741
12	0.788	0.697
13	0.718	0.651
14	0.613	0.605
15	0.510	0.553
16	0.415	0.502
17	0.332	0.453
18	0.261	0.407
19	0.203	0.364
20	0.157	0.324
21	0.120	0.288
22	0.092	0.255
23	0.070	0.225
24	0.053	0.198
25	0.040	0.174
26	0.030	0.153
27	0.023	0.133
28	0.013	0.117
29	0.010	0.102
30	0.007	0.089
31	0.002	0.027

Source:
U.S. Environmental Protection Agency, *Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025*, EPA-420-D-16-900, July 2016. (Additional resources: https://www.epa.gov/regulations-emissions-vehicles-and-engines/midterm-evaluation-light-duty-vehicle-greenhouse-gas-ghg#TAR)

Using current registration data and a scrappage model by Greenspan and Cohen [1996 paper: www.federalreserve.gov/pubs/feds/1996/199640/199640pap.pdf], ORNL calculated heavy truck (trucks over 26,000 lb gross vehicle weight) scrappage rates. The expected median lifetime for a 1990 model year heavy truck is 29 years. These data are fitted model values which assume constant economic conditions.

Table 3.14
Heavy Truck[a] Scrappage and Survival Rates
1970, 1980, and 1990 Model Years

Vehicle age[b] (years)	1970 model year		1980 model year		1990 model year	
	Survival rate[c]	Scrappage rate[d]	Survival rate[c]	Scrappage rate[d]	Survival rate[c]	Scrappage rate[d]
4	98.8	1.2	98.5	1.5	99.4	0.6
5	97.2	1.6	96.7	1.9	98.6	0.8
6	95.3	1.9	94.5	2.3	97.6	1.0
7	93.2	2.3	92.0	2.7	96.5	1.2
8	90.7	2.6	89.1	3.1	95.2	1.3
9	88.1	3.0	86.0	3.5	93.8	1.5
10	85.2	3.3	82.7	3.9	92.2	1.7
11	82.1	3.6	79.1	4.3	90.5	1.9
12	78.8	4.0	75.4	4.7	88.6	2.0
13	75.4	4.3	71.6	5.1	86.7	2.2
14	71.9	4.7	67.7	5.5	84.6	2.4
15	68.3	5.0	63.7	5.9	82.4	2.6
16	64.6	5.3	59.7	6.3	80.2	2.7
17	61.0	5.7	55.7	6.7	77.9	2.9
18	57.3	6.0	51.8	7.1	75.5	3.1
19	53.7	6.3	47.9	7.4	73.0	3.3
20	50.1	6.7	44.2	7.8	70.5	3.4
21	46.6	7.0	40.6	8.2	68.0	3.6
22	43.2	7.3	37.1	8.6	65.4	3.8
23	39.9	7.6	33.7	9.0	62.8	3.9
24	36.7	8.0	30.6	9.4	60.3	4.1
25	33.7	8.3	27.6	9.7	57.7	4.3
26	30.8	8.6	24.8	10.1	55.1	4.5
27	28.0	8.9	22.2	10.5	52.6	4.6
28	25.4	9.3	19.8	10.9	50.0	4.8
29	23.0	9.6	17.6	11.2	47.6	5.0
30	20.7	9.9	15.5	11.6	45.1	5.1
Median lifetime	20.0 years		18.5 years		28.0 years	

Source:
Schmoyer, Richard L., unpublished study on scrappage rates, Oak Ridge National Laboratory, Oak Ridge, TN, 2001.

[a] Heavy trucks are trucks over 26,000 lb gross vehicle weight.
[b] It was assumed that scrappage for vehicles less than 4 years old is 0.
[c] The percentage of heavy trucks which will be in use at the end of the year.
[d] The percentage of heavy trucks which will be retired from use during the year.

Chapter 4
Light Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source			
Table 4.1	Cars, 2017		
		Registrations (thousands)	*111,177*
		Vehicle miles (billion miles)	*1,424.3*
		Fleet average fuel economy (miles per gallon)	*27.3*
Table 4.2	Two-axle, four-tire trucks, 2017		
		Registrations (thousands)	*137,749*
		Vehicle miles (billion miles)	*1,453.1*
		Fleet average fuel economy (miles per gallon)	*19.7*
Table 4.7	Light truck share of total light vehicle sales		
		1970 calendar year	*14.8%*
		2018 calendar year	*68.6%*
Table 4.9	Cars, 2017 model year		
		Production (thousands)	6,977
		New car fuel economy (miles per gallon)	30.2
Table 4.9	Car SUVs, 2017 model year		
		Production (thousands)	1,961
		New car SUV fuel economy (miles per gallon)	26.2
Table 4.11	Truck SUVs, 2017 model year		
		Production (thousands)	5,402
		New truck SUV fuel economy (miles per gallon)	22.4
Table 4.11	Pickups, 2017 model year		
		Production (thousands)	2,054
		New pickup fuel economy (miles per gallon)	18.9
Table 4.11	Vans, 2017 model year		
		Production (thousands)	617
		New van fuel economy (miles per gallon)	20.0
Table 4.34	Average fuel economy loss from 50 to 70 mph		24.5%

The definition of light truck can change from table to table in this document due to differing definitions among federal government regulations and public nomenclature. See page 4-2 for additional information.

Definition of Light Truck

Often for regulatory purposes, agencies within the federal government have differing definitions for the term "light truck." Private data collectors, such as Ward's Communications or IHS Automotive/Polk, have their own definitions as well. The paragraphs below are intended as a guide to the different definitions which are used in this document.

The data in Table 4.2 are from the Federal Highway Administration (FHWA). From 1970 to 2008 the FHWA defined light trucks as two-axle, four-tire trucks, including pickups, vans, SUVs, and other two-axle, four-tire trucks under 10,000 lb gross vehicle weight rating (GVWR). In 2009, the FHWA changed methodologies and no longer publishes vehicle miles, fuel use, and fuel economy of light trucks separately from cars. They continue to publish vehicle registrations for pickups, vans, SUVs and other two-axle, four tire trucks under 10,000 lb. The methodology used by Oak Ridge National Laboratory (ORNL) to continue the data series on Table 4.2 after 2008 is based on the FHWA data for all light vehicles, thus uses the same definition of light trucks. See Section 7.2 in Appendix A for the methodology of light truck data on Table 4.2 after 2008. Data on energy use in Tables 2.7 through 2.9 also use the FHWA definition of light truck.

Tables 3.11, 4.4, and 4.7 are light truck sales based on Ward's Communications data. Ward's definition of light trucks includes pickups, vans, SUVs, and specialty purpose vehicles up to 14,000 lb GVWR. However, in most cases, data are available by individual GVWR and ORNL summarized only light trucks that were 10,000 lb GVWR or less and did not include the heavier trucks. Thus, the definition on these tables is nearly identical to the FHWA definition.

The Environmental Protection Agency (EPA) and the Department of Transportation, National Highway Traffic Safety Administration (NHTSA), issued joint rulemaking to establish Corporate Average Fuel Economy (CAFE) standards and greenhouse gas emissions standards beginning with model year 2012. The rulemaking established new definitions of cars and light trucks. Before the rule, CAFE standards applied to cars and light trucks (pickups, vans, SUVs, and other trucks) less than 8,500 lb GVWR. After the rule, some two-wheel drive SUVs are considered cars instead of light trucks, and personal passenger vehicles (vans and SUVs) up to 10,000 lb GVWR are considered light trucks. Thus, data are now categorized as cars, car SUVs, truck SUVs, pickups and vans. Table 4.9 gives a listing of which SUVs are considered car SUVs for model year 2016. The EPA revised their data series back to 1975, so the definitions are consistent historically. Data on tables 4.8 through 4.18 are based on EPA data and thus use this definition of cars and light trucks. The CAFE data on Table 4.26 apply to cars only through 2011 and cars plus car SUVs after that. The CAFE data on Table 4.27 are for trucks up to 8,500 lb GVWR through 2011 and after that are for truck SUVs and vans up to 10,000 lb GVWR, and pickup trucks up to 8,500 lb GVWR.

Because of these different definitions, caution is advised when comparing light truck data from different sources.

The data in this table from 1985–on DO NOT include minivans, pickups, or sport utility vehicles. Much of the data for 2009-on were estimated; the FHWA no longer publishes travel and fuel data for cars. A methodology change for the number of cars registered affected the series in 2012.

Table 4.1
Summary Statistics for Cars, 1970–2017

Year	Registrations[a] (thousands)	Vehicle travel (billion miles)	Average annual miles per vehicle	Fuel use (million gallons)	Average fuel economy[b] per vehicle (miles per gallon)
1970	89,244	916.7	10,272	67,820	13.5
1975	106,706	1,034.0	9,690	74,140	13.9
1980	121,601	1,111.6	9,141	69,981	15.9
1985[c]	127,885	1,246.8	9,749	71,518	17.4
1990	133,700	1,408.3	10,533	69,568	20.2
1991	128,300	1,358.2	10,586	64,318	21.1
1992	126,581	1,371.6	10,836	65,436	21.0
1993	127,327	1,374.7	10,797	67,047	20.5
1994	127,883	1,406.1	10,995	67,874	20.7
1995	128,387	1,438.3	11,203	68,072	21.1
1996	129,728	1,469.9	11,330	69,221	21.2
1997	129,749	1,502.6	11,580	69,892	21.5
1998	131,839	1,549.6	11,754	71,695	21.6
1999	132,432	1,569.1	11,848	73,283	21.4
2000	133,621	1,600.3	11,976	73,065	21.9
2001	137,633	1,628.3	11,831	73,559	22.1
2002	135,921	1,658.5	12,202	75,471	22.0
2003	135,670	1,672.1	12,325	74,590	22.4
2004	136,431	1,699.9	12,460	75,402	22.5
2005	136,568	1,708.4	12,510	77,418	22.1
2006	135,400	1,690.5	12,485	75,009	22.5
2007	135,933	1,672.5	12,304	74,377	22.5
2008	137,080	1,615.9	11,788	71,497	22.6 [d]
2009	134,880	1,566.8	11,616	66,587	23.5
2010	130,892	1,496.4	11,432	62,245	24.0
2011	125,657	1,457.8	11,601	59,646	24.4
2012	111,290	1,438.6	12,928	57,899	24.9
2013	113,676	1,446.0	12,720	57,290	25.2
2014	113,899	1,436.6	12,613	56,470	25.4
2015	112,864	1,445.4	12,807	55,212	26.2
2016	112,961	1,453.4	12,866	54,248	26.8
2017	111,177	1,424.3	12,811	52,268	27.3
			Average annual percentage change		
1970–2017	0.5%	0.9%	0.5%	-0.6%	1.5%
2007–2017	-2.0%	-1.6%	0.4%	-3.5%	1.9%

Source:
1970-2008: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Washington, DC, 2011, Table VM-1 and annual. 2009-on: See Section 7.1 in Appendix A. (Additional resources: www.fhwa.dot.gov)

[a] This number differs from IHS Automotive's estimates of "number of cars in use." See Table 3.4.
[b] Average fuel economy for all cars.
[c] Beginning in this year the data were revised to exclude minivans, pickups and sport utility vehicles which may have been previously included.
[d] Due to FHWA methodology changes, data from 2009-on are not comparable with previous data.

Much of the data for 2009-on were estimated; the FHWA no longer publishes travel and fuel use data for two-axle, four-tire trucks. A methodology change for the number of registrations affected the data series in 2012.

Table 4.2
Summary Statistics for Two-Axle, Four-Tire Trucks, 1970–2017

Year	Registrations (thousands)	Vehicle travel (billion miles)	Average annual miles per vehicle	Fuel use (million gallons)	Average fuel economy[a] per vehicle (miles per gallon)	
1970	14,211	123.3	8,675	12,313	10.0	
1975	20,418	200.7	9,830	19,081	10.5	
1980	27,876	290.9	10,437	23,796	12.2	
1985[b]	37,214	391.0	10,506	27,363	14.3	
1986	39,382	423.9	10,764	29,074	14.6	
1987	41,107	456.9	11,114	30,598	14.9	
1988	43,805	502.2	11,465	32,653	15.4	
1989	45,945	536.5	11,676	33,271	16.1	
1990	48,275	574.6	11,902	35,611	16.1	
1991	53,033	649.4	12,245	38,217	17.0	
1992	57,091	706.9	12,381	40,929	17.3	
1993	59,994	745.8	12,430	42,851	17.4	
1994	62,904	764.6	12,156	44,112	17.3	
1995	65,738	790.0	12,018	45,605	17.3	
1996	69,134	816.5	11,811	47,354	17.2	
1997	70,224	850.7	12,115	49,389	17.2	
1998	71,330	868.3	12,173	50,462	17.2	
1999	75,356	901.0	11,957	52,859	17.0	
2000	79,085	923.1	11,672	52,939	17.4	
2001	84,188	943.2	11,204	53,522	17.6	
2002	85,011	966.0	11,364	55,220	17.5	
2003	87,187	984.1	11,287	60,758	16.2	
2004	91,845	1,027.2	11,184	63,417	16.2	
2005	95,337	1,041.1	10,920	58,869	17.7	
2006	99,125	1,082.5	10,920	60,685	17.8	
2007	101,470	1,112.3	10,962	61,836	18.0	
2008	101,235	1,108.6	10,951	61,199	18.1	c
2009	100,154	1,066.5	10,649	61,824	17.3	
2010	102,702	1,152.1	11,218	64,687	17.8	
2011	105,571	1,192.7	11,298	65,786	18.1	
2012	120,847	1,225.5	10,142	66,395	18.5	
2013	120,523	1,231.8	10,220	65,555	18.8	
2014	124,681	1,274.0	10,218	69,012	18.5	
2015	128,553	1,334.3	10,448	70,933	18.8	
2016	132,716	1,396.4	10,521	73,107	19.1	
2017	137,749	1,453.1	10,549	73,835	19.7	
			Average annual percentage change			
1970–2017	5.0%	5.4%	0.4%	3.9%	1.5%	
2007–2017	3.1%	2.7%	-0.4%	1.8%	0.9%	

Source:
1970-2008: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Washington, DC, 2011, Table MV-9. Previous years Table VM-1. 2009-on: See Section 7.2 in Appendix A. (Additional resources: www.fhwa.dot.gov)

[a] Average fuel economy for all two-axle, four-tire trucks.
[b] Beginning in this year the data were revised to include all vans (including mini-vans), pickups and sport utility vehicles.
[c] Due to FHWA methodology changes, data from 2009-on are not comparable with previous data.

These data are the combination of the car and two-axle, four-tire truck data from Tables 4.1 and 4.2 thus the data may not match exactly with the FHWA VM-1 table's light-duty vehicle data. The methodology change after 2008 affects these data as well.

Table 4.3
Summary Statistics for Light Vehicles, 1970–2017

Year	Registrations (thousands)	Vehicle travel (billion miles)	Average annual miles per vehicle	Fuel use (million gallons)	Average fuel economy[a] per vehicle (miles per gallon)
1970	103,455	1,040	10,053	80,133	13.0
1975	127,124	1,235	9,712	93,221	13.2
1980	149,477	1,403	9,383	93,777	15.0
1985[b]	165,099	1,638	9,920	98,881	16.6
1986	169,386	1,694	10,001	102,248	16.6
1987	172,589	1,773	10,272	103,906	17.1
1988	177,641	1,872	10,541	105,998	17.7
1989	180,504	1,938	10,735	107,184	18.1
1990	181,975	1,983	10,896	105,179	18.9
1991	181,333	2,008	11,071	102,535	19.6
1992	183,672	2,078	11,316	106,365	19.5
1993	187,321	2,120	11,320	109,898	19.3
1994	190,787	2,171	11,378	111,986	19.4
1995	194,125	2,228	11,479	113,677	19.6
1996	198,862	2,286	11,497	116,575	19.6
1997	199,973	2,353	11,768	119,281	19.7
1998	203,169	2,418	11,901	122,157	19.8
1999	207,788	2,470	11,888	126,142	19.6
2000	212,706	2,523	11,863	126,004	20.0
2001	221,821	2,572	11,593	127,081	20.2
2002	220,932	2,625	11,879	130,691	20.1
2003	222,857	2,656	11,919	135,348	19.6
2004	228,276	2,727	11,946	138,819	19.6
2005	231,905	2,749	11,856	136,287	20.2
2006	234,525	2,773	11,824	135,694	20.4
2007	237,403	2,785	11,730	136,213	20.4
2008	238,315	2,724	11,432	132,696	20.5 [c]
2009	235,034	2,633	11,204	128,411	20.5
2010	233,594	2,648	11,338	126,932	20.9
2011	231,228	2,650	11,463	125,432	21.1
2012	232,137	2,664	11,476	124,294	21.4
2013	234,199	2,678	11,434	122,845	21.8
2014	238,580	2,711	11,361	125,482	21.6
2015	241,417	2,780	11,514	122,940	22.6
2016	245,677	2,850	11,599	127,355	22.4
2017	248,926	2,877	11,559	126,103	22.8
			Average annual percentage change		
1970–2017	1.9%	2.2%	0.3%	1.0%	1.2%
2007–2017	0.5%	0.3%	-0.1%	-0.8%	1.1%

Sources:
Tables 4.1 and 4.2.

[a] Average fuel economy for all light vehicles.
[b] Beginning in this year the data were revised to include all vans (including mini-vans), pickups and sport utility vehicles.
[c] Due to FHWA methodology changes, data from 2009-on are not comparable with previous data.

Because data on class 2b trucks are scarce, the U.S. DOE funded a study to investigate available sources of data. In the final report, four methodologies are described to estimate the sales of class 2b trucks. The 1999 data are the latest available for fuel use and vehicle miles of travel of class 2b trucks.

Table 4.4
Summary Statistics on Class 1, Class 2a, and Class 2b Light Trucks

Class (truck weight)	CY 1999 truck sales (millions)	2000 truck population (millions)	Percent diesel trucks in population	Average age (years)	Estimated annual miles[a] (billions)	Estimated fuel use (billion[a] gallons)	Estimated fuel economy (miles per gallon)
Class 1 (0-6,000 lbs)	5.7	49.7	0.3%	7.3	672.7	37.4	18.0
Class 2a (6,001 – 8,500 lbs)	1.8	19.2	2.5%	7.4	251.9	18.0	14.0
Class 2b (8,501 – 10,000 lbs)	0.5	5.8	24.0%	8.6	76.7	5.5	13.9

Note: CY - calendar year.

Source:
Davis, S.C. and L.F. Truett, *Investigation of Class 2b Trucks (Vehicles of 8,500 to 10,000 lbs GVWR)*, ORNL/TM-2002/49, March 2002, Table 16.

Table 4.5
Example of Class 2b Vehicle Models, 2017

Manufacturer	Model	Type
Chevrolet	Silverado 2500HD	Pickup
Chevrolet	Express 2500, 3500	Van
FCA	Dodge Ram 2500	Pickup
FCA	Dodge Ram ProMaster 1500	Van
Ford	E-Series 350	Van
Ford	F-250, F-350	Pickup
Ford	F-250, F-350 CC	Chassis Cab
Ford	Transit 150, 250, 350, 350HD	Van
Ford	Transit CC / CA 150, 250, 350, 350HD	Chassis Cab / Cutaway Van
GMC	Savana 2500	Van
GMC	Sierra 2500	Pickup
GMC	Yukon 2500	SUV
Mercedes-Benz	Sprinter	Van

Source:
Birky, Alicia, et al., *Electrification Beyond Light-Duty: Class 2b-3 Commercial Vehicles*, ORNL/TM-2017/744, December 2017.

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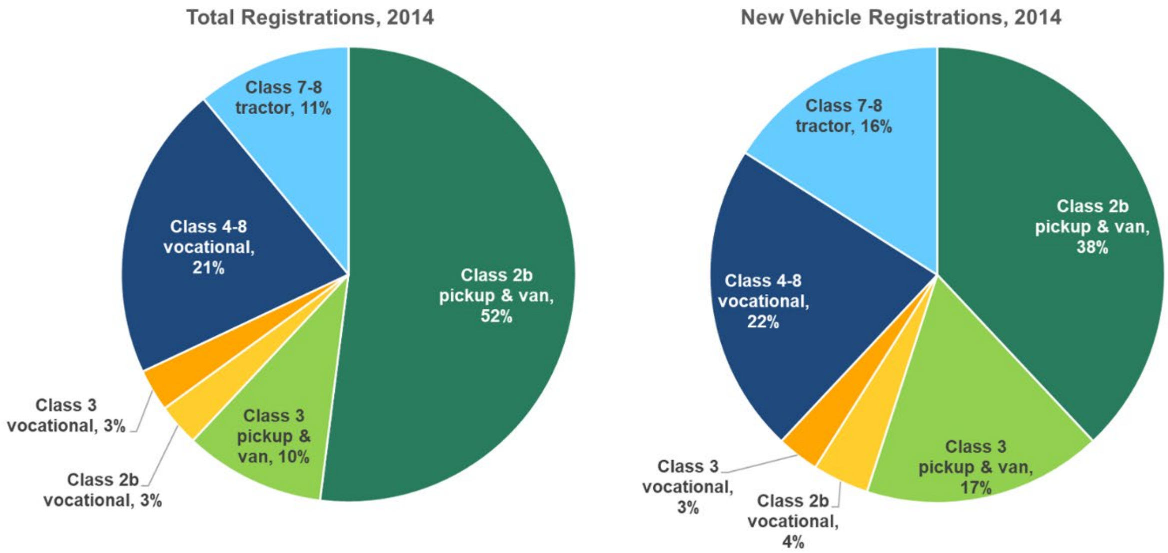
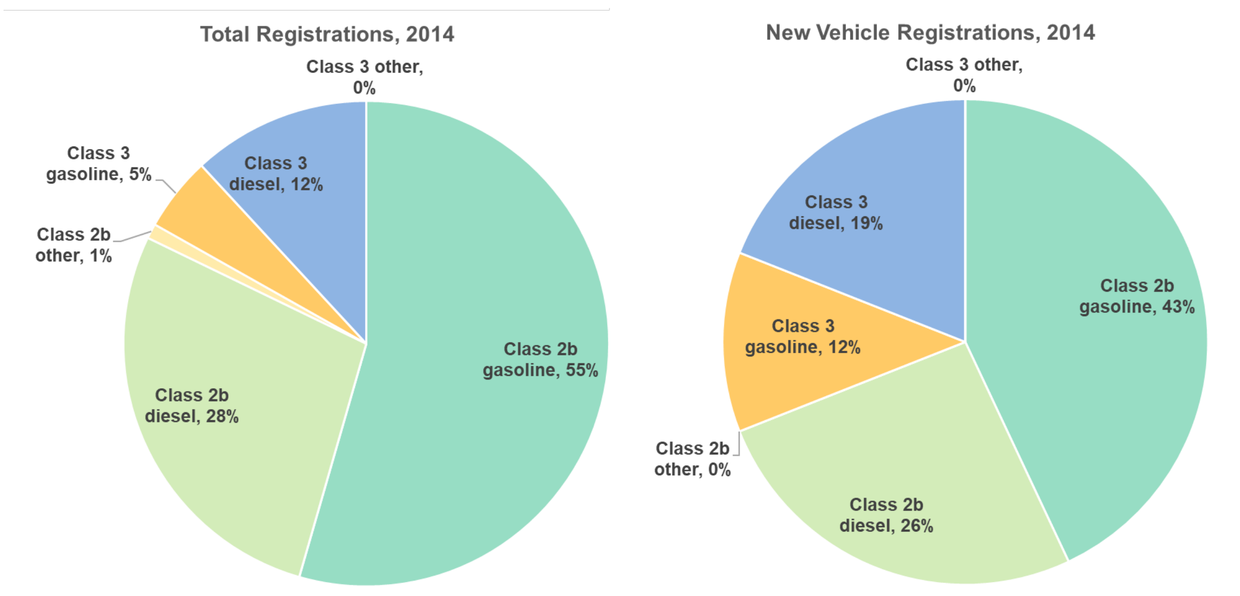
[a] Estimates derived using 2000 population data and 1997 usage data. See source for details.

Figure 4.1. Truck Registrations by Class and Type, 2014



Source:
Birky, Alicia, et al., Electrification Beyond Light Duty: Class 2b-3 Commercial Vehicles, ORNL/TM-2017/744, December 2017.

Figure 4.2. Class 2b and 3 Registrations by Fuel Type, 2014



Source:
Birky, Alicia, et al., *Electrification Beyond Light Duty: Class 2b-3 Commercial Vehicles*, ORNL/TM-2017/744, December 2017.

Car sales in 2009 and 2010 were below 6 million but increased to more than 7.7 million by 2014 before declining to 5.3 million in 2018. Consumer preference towards sport utility vehicles is likely the reason for the decline. In 1980, Chrysler/FCA, Ford and General Motors held 73.8% of the market; by 2018, that had dropped to 23.8%.

Table 4.6
New Retail Car Sales in the United States, 1970–2018

Calendar year	Domestic[a] (thousands)	Import[b] (thousands)	Total[c] (thousands)	Percentage imports	Percentage FCA/Ford/GM sales[d]	Percentage diesel
1970	7,112	1,209	8,321	14.5%	[e]	0.07%
1975	6,945	1,541	8,486	18.2%	[e]	0.32%
1980	6,580	2,369	8,949	26.5%	73.8%	4.32%
1985	8,205	2,775	10,979	25.3%	72.9%	0.83%
1990	6,917	2,384	9,301	25.6%	65.7%	0.08%
1991	6,162	2,023	8,185	24.7%	64.2%	0.10%
1992	6,286	1,927	8,213	23.5%	65.8%	0.06%
1993	6,742	1,776	8,518	20.9%	67.3%	0.04%
1994	7,255	1,735	8,991	19.3%	65.9%	0.04%
1995	7,114	1,506	8,620	17.5%	65.3%	0.03%
1996	7,206	1,272	8,479	15.0%	64.1%	0.09%
1997	6,862	1,355	8,217	16.5%	62.2%	0.09%
1998	6,705	1,380	8,085	17.1%	59.7%	0.14%
1999	6,919	1,719	8,638	19.9%	58.3%	0.16%
2000	6,762	2,016	8,778	23.0%	55.0%	0.26%
2001	6,254	2,098	8,352	25.1%	51.4%	0.18%
2002	5,817	2,226	8,042	27.7%	48.4%	0.39%
2003	5,473	2,083	7,556	27.6%	47.1%	0.52%
2004	5,333	2,149	7,483	28.7%	44.9%	0.40%
2005	5,473	2,187	7,660	28.5%	43.1%	0.63%
2006	5,417	2,345	7,762	30.2%	40.5%	0.82%
2007	5,197	2,365	7,562	31.3%	36.9%	0.11%
2008	4,491	2,278	6,769	33.7%	34.2%	0.11%
2009	3,558	1,843	5,402	34.1%	31.3%	2.93%
2010	3,791	1,844	5,636	32.7%	31.7%	2.69%
2011	4,146	1,947	6,093	32.0%	33.3%	1.47%
2012	5,120	2,125	7,245	29.3%	31.6%	2.69%
2013	5,433	2,153	7,586	28.4%	32.4%	2.45%
2014	5,610	2,098	7,708	27.2%	31.2%	2.41%
2015	5,595	1,922	7,517	25.6%	29.7%	1.14%
2016	5,146	1,727	6,873	25.1%	27.9%	0.12%
2017	4,593	1,488	6,081	24.5%	25.8%	0.09%
2018	4,087	1,217	5,304	22.9%	23.8%	0.08%
		Average annual percentage change				
1970–2018	-1.1%	0.0%	-0.9%			
2008–2018	-0.9%	-6.1%	-2.4%			

Source:
Domestic and import data - 1970–97: American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1998*, Detroit, MI, 1998, p. 15, and annual. 1997 data from *Economic Indicators, 4th Quarter 1997.* 1998–2018: Ward’s Communication, www.wardsauto.com.
Diesel data - Ward's Communications, www.wardsauto.com.

[a] Any vehicle built in North America regardless of manufacturer.
[b] Any vehicle built outside of North America regardless of manufacturer. Does not include import tourist deliveries.
[c] Sums may not add to totals due to rounding.
[d] Includes Ford, General Motors, and Fiat-Chrysler (and predecessor entities).
[e] Data are not available.

Light trucks, which include pick-ups, minivans, sport-utility vehicles, and other trucks less than 10,000 pounds gross vehicle weight (GVW), have grown more popular and by 2018 accounted for 68.6% of all light vehicle sales. Imports accounted for 23.7% of 2018 light truck sales.

Table 4.7
New Retail Sales of Trucks 10,000 Pounds GVW and Less in the United States, 1970–2018

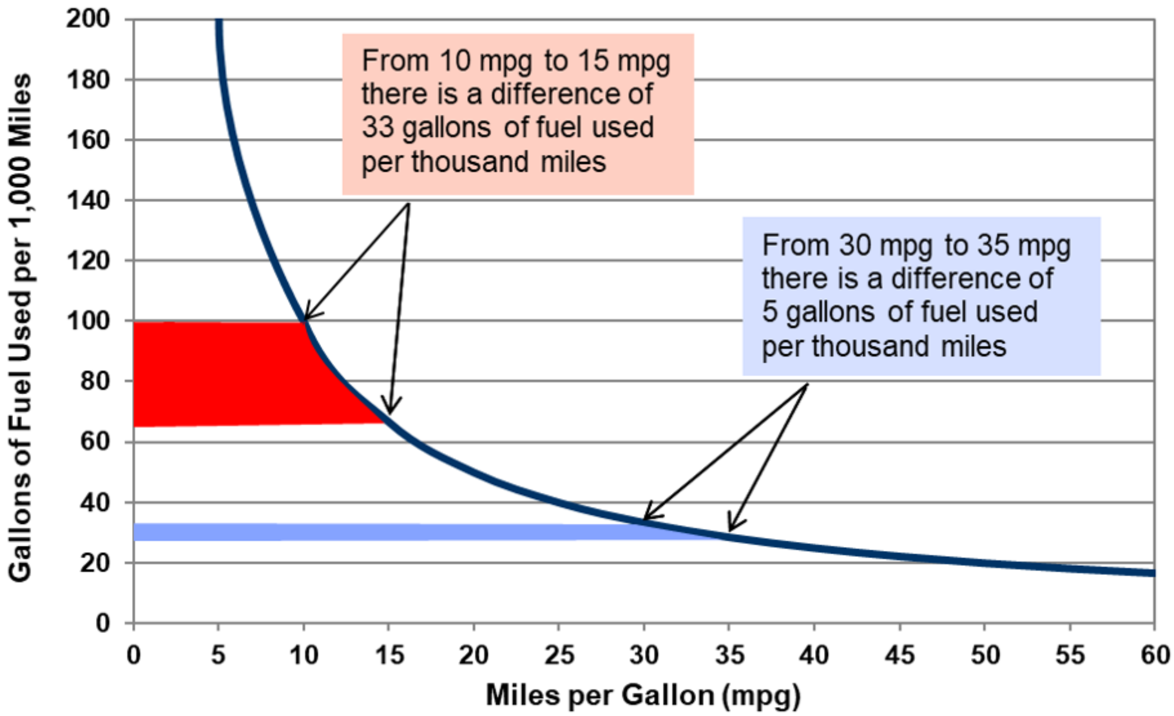
		Percentages				
Calendar year	Light truck sales[a] (thousands)	Import[b]	FCA/Ford/GM sales[c]	Diesel[d]	Light trucks of all light vehicle sales[e]	Light trucks of total truck sales
1970	1,457	4.5%	Not available	[f]	14.8%	77.8%
1975	2,053	10.0%	Not available	[f]	20.9%	78.6%
1980	1,960	24.4%	Not available	4.0%	17.5%	78.1%
1985	3,688	22.6%	78.2%	4.0%	25.1%	77.7%
1990	4,548	13.5%	80.9%	2.3%	32.8%	93.8%
1991	4,122	13.1%	79.4%	3.2%	33.5%	94.4%
1992	4,629	8.8%	83.1%	2.5%	36.0%	94.4%
1993	5,351	7.1%	83.4%	2.3%	38.6%	94.2%
1994	6,033	6.8%	82.9%	2.5%	40.2%	94.0%
1995	6,053	6.6%	83.4%	3.8%	41.3%	93.2%
1996	6,519	6.7%	83.8%	3.1%	43.5%	93.4%
1997	6,797	8.5%	81.9%	2.7%	45.3%	93.4%
1998	7,299	9.0%	80.5%	2.6%	47.4%	92.6%
1999	8,073	9.6%	78.0%	2.9%	48.3%	92.0%
2000	8,386	10.2%	76.1%	3.4%	48.9%	92.8%
2001	8,598	11.4%	75.3%	2.9%	50.7%	94.3%
2002	8,633	12.4%	74.7%	2.7%	51.8%	94.9%
2003	8,938	13.7%	72.4%	2.9%	54.2%	95.0%
2004	9,254	13.5%	70.1%	2.8%	55.3%	94.3%
2005	9,114	13.3%	68.2%	2.7%	54.3%	93.1%
2006	8,574	15.7%	63.9%	2.8%	52.5%	92.3%
2007	8,305	16.7%	61.9%	3.2%	52.3%	93.3%
2008	6,246	17.6%	61.2%	3.4%	48.0%	92.9%
2009	4,834	18.3%	57.8%	4.2%	47.2%	93.0%
2010	5,758	15.6%	57.6%	4.9%	50.5%	93.8%
2011	6,449	15.2%	59.4%	5.4%	51.4%	92.7%
2012	6,975	15.2%	57.7%	5.5%	49.0%	92.6%
2013	7,693	16.1%	57.3%	5.3%	50.3%	92.7%
2014	8,484	16.0%	57.6%	5.4%	52.4%	92.7%
2015	9,578	18.6%	57.0%	5.5%	56.0%	92.7%
2016	10,296	20.9%	55.6%	5.4%	60.0%	93.7%
2017	10,738	22.4%	54.2%	4.4%	63.8%	93.6%
2018	11,609	23.7%	53.1%	4.2%	68.6%	93.6%
			Average annual percentage change			
1970–2018	4.4%					
2008–2018	6.4%					

Source:
Ward's Communications, www.wardsauto.com.

[a] Includes all trucks of 10,000 pounds gross vehicle weight and less sold in the United States.
[b] Excluding transplants.
[c] Includes Ford, General Motors, and Fiat-Chrysler (and predecessor entities).
[d] Based on model year factory installations from 1970-2016. Based on retail sales thereafter.
[e] Includes cars and light trucks up to 10,000 lb gross vehicle weight.
[f] Indicates less than 1 percent.

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. Replacing a low-mpg car or truck with one that has just slightly better fuel economy will save more fuel than replacing a high-mpg car or truck with a more efficient vehicle. For example, replacing 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, replacing a 30-mpg car with a new car that gets 35 mpg will save 5 gallons of fuel for every 1,000 miles driven.

Figure 4.3. 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 www.fueleconomy.gov.

The fuel economy values that manufacturers must use to comply with the Corporate Average Fuel Economy (CAFE) standards are not the same as fuel economy values on new vehicle window stickers. Nor are they the same as the real-world estimates published in Tables 4.9, 4.11, and 4.12. The number of test cycles used and the weighting of city and highway mileage differs with these three fuel economy metrics. The example of a 2017 Toyota Prius Eco shows a combined fuel economy of 81 miles per gallon (mpg) for CAFE purposes, 56 mpg for the window sticker, and 55 mpg as the best real-world estimate. The fuel economy difference is not constant among vehicle models.

Table 4.8
Fuel Economy Comparison Among CAFE, Window Sticker, and Real-World Estimates for the 2017 Toyota Prius Eco

				Fuel economy value (miles per gallon)		
Fuel economy metric	Purpose	City/highway weighting	Test basis	City	Hwy	Combined City/Hwy
CAFE unadjusted 2-cycle test	Basis for manufacturer compliance with CAFE standards	55%/45%	2-cycle	84	78	81
New vehicle window sticker	Consumer information to compare individual vehicles	55%/45%	5-cycle	58	53	56
Estimated real-world	Best estimate of real-world performance	43%/57%	5-cycle	58	53	55

Notes: CAFE estimates and standards are shown in Tables 4.27 and 4.28. Test cycles are shown in Figures 4.8-4.12.

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: www.epa.gov/fuel-economy-trends)

The production-weighted fuel economy of cars increased dramatically from 1975 (13.5 mpg) to 1985 (23.0 mpg) but rose only 0.5 mpg from 1985 to 2005. Since 2005, fuel economy rose 7.3 mpg—from 23.5 mpg in 2005 to 30.8 mpg in 2018. The fuel economy values have been adjusted to provide the best estimate of real-world performance.

Table 4.9
Production, Production Shares, and Production-Weighted Fuel Economies of New Domestic and Import Cars, Model Years 1975-2018[a]

	Car			Car SUV		
Model year	Production (thousands)	Production share (%)[b]	Fuel economy (mpg)	Production (thousands)	Production share (%)[b]	Fuel economy (mpg)
1975	8,237	99.9%	13.5	10	0.1%	11.1
1980	9,443	100.0%	20.0	0	0.0%	14.6
1990	8,810	99.3%	23.3	65	0.7%	18.8
1991	8,524	97.4%	23.4	224	2.6%	18.2
1992	8,108	97.1%	23.1	243	2.9%	17.8
1993	8,456	94.7%	23.5	473	5.3%	17.0
1994	8,415	96.2%	23.3	332	3.8%	18.0
1995	9,396	97.7%	23.4	220	2.3%	17.8
1996	7,890	96.5%	23.3	287	3.5%	18.4
1997	8,334	95.8%	23.4	361	4.2%	19.2
1998	7,971	94.6%	23.4	454	5.4%	18.2
1999	8,376	94.5%	23.0	488	5.5%	18.5
2000	9,125	93.7%	22.9	617	6.3%	17.9
2001	8,405	91.9%	23.0	743	8.1%	18.8
2002	8,301	93.2%	23.1	603	6.8%	19.3
2003	7,921	93.2%	23.3	575	6.8%	19.9
2004	7,537	92.2%	23.1	639	7.8%	20.0
2005	8,027	90.8%	23.5	813	9.2%	20.2
2006	7,993	91.4%	23.3	751	8.6%	20.5
2007	8,082	89.8%	24.1	919	10.2%	20.6
2008	7,319	88.8%	24.3	924	11.2%	21.2
2009	5,636	90.3%	25.3	608	9.7%	22.0
2010	6,061	86.9%	26.2	915	13.1%	23.0
2011	5,743	82.6%	25.8	1,207	17.4%	23.5
2012	7,393	85.4%	27.6	1,265	14.6%	23.3
2013	8,226	84.5%	28.4	1,514	15.5%	24.3
2014	7,639	83.0%	28.4	1,566	17.0%	24.4
2015	7,899	82.3%	29.0	1,701	17.7%	25.1
2016	7,130	79.2%	29.2	1,870	20.8%	26.2
2017	6,977	78.1%	30.2	1,961	21.9%	26.2
2018[c]	[d]	81.2%	30.8	[d]	18.8%	26.8

Note: See Table 4.11 for all cars (car + car SUV). See Table 4.9 for car SUV listing.

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: (Additional resources: www.epa.gov/fuel-economy-trends)

[a] The fuel economy data on this table are adjusted to provide the best estimate of real world performance. See section 10 of the source document for details on adjustment methodology. These data are typically 20-25% lower than Corporate Average Fuel Economy data.
[b] Production share is based on total of cars plus car SUVs. Percentages may not sum to totals due to rounding.
[c] Data for 2018 are preliminary.
[d] Data are not available.

A vehicle classification was created to match the Corporate Average Fuel Economy (CAFE) methodology. Under CAFE, two-wheel drive sport utility vehicles that are under 6,000 lb gross vehicle weight and have off road capabilities will be held to the same standards as cars. The Environmental Protection Agency has labeled these vehicles as "car SUVs."

Table 4.10
Definition of Car Sport Utility Vehicles in Model Year 2018

Acura RDX FWD	Jeep Cherokee FWD
Buick Encore	Jeep Compass 4X2
Buick Envision FWD	Jeep Renegade 4x2
BYD Motors e6	Kia Sportage FE FWD
Chevrolet Equinox AWD	Kia Sportage FWD
Chevrolet Equinox FWD	Lexus RX 350
Chevrolet TRAX	Lincoln MKC FWD
Dodge Journey	Lincoln MKX FWD
Fiat 500X	Mazda CX-5 2WD
Ford ECOSPORT FWD	Mercedes GLA 250
Ford Edge FWD	Mercedes GLC 300
Ford Escape FWD	Mitsubishi Outlander Sport 2WD
Ford Escape FWD FFV	Nissan Rogue FWD
GMC Terrain FWD	Nissan Rogue FWD Hybrid
Honda CR-V FWD	Tesla Model X 100D
Hyundai Santa Fe Sport AWD	Tesla Model X 75D
Hyundai Santa Fe Sport FWD	Tesla Model X P100D
Hyundai Santa Fe Sport Ultimate AWD	Toyota RAV4
Hyundai Tucson AWD	Toyota RAV4 LE/XLE
Hyundai Tucson FWD	VW Tiguan

Note: 2WD = Two-wheel drive. 4WD = Four-wheel drive. AWD = All-wheel drive. FWD = Front-wheel drive.

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: www.epa.gov/fuel-economy-trends)

Production of sport utility vehicles (SUVs) has grown substantially since 1975. The production-weighted fuel economy of truck SUVs was nearly 23 mpg in 2017. Estimates show 66% of all light trucks produced in 2018 were truck SUVs.

Table 4.11
Production, Production Shares, and Production-Weighted Fuel Economies of New Domestic and Import Light Trucks, Model Years 1975-2018[a]

	Pickup			Van			Truck SUV		
Model Year	Production (Thousands)	Share (%)[b]	Fuel Economy (mpg)	Production (Thousands)	Share (%)[b]	Fuel Economy (mpg)	Production (Thousands)	Share (%)[b]	Fuel Economy (mpg)
1975	1,343	67.9%	11.9	457	23.1%	11.1	177	9.0%	11.0
1980	1,437	77.1%	16.5	242	13.0%	14.1	184	9.9%	13.2
1985	2,078	58.0%	18.2	855	23.9%	16.5	648	18.1%	16.5
1986	2,532	59.0%	18.9	1,044	24.3%	17.5	714	16.6%	17.0
1987	2,147	53.2%	19.0	1,114	27.6%	17.7	779	19.3%	17.3
1988	2,459	55.3%	18.1	1,133	25.5%	17.9	859	19.3%	17.0
1989	2,232	51.6%	17.8	1,278	29.5%	17.8	818	18.9%	16.6
1990	1,835	49.1%	17.4	1,262	33.7%	17.8	643	17.2%	16.4
1991	1,920	50.2%	18.2	1,034	27.0%	17.9	871	22.8%	16.7
1992	1,840	48.1%	17.5	1,221	31.9%	17.9	761	19.9%	16.2
1993	2,002	46.8%	17.6	1,441	33.7%	18.2	838	19.6%	16.3
1994	2,669	49.6%	17.4	1,418	26.4%	17.8	1,291	24.0%	16.0
1995	2,271	41.1%	16.9	1,662	30.1%	18.1	1,596	28.9%	16.0
1996	1,955	39.4%	17.1	1,409	28.4%	18.3	1,603	32.3%	16.2
1997	2,408	41.8%	16.8	1,265	22.0%	18.2	2,089	36.3%	16.1
1998	2,415	40.0%	17.0	1,489	24.7%	18.7	2,127	35.3%	16.2
1999	2,544	40.1%	16.3	1,463	23.0%	18.3	2,342	36.9%	16.1
2000	2,612	38.2%	16.7	1,691	24.8%	18.6	2,526	37.0%	16.0
2001	2,519	39.0%	16.0	1,232	19.1%	18.0	2,707	41.9%	16.4
2002	2,380	33.0%	15.8	1,243	17.2%	18.7	3,588	49.8%	16.3
2003	2,474	34.0%	16.1	1,232	16.9%	19.0	3,571	49.1%	16.4
2004	2,505	33.3%	15.7	953	12.7%	19.2	4,075	54.1%	16.5
2005	2,300	32.6%	15.8	1,481	21.0%	19.3	3,272	46.4%	16.7
2006	2,188	34.4%	16.1	1,166	18.3%	19.5	3,006	47.3%	17.2
2007	2,113	33.7%	16.2	847	13.5%	19.5	3,314	52.8%	17.7
2008	1,794	31.7%	16.5	790	14.0%	19.8	3,072	54.3%	18.2
2009	989	32.2%	16.9	368	12.0%	20.1	1,714	55.8%	19.3
2010	1,276	30.8%	16.9	559	13.5%	20.1	2,305	55.7%	19.7
2011	1,479	29.2%	17.2	521	10.3%	20.9	3,069	60.5%	19.8
2012	1,357	28.3%	17.2	662	13.8%	21.3	2,771	57.9%	20.0
2013	1,577	28.9%	17.5	571	10.5%	21.1	3,310	60.6%	20.8
2014	1,929	30.6%	18.0	672	10.6%	21.3	3,706	58.8%	21.6
2015	1,786	25.0%	18.8	655	9.2%	21.8	4,697	65.8%	21.9
2016	1,907	26.2%	18.9	630	8.7%	21.7	4,730	65.1%	22.2
2017	2,054	25.4%	18.9	617	7.6%	22.2	5,402	66.9%	22.4
2018[c]	[d]	27.5%	19.3	[d]	6.8%	22.9	[d]	65.6%	23.0

Note: Data include pickups, vans, and truck SUV less than 8,500 lb. Beginning with 2011, truck SUV and passenger vans up to 10,000 lb were also included. See Table 4.11 for all light trucks (pickup + van + truck SUV).

Source:
U.S. Environmental Protection Agency, The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975, EPA-420-R-19-002, March 2019. (Additional resources: https://www.epa.gov/automotive-trends)

[a] The fuel economy data on this table are adjusted to provide the best estimate of real world performance. See section 10 of the source document for details on adjustment methodology. These data are typically 20-25% lower than Corporate Average Fuel Economy data.

[b] Production share is based on the total of pickups, plus vans and truck SUVs. Percentages may not sum to totals due to rounding.

[c] Data for 2018 are preliminary.

[d] Data are not available.

The average fuel economy of cars more than doubled from 1975 to 2018 while the average fuel economy of light trucks grew by 88% in that same time period. This was not steady annual growth, but growth in the 1970's and early 1980's followed by a long period with little improvement. Growth resumed around 2008-2009.

Table 4.12
Production and Production-Weighted Fuel Economies of New Domestic and Import Cars, Light Trucks and Light Vehicles, Model Years 1975-2018[a]

Model Year	All Cars[b] Production (Thousands)	All Cars[b] Fuel Economy (mpg)	All Light Trucks Production (Thousands)	All Light Trucks Fuel Economy (mpg)	All Light Vehicles Production (Thousands)	All Light Vehicles Fuel Economy (mpg)
1975	8,247	13.5	1,977	11.6	10,224	13.1
1980	9,444	20.0	1,863	15.8	11,307	19.2
1985	10,879	23.0	3,581	17.5	14,460	21.3
1990	8,875	23.3	3,740	17.4	12,615	21.2
1995	9,616	23.3	5,529	17.0	15,145	20.5
1996	8,177	23.1	4,967	17.2	13,144	20.4
1997	8,695	23.2	5,762	16.8	14,457	20.2
1998	8,425	23.0	6,030	17.1	14,455	20.1
1999	8,865	22.7	6,350	16.6	15,215	19.7
2000	9,742	22.5	6,829	16.8	16,571	19.8
2001	9,148	22.6	6,458	16.5	15,606	19.6
2002	8,904	22.8	7,211	16.5	16,115	19.5
2003	8,496	23.0	7,277	16.7	15,773	19.6
2004	8,176	22.9	7,533	16.5	15,709	19.3
2005	8,839	23.1	7,053	16.9	15,892	19.9
2006	8,744	23.0	6,360	17.2	15,104	20.1
2007	9,001	23.7	6,275	17.4	15,276	20.6
2008	8,243	23.9	5,656	17.8	13,898	21.0
2009	6,244	25.0	3,071	18.5	9,316	22.4
2010	6,976	25.7	4,141	18.8	11,116	22.6
2011	6,949	25.4	5,069	19.1	12,018	22.3
2012	8,659	26.9	4,790	19.3	13,449	23.6
2013	9,740	27.7	5,458	19.8	15,198	24.2
2014	9,205	27.6	6,307	20.3	15,512	24.1
2015	9,601	28.2	7,138	21.1	16,739	24.6
2016	9,000	28.5	7,267	21.2	16,267	24.7
2017	8,938	29.2	8,072	21.4	17,011	24.9
2018[c]	[d]	29.9	[d]	21.8	[d]	25.4

Note: Data include pickups, vans, and truck SUV less than 8,500 lb. Beginning with 2011, truck SUVs and passenger vans up to 10,000 lb were also included.

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: www.epa.gov/fuel-economy-trends)

[a] The fuel economy data on this table are adjusted to provide the best estimate of real world performance. See section 10 of the source document for details on adjustment methodology. These data are typically 20-25% lower than Corporate Average Fuel Economy data.

[b] All Cars include both car and car SUV categories.

[c] Data for 2018 are preliminary.

[d] Data are not available, but 51.7% of all light vehicles were cars (car + car SUV) and 48.3% were light trucks (pickups, vans, and truck SUV) in 2018.

Back in 1975 only 19.3% of new light vehicles produced were light trucks. Because of the boom in production of minivans, sport utility vehicles, and pick-up trucks, that number rose to over 40% in 1998. In 2018, 48.3% of light vehicles produced were light trucks. The car SUV category was 9.7% of production in 2018 and the truck SUVs were 31.7%.

Table 4.13
Light Vehicle Production Shares[a], Model Years 1975–2018

Model Year	Car	Car SUV	Pickup	Van	Truck SUV	Total Light Vehicles Produced (thousands)	Production Share	
							Cars[b]	Light Trucks
1975	80.6%	0.1%	13.1%	4.5%	1.7%	10,224	80.7%	19.3%
1980	83.5%	0.0%	12.7%	2.1%	1.6%	11,306	83.5%	16.5%
1985	74.6%	0.6%	14.4%	5.9%	4.5%	14,460	75.2%	24.8%
1990	69.8%	0.5%	14.5%	10.0%	5.1%	12,615	70.4%	29.6%
1991	67.8%	1.8%	15.3%	8.2%	6.9%	12,573	69.6%	30.4%
1992	66.6%	2.0%	15.1%	10.0%	6.2%	12,172	68.6%	31.4%
1993	64.0%	3.6%	15.2%	10.9%	6.3%	13,211	67.6%	32.4%
1994	59.6%	2.3%	18.9%	10.0%	9.1%	14,125	61.9%	38.1%
1995	62.0%	1.5%	15.0%	11.0%	10.5%	15,145	63.5%	36.5%
1996	60.0%	2.2%	14.9%	10.7%	12.2%	13,144	62.2%	37.8%
1997	57.6%	2.5%	16.7%	8.8%	14.5%	14,458	60.1%	39.9%
1998	55.1%	3.1%	16.7%	10.3%	14.7%	14,456	58.3%	41.7%
1999	55.1%	3.2%	16.7%	9.6%	15.4%	15,215	58.3%	41.7%
2000	55.1%	3.7%	15.8%	10.2%	15.2%	16,571	58.8%	41.2%
2001	53.9%	4.8%	16.1%	7.9%	17.3%	15,605	58.6%	41.4%
2002	51.5%	3.7%	14.8%	7.7%	22.3%	16,115	55.3%	44.7%
2003	50.2%	3.6%	15.7%	7.8%	22.6%	15,773	53.9%	46.1%
2004	48.0%	4.1%	15.9%	6.1%	25.9%	15,709	52.0%	48.0%
2005	50.5%	5.1%	14.5%	9.3%	20.6%	15,892	55.6%	44.4%
2006	52.9%	5.0%	14.5%	7.7%	19.9%	15,104	57.9%	42.1%
2007	52.9%	6.0%	13.8%	5.5%	21.7%	15,276	58.9%	41.1%
2008	52.7%	6.6%	12.9%	5.7%	22.1%	13,898	59.3%	40.7%
2009	60.5%	6.5%	10.6%	4.0%	18.4%	9,316	67.0%	33.0%
2010	54.5%	8.2%	11.5%	5.0%	20.7%	11,116	62.8%	37.3%
2011	47.8%	10.0%	12.3%	4.3%	25.5%	12,018	57.8%	42.2%
2012	55.0%	9.4%	10.1%	4.9%	20.6%	13,449	64.4%	35.6%
2013	54.1%	10.0%	10.4%	3.8%	21.8%	15,198	64.1%	35.9%
2014	49.2%	10.1%	12.4%	4.3%	23.9%	15,512	59.3%	40.7%
2015	47.2%	10.2%	10.7%	3.9%	28.1%	16,739	57.4%	42.6%
2016	43.8%	11.5%	11.7%	3.9%	29.1%	16,267	55.3%	44.7%
2017	41.0%	11.5%	12.1%	3.6%	31.8%	17,011	52.5%	47.5%
2018[c]	42.0%	9.7%	13.3%	3.3%	31.7%	[d]	51.7%	48.3%

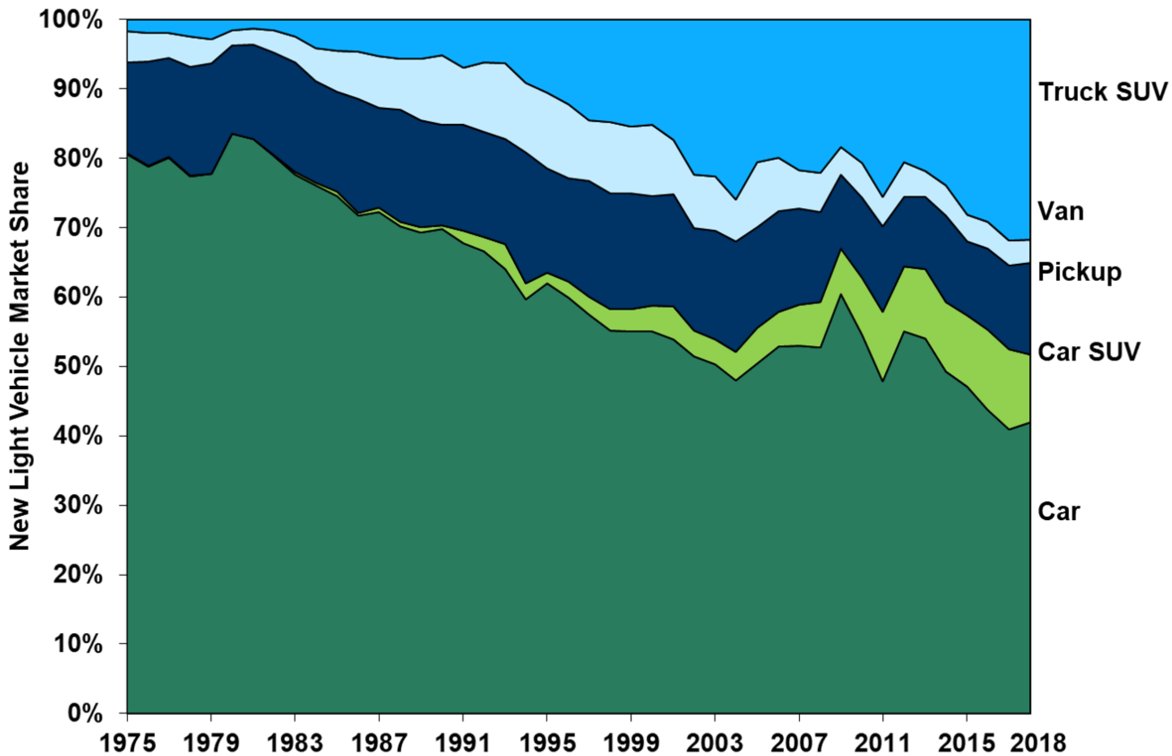
Note: Light truck data include pickups, vans, and truck SUVs less than 8,500 lb. Beginning with 2011, SUV and passenger vans up to 10,000 lb were also included.

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: https://www.epa.gov/automotive-trends)

[a] Percentages may not sum to totals due to rounding.
[b] Cars include both car and car SUV categories.
[c] Data for 2018 are preliminary.
[d] Data are not available.

The effects of the Japanese earthquake/tsunami in 2011 are apparent in the large decline in car production for that year. Light trucks were gaining market share from the early 1980s until 2004, mainly due to increases in the market share of sport utility vehicles (SUVs) and pickup trucks. Car SUVs are two-wheel drive SUVs that are counted as cars in the Corporate Average Fuel Economy Standards for model years 2011-on. A listing of the makes/models of car SUVs is in Table 4.10.

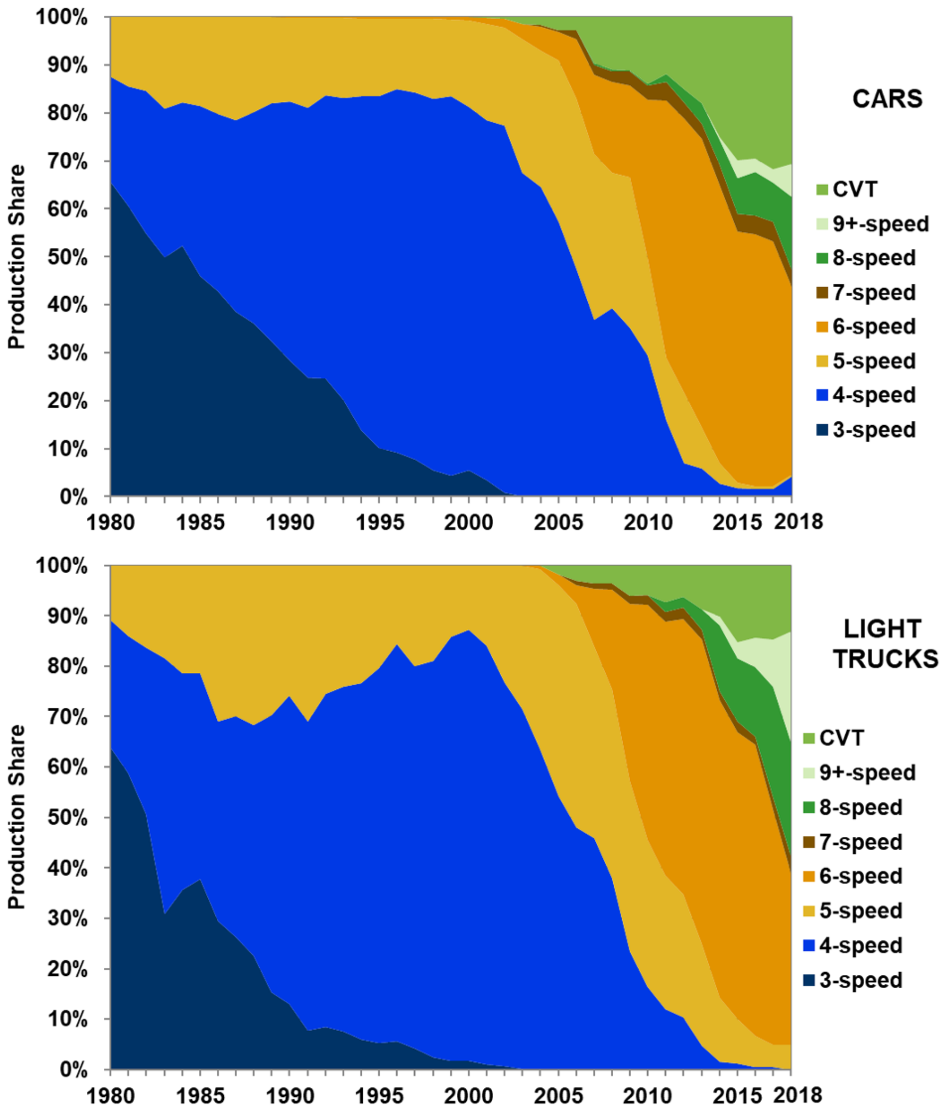
Figure 4.4. Light Vehicle Production Shares, Model Years 1975–2018



Source:
See Table 4.13.

The number of transmission speeds in new light-duty vehicles has been growing over the last few decades. By 2018, 96% of cars and 95% of light trucks were at least six speeds. The share of light truck transmissions in the 9+ category grew to 22% in 2018. Continuously variable transmissions (CVTs) were almost one-third of car production and 13% of light truck production. A greater number of gears improves fuel economy and performance by more closely matching the wheel speed to the optimum engine speed.

Figure 4.5. Car and Light Truck Production by Transmission Speed, Model Years 1980-2018



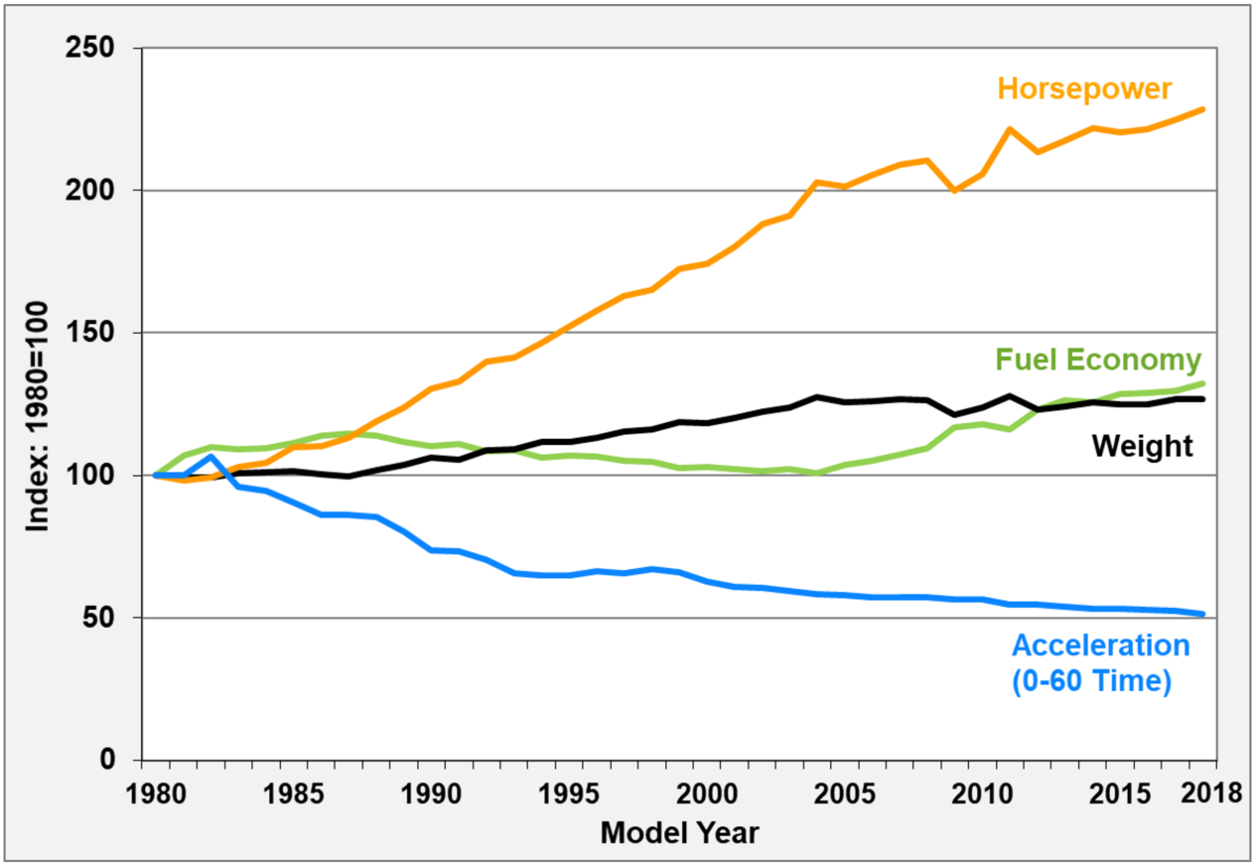
Note: Data are production-weighted averages for each model year. Data for model year 2018 are preliminary. CVT data include both hybrid and non-hybrid. Data include light trucks less than 8,500 lb. Beginning with 2011, SUVs and passenger vans up to 10,000 lb were also included.

Source:

U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: https://www.epa.gov/automotive-trends)

Increased performance typically comes as a trade-off with fuel economy. But light vehicle manufacturers have been able to employ advanced technologies to improve both performance and fuel economy. Despite a 128% increase in horsepower and 49% improvement in acceleration from model year 1980 to 2018, the fuel economy of vehicles improved 32%. In the 1990s and early 2000s, fuel economy decreased while vehicle weight increased. Fuel economy has improved nearly every year since 2004.

Figure 4.6. Horsepower, Fuel Economy, Weight, and 0-60 Time for New Light Vehicles, Model Years 1980-2018



Note: Data are production-weighted averages for each model year and do not represent any individual vehicle. Data for model year 2018 are preliminary. Data include light trucks less than 8,500 lb. Beginning with 2011, SUVs and passenger vans up to 10,000 lb were also included.

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: https://www.epa.gov/automotive-trends)

Manufacturers have introduced new technologies that have played a significant role in improving the fuel economy of passenger cars. Turbocharging has enabled manufacturers to downsize engines without sacrificing performance while gasoline direct injection has improved combustion efficiency in the engine. Cylinder deactivation is another strategy for reducing engine displacement that shuts down cylinders under light load conditions. Stop-start reduces unnecessary idling by automatically shutting down the engine when the vehicle is stopped and restarting the engine only when needed. Continuously variable transmissions improve efficiency by maintaining optimum engine speed as the vehicle speed varies. Penetration of direct injection has grown rapidly and was installed on 54.1% of all new cars in 2018. Turbochargers were installed on 35.9% of new cars produced in 2018.

Table 4.14
Car Technology Penetration, 1996-2018

Model year	Turbo	Continuously variable transmission (non-hybrid)	Continuously variable transmission (hybrid)	Gasoline direct injection	Cylinder deactivation	Stop-start (non-hybrid)	Stop-start (hybrid)
1996	0.3%	0.0%	[a]	[a]	[a]	[a]	[a]
1997	0.7%	0.1%	[a]	[a]	[a]	[a]	[a]
1998	1.4%	0.1%	[a]	[a]	[a]	[a]	[a]
1999	2.5%	0.0%	[a]	[a]	[a]	[a]	[a]
2000	2.2%	0.0%	[a]	[a]	[a]	[a]	0.1%
2001	3.3%	0.0%	0.2%	[a]	[a]	[a]	0.2%
2002	3.9%	0.1%	0.3%	[a]	[a]	[a]	0.3%
2003	2.0%	1.0%	0.5%	[a]	[a]	[a]	0.6%
2004	3.6%	0.9%	0.8%	[a]	[a]	[a]	0.9%
2005	2.4%	1.1%	1.7%	[a]	1.0%	[a]	1.9%
2006	3.2%	1.2%	1.5%	[a]	2.0%	[a]	1.5%
2007	3.6%	6.7%	3.0%	0.3%	0.9%	[a]	3.2%
2008	4.5%	7.7%	3.2%	3.1%	2.0%	[a]	3.3%
2009	4.0%	8.3%	2.8%	4.2%	1.8%	[a]	2.9%
2010	4.1%	8.4%	5.5%	9.2%	2.1%	[a]	5.6%
2011	8.2%	8.8%	3.1%	18.4%	1.3%	[a]	3.4%
2012	9.7%	11.0%	4.0%	27.4%	1.7%	0.9%	4.6%
2013	15.1%	13.7%	4.3%	37.3%	1.9%	2.9%	5.3%
2014	18.1%	21.3%	3.7%	42.7%	2.2%	6.8%	4.1%
2015	18.1%	26.3%	3.6%	44.0%	2.2%	8.3%	4.0%
2016	23.6%	27.2%	2.4%	49.6%	2.1%	8.9%	2.7%
2017	29.0%	29.1%	2.7%	52.4%	3.0%	15.8%	3.4%
2018[b]	35.9%	26.7%	3.9%	51.7%	3.3%	21.3%	4.9%

Note: Based on production. Car category includes car SUV. See Table 4.9 for car SUV listing.

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: https://www.epa.gov/automotive-trends)

[a] The Environmental Protection Agency did not record market penetration for this technology in this year.
[b] Data for 2018 are preliminary.

Manufacturers have introduced a number of engine and transmission technologies to improve the fuel efficiency and performance of light trucks. Gasoline direct injection has seen rapid market penetration from about 1% of all new light trucks produced in 2008 to nearly half by 2018. Cylinder deactivation, turbocharging, and stop-start have all seen increased penetration with each of these technologies reaching more than 20% of production for light trucks in 2018. The penetration of continuously variable transmissions (CVT) is lower for light trucks than for cars because CVTs are not generally well suited to the high horsepower and high torque requirements of pickup trucks and large SUVs that provide greater load hauling and towing capability.

Table 4.15
Light Truck Technology Penetration, 2002-2018

Model year	Turbo	Continuously variable transmission (non-hybrid)	Continuously variable transmission (hybrid)	Gasoline direct injection	Cylinder deactivation	Stop-start (non-hybrid)	Stop-start (hybrid)
2002	[a]	0.0%	[a]	[a]	[a]	[a]	[a]
2003	0.2%	0.6%	[a]	[a]	[a]	[a]	[a]
2004	0.8%	0.6%	[a]	[a]	[a]	[a]	0.0%
2005	0.7%	1.7%	0.1%	[a]	0.5%	[a]	0.1%
2006	0.6%	1.6%	1.5%	[a]	5.9%	[a]	1.5%
2007	1.0%	2.9%	0.7%	[a]	16.4%	[a]	0.8%
2008	1.0%	2.3%	1.3%	1.1%	13.6%	[a]	1.3%
2009	1.7%	5.1%	0.9%	4.2%	18.3%	[a]	0.9%
2010	1.8%	5.1%	0.8%	6.8%	13.8%	[a]	0.9%
2011	4.9%	6.9%	0.4%	11.3%	20.6%	[a]	0.4%
2012	6.1%	5.9%	0.3%	13.5%	19.6%	0.3%	0.4%
2013	11.8%	8.4%	0.4%	18.4%	18.1%	1.1%	0.4%
2014	9.9%	9.8%	0.3%	29.7%	22.9%	2.5%	0.4%
2015	12.6%	15.0%	0.3%	39.0%	21.7%	5.6%	0.3%
2016	15.3%	13.6%	0.8%	46.2%	20.7%	10.3%	0.8%
2017	17.3%	13.8%	1.0%	46.6%	21.8%	20.0%	1.1%
2018[b]	25.4%	11.9%	1.3%	49.7%	20.9%	35.7%	2.1%

Note: Based on production. Data include pickups, vans, and truck SUV less than 8,500 lb. Beginning with 2011, truck SUVs and passenger vans up to 10,000 lb were also included.

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: https://www.epa.gov/automotive-trends)

[a] The Environmental Protection Agency did not record market penetration for this technology in this year.
[b] Data for 2018 are preliminary.

The production-weighted average engine displacement of cars in 1975 was 4.72 liters but had declined to 2.23 liters by 2018. Car SUVs also experienced a decline in engine displacement. For a list of car SUVs, see Table 4.10.

Table 4.16
Production-Weighted Engine Size of New Domestic and Import Cars
Model Years 1975-2018
(liters[a])

Model Year	Car	Car SUV
1975	4.73	4.29
1980	3.08	4.59
1985	2.90	2.80
1986	2.74	2.78
1987	2.65	2.93
1988	2.63	3.26
1989	2.67	3.70
1990	2.67	3.42
1991	2.66	3.52
1992	2.78	3.44
1993	2.73	3.91
1994	2.75	3.42
1995	2.74	3.51
1996	2.71	3.52
1997	2.68	3.11
1998	2.68	3.58
1999	2.72	3.45
2000	2.71	3.47
2001	2.70	3.17
2002	2.71	3.00
2003	2.71	2.97
2004	2.76	3.13
2005	2.72	3.05
2006	2.82	3.01
2007	2.71	3.04
2008	2.70	2.93
2009	2.54	2.87
2010	2.56	2.81
2011	2.61	2.72
2012	2.42	2.74
2013	2.37	2.63
2014	2.40	2.52
2015	2.37	2.51
2016	2.32	2.33
2017	2.26	2.25
2018[b]	2.23	2.11
Annual average percentage change		
1975–2018	-1.7%	-1.6%
2008–2018	-1.9%	-3.2%

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: https://www.epa.gov/automotive-trends)

[a] 1 liter = 61.02 cubic inches.
[b] Data for 2018 are preliminary.

The production-weighted engine size of truck sport utility vehicles (SUVs) declined an average of 2.4% per year from 2008 to 2018, while the engine size of pickups in 2018 decreased by only 0.9%.

Table 4.17
Production-Weighted Engine Size of New Domestic and Import Light Trucks, Model Years 1975-2018
(liters[a])

Model Year	Pickup	Van	Truck SUV
1975	5.02	5.20	5.44
1980	3.86	4.72	4.83
1985	3.63	3.87	3.63
1990	4.04	3.69	3.85
1991	3.80	3.60	3.82
1992	4.01	3.64	3.85
1993	4.00	3.57	4.00
1994	4.06	3.70	4.01
1995	4.20	3.79	4.01
1996	4.12	3.61	4.24
1997	4.33	3.61	4.19
1998	4.13	3.56	4.14
1999	4.38	3.65	4.14
2000	4.18	3.55	4.15
2001	4.41	3.75	3.92
2002	4.45	3.57	4.01
2003	4.33	3.59	4.05
2004	4.61	3.58	4.13
2005	4.65	3.53	4.00
2006	4.55	3.54	3.87
2007	4.69	3.59	3.94
2008	4.69	3.60	3.76
2009	4.70	3.53	3.46
2010	4.80	3.51	3.48
2011	4.63	3.47	3.56
2012	4.69	3.44	3.52
2013	4.62	3.43	3.36
2014	4.80	3.49	3.21
2015	4.54	3.32	3.24
2016	4.36	3.37	3.13
2017	4.48	3.37	3.11
2018[b]	4.29	3.30	2.95
Annual average percentage change			
1975-2018	-0.4%	-1.1%	-1.4%
2008-2018	-0.9%	-0.9%	-2.4%

Note: Data include pickups, vans, and truck SUV less than 8,500 lb. Beginning with 2011, truck SUVs and passenger vans up to 10,000 lb were also included.

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: https://www.epa.gov/automotive-trends)

[a] 1 liter = 61.02 cubic inches.
[b] Data for 2018 are preliminary.

The production-weighted loaded vehicle weight of cars declined by 525 lb from 1975 to 2018, while car SUVs declined by 222 lb.

Table 4.18
Production-Weighted Loaded Vehicle Weight[a] of New Domestic and Import Cars, Model Years 1975–2018
(pounds)

Model Year	Car	Car SUV
1975	4,058	4,000
1980	3,101	4,000
1985	3,093	3,469
1986	3,041	3,479
1987	3,031	3,492
1988	3,047	3,495
1989	3,099	3,497
1990	3,176	3,518
1991	3,154	3,733
1992	3,240	3,713
1993	3,207	3,848
1994	3,250	3,735
1995	3,263	3,763
1996	3,282	3,710
1997	3,274	3,549
1998	3,306	3,824
1999	3,365	3,831
2000	3,369	3,870
2001	3,380	3,765
2002	3,391	3,747
2003	3,417	3,716
2004	3,462	3,854
2005	3,463	3,848
2006	3,534	3,876
2007	3,507	3,935
2008	3,527	3,902
2009	3,464	3,846
2010	3,474	3,949
2011	3,559	3,890
2012	3,452	3,915
2013	3,465	3,966
2014	3,497	3,865
2015	3,489	3,868
2016	3,468	3,782
2017	3,470	3,855
2018[b]	3,532	3,778
Annual average percentage change		
1975-2018	-0.3%	-0.1%
2008-2018	0.0%	-0.3%

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: https://www.epa.gov/automotive-trends)

[a] Loaded vehicle weight is equal to the vehicle's curb weight plus 300 pounds.
[b] Data for 2018 are preliminary.

The production-weighted loaded vehicle weight of pickups, vans, and truck SUVs increased from 1975 to 2018. Pickups gained more than 1,100 lb while vans gained 290 lb and truck SUVs gained 225 lb.

Table 4.19
Production-Weighted Loaded Vehicle Weight of New Domestic and Import Light Trucks, Model Years 1975–2018
(pounds)

Model Year	Pickup	Van	Truck SUV
1975	4,012	4,196	4,214
1980	3,740	4,353	4,237
1985	3,642	3,975	4,092
1990	3,928	4,095	4,098
1991	3,779	4,133	4,157
1992	3,976	4,151	4,204
1993	3,996	4,105	4,331
1994	4,056	4,156	4,331
1995	4,182	4,110	4,323
1996	4,190	4,195	4,386
1997	4,415	4,240	4,463
1998	4,282	4,183	4,450
1999	4,486	4,306	4,518
2000	4,340	4,276	4,602
2001	4,551	4,518	4,546
2002	4,690	4,394	4,636
2003	4,642	4,393	4,754
2004	4,939	4,487	4,756
2005	4,988	4,430	4,756
2006	4,968	4,475	4,715
2007	5,144	4,479	4,797
2008	5,161	4,527	4,727
2009	5,176	4,572	4,548
2010	5,309	4,533	4,555
2011	5,268	4,502	4,665
2012	5,335	4,442	4,640
2013	5,429	4,543	4,584
2014	5,485	4,489	4,483
2015	5,165	4,416	4,533
2016	5,150	4,459	4,482
2017	5,217	4,503	4,510
2018[b]	5,184	4,485	4,438
Annual average percentage change			
1975-2018	0.6%	0.2%	0.1%
2008-2018	0.0%	-0.1%	-0.6%

Note: Data include pickups, vans, and truck SUV less than 8,500 lb. Beginning with 2011, truck SUVs and passenger vans up to 10,000 lb were also included.

Source:
U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. (Additional resources: https://www.epa.gov/automotive-trends)

[a] Loaded vehicle weight is equal to the vehicle's curb weight plus 300 pounds.
[b] Data for 2018 are preliminary.

The average light vehicle in 2017 contained more than 2,000 pounds of steel, most of it conventional steel. High and medium strength steel, however, were more than 19% of the vehicle. The use of aluminum grew from 1995 to 2017, while the use of iron castings declined.

Table 4.20
Average Material Consumption for a Domestic Light Vehicle,[a]
Model Years 1995, 2000, and 2017

	1995		2000		2017	
Material	Pounds	Percentage	Pounds	Percentage	Pounds	Percentage
Regular steel	1,630	44.1%	1,655	42.4%	1,222	30.9%
High and medium strength steel	324	8.8%	408	10.5%	765	19.3%
Stainless steel	51	1.4%	62	1.6%	72	1.8%
Other steels	46	1.2%	26	0.7%	31	0.8%
Iron castings	466	12.6%	432	11.1%	243	6.1%
Aluminum	231	6.3%	268	6.9%	416	10.5%
Magnesium castings	4	0.1%	8	0.2%	8	0.2%
Copper and brass	50	1.4%	52	1.3%	69	1.8%
Lead	33	0.9%	36	0.9%	37	0.9%
Zinc castings	19	0.5%	13	0.3%	9	0.2%
Powder metal parts	29	0.8%	36	0.9%	44	1.1%
Other metals	4	0.1%	4	0.1%	5	0.1%
Plastics and plastic composites	240	6.5%	286	7.3%	342	8.6%
Rubber	149	4.0%	166	4.3%	206	5.2%
Coatings	23	0.6%	25	0.6%	29	0.7%
Textiles	42	1.1%	44	1.1%	46	1.2%
Fluids and lubricants	192	5.2%	207	5.3%	222	5.6%
Glass	97	2.6%	103	2.6%	95	2.4%
Other materials	64	1.7%	71	1.8%	92	2.6%
Total	3,694	100.0%	3,902	100.0%	3,953	100.0%

Source:
Ward's Communications, www.wardsauto.com. (Original source: American Chemistry Council)

[a] Data are for vehicles built in North America. Percentages may not sum to totals due to rounding.

In the automotive industry, a tier 1 supplier is a company that sells directly to the original equipment manufacturer (OEM). Globally, Robert Bosch GMbH is the top automotive supplier. Of the top 20 global tier 1 suppliers, only Magna International has half its market in North America (50%).

Table 4.21
List of Top Twenty Tier 1 Global Suppliers, 2018

			Market share				
Rank	Company	Headquarters location	North America	Europe	Asia	Rest of World	Total
1	Robert Bosch GMbH	Germany	17%	45%	36%	2%	100%
2	Denso Corp.	Japan	23%	12%	64%	1%	100%
3	Magna International, Inc.	Canada	50%	42%	6%	2%	100%
4	Continental AG	Germany	28%	50%	22%	0%	100%
5	ZF Friedrichshafen AG	Germany	28%	47%	21%	4%	100%
6	Aisin Seiki	Japan	17%	9%	75%	2%	103%
7	Hyundai Mobis	Korea	12%	9%	76%	3%	100%
8	Lear Corp.	United States	36%	41%	19%	4%	100%
9	Faurecia	France	25%	51%	19%	5%	100%
10	Valeo SA	France	20%	46%	32%	2%	100%
11	Yazaki Corp.	Japan	31%	17%	52%	0%	100%
12	Panasonic Automotive Systems Co	Japan	34%	16%	50%	0%	100%
13	Adient (spun from Johnson Controls)	United States	30%	27%	43%	0%	100%
14	Sumitomo Electric Industries	Japan	24%	[a]	[a]	[a]	[a]
15	Yanfeng Automotive Trim Systems Co.	China	19%	12%	69%	0%	100%
16	Thyssenkrupp AG	Germany	25%	65%	8%	2%	100%
17	Mahle GmbH	Germany	27%	48%	20%	5%	100%
18	JTEKT Corp.	Japan	19%	16%	59%	6%	100%
19	BASF	Germany	26%	42%	23%	9%	100%
20	Apitiv	Ireland	38%	31%	29%	2%	100%

Source:
Crain Communications, Automotive News Supplement, "Top Suppliers," June 2019. (Additional resources: www.autonews.com)

[a] Data are not available.

There are 23 U.S.-based companies in the top 100 automotive global suppliers. Nine of these companies had at least half of their sales in North America in 2018.

Table 4.22
U.S.-Based Tier 1 Suppliers in the Global Top 100, 2018

Rank	Company	Percent North American sales	Products
8	Lear Corp.	36%	Seating & electrical systems (E-Systems)
13	Adient (spun from Johnson Controls)	30%	Seating & seating systems & components
22	BorgWarner, Inc.	34%	Turbochargers, electric motors, electronic control units, engine valve-timing, ignition systems, thermal systems, transmission-clutch systems, transmission-control & torque management systems
26	Tenneco, Inc.	47%	Emission control systems, manifolds, catalytic converters, diesel aftertreatment systems, catalytic reduction mufflers, shock absorbers, struts, electronic suspension products & systems
31	Flex-N-Gate Corp.	80%	Interior & exterior plastics, metal bumpers & hitches, structural metal assemblies, forward & signal lighting, mechanical assemblies, prototyping & sequencing
33	Dana Holding Corp.	50%	Axles, driveshafts, sealing & thermal management products
40	American Axle & Mfg Holdings, Inc	78%	Driveline & drivetrain systems & related components
60	Nexteer Automotive	67%	Electric power steering, hydraulic power steering, steering columns & halfshafts
63	Federal-Mogul Corp.	43%	Pistons, rings, cylinder liners, spark plugs, bearings, valvetrain products gaskets, seals, heat shields, brake materials, wipers, fuel pumps
64	Cooper Standard Automotive	53%	Systems & components, rubber & plastic sealing, fuel & brake lines, fluid transfer hoses & anti-vibration systems
69	DuPont, Transportation & Industry	24%	Engineered polymers, glass bonding adhesives, structural adhesives, lubricants, fluids & silicones
71	Flex	50%	Autonomy, connectivity, electrification & smart tech
72	Visteon Corp.	24%	Cockpit electronics: instrument clusters, head-up & information displays, infotainment, connected audio & connectivity & telematics
73	Novelis Inc.	56%	Flat-rolled aluminum sheet for vehicle structures, body panels, heat exchangers, heat shields & other automotive applications
76	Piston Group	100%	Electric batteries, cooling modules, brake corners, grille & shock assemblies, instrument panels, seat trim, sun visors, armrests/bolsters, shades, injection molding & brazed evaporator heater cores

(Continued)

Table 4.22 (Continued)
U.S.-Based Tier 1 Suppliers in the Global Top 100, 2018

Rank	Company	Percent North American Sales	Products
77	Inteva Products	30%	Closure systems, interior systems, roof systems, motors & electronic systems
84	Arconic Inc.	85%	Aluminum sheet for closure panels, hoods & trunks, bumper systems & crash management systems; extrusions for drive shafts
85	Bridgewater Interiors	100%	Automotive seating systems
90	Gentex Corp.	31%	Interior & exterior auto-dimming rearview mirrors, SmartBeam advanced lighting-assist, rear camera displays, compasses, LED turn signals, side blind-zone indicators & driver assist features
95	Tower International	97%	Body structures & assemblies, lower vehicle frames & structures, chassis modules & systems & suspension components
97	Dura Automotive Systems	42%	Mechatronic controls, shift-by-wire systems; electronics, actuators & advanced driver assist systems; lightweight structural body systems & exterior trim
99	Auria	52%	Flooring, acoustical, thermal products & fiber-based components
100	Henniges Automotive	68%	Weather seals & anti-vibration products

Note: Rank based on total global OEM automotive parts sales in 2018.

Source:
Crain Communications, Automotive News Supplement, "Top Suppliers," June 2019. (Additional resources: www.autonews.com)

The number of franchised dealerships which sell new light-duty vehicles (cars and light trucks) has declined 46% since 1970. This decline, along with light vehicle sales of nearly 17 million, caused the average number of vehicles sold to be 1,010 vehicles per dealer in 2018.

Table 4.23
New Light Vehicle Dealerships and Sales, 1970–2018

Calendar year	Number of franchised new light vehicle dealerships[a]	New light vehicle sales[b] (thousands)	Light vehicle sales per dealer
1970	30,800	9,856	320
1975	29,600	10,677	361
1980	27,900	10,909	391
1985	24,725	14,667	593
1986	24,825	15,998	644
1987	25,150	14,802	589
1988	25,025	15,347	613
1989	25,000	14,389	576
1990	24,825	13,851	558
1991	24,200	12,307	509
1992	23,500	12,842	546
1993	22,950	13,869	604
1994	22,850	15,024	657
1995	22,800	14,673	644
1996	22,750	14,998	659
1997	22,700	15,014	661
1998	22,600	15,384	681
1999	22,400	16,711	746
2000	22,250	17,164	771
2001	22,150	16,950	765
2002	21,800	16,675	765
2003	21,725	16,494	759
2004	21,650	16,737	773
2005	21,640	16,774	775
2006	21,495	16,336	760
2007	21,200	15,867	748
2008	20,770	13,015	627
2009	20,010	10,236	512
2010	18,460	11,394	617
2011	17,700	12,542	709
2012	17,540	14,220	811
2013	17,665	15,279	865
2014	16,396	16,192	988
2015	16,545	17,095	1,033
2016	16,708	17,169	1,028
2017	16,802	16,818	1,001
2018	16,753	16,913	1,010
	Average annual percentage change		
1970-2018	-1.3%	1.1%	2.4%
2008-2018	-2.1%	2.7%	4.9%

Source:
Number of dealers - National Automobile Dealers Association website, www.nada.org. (Additional resources: www.nada.org). Light vehicle sales - See tables 4.5 and 4.6.

[a] As of the beginning of the year.
[b] Includes cars and trucks up to 10,000 lb gross vehicle weight.

Table 4.24
Conventional Refueling Stations, 1972–2019

Year	Number of stations	Vehicles in operation (thousands)	Stations per thousand vehicles	Thousand vehicles per station
1972	287,000	106,212	2.70	0.37
1973	272,000	111,217	2.45	0.41
1974	257,000	115,920	2.22	0.45
1975	242,000	120,054	2.02	0.50
1976	230,000	124,378	1.85	0.54
1977	220,000	128,126	1.72	0.58
1978	210,000	133,522	1.57	0.64
1979	203,000	137,260	1.48	0.68
1980	196,000	139,832	1.40	0.71
1981	191,000	141,908	1.35	0.74
1982	186,000	143,854	1.29	0.77
1983	182,000	147,104	1.24	0.81
1984	180,000	152,162	1.18	0.85
1985	178,000	157,049	1.13	0.88
1986	177,000	162,094	1.09	0.92
1987	176,000	167,193	1.05	0.95
1988	176,000	171,740	1.02	0.98
1989	175,000	175,960	0.99	1.01
1990	174,000	179,299	0.97	1.03
1991	172,000	181,447	0.95	1.05
1992	169,000	181,519	0.93	1.07
1993	167,000	186,315	0.90	1.12
1994	165,000	188,714	0.87	1.14
1995	164,000	193,441	0.85	1.18
1996	163,000	198,294	0.82	1.22
1997	162,000	201,071	0.81	1.24
1998	147,000	205,043	0.72	1.39
1999	141,000	209,509	0.67	1.49
2000	139,000	213,300	0.65	1.53
2001	137,000	216,683	0.63	1.58
2002	135,000	221,027	0.61	1.64
2003	137,000	225,882	0.61	1.65
2004	140,000	232,167	0.60	1.66
2005	144,000	238,384	0.60	1.66
2006	148,000	244,643	0.60	1.65
2007	150,000	248,701	0.60	1.66
2008	151,000	249,813	0.60	1.65
2009	148,000	248,972	0.59	1.68
2010	147,000	248,232	0.59	1.69
2011	147,000	248,932	0.59	1.69
2012	146,000	251,497	0.58	1.72
2013	145,000	252,715	0.57	1.74
2014	145,000	258,027	0.56	1.78
2015	145,000	264,194	0.55	1.82
2016	144,000	270,566	0.53	1.88
2017	143,000	275,979	0.52	1.93
2018	143,000	[a]	[a]	[a]
2019	142,000	[a]	[a]	[a]

Notes: Includes all outlets open to the public and selling gasoline. Lundberg survey dates were 1972, 1982, 2002, 2006, 2008, 2013, 2015, 2017, and 2019. Other years were estimated by Lundberg Survey, Inc.

Sources:
Conventional refueling stations: Lundberg Survey, Inc. Used with permission.
Conventional vehicles: IHS Automotive, Detroit, MI. Used with permission.

[a] Data are not available.

The National Highway Traffic Safety Administration and the Environmental Protection Agency issued joint rulemaking to establish a new National Program to regulate fuel economy and greenhouse gas emissions for model year (MY) 2012-2025 cars and light trucks. The standards for model years 2021-2025 are currently under review.

Table 4.25
Fuel Economy and Carbon Dioxide Emissions Standards, MY 2012–2025

Year	Cars	Light trucks	Combined cars and light trucks	
		Average required fuel economy (miles per gallon)		
2012	33.3	25.4	29.7	
2013	34.2	26.0	30.5	
2014	34.9	26.6	31.3	
2015	36.2	27.5	32.6	
2016	37.8	28.8	34.1	
2017	40.1	29.4	35.4	
2018	41.6	30.0	36.5	
2019	43.1	30.6	37.7	
2020	44.8	31.2	38.9	
2021	46.8	33.3	41.0	Standards under review
2022	49.0	34.9	43.0	
2023	51.2	36.6	45.1	
2024	53.6	38.5	47.4	
2025	56.2	40.3	49.7	
		Average projected emissions compliance levels under the footprint-based carbon dioxide standards (grams per mile)		
2012	263	346	295	
2013	256	337	286	
2014	247	326	276	
2015	236	312	263	
2016	225	298	250	
2017	212	295	243	
2018	202	285	232	
2019	191	277	222	
2020	182	269	213	
2021	172	249	199	Standards under review
2022	164	237	190	
2023	157	225	180	
2024	150	214	171	
2025	143	203	163	

Note: The required fuel economy and CO_2 emissions shown here use a model year 2008 baseline. The presented rates of increase in stringency for NHTSA CAFE standards are lower than the Environmental Protection Agency (EPA) rates of increase in stringency for greenhouse gas (GHG) standards. One major difference is that NHTSA's standards, unlike EPA's, do not reflect the inclusion of air conditioning system refrigerant and leakage improvements, but EPA's standards would allow consideration of such improvements which reduce GHGs but generally do not affect fuel economy. The 2025 EPA GHG standard of 163 grams/mile would be equivalent to 54.5 mpg, if the vehicles were to meet this level all through fuel economy improvements. The agencies expect, however, that a portion of these improvements will be made through reductions in air conditioning leakage, which would not contribute to fuel economy.

Source:
Federal Register, Vol. 77, No. 199, October 15, 2012. (Additional resources: www.nhtsa.gov/fuel-economy)

The target levels for the fuel economy and carbon dioxide emission standards for vehicles manufactured in model years 2012-on are assigned based on a vehicle's "footprint." Each footprint has a different target. The vehicle footprint is calculated as:

footprint = track width × wheelbase,

where

track width = lateral distance between the centerlines of the base tires at ground, and
wheelbase = longitudinal distance between the front and rear wheel centerlines.

Table 4.26
Fuel Economy and Carbon Dioxide Targets for Model Year 2025

Vehicle type	Example models	Example model footprint (square feet)	CO_2 emissions target (grams per mile)	Fuel economy target (miles per gallon)
		Example Passenger Cars		
Compact car	Honda Fit	40	131	61.1
Midsize car	Ford Fusion	46	147	54.9
Fullsize car	Chrysler 300	53	170	48.0
		Example Light-Duty Trucks		
Small SUV	4WD Ford Escape	44	170	47.5
Midsize crossover	Nissan Murano	49	188	43.4
Minivan	Toyota Sienna	55	209	39.2
Large pickup truck	Chevy Silverado	67	252	33.0

Notes: The model year 2025 targets are currently under review. Examples in table use model year 2012 vehicle specifications. The fuel economy from this table will not match the fuel economy listed on the window sticker of a new vehicle. Window sticker fuel economy is calculated by a different methodology than the Corporate Average Fuel Economy.

Source:
Federal Register, Vol. 77, No. 199, October 15, 2012. (Additional resources: www.nhtsa.gov/fuel-economy)

The Corporate Average Fuel Economy standards were first established by the U.S. Energy Policy and Conservation Act of 1975 (PL94-163). These standards must be met at the manufacturer level. Legislation passed in December 2007 changed the CAFE standards beginning in the 2011 model year (MY). Some two-wheel drive sport utility vehicles are classified as cars under the final standards for MY 2011-2021.

Table 4.27
Car Corporate Average Fuel Economy (CAFE) Standards versus Sales-Weighted Fuel Economy Estimates, 1978–2017[a]
(miles per gallon)

	Cars				CAFE estimates
Model	CAFE standards		CAFE estimates[c]		Cars and light
year[b]	Domestic	Import	Domestic	Import	trucks combined
1978	18.0	18.0	18.7	27.3	19.9
1980	20.0	20.0	22.6	29.6	23.1
1985	27.5	27.5	26.3	31.5	25.4
1990	27.5	27.5	26.9	29.9	25.4
1991	27.5	27.5	27.3	30.1	25.6
1992	27.5	27.5	27.0	29.2	25.1
1993	27.5	27.5	27.8	29.6	25.2
1994	27.5	27.5	27.5	29.6	24.7
1995	27.5	27.5	27.7	30.3	24.9
1996	27.5	27.5	28.1	29.6	24.9
1997	27.5	27.5	27.8	30.1	24.6
1998	27.5	27.5	28.6	29.2	24.7
1999	27.5	27.5	28.0	29.0	24.5
2000	27.5	27.5	28.7	28.3	24.8
2001	27.5	27.5	28.7	29.0	24.5
2002	27.5	27.5	29.1	28.8	24.7
2003	27.5	27.5	29.1	29.9	25.1
2004	27.5	27.5	29.9	28.7	24.6
2005	27.5	27.5	30.5	29.9	25.4
2006	27.5	27.5	30.3	29.7	25.8
2007	27.5	27.5	30.6	32.2	26.6
2008	27.5[d]	27.5	31.2	31.8	27.1
2009	27.5[d]	27.5	32.1	33.8	29.0
2010	27.5[d]	27.5	33.1	35.2	29.3
2011	30.0	30.4	32.7	33.7	29.0
2012	32.7	33.4	34.8	36.0	30.8
2013	33.2	33.9	36.1	36.8	31.6
2014	34.0	34.6	36.3	36.9	31.7
2015	35.2	35.8	37.2	37.3	32.2
2016	36.5	37.4	37.3	38.2	32.2
2017	39.1	39.3	39.2	38.7	32.9

Source:
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, December 2014 and updates 2017. (Additional resources: www.nhtsa.gov)

[a] Only vehicles with at least 75 percent domestic content can be counted in the average domestic fuel economy for a manufacturer.
[b] Model year as determined by the manufacturer on a vehicle by vehicle basis.
[c] All CAFE calculations are sales-weighted.
[d] Unreformed standards, which were an option from 2008-2010. See Table 4.25 for reformed standards.

The Corporate Average Fuel Economy standards for light trucks are lower than the car standards. Light trucks include pickups, minivans, sport utility vehicles and vans. New legislation passed in December 2007 changed the CAFE standards beginning in the 2011 model year (MY). Some two-wheel drive sport utility vehicles are classified as cars under the final standards for MY 2011-2021.

Table 4.28
Light Truck Corporate Average Fuel Economy (CAFE) Standards versus Sales-Weighted Fuel Economy Estimates, 1978–2017[a]
(miles per gallon)

	Light trucks[b]				CAFE estimates
		CAFE estimates[d]			
Model year[c]	CAFE standards	Domestic	Import	Combined	Cars and light trucks combined
1978	[e]	[f]	[f]	[f]	19.9
1980	[e]	16.8	24.3	18.5	23.1
1985	19.5	19.6	26.5	20.7	25.4
1990	20.0	20.3	23.0	20.8	25.4
1991	20.2	20.9	23.0	21.3	25.6
1992	20.2	20.5	22.7	20.8	25.1
1993	20.4	20.7	22.8	21.0	25.2
1994	20.5	20.5	22.1	20.8	24.7
1995	20.6	20.3	21.5	20.5	24.9
1996	20.7	20.5	22.2	20.8	24.9
1997	20.7	20.1	22.1	20.6	24.6
1998	20.7	20.5	23.0	21.0	24.7
1999	20.7	20.4	22.5	20.9	24.5
2000	20.7	21.1	19.7	21.3	24.8
2001	20.7	20.6	21.8	20.9	24.5
2002	20.7	20.6	21.9	21.4	24.7
2003	20.7	21.8	22.4	21.8	25.1
2004	20.7	20.7	22.3	21.5	24.6
2005	21.0	[f]	[f]	22.1	25.4
2006	21.6	[f]	[f]	22.5	25.8
2007	22.2	[f]	[f]	23.1	26.6
2008	22.4[g]	[f]	[f]	23.6	27.1
2009	23.0[g]	[f]	[f]	24.8	29.0
2010	23.4[g]	[f]	[f]	25.2	29.3
2011	24.3	[f]	[f]	24.7	29.0
2012	25.3	[f]	[f]	25.0	30.8
2013	25.9	[f]	[f]	25.7	31.6
2014	26.3	[f]	[f]	26.5	31.7
2015	27.6	[f]	[f]	27.3	32.2
2016	28.8	[f]	[f]	27.4	32.2
2017	29.2	[f]	[f]	28.1	32.9

Source:
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, December 2014 and updates 2017. (Additional resources: www.nhtsa.gov)

[a] Only vehicles with at least 75% domestic content can be counted in the average domestic fuel economy for a manufacturer.

[b] Represents two- and four-wheel drive trucks combined. Gross vehicle weight of 0-6,000 pounds for model year 1978-1979 and 0-8,500 pounds for subsequent years.

[c] Model year as determined by the manufacturer on a vehicle by vehicle basis.

[d] All CAFE calculations are sales-weighted.

[e] Standards were set for two-wheel drive and four-wheel drive light trucks, but no combined standard was set in this year.

[f] Data are not available.

[g] Unreformed standards, which were an option from 2008-2010. See Table 4.25 for reformed standards.

Manufacturers of cars and light trucks whose vehicles do not meet the CAFE standards are fined. Data from the National Highway Traffic Safety Administration show the CAFE fine in the year in which the money was collected, which may not be the same year in which it was assessed. A manufacturer can also use CAFE credits to offset fines. Fines for recent model years have not been collected.

Table 4.29
Corporate Average Fuel Economy (CAFE) Fines Collected, as of April 2018[a]

Model year	Current dollars	2014 constant dollars[b]
1982	$120,000	$294,387
1983	$57,970	$137,795
1984	$5,958,020	$13,572,370
1985	$15,564,540	$34,241,988
1986	$29,871,815	$64,523,120
1987	$31,260,530	$65,146,945
1988	$43,470,545	$86,984,561
1989	$48,549,420	$92,680,843
1990	$48,308,615	$87,486,902
1991	$42,243,030	$73,418,386
1992	$38,286,565	$64,589,435
1993	$28,688,380	$46,991,566
1994	$31,498,570	$50,303,216
1995	$40,787,498	$63,342,984
1996	$19,301,930	$29,126,612
1997	$36,211,850	$53,412,479
1998	$21,739,774	$31,566,151
1999	$27,516,451	$39,100,876
2000	$51,067,038	$70,217,177
2001	$35,507,412	$47,473,409
2002	$20,041,533	$26,374,657
2003	$15,225,419	$19,595,114
2004	$30,411,986	$38,106,218
2005	$25,057,126	$30,369,236
2006	$40,933,954	$48,056,461
2007	$37,385,941	$42,694,745
2008	$11,619,696	$12,781,666
2009	$9,148,425	$10,090,713
2010	$23,803,412	$25,850,505
2011	$40,013,270	$42,093,960
2012	$14,962,382	$15,426,216
2013	$19,036,963	$19,341,554
2014	$2,289,788	$2,289,788

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Vehicle Safety Compliance, Washington, DC, December 2014 and updates, April 2018. Data accessed July 13, 2018. (Additional resources: www.nhtsa.gov)

[a] These are fines which are actually collected. Fines which are assessed in certain year may not have been collected in that year.

[b] Adjusted using the Consumer Price Inflation Index.

Consumers must pay the Gas Guzzler Tax when purchasing a car that has an Environmental Protection Agency (EPA) fuel economy rating (combined city and highway) less than that stipulated in the table below. The Gas Guzzler Tax doubled in 1991 after remaining constant from 1986 to 1990. The tax has not changed since 1991. This tax does not apply to light trucks such as pickups, minivans, sport utility vehicles, and vans.

Table 4.30
The Gas Guzzler Tax on New Cars
(dollars per vehicle)

Vehicle fuel economy (mpg)	1980	1981	1982	1983	1984	1985	1986–90	1991 - on
Over 22.5	0	0	0	0	0	0	0	0
22.0–22.5	0	0	0	0	0	0	500	1,000
21.5–22.0	0	0	0	0	0	0	500	1,000
21.0–21.5	0	0	0	0	0	0	650	1,300
20.5–21.0	0	0	0	0	0	500	650	1,300
20.0–20.5	0	0	0	0	0	500	850	1,700
19.5–20.0	0	0	0	0	0	600	850	1,700
19.0–19.5	0	0	0	0	450	600	1,050	2,100
18.5–19.0	0	0	0	350	450	800	1,050	2,100
18.0–18.5	0	0	200	350	600	800	1,300	2,600
17.5–18.0	0	0	200	500	600	1,000	1,300	2,600
17.0–17.5	0	0	350	500	750	1,000	1,500	3,000
16.5–17.0	0	200	350	650	750	1,200	1,500	3,000
16.0–16.5	0	200	450	650	950	1,200	1,850	3,700
15.5–16.0	0	350	450	800	950	1,500	1,850	3,700
15.0–15.5	0	350	600	800	1,150	1,500	2,250	4,500
14.5–15.0	200	450	600	1,000	1,150	1,800	2,250	4,500
14.0–14.5	200	450	750	1,000	1,450	1,800	2,700	5,400
13.5–14.0	300	550	750	1,250	1,450	2,200	2,700	5,400
13.0–13.5	300	550	950	1,250	1,750	2,200	3,200	6,400
12.5–13.0	550	650	950	1,550	1,750	2,650	3,200	6,400
Under 12.5	550	650	1,200	1,550	2,150	2,650	3,850	7,700

Source:
Internal Revenue Service, Form 6197, (Rev. 10-05), "Gas Guzzler Tax." (Additional resources: www.irs.ustreas.gov)

Consumers who purchased these 2018 model year vehicles paid the Gas Guzzler tax. The tax is based on unadjusted combined city/highway fuel economy. Adjusted combined fuel economy is on the window sticker.

Table 4.31
List of Model Year 2018 Cars with Gas Guzzler Taxes[a]

Manufacturer	Model(s)	Size class	Unadjusted combined city/highway fuel economy	Adjusted combined city/highway fuel economy
Bentley	Mulsanne	Midsize Cars	17	14
Bentley	Continental GT Convertible	Subcompact Cars	18	14
Bentley	Flying Spur	Midsize Cars	18	14
Bentley	Continental Supersports Convt	Subcompact Cars	18	14
BMW	M5	Midsize Cars	22	17
BMW	M6 Convertible (manual)	Subcompact Cars	22	17
BMW	M6 Convertible (automatic)	Subcompact Cars	20	16
BMW	M6 Gran Coupe (manual)	Compact Cars	22	17
BMW	M6 Gran Coupe (automatic)	Compact Cars	20	16
BMW	M760i xDrive	Large Cars	20	16
Bugatti	Chiron	Two Seaters	13	11
Cadillac	XTS Limo	Special Purpose Vehicle 2WD	22	17
Cadillac	CTS-V	Midsize Cars	22	17
Chevrolet	Camaro (manual)	Subcompact Cars	20	16
Chevrolet	Camaro (automatic)	Subcompact Cars	19	15
Chevrolet	Corvette	Two Seaters	20	16
Dodge	Charger SRT	Large Cars	20	16
Dodge	Challenger	Midsize Cars	22	17
Dodge	Challenger SRT (automatic)	Midsize Cars	20	16
Dodge	Challenger SRT (manual 6.2L)	Midsize Cars	20	16
Dodge	Challenger SRT (manual 6.4L)	Midsize Cars	22	17
Ferrari	GTC4Lusso	Minicompact Cars	17	13
Ferrari	GTC4Lusso T	Minicompact Cars	22	17
Ferrari	812 Superfast	Two Seaters	17	13
Ford	Shelby GT350 Mustang	Subcompact Cars	21	16
Ford	GT	Two Seaters	17	14
Koenigsegg	Agera RS	Two Seaters	17	13
Lamborghini	Aventador S Coupe	Two Seaters	15	12
Lamborghini	Aventador Coupe	Two Seaters	15	12
Lamborghini	Aventador S Roadster	Two Seaters	15	12
Lamborghini	Aventador Roadster	Two Seaters	14	12
Lamborghini	Huracan	Two Seaters	19	16
Lamborghini	Huracan Spyder	Two Seaters	19	15
Lamborghini	Huracan 2WD	Two Seaters	20	16
Lamborghini	Huracan Spyder 2WD	Two Seaters	20	16
Maserati	Granturismo	Subcompact Cars	20	16
Maserati	Granturismo Convertible	Subcompact Cars	20	15
Maserati	Quattroporte V8	Large Cars	22	17
Mercedes-Benz	AMG GT C (coupe)	Two Seaters	22	17
Mercedes-Benz	AMG GT R (coupe)	Two Seaters	22	17
Mercedes-Benz	Maybach S 650	Large Cars	20	16
Mercedes-Benz	AMG S 65	Large Cars	19	16
Mercedes-Benz	AMG S 65 (coupe)	Compact Cars	20	16

Table 4.31 (Continued)
List of Model Year 2018 Cars with Gas Guzzler Taxes[a]

Make	Model(s)	Size class	Unadjusted combined city/highway fuel economy	Adjusted combined city/highway fuel economy
Mercedes-Benz	AMG SL 65	Two Seaters	21	16
Mercedes-Benz	AMG GT C (roadster)	Two Seaters	22	17
Mercedes-Benz	AMG S 65 (convertible)	Subcompact Cars	20	16
Pagani	Huayra	Two Seaters	15	13
Porsche	911 GT3 (manual)	Two Seaters	20	16
Porsche	911 GT3 (automatic)	Two Seaters	22	17
Porsche	911 GT3 Touring	Two Seaters	21	17
Rolls-Royce	Phantom	Large Cars	18	14
Rolls-Royce	Phantom EWB	Large Cars	18	14
Rolls-Royce	Ghost	Large Cars	18	14
Rolls-Royce	Ghost EWB	Large Cars	18	14
Rolls-Royce	Wraith	Midsize Cars	18	14
Rolls-Royce	Dawn	Compact Cars	18	14

Source:
U.S. Department of Energy and U.S. Environmental Protection Agency, Fuel Economy Guide database, www.fueleconomy.gov

[a] Tax is based on unadjusted combined fuel economy; adjusted combined fuel economy is used on window stickers.

The IRS collected $36.7 million from those buying model year 2017 cars with combined city/highway fuel economy less than 22.5 miles per gallon. This tax does not apply to light trucks such as pickups, minivans, sport utility vehicles, and vans. It is worthy to note that total revenue from fines paid by consumers to purchase gas-guzzling vehicles greatly exceeds the overall fines paid by manufacturers whose vehicles fail to meet CAFE standards (see Table 4.27).

Table 4.32
Tax Receipts from the Sale of Gas Guzzlers, 1980–2017
(thousands)

Model year	Current dollars	2017 constant dollars[a]
1980	740	2,201
1981	780	2,103
1982	1,720	4,369
1983	4,020	9,893
1984	8,820	20,808
1985	39,790	90,644
1986	147,660	330,241
1987	145,900	314,815
1988	116,780	241,971
1989	109,640	216,734
1990	103,200	193,545
1991	118,400	213,085
1992	144,200	251,934
1993	111,600	189,311
1994	64,100	106,020
1995	73,500	118,217
1996	52,600	82,175
1997	48,200	73,612
1998	47,700	71,731
1999	68,300	100,490
2000	70,800	100,781
2001	78,200	108,235
2002	79,700	108,594
2003	126,700	168,786
2004	140,800	182,705
2005	163,800	205,585
2006	201,700	245,242
2007	178,700	211,259
2008	172,400	196,275
2009	99,300	113,456
2010	85,200	95,775
2011	68,900	75,082
2012	73,500	78,470
2013	61,300	64,501
2014	48,200	49,907
2015	58,700	60,707
2016	72,500	74,045
2017	36,700	36,700

Source:
Ward's Communications, Detroit, MI, 2019. Original data source: Internal Revenue Service. (Additional resources: www.epa.gov/fueleconomy/guzzler)

[a] Adjusted using the Consumer Price Inflation Index.

Autonomie is a system simulation tool for vehicle energy consumption and performance analysis. It is used to evaluate the energy consumption and cost of multiple advanced powertrain technologies. Autonomie was used to develop data on the relationship between steady-state vehicle speed and fuel economy.

Table 4.33
Fuel Economy by Speed, Autonomie Model Results, Model Year 2016

	Gasoline conventional			Diesel conventional			Hybrid vehicle
Speed (mph)	Midsize car	Small SUV	Large SUV	Midsize car	Small SUV	Large SUV	Midsize Car
			(miles per gallon)				
45	43	37	35	57	48	48	55
55	45	36	31	55	45	40	46
65	38	30	29	45	36	35	38
75	32	26	25	37	30	29	33
			Fuel economy loss				
55 - 65 mph	15%	16%	7%	18%	19%	13%	18%
65 - 75 mph	15%	16%	15%	18%	18%	17%	12%
55 - 75 mph	28%	29%	21%	33%	34%	27%	28%

Source:
Argonne National Laboratory, Autonomie model, August 2016, www.autonomie.net. (Additional resources: www.anl.gov/energy/transportation)

The latest study of vehicle fuel economy by speed indicated higher fuel economy around 40 miles per hour, as did the 1973 and 1984 studies. Engineers at Oak Ridge National Laboratory believe that the lowest speed in the vehicle's highest gear is where the best fuel economy is typically obtained. That speed will be different for individual vehicles.

Table 4.34
Fuel Economy by Speed, 1973, 1984, 1997, and 2012 Studies
(miles per gallon)

Speed (miles per hour)	1973[a] (13 vehicles)	1984[b] (15 vehicles)	1997[c] (9 vehicles)	2012[d] (74 vehicles)
15	[e]	21.1	24.4	[e]
20	[e]	25.5	27.9	[e]
25	[e]	30.0	30.5	[e]
30	21.1	31.8	31.7	[e]
35	21.1	33.6	31.2	[e]
40	21.1	33.6	31.0	33.2
45	20.3	33.5	31.6	[e]
50	19.5	31.9	32.4	31.9
55	18.5	30.3	32.4	[e]
60	17.5	27.6	31.4	27.9
65	16.2	24.9	29.2	[e]
70	14.9	22.5	26.8	24.1
75	[e]	20.0	24.8	[e]
80	[e]	[e]	[e]	20.5
		Fuel economy loss		
50–60 mph	10.3%	13.5%	3.1%	12.5%
60–70 mph	14.9%	18.5%	14.6%	13.6%
50–70 mph	23.6%	29.5%	17.3%	24.5%

Sources:

1973- U.S. Department of Transportation, Federal Highway Administration, Office of Highway Planning, *The Effect of Speed on Automobile Gasoline Consumption Rates*, Washington, DC, October 1973.

1984 - U.S. Department of Transportation, Federal Highway Administration, *Fuel Consumption and Emission Values for Traffic Models*, Washington, DC, May 1985.

1997 - West, B.H., R.N. McGill, J.W. Hodgson, S.S. Sluder, and D.E. Smith, *Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values for Traffic Models*, FHWA-RD-99-068, U.S. Department of Transportation, Federal Highway Administration, Washington, DC, March 1999.

2012 - U.S. Department of Energy and U.S. Environmental Protection Agency, Fuel Economy Guide website: www.fueleconomy.gov. The Green Car Congress, "ORNL researchers quantify the effect of increasing highway speed on fuel economy." February 8, 2013.

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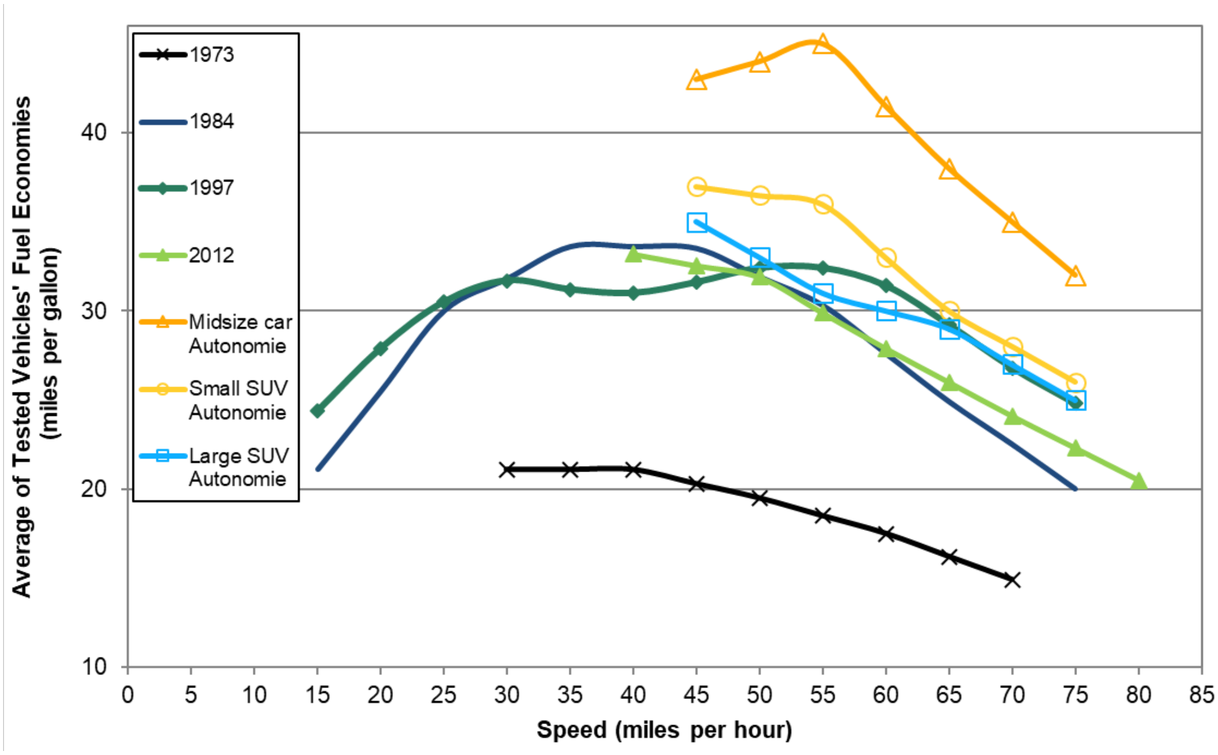
[a] Model years 1970 and earlier cars.
[b] Model years 1981–84 cars and light trucks.
[c] Model years 1988–97 cars and light trucks.
[d] Model years 2003-2012 cars and light trucks.
[e] Data are not available.

Figure 4.7. Fuel Economy by Speed, 1973, 1984, 1997, and 2012 Studies and Autonomie Model 2016 Results



Sources:
See Tables 4.33 and 4.34.

This table shows the driving cycles for the new methodology that the Environmental Protection Agency (EPA) used to determine fuel economy ratings for new vehicles beginning in model year 2008. In addition to the Urban Driving Cycle and the Highway Driving cycle, the EPA will also use three additional tests to adjust fuel economy ratings to account for higher speeds, air conditioner use, and colder temperatures. Though the EPA uses a complex combination of these five cycles to determine the fuel economy that will be posted on a new vehicle window sticker, the manufacturer's Corporate Average Fuel Economy is still calculated using only the city and highway driving cycles. To know more about new vehicle fuel economy ratings, visit www.fueleconomy.gov.

Table 4.35
Driving Cycle Attributes

	Test schedule				
	City	Highway	High speed	Air conditioner (AC)	Cold temp
Trip type	Low speeds in stop-and-go urban traffic	Free-flow traffic at highway speeds	Higher speeds; harder acceleration & braking	AC use under hot ambient conditions	*City* test w/colder outside temperature
Top speed	56 mph	60 mph	80 mph	54.8 mph	56 mph
Average speed	21 mph	48 mph	48 mph	21 mph	21 mph
Max. acceleration	3.3 mph/sec	3.2 mph/sec	8.46 mph/sec	5.1 mph/sec	3.3 mph/sec
Simulated distance	11 mi.	10.3 mi.	8 mi.	3.6 mi.	11 mi.
Time	31.2 min.	12.6 min.	9.9 min.	9.9 min.	31.2 min.
Stops	23	None	4	5	23
Idling time	18% of time	None	7% of time	19% of time	18% of time
Engine startup[a]	Cold	Warm	Warm	Warm	Cold
Lab temperature	68-86° F	68-86° F	68-86° F	95° F	20° F
Vehicle air conditioning	Off	Off	Off	On	Off

Source:
U.S. Department of Energy and U.S. Environmental Protection Agency, Fuel Economy website, www.fueleconomy.gov.

[a] A vehicle's engine doesn't reach maximum fuel efficiency until it is warm.

These driving cycles simulate the performance of an engine while driving in the city and on the highway. Once the city cycle is completed, the engine is stopped, and then started again for the 8.5-minute hot start cycle. Three additional cycles also influence new vehicle fuel economy ratings beginning with the 2008 model year.

Figure 4.8. City Driving Cycle

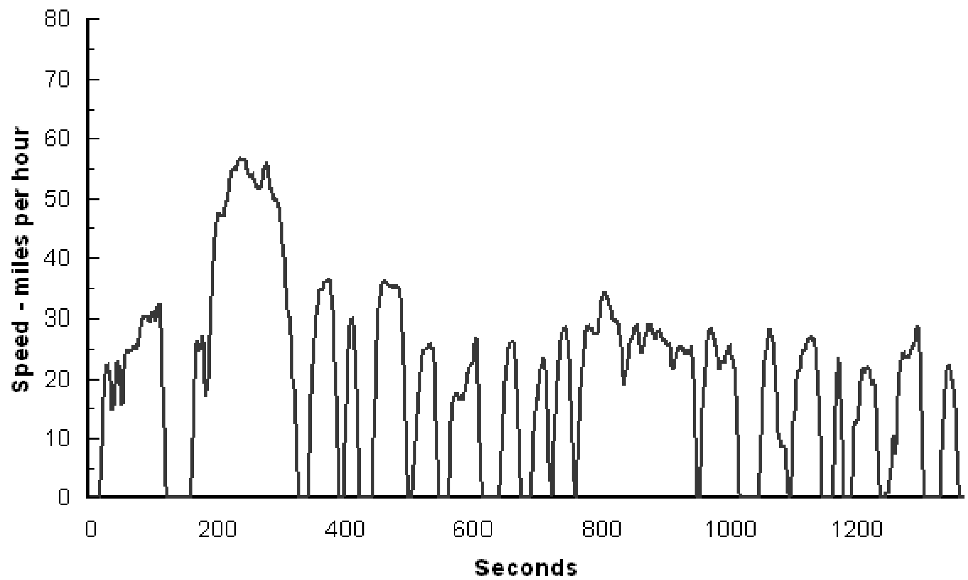
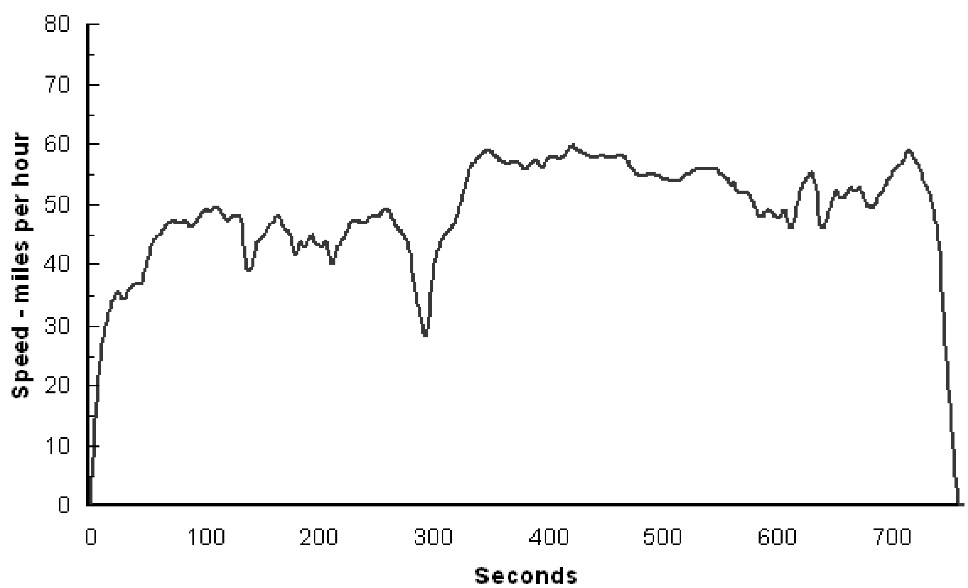


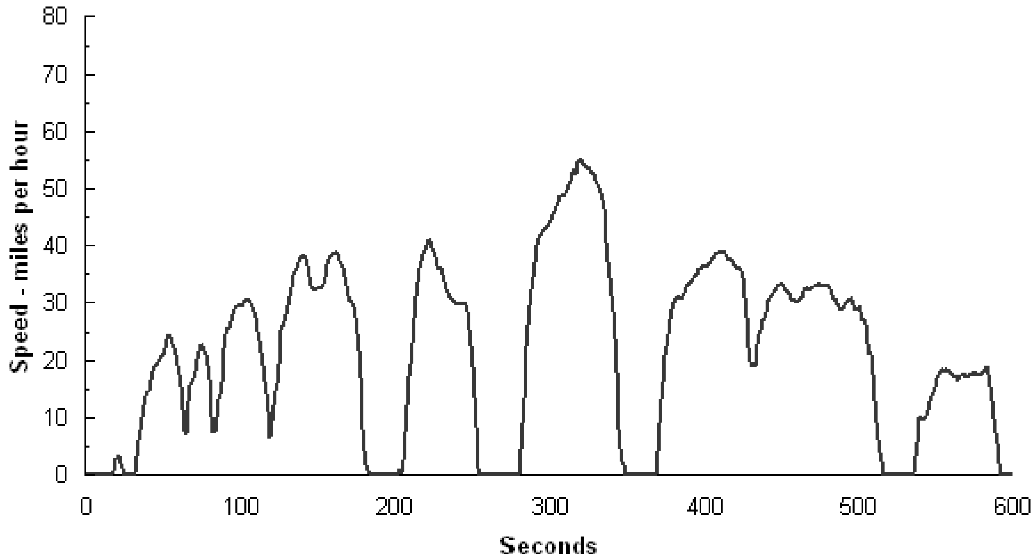
Figure 4.9. Highway Driving Cycle



Source:
Code of Federal Regulations, 40CFR, "Subpart B - Fuel Economy Regulations for 1978 and Later Model Year Automobiles - Test Procedures," July 1, 1988 edition, p. 676.

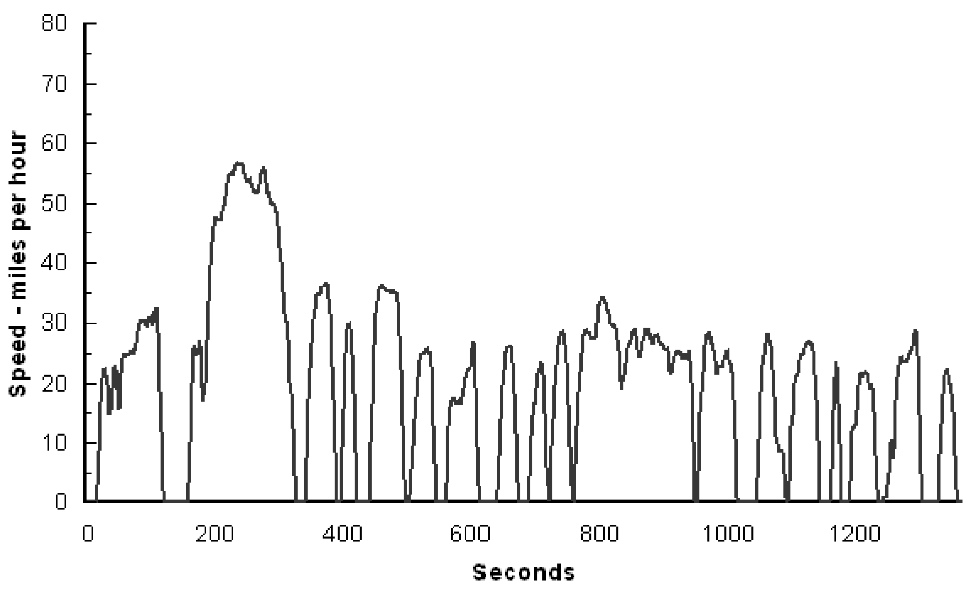
Beginning with the 2008 model year, these cycles influence the new vehicle fuel economy ratings.

Figure 4.10. Air Conditioning (SC03) Driving Cycle



Source:
U.S. Department of Energy and Environmental Protection Agency, Fuel Economy website, www.fueleconomy.gov.

Figure 4.11. Cold Temperature (Cold FTP) Driving Cycle[a]



Source:
U.S. Department of Energy and Environmental Protection Agency, Fuel Economy website, www.fueleconomy.gov.

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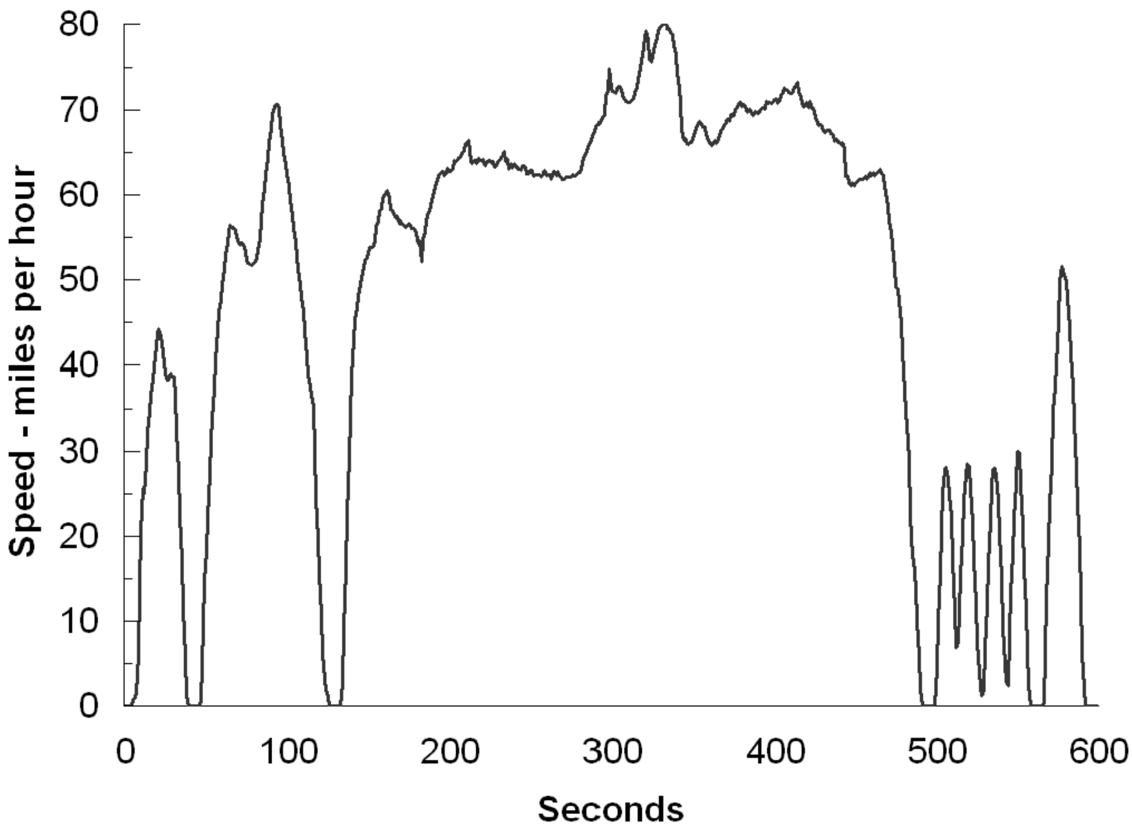
[a] Cold FTP uses the same speeds as the city driving cycle. Tests the effects of colder outside temperatures on cold-start driving in stop-and-go traffic.

Beginning with the 2008 model year, this cycle influences the new vehicle fuel economy ratings. The US06 driving cycle was originally developed as a supplement to the Federal Test Procedure. It is a short-duration cycle (600 seconds) which represents hard-acceleration driving.

Figure 4.12. High-Speed (US06) Driving Cycle



Source:
U.S. Department of Energy and Environmental Protection Agency, Fuel Economy website, www.fueleconomy.gov.

Two other test cycles are sometimes used by researchers and engineers to test new vehicles (although these do not affect the fuel economy ratings). The New York Test Cycle was developed in the 1970's in order to simulate driving in downtown congested areas. The Representative Number Five Test Cycle was developed in the 1990's to better represent actual on-road driving by combining modern city and freeway driving.

Figure 4.13. New York City Driving Cycle

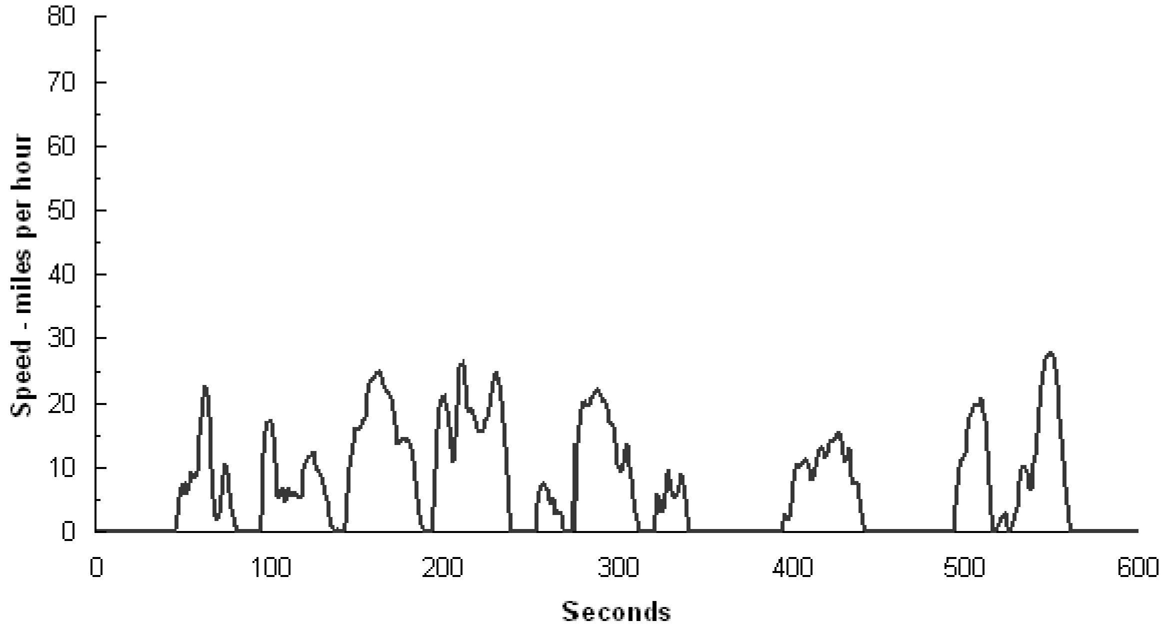
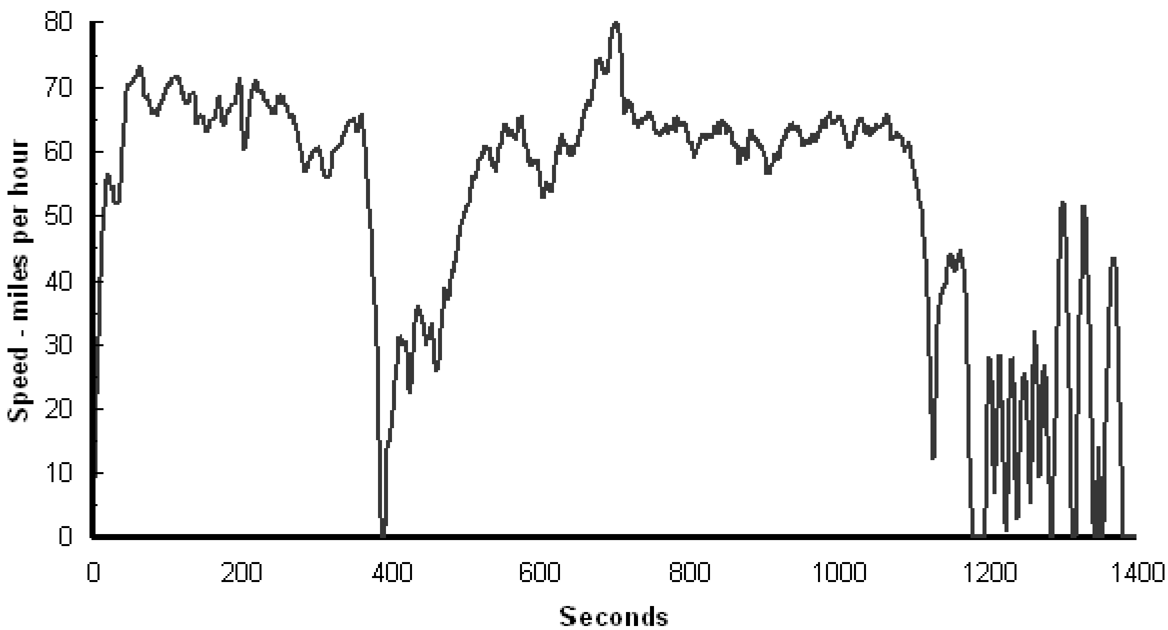


Figure 4.14. Representative Number Five Driving Cycle



Source:
Data obtained from Michael Wang, Argonne National Laboratory, Argonne, IL, 1997.

Testing cycles to determine vehicle fuel economy and emissions vary by country. The United States currently uses five different drive cycles to determine vehicle fuel economy. In Europe, the NEDC cycle is being replaced by the WLTC, but the NEDC continues to be used in China. The ARTEMIS cycles are not used in vehicle certification but are used to represent real world driving in Europe.

Table 4.36
Comparison of U.S., European, and Japanese Driving Cycles Attributes

Cycle	Time (seconds)	Distance (miles)	Average Speed (mph)	Maximum Speed (mph)	Maximum Acceleration (mph/s)
United States					
City	1,872	11.0	21.2	56.0	3.3
Highway	765	10.3	48.3	60.0	3.2
High-Speed	594	8.0	48.4	80.0	8.5
Air Conditioner Use	594	3.6	21.2	54.8	5.1
Cold Temperatures	1,872	11.0	21.2	56.0	3.3
World Light Vehicle Test Cycle (WLTC)					
Low	589	1.9	11.7	35.1	3.6
Medium	433	3.0	24.5	47.6	3.6
High	455	4.4	35.1	60.5	3.7
Extra High	323	5.1	57.0	81.6	2.3
Total WLTC	1,800	14.5	28.9	81.6	3.7
Japan					
JC08	1,204	5.1	15.2	50.7	3.8
New European Driving Cycle (NEDC)					
Urban Driving Cycle (UDC)	780	2.5	11.8	31.1	2.3
Extra Urban Driving Cycle (EUDC)	400	4.3	38.9	74.6	1.9
Total NEDC	1,180	6.8	20.9	74.6	2.3
ARTEMIS					
Urban	993	3.0	11.0	35.9	6.4
Rural Road	1,082	10.7	35.7	69.3	5.3
Motorway	1,068	17.9	60.1	81.9	4.3
Total ARTEMIS	3,143	31.6	36.2	81.9	6.4

Source:
United States - U.S. Department of Energy, Fuel Economy Guide website,
www.fueleconomy.gov/feg/fe_test_schedules.shtml
All other - Compiled from public sources by Aymeric Rousseau, Argonne National Laboratory, September 2016.

Testing cycles to determine vehicle fuel economy and emissions vary by country and therefore it is difficult to make a direct comparison. Simulation results show up to a 28% difference in the test cycles for each vehicle type. Note that the differences in these cycle results also vary with each individual vehicle tested.

Table 4.37
Example of Differing Results Using the U.S., European, and Japanese Driving Cycles

	Miles per gallon			Percentage difference from	
Vehicle type	U.S. Corporate Average Fuel Economy (CAFE) cycle	New European Driving Cycle (NEDC)	Japan JC08 cycle	CAFE to NEDC	CAFE to JC08
Small car	34.8	32.4	27.6	-7%	-21%
Large car	26.6	24.7	21.5	-7%	-19%
Minivan	23.9	20.5	17.2	-14%	-28%
Sport-utility vehicle	20.2	17.6	14.6	-13%	-28%
Pickup	18.8	15.9	13.5	-15%	-28%

Note: Simulation results for identical gasoline vehicles (i.e., results for the same small car on each of the three cycles).

Source:
The International Council on Clean Transportation, *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update*, July 2009.

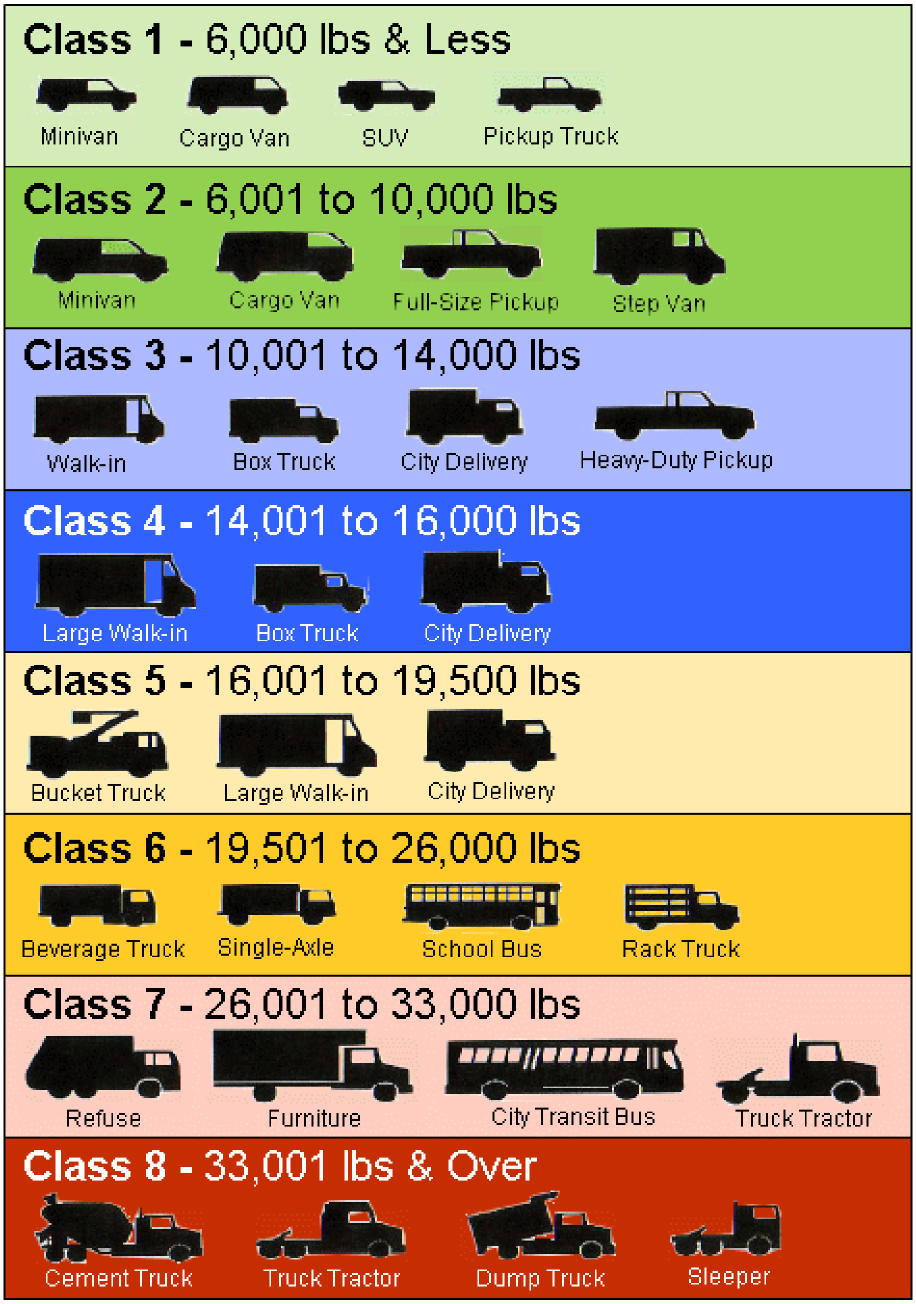
Chapter 5
Heavy Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 5.1	Class 3-8 single-unit trucks, 2017	
	Registration (thousands)	*9,337*
	Vehicle miles (millions)	*116,102*
	Fuel economy (miles per gallon)	*7.4*
Table 5.2	Class 7-8 combination trucks, 2017	
	Registration (thousands)	*2,892*
	Vehicle miles (millions)	*181,490*
	Fuel economy (miles per gallon)	6.0
Table 5.15	Freight Shipments, 2012 Commodity Flow Survey	
Table 5.15	*Value (billion dollars)*	*13,852*
Table 5.16	*Tons (millions)*	*11,299*
Table 5.17	*Ton-miles (billions)*	*2,970*

There are eight truck classes, categorized by the gross vehicle weight rating that the vehicle is assigned when it is manufactured. The pictures below show examples of some of the different body types that would be included in each class. Many of the body types can be in more than one category, depending on the vehicle's attributes. Examples of this include pickups, box trucks, buses, and truck tractors.

Figure 5.1. Examples of Body Types in Each Truck Class



Source:
Oak Ridge National Laboratory, National Transportation Research Center, Oak Ridge, TN. Gross vehicle weight category definitions from 49CFR565.6 (2000).

Class 3-8 single-unit trucks include trucks over 10,000 lb gross vehicle weight with the cab/engine and cargo space together as one unit. Most of these trucks would be used for business or for individuals with heavy hauling or towing needs. Very heavy single-units, such as concrete mixers and dump trucks, are also in this category. The data series was changed by the FHWA back to 2007.

Table 5.1
Summary Statistics for Class 3-8 Single-Unit Trucks, 1970–2017

Year	Registrations (thousands)	Vehicle travel (million miles)	Average annual miles per vehicle	Fuel use (million gallons)	Average fuel economy per vehicle (miles per gallon)
1970	3,681	27,081	7,357	3,968	6.8
1975	4,232	34,606	8,177	5,420	6.4
1980	4,374	39,813	9,102	6,923	5.8
1985	4,593	45,441	9,894	7,399	6.1
1986	4,313	45,637	10,581	7,386	6.2
1987	4,188	48,022	11,467	7,523	6.4
1988	4,470	49,434	11,059	7,701	6.4
1989	4,519	50,870	11,257	7,779	6.5
1990	4,487	51,901	11,567	8,357	6.2
1991	4,481	52,898	11,805	8,172	6.5
1992	4,370	53,874	12,328	8,237	6.5
1993	4,408	56,772	12,879	8,488	6.7
1994	4,906	61,284	12,492	9,032	6.8
1995	5,024	62,705	12,481	9,216	6.8
1996	5,266	64,072	12,167	9,409	6.8
1997	5,293	66,893	12,638	9,576	7.0
1998	5,414	67,894	12,540	9,741	7.0
1999	5,763	70,304	12,199	9,372	7.5
2000	5,926	70,500	11,897	9,563	7.4
2001	5,704	72,448	12,701	9,667	7.5
2002	5,651	75,866	13,425	10,321	7.4
2003	5,849	77,757	13,294	8,881	8.8
2004	6,161	78,441	12,732	8,959	8.8
2005	6,395	78,496	12,275	9,501	8.3
2006	6,649	80,344	12,084	9,852	8.2 [a]
2007	8,117	119,979	14,781	16,314	7.3
2008	8,228	126,855	15,417	17,144	7.4
2009	8,356	120,207	14,386	16,253	7.4
2010	8,217	110,738	13,477	15,097	7.3
2011	7,819	103,803	13,276	14,214	7.3
2012	8,190	105,605	12,894	14,376	7.3
2013	8,126	106,582	13,116	14,502	7.3
2014	8,329	109,301	13,123	14,894	7.3
2015	8,456	109,597	12,961	14,850	7.4
2016	8,747	113,338	12,958	15,338	7.4
2017	9,337	116,102	12,435	15,600	7.4
			Average annual percentage change		
1970-2017	2.0%	3.1%	1.1%	3.0%	0.2%
2007-2017	1.4%	-0.3%	-1.7%	-0.4%	0.2%

Source:
U. S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2017*, Washington, DC, 2019, Table VM-1 and annual. (Additional resources: www.fhwa.dot.gov)

[a] Due to FHWA methodology changes, data from 2007-on are not comparable with previous data.

Class 7-8 combination trucks include all trucks designed to be used in combination with one or more trailers with a gross vehicle weight rating over 26,000 lb. The average vehicle travel of these trucks (on a per truck basis) far surpasses the travel of other trucks due to long-haul freight movement. The data series was changed by the FHWA back to 2007.

Table 5.2
Summary Statistics for Class 7-8 Combination Trucks, 1970–2017

Year	Registrations (thousands)	Vehicle travel[a] (million miles)	Average annual miles per vehicle	Fuel use (million gallons)	Average fuel economy per vehicle (miles per gallon)
1970	905	35,134	38,822	7,348	4.8
1975	1,131	46,724	41,312	9,177	5.1
1980	1,417	68,678	48,467	13,037	5.3
1985	1,403	78,063	55,640	14,005	5.6
1986	1,408	81,038	57,555	14,475	5.6
1987	1,530	85,495	55,879	14,990	5.7
1988	1,667	88,551	53,120	15,224	5.8
1989	1,707	91,879	53,825	15,733	5.8
1990	1,709	94,341	55,202	16,133	5.8
1991	1,691	96,645	57,153	16,809	5.7
1992	1,675	99,510	59,409	17,216	5.8
1993	1,680	103,116	61,379	17,748	5.8
1994	1,681	108,932	64,802	18,653	5.8
1995	1,696	115,451	68,073	19,777	5.8
1996	1,747	118,899	68,059	20,192	5.9
1997	1,790	124,584	69,600	20,302	6.1
1998	1,831	128,159	69,994	21,100	6.1
1999	2,029	132,384	65,246	24,537	5.4
2000	2,097	135,020	64,387	25,666	5.3
2001	2,154	136,584	63,409	25,512	5.4
2002	2,277	138,737	60,930	26,480	5.2
2003	1,908	140,160	73,459	23,815	5.9
2004	2,010	142,370	70,831	24,191	5.9
2005	2,087	144,028	69,012	27,689	5.2
2006	2,170	142,169	65,516	28,107	5.1 [b]
2007	2,635	184,199	69,905	30,904	6.0
2008	2,585	183,826	71,113	30,561	6.0
2009	2,617	168,100	64,234	28,050	6.0
2010	2,553	175,789	68,856	29,927	5.9
2011	2,452	163,791	66,809	28,181	5.8
2012	2,469	163,602	66,262	27,975	5.8
2013	2,471	168,436	68,155	28,795	5.8
2014	2,577	169,830	65,897	29,118	5.8
2015	2,747	170,246	61,978	28,886	5.9
2016	2,752	174,557	63,428	29,555	5.9
2017	2,892	181,490	62,751	30,364	6.0
			Average annual percentage change		
1970-2017	2.5%	3.6%	1.0%	3.1%	0.5%
2007-2017	0.9%	-0.1%	-1.1%	-0.2%	0.0%

Source:
U. S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2017*, Washington, DC, 2019, Table VM-1 and annual. (Additional resources: www.fhwa.dot.gov)

[a] The Federal Highway Administration changed the combination truck travel methodology in 1993.
[b] Due to FHWA methodology changes, data from 2007-on are not comparable with previous data.

Truck sales were at an all-time high of 11.4 million in 2018. Trucks under 10,000 lb continue to dominate truck sales.

Table 5.3
New Retail Truck Sales by Gross Vehicle Weight, 1970–2018[a]
(thousands)

Calendar year	Class 1 6,000 lb or less	Class 2 6,001–10,000 lb	Class 3 10,001–14,000 lb	Class 4 14,001–16,000 lb	Class 5 16,001–19,500 lb	Class 6 19,501–26,000 lb	Class 7 26,001–33,000 lb	Class 8 33,001 lb and over	Total
Domestic sales (import data are not available)									
1970[b]	1,049	408	6	12	58	133	36	89	1,791
1975	1,101	952	23	1	9	159	23	83	2,351
1980	985	975	4	[c]	2	90	58	117	2,231
1981	896	850	1	[c]	2	72	51	100	1,972
1982	1,102	961	1	[c]	1	44	62	76	2,248
1983	1,314	1,207	[c]	[c]	1	47	59	82	2,710
1984	2,031	1,224	6	[c]	5	55	78	138	3,538
1985	2,408	1,280	11	[c]	5	48	97	134	3,983
Domestic and import sales									
1986	3,380	1,214	12	[c]	6	45	101	113	4,870
1990	3,451	1,097	21	27	5	38	85	121	4,846
1991	3,246	876	21	24	3	22	73	99	4,365
1992	3,608	1,021	26	26	4	28	73	119	4,903
1993	4,119	1,232	27	33	4	27	81	158	5,681
1994	4,527	1,506	35	44	4	20	98	186	6,421
1995	4,422	1,631	40	53	4	23	107	201	6,481
1996	4,829	1,690	52	59	7	19	104	170	6,930
1997	5,085	1,712	53	57	9	18	114	179	7,226
1998	5,263	2,036	102	43	25	32	115	209	7,826
1999	5,707	2,366	122	49	30	48	130	262	8,716
2000	5,965	2,421	117	47	29	51	123	212	8,965
2001	6,073	2,525	102	52	24	42	92	140	9,050
2002	6,068	2,565	80	38	24	45	69	146	9,035
2003	6,267	2,671	91	40	29	51	67	142	9,357
2004	6,458	2,796	107	47	36	70	75	203	9,793
2005	6,586	2,528	167	49	46	60	89	253	9,777
2006	6,136	2,438	150	50	49	70	91	284	9,268
2007	5,682	2,623	166	51	45	54	70	151	8,842
2008	4,358	1,888	135	36	40	39	49	133	6,680
2009	3,528	1,306	112	20	24	22	39	95	5,145
2010	4,245	1,513	161	12	31	29	38	107	6,137
2011	4,714	1,735	195	10	42	41	41	171	6,951
2012	5,164	1,811	223	9	55	40	47	195	7,544
2013	5,615	2,077	254	12	60	47	48	185	8,298
2014	6,209	2,275	264	13	67	52	54	220	9,154
2015	7,161	2,417	283	14	72	55	59	249	10,310
2016	7,724	2,572	296	14	72	62	60	193	10,993
2017	8,102	2,637	317	19	79	63	62	192	11,470
2018	8,881	2,728	301	21	81	72	64	251	12,398
Average annual percentage change									
1970-2018	4.6%	4.0%	8.5%	1.1%	0.7%	-1.3%	1.2%	2.2%	4.1%
1986-2018	3.1%	2.6%	10.6%	7.8%	8.5%	1.5%	-1.4%	2.5%	3.0%
2008-2018	7.4%	3.8%	8.3%	-5.5%	7.4%	6.3%	2.7%	6.5%	6.4%

Source:
Ward's Communications, www.wardsauto.com. (Additional resources: www.wardsauto.com)

[a] Sales include domestic-sponsored imports.
[b] Data for 1970 is based on new truck registrations.
[c] Data are not available.
[d] 1987-2018.

Based on factory sales, the share of diesel medium/heavy trucks sold has declined from 1995 to 2018 for truck gross vehicle weight rating (GVWR) classes 4, 5, and 7. Class 6 diesel sales share increased in that period and class 8 continued to be 100% diesel. The result for all class 4 through 8 trucks combined was a decline from 87% diesel share in 1995 to 80% in 2018.

Table 5.4
Diesel Share of Medium and Heavy Truck Sales by Gross Vehicle Weight, 1995–2018[a]

Calendar year	Class 4 14,001–16,000 lb	Class 5 16,001–19,500 lb	Class 6 19,501–26,000 lb	Class 7 26,001–33,000 lb	Class 8 33,001 lb and over	Total (Class 4 - Class 8)
1995	68%	87%	70%	74%	100%	87%
1996	66%	92%	69%	68%	100%	85%
1997	61%	90%	82%	70%	100%	85%
1998	72%	91%	88%	72%	100%	88%
1999	62%	86%	90%	74%	100%	88%
2000	62%	93%	54%	68%	100%	83%
2001	91%	90%	70%	59%	100%	84%
2002	68%	93%	66%	54%	100%	82%
2003	74%	92%	77%	47%	100%	83%
2004	71%	92%	76%	54%	100%	85%
2005	74%	92%	73%	56%	100%	87%
2006	76%	92%	75%	59%	100%	88%
2007	78%	92%	52%	50%	100%	81%
2008	81%	92%	58%	50%	100%	84%
2009	87%	91%	56%	36%	100%	80%
2010	94%	93%	92%	39%	100%	87%
2011	82%	80%	95%	49%	100%	91%
2012	14%	79%	95%	49%	100%	89%
2013	39%	80%	96%	46%	100%	88%
2014	32%	80%	91%	45%	100%	88%
2015	24%	80%	98%	48%	100%	89%
2016	21%	54%	89%	45%	100%	78%
2017	16%	52%	87%	45%	100%	75%
2018	18%	53%	87%	50%	100%	80%

Source:
Ward's Communications, www.wardsauto.com. (Additional resources: www.wardsauto.com)

[a] Estimates based on available factory sales. May not represent the entire industry.

The Vehicle Inventory and Use Survey (VIUS) was discontinued, thus the 2002 VIUS data remain the latest available.

Vehicle Inventory and Use Survey

The Vehicle Inventory and Use Survey (VIUS), which was formerly the Truck Inventory and Use Survey (TIUS), provides data on the physical and operational characteristics of the Nation's truck population. It is based on a probability sample of private and commercial trucks registered (or licensed) in each state. In 1997, the survey was changed to the Vehicle Inventory and Use Survey due to future possibilities of including additional vehicle types. The 2002 VIUS, however, only includes trucks. Internet site: **www.census.gov/econ/overview/se0501.html**

Since 1987, the survey has included minivans, vans, station wagons on truck chassis, and sport utility vehicles in addition to the bigger trucks. The 1977 and 1982 surveys did not include those vehicle types. The estimated number of trucks that were within the scope of the 2002 VIUS and registered in the United States as of July 1, 2002 was 85.2 million. These trucks were estimated to have been driven a total of 1,115 billion miles during 2002, an increase of 6.8% from 1997. The average annual miles traveled per truck was estimated at 13,100 miles.

The California Department of Transportation is conducting a survey to collect data on the physical and operational characteristics of the State's commercial vehicle population called the California Vehicle Inventory Use and Survey. Internet site:
www.dot.ca.gov/hq/tpp/offices/omsp/statewide_modeling/cal_vehicle_survey.html

Table 5.5
Truck Statistics by Gross Vehicle Weight Class, 2002

Manufacturer's gross vehicle weight class	Number of trucks	Percentage of trucks	Average annual miles per truck	Harmonic mean fuel economy	Percentage of fuel use
1) 6,000 lb and less	51,941,389	61.0%	11,882	17.6	42.7%
2) 6,001 – 10,000 lb	28,041,234	32.9%	12,684	14.3	30.5%
3) 10,001 – 14,000 lb	691,342	0.8%	14,094	10.5	1.1%
4) 14,001 – 16,000 lb	290,980	0.3%	15,441	8.5	0.5%
5) 16,001 – 19,500 lb	166,472	0.2%	11,645	7.9	0.3%
6) 19,501 – 26,000 lb	1,709,574	2.0%	12,671	7.0	3.2%
7) 26,001 – 33,000 lb	179,790	0.2%	30,708	6.4	0.9%
8) 33,001 lb and up	2,153,996	2.5%	45,739	5.7	20.7%
Total	85,174,777	100.0%	13,088	13.5	100.0%
Light truck subtotal (1–2)	79,982,623	93.9%	12,163	16.2	73.2%
Medium truck subtotal (3–6)	2,858,368	3.4%	13,237	8.0	5.2%
Heavy truck subtotal (7–8)	2,333,786	2.7%	44,581	5.8	21.6%

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Microdata File on CD, 2005. (Additional resources: www.census.gov/svsd/www.tiusview.html)

Table 5.6
Truck Harmonic Mean Fuel Economy by Size Class, 1992, 1997, and 2002
(miles per gallon)

Manufacturer's gross vehicle weight class	1992 TIUS	1997 VIUS	2002 VIUS
1) 6,000 lb and less	17.2	17.1	17.6
2) 6,001–10,000 lb	13.0	13.6	14.3
3) 10,000–14,000 lb	8.8	9.4	10.5
4) 14,001–16,000 lb	8.8	9.3	8.5
5) 16,001–19,500 lb	7.4	8.7	7.9
6) 19,501–26,000 lb	6.9	7.3	7.0
7) 26,001–33,000 lb	6.5	6.4	6.4
8) 33,001 lb and over	5.5	5.7	5.7
Light truck subtotal (1–2)	15.7	15.8	16.2
Medium truck subtotal (3–6)	7.3	8.6	8.0
Large truck subtotal (7–8)	5.6	6.1	5.8

Note: Based on average fuel economy as reported by respondent.

Sources:
Estimates are based on data provided on the following public use files: U.S. Department of Commerce, Bureau of the Census, Census of Transportation, Washington, DC, *1992 Truck Inventory and Use Survey*, 1995; *1997 Vehicle Inventory and Use Survey*, 2000, and *2002 Vehicle Inventory and Use Survey*, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

As expected, most light trucks travel within 50 miles of their home base and refuel at public stations. About sixty percent of heavy trucks travel over 50 miles from their home base and 36% of them refuel at central company-owned refueling stations.

Table 5.7
Truck Statistics by Size, 2002

	Manufacturer's gross vehicle weight class			
	Light (< 10,000 lb)	Medium (10,001–26,000 lb)	Heavy (> 26,000 lb)	Total
	Typical trip miles or range of operation[a]			
Under 50 miles	69.2%	61.5%	40.7%	68.2%
51–100 miles	8.5%	11.7%	13.5%	8.7%
101–200 miles	2.4%	3.2%	6.7%	2.5%
201–500 miles	1.1%	1.8%	7.6%	1.3%
501 miles or more	1.4%	2.2%	10.4%	1.7%
Off-road	1.1%	3.5%	3.2%	1.2%
Vehicle not in use	2.2%	4.4%	3.2%	2.3%
Not reported	14.1%	11.7%	14.7%	14.1%
Total[b]	**100.0%**	**100.0%**	**100.0%**	**100.0%**
	Primary refueling facility			
Gas station	96.9%	62.4%	28.4%	93.9%
Truck stop	0.7%	7.7%	31.9%	1.8%
Own facility	2.0%	27.3%	36.2%	3.7%
Other nonpublic facility	0.3%	2.6%	3.5%	0.5%
Other	0.0%	0.0%	0.0%	0.0%
Total[b]	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Microdata. File on CD, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

[a] The respondent was asked to choose the category which best described the trips made by the vehicle.
[b] Percentages may not sum to totals due to rounding.

More medium truck owners listed construction as the truck's major use than any other major use category. Construction was the second highest major use for light trucks and heavy trucks.

Table 5.8
Percentage of Trucks by Size Ranked by Major Use, 2002

Rank	Light (< 10,000 lb average weight)	Medium (10,001 – 26,000 lb average weight)	Heavy (> 26,000 lb average weight)
1	**Personal** 81.5%	**Construction** 18.4%	**For hire** 30.1%
2	**Construction** 4.6%	**Agriculture** 16.2%	**Construction** 15.9%
3	**Other services** [a] 2.5%	**For hire** 9.6%	**Agriculture** 12.2%
4	**Not in use** 2.2%	**Retail** 7.1%	**Retail** 5.4%
5	**Agriculture** 1.9%	**Not in use** 6.4%	**Not in use** 5.1%
6	**Retail** 1.5%	**Leasing** 6.2%	**Waste management** 5.0%
7	**Unknown** 1.3%	**Wholesale** 5.5%	**Manufacturing** 4.9%
8	**Leasing** 0.7%	**Waste management** 5.4%	**Wholesale** 4.8%
9	**Manufacturing** 0.7%	**Utilities** 5.0%	**Leasing** 4.6%
10	**Utilities** 0.6%	**Personal** 4.8%	**Unknown** 3.2%
11	**Waste management** 0.6%	**Unknown** 4.4%	**Personal** 2.5%
12	**Wholesale** 0.6%	**Manufacturing** 3.3%	**Mining** 2.4%
13	**Information services** 0.4%	**Other services**[a] 3.2%	**Other services**[a] 1.3%
14	**For hire** 0.4%	**Food services** 1.6%	**Utilities** 1.1%
15	**Food services** 0.3%	**Information services** 1.3%	**Food services** 1.1%
16	**Arts** 0.2%	**Mining** 1.1%	**Arts** 0.3%
17	**Mining** 0.1%	**Arts** 0.5%	**Information services** 0.1%

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Micro data File on CD, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

[a] Business and personal services.

Nearly half of trucks in fleets of 11-20 and 21-50 vehicles use company-owned facilities. Most trucks in smaller fleets use public gas stations for fueling.

Table 5.9
Percentage of Trucks by Fleet Size and Primary Fueling Facility, 2002

	Primary refueling facility				
Truck fleet size	Gas station	Truck stop	Own facility	Other's facility	Total[a]
1–5	73.8%	6.1%	18.2%	1.9%	100.0%
6–10	55.3%	5.7%	35.5%	3.4%	100.0%
11–20	41.1%	5.1%	48.9%	4.9%	100.0%
21–50	42.9%	3.7%	49.8%	3.6%	100.0%
51 or more	48.3%	6.3%	44.4%	1.0%	100.0%
Fleets of 6 or more vehicles	47.6%	5.2%	43.9%	3.4%	100.0%
No fleet	**96.4%**	**1.6%**	**1.7%**	**0.3%**	**100.0%**

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Microdata File on CD, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

[a] Percentages may not sum to totals due to rounding.

Most trucks are fueled at gas stations, but for-hire or warehousing trucks are more often fueled at truck stops. Mining trucks and vehicle leasing or rental trucks fuel at the companies' own facility more than 30% of the time.

Table 5.10
Share of Trucks by Major Use and Primary Fueling Facility, 2002

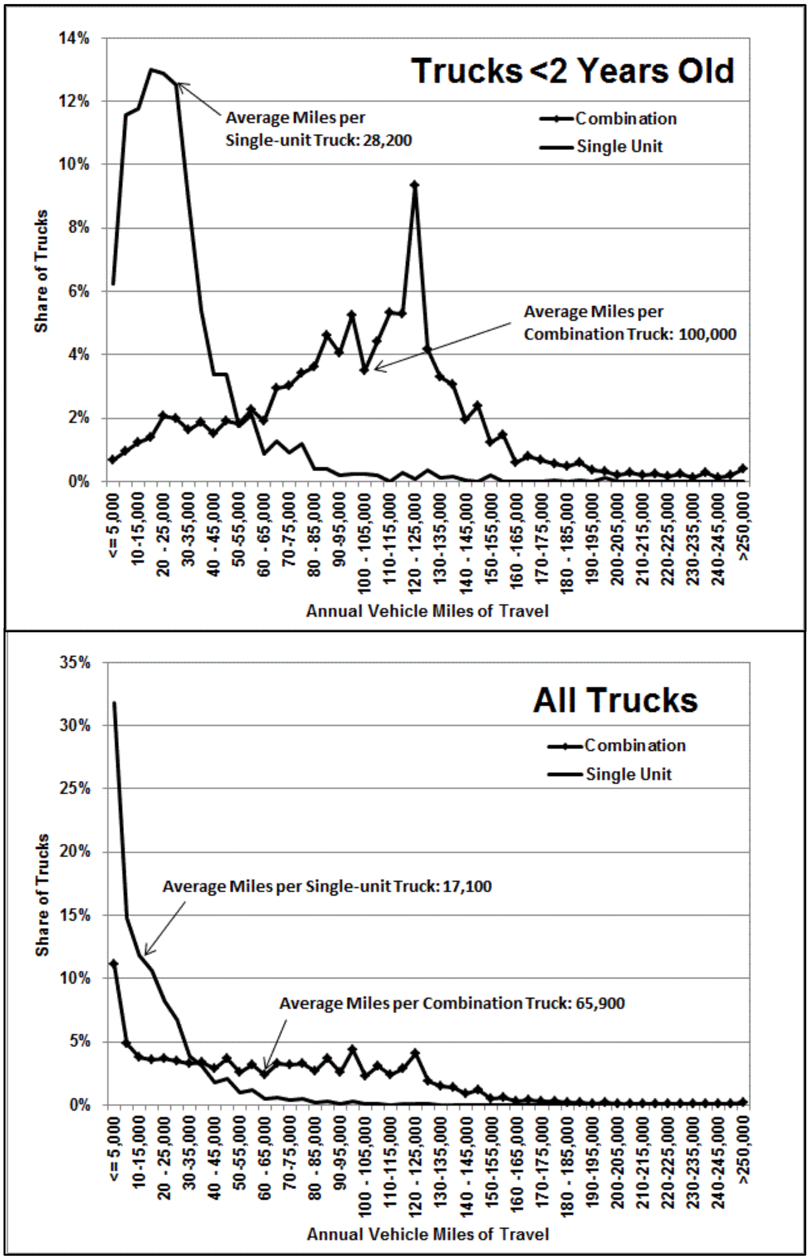
Major use	Gas station	Truck stop	Own facility	Others facility	Other	All[a]
Personal	98.6%	0.6%	0.7%	0.1%	0.1%	100.0%
Other services	96.0%	1.4%	1.6%	0.9%	0.1%	100.0%
Information services	92.3%	0.4%	7.2%	0.1%	0.0%	100.0%
Retail trade	86.6%	3.5%	8.6%	1.2%	0.0%	100.0%
Construction	84.7%	3.3%	9.8%	2.2%	0.0%	100.0%
Accommodation or food services	82.4%	7.5%	8.8%	1.3%	0.0%	100.0%
Manufacturing	81.5%	5.1%	11.9%	1.5%	0.0%	100.0%
Arts, entertainment, recreation services	81.1%	4.3%	14.2%	0.3%	0.0%	100.0%
Waste mgmt, landscaping, admin/support services	78.2%	3.0%	17.1%	1.6%	0.0%	100.0%
Wholesale trade	76.2%	6.6%	12.0%	5.1%	0.0%	100.0%
Utilities	72.6%	1.8%	24.3%	1.3%	0.0%	100.0%
Agriculture, forestry, fishing, hunting	62.7%	6.7%	29.4%	1.0%	0.1%	100.0%
Vehicle leasing or rental	60.2%	1.3%	31.8%	6.8%	0.0%	100.0%
Mining	48.7%	8.5%	34.3%	8.5%	0.0%	100.0%
For-hire or warehousing	33.3%	38.7%	25.8%	2.3%	0.0%	100.0%
Overall	**93.9%**	**1.8%**	**3.7%**	**0.5%**	**0.0%**	**100.0%**

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Microdata File on CD, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

[a] Percentages may not sum to totals due to rounding.

The figure below shows the distribution of annual travel the two types of Class 7 and 8 vehicles–combination units (separate tractor and trailer) and single units (tractor and trailer on a single chassis). This information is for all trucks and trucks two years old or less. Combination trucks, dominated by box-type trailers, display the greatest amount of annual travel of all heavy vehicle types, as is evidenced both by the range of annual use. Most of the single-unit trucks in the survey travel 40,000 miles per year or less.

Figure 5.2. Distribution of Trucks over 26,000 lb by Vehicle-Miles Traveled, 2002



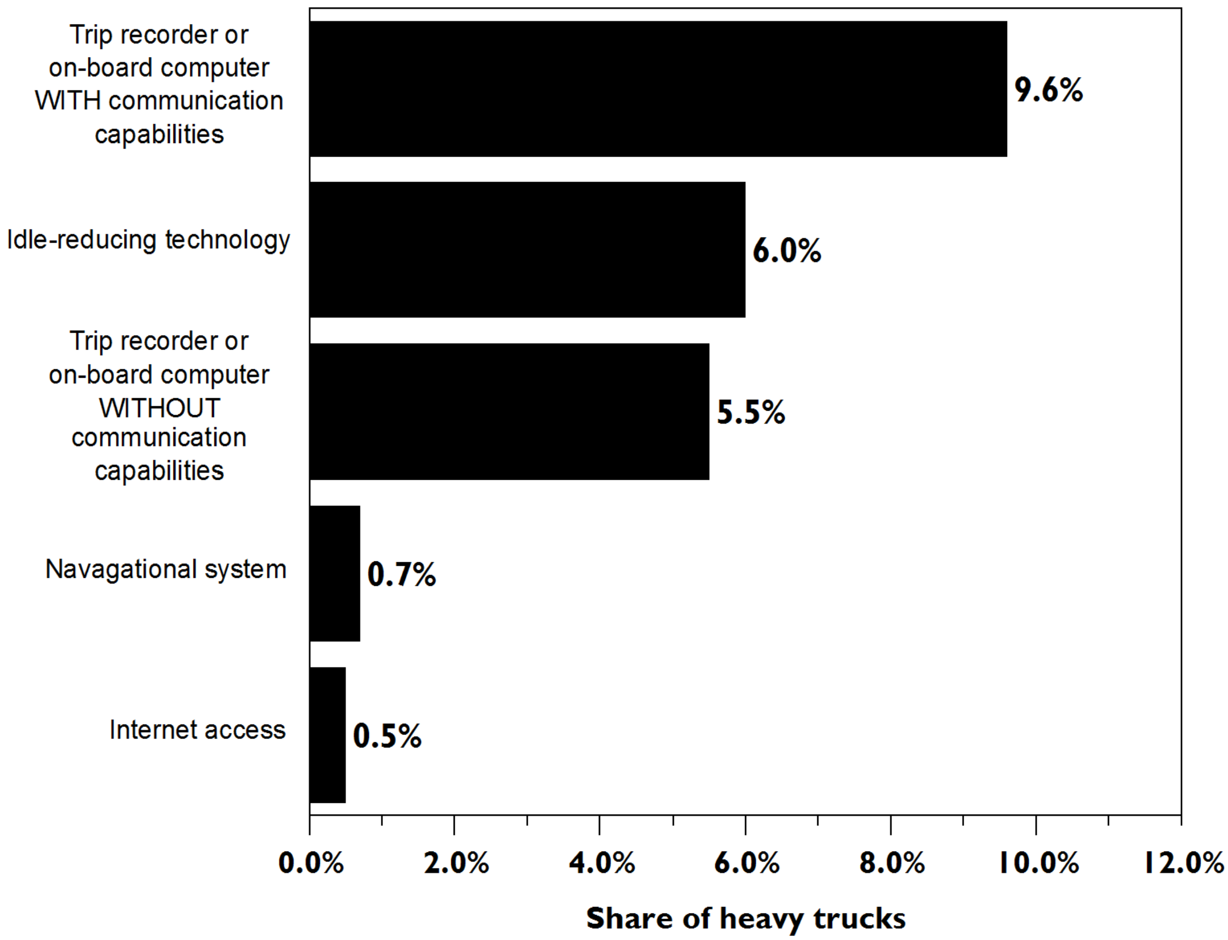
Note: Heavy trucks (class 7 & 8) are greater than 26,000 pounds gross vehicle weight based on the manufacturer's rating.

Source:

U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Microdata File on CD, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

The latest Vehicle Inventory and Use Survey asked truck owners if the truck had certain features as permanent equipment on the truck. Some of the features asked about were onboard computers, idle-reduction devices, navigational systems, and Internet access. Of the 2.3 million heavy trucks (class 7 & 8) in the United States, nearly 10% were equipped with onboard computers that had communication capabilities and another 5% had onboard computers without communication capabilities. Six percent of heavy trucks were equipped with idle-reducing technology. Navigational systems and Internet access were available in less than one percent of heavy trucks.

Figure 5.3. Share of Heavy Trucks with Selected Electronic Features, 2002



Note: Heavy trucks (class 7 & 8) are greater than 26,000 pounds gross vehicle weight based on the manufacturer's rating.

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and User Survey*, Microdata File on CD, 2005.

Fuel Economy Study for Class 8 Trucks

As part of a study sponsored by the U.S. Department of Energy (DOE) Vehicle Technologies Office (VTO), the Oak Ridge National Laboratory (ORNL) in conjunction with several industry partners has collected data and information related to heavy-truck operation in real-world highway environments. The primary objective of the project was to collect real-world performance and spatial data for long-haul operations of Class 8 tractor-trailers from a fleet engaged in normal freight operations. Six model-year 2005 Class 8 trucks from the selected fleet, which operates within a large area of the country extending from the east coast to Mountain Time Zone and from Canada to the US-Mexican border, were instrumented and 60 channels of data were collected for over a year at a rate of 5 Hz (or 5 readings per second). Those channels included information such as instantaneous fuel rate, engine speed, gear ratio, vehicle speed, and other information read from the vehicle's databus; weather information (wind speed, precipitation, air temperature, etc.) gathered from an on-board weather station; spatial information (latitude, longitude, altitude) acquired from a GPS (Global Positioning System) device; and instantaneous tractor and trailer weight obtained from devices mounted on the six participating tractors and ten trailers. Three of the six instrumented tractors and five of the ten instrumented trailers were mounted with New Generation Single Wide-Based Tires and the others with regular dual tires. Over the duration of this phase of the project (just over a year) the six tractors traveled nearly 700,000 miles.

To find out more about this project, contact Oscar Franzese, franzeseo@ornl.gov, 865-946-1304. The final report on this project is available on-line at:
cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2008-122.pdf.

The type of terrain a truck is traveling on can cause significant differences in fuel efficiency. This study (see page 5–15 for project description) shows fuel economy on severe upslopes is less than half that on flat terrain. On severe downslopes, the fuel economy was two times higher than on flat terrain.

Table 5.11
Effect of Terrain on Class 8 Truck Fuel Economy

		Average fuel efficiency (mpg)			
Type of terrain	Share of data records	All trucks	Tractors with dual tires	Tractors with single (wide) tires	Difference between dual and single tires (percent)
Severe upslope (>4%)	0.7%	2.90	2.86	2.94	2.91%
Mild upslope (1% to 4%)	13.2%	4.35	4.25	4.44	4.35%
Flat terrain (1% to 1%)	72.4%	7.33	7.08	7.58	7.13%
Mild downslope (-4% to -1%)	12.6%	15.11	14.64	15.57	6.36%
Severe downslope (<-4%)	1.1%	23.5	21.82	25.3	15.97%

Source:
Capps, Gary, Oscar Franzese, Bill Knee, M.B. Lascurain, and Pedro Otaduy. *Class-8 Heavy Truck Duty Cycle Project Final Report*, ORNL/TM-2008/122, Oak Ridge National Laboratory, Oak Ridge, TN, December 2008. (Additional resources: cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2008-122.pdf)

This table presents a distribution of distance traveled, fuel consumed, and fuel economy by speed and by type of tires for the vehicles participating in the project (see page 5-15 for project description). The speed bins are divided into 5-mile intervals, going from 0+ mph (i.e., speed > 0.00 mph) to 85 mph, while the four main columns of the table are organized by the type of tires that were mounted on the tractor and trailers. The first row of the table contains information about fuel consumed while the vehicle was idling (i.e., the vehicle was static with the engine on) with the following rows presenting information about the distance traveled, fuel consumed, and fuel economy for each one of the speed intervals. The next-to-the-last row shows the totals for both traveled distances and fuel consumed as well as the overall fuel economy for each tire-combination category. The latter are then used to compute the percentage difference in terms of fuel economy from dual tire tractors and trailers, which is the most common tire setup for large trucks at the present time.

Table 5.12
Fuel Economy for Class 8 Trucks as Function of Speed and Tractor-Trailer Tire Combination

Speed (mph)	Dual tire tractor – dual tire trailer			Dual tire tractor – single (wide) tire trailer			Single (wide) tire tractor – dual tire trailer			Single (wide) tire tractor - single (wide) tire trailer		
	Distance traveled (miles)	Fuel cons. (gal)	Fuel econ. (MPG)	Distance traveled (miles)	Fuel cons. (gal)	Fuel econ. (MPG)	Distance traveled (miles)	Fuel cons. (gal)	Fuel econ. (MPG)	Distance traveled (miles)	Fuel cons. (gal)	Fuel econ. (MPG)
Idling	N/A	1,858.5	N/A	N/A	967.9	N/A	N/A	1,676.4	N/A	N/A	706.0	N/A
0+ to 5	281	101.8	2.76	148	50.4	2.93	368.0	124.2	3.0	156	52.8	2.96
5+ to 10	674	198.8	3.39	368	103.2	3.56	808.0	245.4	3.3	331	98.8	3.35
10+ to 15	723	192.0	3.77	396	98.3	4.03	848.0	216.5	3.9	343	87.0	3.95
15+ to 20	744	199.1	3.73	404	100.9	4.00	882.0	221.6	4.0	361	90.5	3.98
20+ to 25	938	228.4	4.11	489	113.6	4.31	1,111.0	244.2	4.6	462	101.1	4.57
25+ to 30	1,178	266.9	4.41	609	131.5	4.63	1,420.0	286.9	5.0	580	117.6	4.93
30+ to 35	1,481	336.8	4.40	753	154.2	4.88	1,774.0	341.1	5.2	708	141.1	5.02
35+ to 40	1,917	403.5	4.75	1,000	193.6	5.17	2,284.0	433.6	5.3	941	184.3	5.10
40+ to 45	2,955	584.1	5.06	1,543	285.9	5.40	3,380.0	603.6	5.6	1,350	254.4	5.31
45+ to 50	4,935	907.9	5.43	2,573	447.7	5.75	5,410.0	872.8	6.2	2,177	360.4	6.04
50+ to 55	9,397	1,629.8	5.77	4,962	811.5	6.11	10,046.0	1,622.7	6.2	3,877	625.5	6.20
55+ to 60	20,656	3,297.2	6.26	11,707	1,721.9	6.80	22,373.0	3,257.8	6.9	8,710	1,246.9	6.99
60+ to 65	38,964	5,879.6	6.63	21,472	2,980.8	7.20	34,517.0	4,840.0	7.1	14,944	2,049.4	7.29
NOT ADJUSTED FOR TERRAIN: See note below.												
65+ to 70	58,304	8,313.2	7.01	27,931	3,652.2	7.65	65,063.0	9,256.4	7.0	27,144	3,880.1	7.00
70+ to 75	56,378	7,483.2	7.53	21,751	2,745.5	7.92	66,882.0	8,435.6	7.9	32,887	4,056.1	8.11
75+ to 85	7,849	808.2	9.71	3,610	403.2	8.95	11,513.0	911.1	12.6	6,817	512.2	13.31
Total[a]	207,374	30,831.0	6.73	99,714	13,994.0	7.13	228,680.0	31,913.0	7.2	101,790	13,858.0	7.35
Percent increase in fuel economy from dual tire trac/trail			0.00%			5.93%			6.53%			9.20%

Note: These data were not adjusted to account for the effects of terrain. The increase in fuel economy for speeds above 70 mph is likely due to the vehicle achieving high speeds while traveling down slope. Therefore, this increase in fuel economy is not expected to be characteristic of all travel at these higher speeds.

Source:

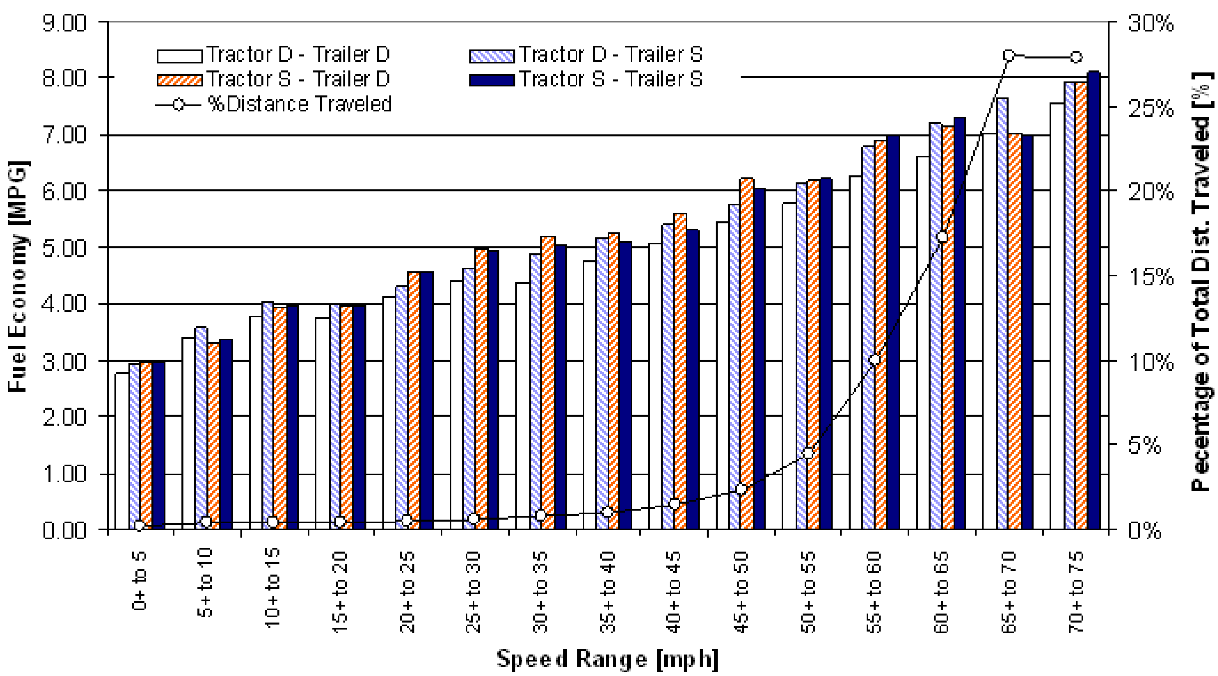
Capps, Gary, Oscar Franzese, Bill Knee, M.B. Lascurain, and Pedro Otaduy. *Class-8 Heavy Truck Duty Cycle Project Final Report*, ORNL/TM-2008/122, Oak Ridge National Laboratory, Oak Ridge, TN, December 2008. (Additional resources: cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2008-122.pdf)

[a] Total fuel consumed does not include fuel consumed while idling.

The fuel economy information presented in Table 5.12 is on the upper limits of today's large-truck fleets and is mostly a result of driver training and the extensive vehicle maintenance (including constant tire pressure) to which the fleet company participating in this project adheres. Nevertheless, the results of this extensive test indicate that there are substantial gains in terms of fuel economy for large trucks when single (wide) tires are used in combination with dual tires or alone (best case). Figure 5.4 shows the information from Table 5.12 in a graphical form (bars) and also displays for each speed bin the percentage of the total distance that is traveled at that speed (line). It is possible to observe that above 80% of the distance traveled by long-haul Class 8 trucks is done at speeds above 55 mph. Therefore, any gains in fuel economies at these speeds derived from a given tire combination would have a very large impact on the overall fuel economy of these types of trucks. Figure 5.4 shows that, except for the D-S combination within the 65+ to 70 mph, the combinations with all single (wide) tires perform better and, therefore, obtain the largest overall fuel economy.

Figure 5.4. Class 8 Truck Fuel Economy as a Function of Speed and Tractor-Trailer Tire Combination and Percentage of Total Distance Traveled as a Function of Speed

NOT ADJUSTED FOR TERRAIN: See note below.



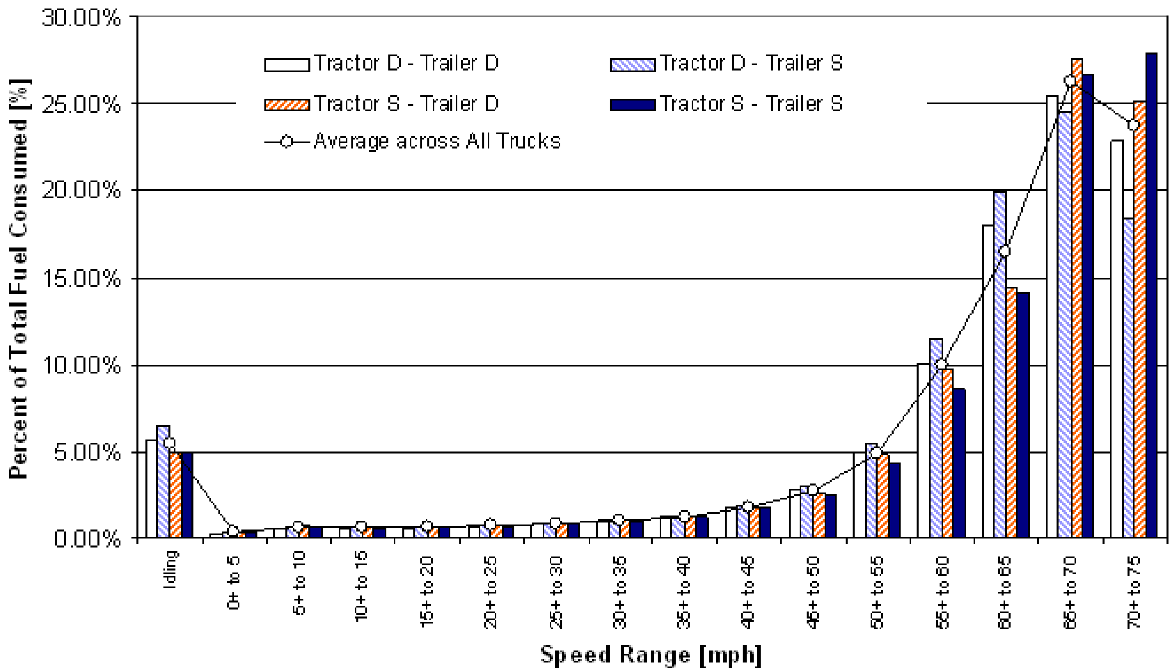
Note: D = Dual tire. S = Single (wide) tire.
These data were not adjusted to account for the effects of terrain. The increase in fuel economy for speeds above 70 mph is likely due to the vehicle achieving high speeds while traveling down slope. Therefore, this increase in fuel economy is not expected to be characteristic of all travel at these higher speeds.

Source:
Capps, Gary, Oscar Franzese, Bill Knee, M.B. Lascurain, and Pedro Otaduy. *Class-8 Heavy Truck Duty Cycle Project Final Report*, ORNL/TM-2008/122, Oak Ridge National Laboratory, Oak Ridge, TN, December 2008. (Additional resources: cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2008-122.pdf)

This graph presents for each one of the four tire-combination categories the percent of total fuel that is consumed when traveling at different speeds (bars) as well as the average percent of fuel consumed for each speed bin (line). As opposed to Table 5.12, the total fuel consumed on this graph includes the fuel consumed while idling.

Figure 5.5. Class 8 Truck Percent of Total Fuel Consumed as a Function of Speed and Tractor-Trailer Tire Combination

NOT ADJUSTED FOR TERRAIN: See note below



Note: D = Dual tire. S = Single (wide) tire.
These data were not adjusted to account for the effects of terrain. The increase in fuel economy for speeds above 70 mph is likely due to the vehicle achieving high speeds while traveling down slope. Therefore, this increase in fuel economy is not expected to be characteristic of all travel at these higher speeds.

Source:
Capps, Gary, Oscar Franzese, Bill Knee, M.B. Lascurain, and Pedro Otaduy. *Class-8 Heavy Truck Duty Cycle Project Final Report*, ORNL/TM-2008/122, Oak Ridge National Laboratory, Oak Ridge, TN, December 2008. (Additional resources: cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2008-122.pdf)

A typical class 8 truck tractor weighs about 17,000 lb. The powertrain is nearly a quarter of the weight (24%) while the truck body structure is 19%.

Table 5.13
Class 8 Truck Weight by Component

	Pounds	Share of total
Wheels and tires	1,700	10%
Chassis/frame	2,040	12%
Drivetrain and suspension	2,890	17%
Misc. accessories/systems	3,060	18%
Truck body structure	3,230	19%
Powertrain	4,080	24%
Total	17,000	100%

Notes:
- Powertrain includes engine and cooling system, transmission and accessories.
- Truck body structure includes cab-in-white, sleeper unit, hood and fairings, interior and glass.
- Miscellaneous accessories/systems include batteries, fuel system, and exhaust hardware.
- Drivetrain and suspension include drive axles, steer axle, and suspension system.
- Chassis/frame includes frame rails and crossmembers, fifth wheel and brackets. Wheels and tires include a set of 10 aluminum wheels, plus tires.

Source:
National Academy of Sciences, *Technologies and Approaches to Reducing the Fuel Consumption of Medium and Heavy-Duty Vehicles*, 2010, p. 117.

The gross weight of a vehicle (GVW) is the weight of the empty vehicle plus the weight of the maximum payload that the vehicle was designed to carry. In cars and small light trucks, the difference between the empty weight of the vehicle and the GVW is not significantly different (1,000 to 1,500 lb). The largest trucks and tractor-trailers, however, have a payload capacity share of 200%, which means they can carry 200% of their empty weight. The medium-sized trucks (truck classes 3-6) have payload capacity shares between 50% and 100%.

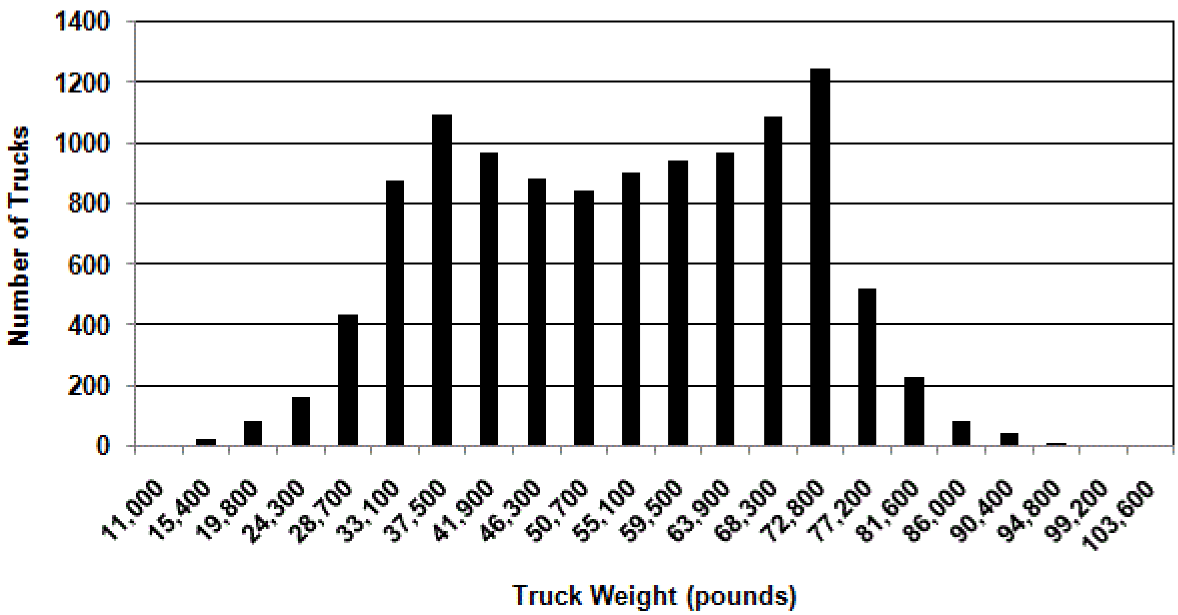
Table 5.14
Gross Vehicle Weight versus Empty Vehicle Weight

Vehicle description	Truck class	Gross vehicle weight range (pounds)	Empty vehicle weight range (pounds)	Maximum payload capacity (pounds)	Payload capacity share (percent of empty weight)
Cars		3,200-6,000	2,400-5,000	1,000	20%
Minivans, small SUVs, small pick-ups	1	4,000-2,400	3,200-4,500	1,500	33%
Large SUVs, standard pick-ups	2a	6,001-8,500	4,500-6,000	2,500	40%
Large SUVs, standard pick-ups	2b	8,501-10,000	5,000-6,300	3,700	60%
Utility van, multi- purpose, mini-bus, step van	3	10,001-14,000	7,650-8,750	5,250	60%
City delivery, parcel delivery, large walk-in, bucket, landscaping	4	14,001-16,000	7,650-8,750	7,250	80%
City delivery, parcel delivery, large walk-in, bucket	5	16,001-19,500	9,500-10,000	8,700	80%
City delivery, school bus, large walk-in, bucket	6	19,501-26,000	11,500-14,500	11,500	80%
City bus, furniture, refrigerated, refuse, fuel tanker, dump, tow, concrete, fire engine, tractor-trailer	7	26,001-33,000	11,500-14,500	18,500	125%
Refuse, concrete, furniture, city bus, tow, fire engine (straight trucks)	8a	33,001-80,000	20,000-26,000	54,000	200%
Tractor-trailer: van, refrigerated, bulk tanker, flat bed (combination trucks)	8b	33,001-80,000	20,000-26,000	54,000	200%

Source:
National Academy of Sciences, *Technologies and Approaches to Reducing the Fuel Consumption of Medium and Heavy-Duty Vehicles*, 2010, pp. 18 and 116.

According to weigh-in-motion data collected by fifteen states, the majority of 5-axle tractor-trailers on the road weigh between 33,000 and 73,000 lb. Eleven percent of the tractor-trailers had weight recorded around 72,800 lb and 10% around 68,300 lb. Another 10% of tractor-trailers were on the lighter end of the scale – around 37,500 lb. These data show that only a small percent of trucks on the road are near the maximum roadway gross vehicle weight of 80,000 lb. Thus, most trucks are filling the trailer space to capacity (cubing-out) before they reach the maximum weight limit (weighing-out).

Figure 5.6. Distribution of Class 8 Trucks by On-Road Vehicle Weight, 2008[a]



Note: Data are from these 15 States: California, Connecticut, Florida, Georgia, Hawaii, Iowa, Minnesota, Missouri, Montana, North Carolina, Oregon, Pennsylvania, South Dakota, Texas, and Washington.

Source:
National Academy of Sciences, *Technologies and Approaches to Reducing the Fuel Consumption of Medium and Heavy-Duty Vehicles*, 2010, p. 118. Original source: Federal Highway Administration, Vehicle Travel Information System, 2008.

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[a] Study reported data on 5-axle tractor-trailers which are class 8 trucks. Single-unit class 8 trucks were not considered in the study.

Commodity Flow Survey

The Commodity Flow Survey (CFS) is designed to provide data on the flow of goods and materials by mode of transport. The survey was first conducted in various years from 1963 to 1977, and was again conducted in 1993, 1997, 2002, 2007, and 2012 with improvements in methodology, sample size, and scope. Data collection for the 2017 survey began in late 2016 and preliminary data are expected in December 2018. It is a shipper-based survey which covers business establishments from these industries:

- Mining
- Manufacturing
- Wholesale trade
- Select Retail and Services

Industries not covered by CFS include transportation, construction, most retail and services industries, farms, fisheries, foreign establishments, and most government-owned establishments. Before 1993 data were collected only on the principal mode of travel, but after that time all modes of a shipment were captured in the data.

The CFS is a joint effort of the Bureau of Transportation Statistics and the U.S. Census Bureau. Additional information on the survey can be found at:

www.bts.gov/content/commodity-flow-survey-overview
www.census.gov/programs-surveys/cfs.html

Industries covered by the 2012 Commodity Flow Survey (CFS) shipped goods worth over $13 trillion. Compared to the 1993 CFS, the value of shipments is up 1.7% per year and tons shipped are up 0.8% per year. By value, multiple mode shipments increased 2.8% per year from 1993 to 2012.

Table 5.15
Value of Goods Shipped in the United States: Comparison of the 1993, 1997, 2002, 2007 and 2012 Commodity Flow Surveys[a]

	1993 (billion 2012 dollars)	1997 (billion 2012 dollars)	2002 (billion 2012 dollars)	2007 (billion 2012 dollars)	2012 (billion dollars)	Average annual percent change (1993-2012)
All modes	**10,106.6**	**9,933.3**	**10,716.8**	**12,938.9**	**13,852.1**	**1.7%**
Single modes	**8,542.3**	**8,181.8**	**8,996.6**	**10,562.8**	**11,900.4**	**1.8%**
Truck[b]	7,612.4	7,126.0	7,957.3	9,230.4	10,132.2	1.5%
For-hire truck	4,538.0	4,150.4	4,794.9	5,487.5	6,504.6	1.9%
Private truck	3,035.4	2,913.2	3,120.8	3,742.8	3,627.6	0.9%
Rail	427.7	457.2	396.8	483.3	473.1	0.5%
Water	106.6	108.5	114.0	127.2	301.6	5.6%
Inland water	70.4	77.1	73.3	100.8	218.9	6.2%
Great Lakes	[c]	2.2	1.1	[c]	0.4	[c]
Deep sea	34.2	29.2	39.6	25.5	59.9	3.0%
Multiple waterways	[c]	[d]	[d]	[d]	22.3	[c]
Air (includes truck and air)	240.4	327.7	338.1	279.4	450.6	3.4%
Pipeline[e]	155.4	162.4	190.4	442.5	542.9	6.8%
Multiple modes	**1,145.4**	**1,353.1**	**1,377.3**	**2,067.1**	**1,950.8**	**2.8%**
Parcel, U.S.P.S. or courier	973.7	1,224.4	1,260.6	1,729.5	1,688.2	2.9%
Truck and rail	143.6	108.3	89.2	207.3	224.8	2.4%
Truck and water	16.2	11.8	18.3	64.7	29.0	3.1%
Rail and water	6.4	2.5	4.2	15.4	8.0	1.2%
Other multiple modes	5.6	6.1	4.9	50.2	0.7	-10.3%
Other and unknown modes	**418.8**	**398.5**	**342.8**	**309.1**	**1.0**	**-27.2%**

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics and U.S. Department of Commerce, Bureau of the Census, *1993, 1997, 2002, 2007, and 2012 Commodity Flow Surveys*, Table 1a. (Additional resources: www.census.gov/programs-surveys/cfs.html)

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[a] Detail may not add to total because of rounding.
[b] "Truck" as a single mode includes shipments which went by private truck only, for-hire truck only, or a combination of private truck and for-hire truck.
[c] Denotes data do not meet publication standards because of high sampling variability or poor response quality.
[d] Data are not available.
[e] CFS data for pipeline exclude most shipments of crude oil.

Industries covered by the 2012 Commodity Flow Survey (CFS) shipped over 11 billion tons of goods nationwide. Nearly three-quarters of the freight tonnage was shipped by truck.

Table 5.16
Tons of Freight in the United States: Comparison of the 1993, 1997, 2002, 2007 and 2012 Commodity Flow Surveys[a]

	1993 (millions)	1997 (millions)	2002 (millions)	2007 (millions)	2012 (millions)	Average annual percent change (1993-2012)
All modes	**9,688.50**	**11,089.7**	**11,667.9**	**12,543.4**	**11,299.4**	**0.8%**
Single modes	**8,922.30**	**10,436.5**	**11,086.7**	**11,698.1**	**10,905.5**	**1.1%**
Truck[b]	6,385.9	7,700.7	7,842.8	8,778.7	8,060.2	1.2%
For-hire truck	2,808.3	3,402.6	3,657.3	4,075.1	4,298.7	2.3%
Private truck	3,543.5	4,137.3	4,149.7	4,703.6	3,761.3	0.3%
Rail	1,544.10	1,549.8	1,873.9	1,861.3	1,628.5	0.3%
Water	505.4	563.4	681.2	403.6	576.0	0.7%
Inland water	362.5	414.8	458.6	343.3	424.5	0.8%
Great Lakes	33	38.4	38.0	17.8	31.4	-0.3%
Deep sea	109.9	110.2	184.6	42.5	73.0	-2.1%
Multiple waterways	[c]	[c]	[c]	[c]	47.1	[c]
Air (includes truck and air)	3.1	4.5	3.8	3.6	4.8	2.3%
Pipeline[d]	483.6	618.2	685.0	650.9	636.0	1.5%
Multiple modes	**225.7**	**216.7**	**216.7**	**573.7**	**357.0**	**2.4%**
Parcel, U.S.P.S. or courier	18.9	23.7	25.5	33.9	28.5	2.2%
Truck and rail	40.6	54.2	43.0	225.6	213.8	9.1%
Truck and water	68	33.2	23.3	145.5	56.7	-1.0%
Rail and water	79.2	79.3	105.1	54.9	55.6	-1.8%
Other multiple modes	18.9	26.2	19.8	113.8	2.5	-10.1%
Other and unknown modes	**540.5**	**436.5**	**364.6**	**271.6**	**36.8**	**-13.2%**

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics and U.S. Department of Commerce, Bureau of the Census, *1993, 1997, 2002, 2007, and 2012 Commodity Flow Survey*, Table 1a. (Additional resources: www.census.gov/programs-surveys/cfs.html)

[a] Detail may not add to total because of rounding.
[b] "Truck" as a single mode includes shipments which went by private truck only, for-hire truck only, or a combination of private truck and for-hire truck.
[c] Data are not available.
[d] CFS data for pipeline exclude most shipments of crude oil.

Industries covered by the 2012 Commodity Flow Survey (CFS) accounted for 2.9 trillion ton-miles on the nation's highways, railways, waterways, pipelines, and aviation system. Ton-miles increased an average of 1.1% per year from 1993 to 2012.

Table 5.17
Ton-Miles of Freight in the United States: Comparison of the 1993, 1997, 2002, 2007 and 2012 Commodity Flow Surveys[a]

	1993 (billions)	1997 (billions)	2002 (billions)	2007 (billions)	2012 (billions)	Average annual percent change (1993-2012)
All modes	**2,420.90**	**2,661.4**	**3,137.9**	**3,344.7**	**2,969.5**	**1.1%**
Single modes	**2,136.90**	**2,383.5**	**2,867.9**	**2,894.3**	**2,697.4**	**1.2%**
Truck[b]	869.5	1,023.5	1,255.9	1,342.1	1,247.7	1.9%
For-hire truck	629	741.1	959.6	1,055.6	1,050.9	2.7%
Private truck	235.9	268.6	291.1	286.5	196.8	-0.9%
Rail	942.6	1,022.5	1,261.6	1,344.0	1,211.5	1.3%
Water	272	261.7	282.7	157.3	192.9	-1.8%
Inland water	164.4	189.3	211.5	117.5	118.7	-1.7%
Great Lakes	12.4	13.4	13.8	6.9	11.0	-0.6%
Deep sea	95.2	59.0	57.4	33.0	22.1	-7.4%
Multiple waterways	[c]	[c]	[c]	[c]	41.0	[c]
Air (includes truck and air)	4	6.2	5.8	4.5	5.8	2.0%
Pipeline[d]	[c]	[e]	[e]	[e]	[e]	[c]
Multiple modes	**191.5**	**204.5**	**225.7**	**416.6**	**271.8**	**1.9%**
Parcel, U.S.P.S. or courier	13.2	18.0	19.0	28.0	22.7	2.9%
Truck and rail	37.7	55.6	45.5	196.8	169.5	8.2%
Truck and water	40.6	34.8	32.4	98.4	48.6	1.0%
Rail and water	70.2	77.6	115.0	47.1	29.2	-4.5%
Other multiple modes	[c]	18.6	13.8	46.4	1.9	[c]
Other and unknown modes	**92.6**	**73.4**	**44.2**	**33.8**	**0.3**	**-26.0%**

Source:

U.S. Department of Transportation, Bureau of Transportation Statistics and U.S. Department of Commerce, Bureau of the Census, *1993, 1997, 2002, 2007 and 2012 Commodity Flow Surveys*, Table 1a. (Additional resources: www.census.gov/programs-surveys/cfs.html)

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[a] Detail may not add to total because of rounding.

[b] "Truck" as a single mode includes shipments which went by private truck only, for-hire truck only, or a combination of private truck and for-hire truck.

[c] Data are not available.

[d] CFS data for pipeline exclude most shipments of crude oil.

[e] Denotes data do not meet publication standards because of high sampling variability or poor response quality.

Industries covered by the 2012 Commodity Flow Survey (CFS) had an average shipment length of 630 miles, a 49% increase from the 1993 survey. For single mode shipments, air had the highest shipment length in 2012; for multiple modes, truck and water had the highest length.

Table 5.18
Average Miles per Shipment in the United States: Comparison of the 1993, 1997, 2002, 2007 and 2012 Commodity Flow Surveys[a]

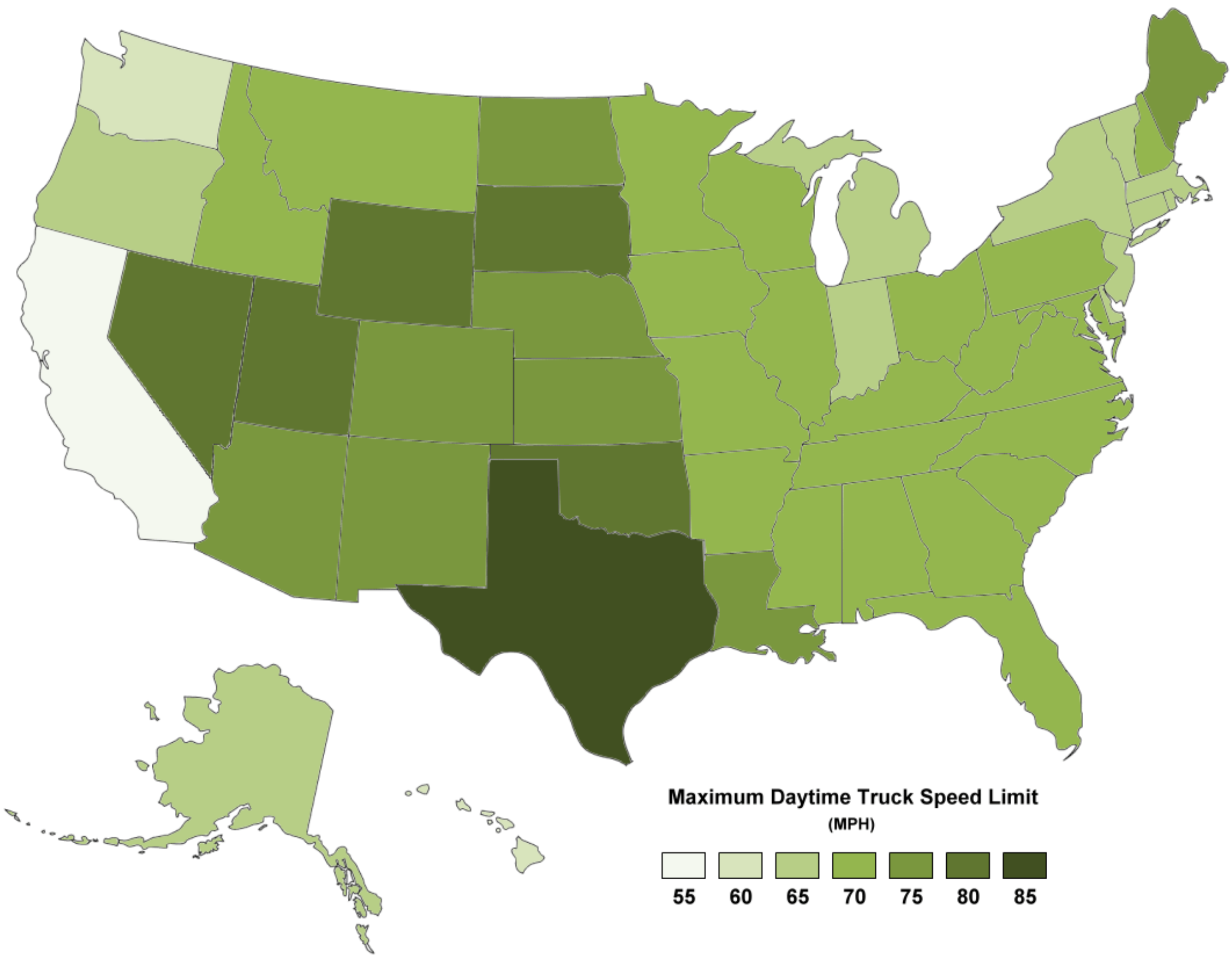
	1993 (miles)	1997 (miles)	2002 (miles)	2007 (miles)	2012 (miles)	Average annual percent change (1997-2012)
All modes	**424**	**472**	**546**	**619**	**630**	**2.1%**
Single modes	**197**	**184**	**240**	**234**	**262**	**1.5%**
Truck[b]	144	144	173	206	227	2.4%
For-hire truck	472	485	523	599	508	0.4%
Private truck	52	53	64	57	58	0.6%
Rail	766	769	807	728	805	0.3%
Water	c	482	568	520	908	c
Inland water	c	177	450	144	275	c
Great Lakes	534	204	339	657	347	-2.2%
Deep sea	1,861	1,024	664	923	1,157	-2.5%
Multiple waterways	c	c	c	c	1,034	c
Air (includes truck and air)	1,415	1,380	1,919	1,304	1,295	-0.5%
Pipeline[d]	c	e	e	e	e	c
Multiple modes	**736**	**813**	**895**	**975**	**922**	**1.2%**
Parcel, U.S.P.S. or courier	734	813	894	975	922	1.2%
Truck and rail	1,403	1,347	1,413	1,007	988	-1.8%
Truck and water	1,417	1,265	1,950	1,429	1,562	0.5%
Rail and water	627	1,092	957	1,928	1,073	2.9%
Other multiple modes	1,082	e	e	1,182	e	c
Other and unknown modes	**229**	**122**	**130**	**116**	**2**	**-22.1%**

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics and U.S. Department of Commerce, Bureau of the Census, *1993, 1997, 2002, 2007 and 2012 Commodity Flow Surveys*, Table 1a. (Additional resources: www.census.gov/programs-surveys/cfs.html)

[a] Detail may not add to total because of rounding.
[b] "Truck" as a single mode includes shipments which went by private truck only, for-hire truck only, or a combination of private truck and for-hire truck.
[c] Data are not available.
[d] CFS data for pipeline exclude most shipments of crude oil.
[e] Denotes data do not meet publication standards because of high sampling variability or poor response quality.

Ranging from a speed limit of 55 miles per hour (mph) to 85 mph, the maximum speed limit for trucks varies from state to state and sometimes from year to year. Currently, California has the most conservative maximum speed limit for trucks – 55 mph. At the other end of the spectrum, Texas has some roads where the truck speed limit is 85 mph. Because of the varying limits, there is not one common highway speed at which trucks travel. Manufacturers design the vehicle to perform well over the entire range of speeds.

Figure 5.7. Maximum Daytime Truck Speed Limits by State, 2019

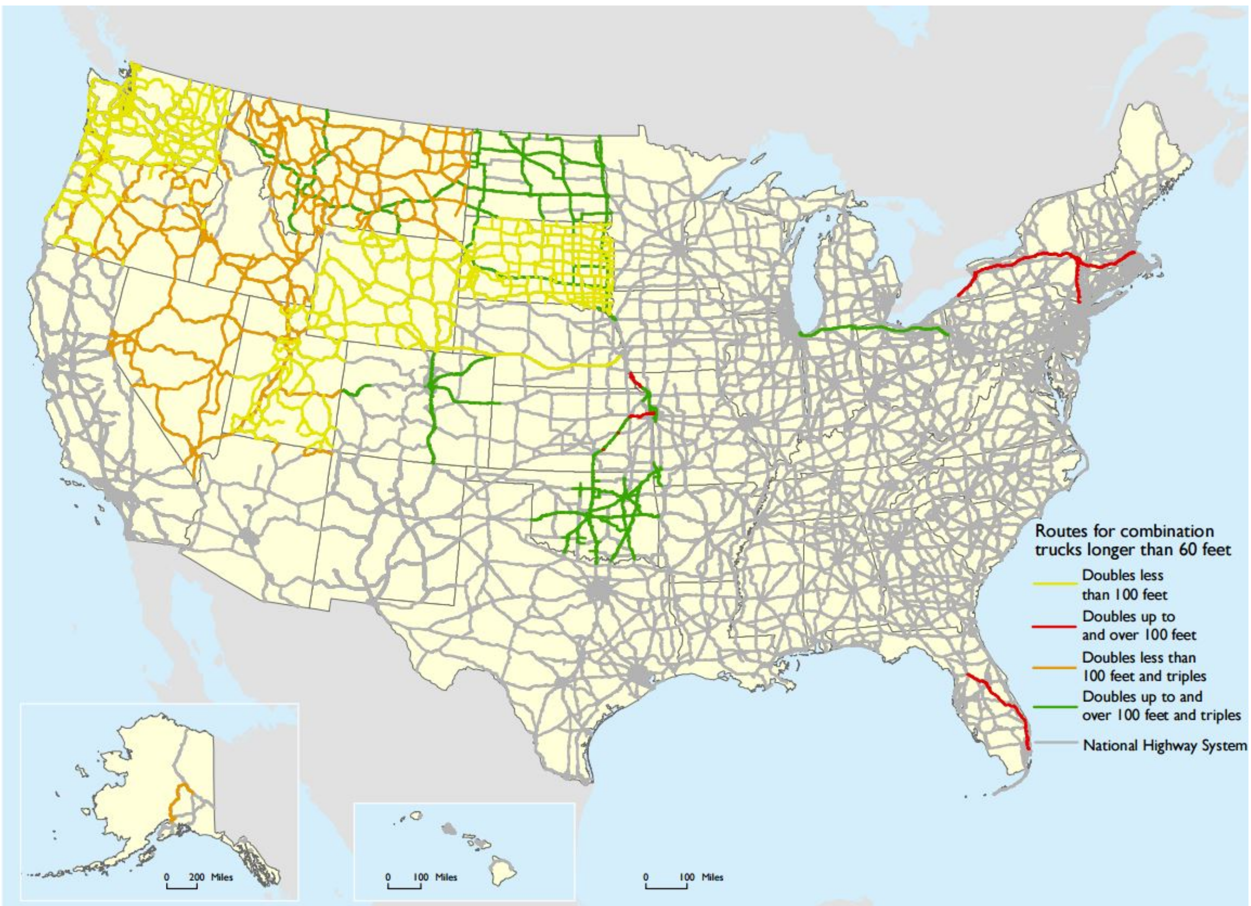


Note: Oklahoma's maximum speed limit is effective November 1, 2019.

Source:
Insurance Institute for Highway Safety, Highway Loss Data Institute, "Speed Limits," July 2019.
(Additional resources: www.iihs.org/iihs/topics/speed/speed-limit-laws)

Although all states allow the conventional combinations consisting of a 28-foot semi-trailer and a 28-foot trailer, only 14 states and six state turnpike authorities allow longer combination vehicles (LCVs) on at least some parts of their road networks. LCVs are tractors pulling a semi-trailer and trailer, with at least one of them – the semi-trailer, the trailer, or both – longer than 28 feet. The routes that these LCVs can travel have not changed since 1991.

Figure 5.8. Routes Where Longer Combination Vehicles Are Permitted, 2017



Note: Empty triples are allowed on I-80 in Nebraska.

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, *Freight Facts and Figures 2017,* 2018. (Additional resources: www.bts.gov/product/freight-facts-and-figures).

Chapter 6
Alternative Fuel and Advanced Technology Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 6.1	Alternative fuel vehicles made available, 2018	1,076,884
	E85	813,774
	LPG	2,468
	CNG	4,451
	Electric	253,678
	LNG	0
	Hydrogen	2,513
Table 6.12	Number of alternative fuel refuel sites, 2018	68,160
	Electric outlets	58,634
	LPG	3,357
	CNG	1,664
	Biodiesel	704
	Hydrogen	60

Fuel type abbreviations are used throughout this chapter.

B20	=	*20% biodiesel, 80% petroleum diesel*
CNG	=	*compressed natural gas*
E85	=	*85% ethanol, 15% gasoline*
E95	=	*95% ethanol, 5% gasoline*
H_2	=	*hydrogen*
LNG	=	*liquefied natural gas*
LPG	=	*liquefied petroleum gas*

Alternative Fuels

The Energy Policy Act of 1992 defines alternative fuels and allows the U.S. Department of Energy (DOE) to add to the list of alternative fuels if the fuel is substantially nonpetroleum, yields substantial energy security benefits, and offers substantial environmental benefits. DOE currently recognizes the following as alternative fuels:

- methanol, ethanol, and other alcohols,
- blends of 85% or more of alcohol with gasoline,
- natural gas and liquid fuels domestically produced from natural gas,
- liquefied petroleum gas (propane),
- coal-derived liquid fuels,
- hydrogen,
- electricity,
- biodiesel (B100),
- fuels (other than alcohol) derived from biological materials,
- P-series.

Alternative Fuels Data Center

DOE established the Alternative Fuels Data Center (AFDC) in 1991 to support its work aimed at fulfilling the Alternative Motor Fuels Act directives. Since then, the AFDC has expanded its focus to include all advanced transportation fuels, vehicles, and technologies. The AFDC is operated and managed by the National Renewable Energy Laboratory (NREL) in Golden, Colorado.

The purposes of the AFDC are:

- to gather and analyze information on the fuel consumption, emissions, operation, and durability of alternative fuel vehicles, and

- to provide unbiased, accurate information on alternative fuels and alternative fuel vehicles to government agencies, private industry, research institutions, and other interested organizations.

Much of the AFDC data can be obtained through their website: **afdc.energy.gov**. Several tables and graphs in this chapter contain statistics which were generated by the AFDC. Below are some links to specific areas of the AFDC website.

Alternative & Advanced Fuels – afdc.energy.gov

Alternative Fueling Station Locator – afdc.energy.gov/stations/#/find/nearest

Alternative & Advanced Vehicles – afdc.energy.gov/fuels

State & Federal Incentives & Laws – afdc.energy.gov/laws

Data Analysis & Trends – afdc.energy.gov/data

Tools – afdc.energy.gov/tools

The Energy Information Administration (EIA) is no longer publishing estimates of the number of alternative vehicles in use in the United States. EIA does publish the number of alternative fuel vehicles "made available" each year, beginning in 2004. The alternative fuel vehicles "made available" are estimates from vehicle manufacturer production and companies performing vehicle conversions. The data are more of a proxy for alternative fuel vehicle sales than for vehicle population, but EIA cautions that the data are not actual sales data.

Table 6.1
Estimates of Alternative Fuel Highway Vehicles Made Available, 2004-2018

Year	CNG	Electric[a]	E85	Hydrogen	LNG	LPG
2004	7,752	2,200	674,678	31	136	2,150
2005	3,304	2,281	743,948	74	68	700
2006	3,128	2,715	1,011,399	40	92	473
2007	2,487	3,152	1,115,069	63	26	356
2008	4,440	2,802	1,175,345	63	384	695
2009	3,770	2,255	805,777	26	126	861
2010	4,973	2,229	1,484,945	64	231	747
2011	5,674	25,382	2,116,273	107	137	1,054
2012	7,672	46,624	2,446,966	56	101	1,134
2013	9,454	130,323	2,665,470	10	344	2,700
2014	6,662	92,594	2,433,113	3	535	1,708
2015	8,744	118,560	1,881,500	2	7	2,248
2016	7,840	162,951	1,272,091	29	10	1,932
2017	5,939	258,689	1,150,097	2,842	0	2,837
2018	4,451	253,678	813,774	2,513	0	2,468
			Average annual percentage change			
2004-2018	-3.9%	40.4%	1.3%	36.9%	-100.0%	1.0%
2008-2018	0.0%	56.9%	-3.6%	44.6%	-100.0%	13.5%

Note: "Made available" refers to the supply of warrantied alternative fuel vehicles by manufacturers and aftermarket conversion companies. These do not represent sales.

Source:
U. S. Department of Energy, Energy Information Administration website, "Alternative Fuel Vehicle Data," www.eia.gov/renewable/afv, September 2019. (Additional resources: www.eia.gov)

[a] Includes plug-in hybrid-electric vehicles and all-electric vehicles.

Hybrid vehicle sales began in 1999 and plug-in electric vehicle sales began in 2010. Hybrids captured 3.2% of the light vehicle market in 2013 but were at 2% in 2018. Plug-in hybrids and all-electrics combined accounted for 2.1% of the light vehicle market in 2018.

Table 6.2
Hybrid and Plug-In Vehicle Sales, 1999-2018

Calendar year	Hybrid vehicle sales (thousands)	Plug-in hybrid vehicle sales (thousands)	All-electric vehicle sales[a] (thousands)	All light vehicle sales[a] (thousands)	Hybrid share of all light vehicles	Plug-in hybrid share of all light vehicles	All-electric share of all light vehicles
1999	0.0	0.0	0.0	16,711	0.0%	0.0%	0.0%
2000	9.4	0.0	0.0	17,164	0.1%	0.0%	0.0%
2001	20.3	0.0	0.0	16,950	0.1%	0.0%	0.0%
2002	36.0	0.0	0.0	16,675	0.2%	0.0%	0.0%
2003	47.6	0.0	0.0	16,494	0.3%	0.0%	0.0%
2004	84.2	0.0	0.0	16,737	0.5%	0.0%	0.0%
2005	205.9	0.0	0.0	16,774	1.2%	0.0%	0.0%
2006	251.9	0.0	0.0	16,336	1.5%	0.0%	0.0%
2007	351.1	0.0	0.0	15,867	2.2%	0.0%	0.0%
2008	315.8	0.0	0.0	13,015	2.4%	0.0%	0.0%
2009	290.3	0.0	0.0	10,236	2.8%	0.0%	0.0%
2010	274.6	0.3	0.0	11,394	2.4%	0.0%	0.0%
2011	266.5	7.7	10.1	12,542	2.1%	0.1%	0.1%
2012	434.6	38.6	14.6	14,220	3.1%	0.3%	0.1%
2013	495.5	49.0	48.1	15,279	3.2%	0.3%	0.3%
2014	452.2	55.4	63.5	16,192	2.8%	0.3%	0.4%
2015	384.4	43.0	71.1	17,095	2.2%	0.3%	0.4%
2016	346.9	72.9	86.7	17,169	2.0%	0.4%	0.5%
2017	362.9	91.1	104.4	16,818	2.2%	0.5%	0.6%
2018	343.2	122.8	238.8	16,913	2.0%	0.7%	1.4%
			Average annual percentage change				
2000-2018	22.2%	[c]	[c]	-0.1%			
2011-2018	3.7%	48.6%	57.1%	4.4%			

Note: Plug-in vehicle sales include only those vehicles certified for highway use. Small electric carts and neighborhood electric vehicles are excluded.

Sources:
Hybrid and Electric Vehicle Sales – Compiled by the Transportation Research Center at Argonne National Laboratory, 2018. (Additional resources: www.anl.gov/energy-systems/project/light-duty-electric-drive-vehicles-monthly-sales-updates)
All Light Vehicle Sales – Table 3.11.

[a] Includes plug-in hybrid-electric vehicles and all-electric vehicles.
[b] Includes cars and trucks up to 10,000 lb gross vehicle weight.
[c] Data are not available.

Trolleybus, heavy rail, and light rail use nearly all alternative fuels. However, the 53.8% of buses using alternative fuels replace a lot of traditional fuel use.

Table 6.3
Transit Vehicle Alternative Fuel Shares by Mode, 1992-2018

Year	Bus[a]	Trolleybus	Vanpool	Demand response	Commuter rail self-propelled[b]	Commuter rail locomotive[b]	Heavy rail[c]	Light rail[d]
1992	2.0%	e	e	e	e	e	e	e
1993	4.1%	e	e	5.8%	e	e	e	e
1994	6.5%	e	e	7.5%	e	e	e	e
1995	6.3%	e	e	11.2%	e	e	e	e
1996	6.4%	100.0%	e	14.0%	e	e	99.9%	100.0%
1997	5.6%	100.0%	e	13.8%	e	e	100.0%	100.0%
1998	6.5%	100.0%	e	13.2%	e	e	100.0%	100.0%
1999	7.5%	100.0%	e	11.4%	e	e	100.0%	100.0%
2000	7.9%	100.0%	e	8.5%	e	e	100.0%	100.0%
2001	9.8%	100.0%	e	5.8%	e	e	100.0%	100.0%
2002	11.8%	100.0%	e	5.1%	e	e	100.0%	100.0%
2003	13.0%	100.0%	e	5.1%	e	e	100.0%	100.0%
2004	13.3%	100.0%	e	5.1%	e	e	100.0%	98.9%
2005	16.0%	100.0%	e	4.9%	e	e	100.0%	100.0%
2006	20.8%	100.0%	e	6.4%	99.3%	11.0%	100.0%	98.0%
2007	22.4%	100.0%	e	5.3%	99.5%	10.2%	100.0%	98.4%
2008	31.6%	100.0%	e	10.9%	99.1%	3.6%	100.0%	99.2%
2009	30.4%	100.0%	e	10.5%	99.5%	10.0%	100.0%	98.2%
2010	33.5%	100.0%	e	8.0%	99.5%	11.3%	100.0%	98.3%
2011	36.6%	100.0%	e	7.7%	99.8%	11.6%	100.0%	98.4%
2013	40.4%	100.0%	e	8.3%	99.2%	16.6%	100.0%	98.4%
2014	41.4%	100.0%	17.0%	16.4%	95.0%	4.1%	100.0%	100.0%
2015	46.9%	100.0%	27.4%	17.0%	98.0%	3.2%	100.0%	100.0%
2016	49.1%	100.0%	29.3%	15.9%	98.2%	1.7%	100.0%	100.0%
2017	54.3%	100.0%	32.1%	19.5%	67.9%	4.4%	100.0%	100.0%
2018	53.8%	100.0%	30.3%	14.4%	98.9%	2.5%	100.0%	100.0%

Source:
American Public Transportation Association, *2019 Public Transportation Fact Book*, Washington, DC, March 2019, Appendix A. (Additional resources: www.apta.com)

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[a] Includes bus rapid transit and commuter bus vehicles.
[b] Electric car or diesel-propelled railway for urban passenger train service between a central city and adjacent suburbs.
[c] An electric railway with the capacity for a heavy volume of traffic.
[d] An electric railway with a light volume traffic capacity with power drawn from an overhead electric line.
[e] Data are not available.

Table 6.4
E85 Flex-Fuel Vehicles Available by Manufacturer, Model Year 2019

Model	EPA Size Class	Range E85 (Miles)
Chevrolet C10 Silverado 2WD	Standard Pick-up Trucks 2WD	312/368
Chevrolet C1500 Suburban 2WD	Standard SUV 2WD	413
Chevrolet C1500 Tahoe 2WD	Standard SUV 2WD	332
Chevrolet Impala	Large Cars	298
Chevrolet K10 Silverado 4WD	Standard Pick-up Trucks 4WD	288/340
Chevrolet K1500 Suburban 4WD	Standard SUV 4WD	382
Chevrolet K1500 Tahoe 4WD	Standard SUV 4WD	332
Chrysler 300	Large Cars	314
Chrysler 300 AWD	Large Cars	296
Dodge Charger	Large Cars	314
Dodge Grand Caravan	Special Purpose Vehicle, minivan 2WD	280
Dodge Journey	Small SUV 2WD	287
Ford Escape FWD FFV	Small SUV 2WD	292
Ford Explorer FFV 2WD	Standard SUV 2WD	279
Ford Explorer FFV AWD	Standard SUV 4WD	260
Ford F150 2WD FFV Base Payload LT	Standard Pick-up Trucks 2WD	382/432
Ford F150 2WD FFV Base Payload LT	Standard Pick-up Trucks 2WD	311/351
Ford F150 4WD FFV Base Payload LT	Standard Pick-up Trucks 4WD	358/405
Ford F150 4WD FFV Base Payload LT	Standard Pick-up Trucks 4WD	311/351
Ford F150 5.0L 2WD FFV GVWR>7599 lb	Standard Pick-up Trucks 2WD	311/351
Ford F150 5.0L 4WD FFV GVWR>7599 lb	Standard Pick-up Trucks 4WD	287/324
Ford F150 Pickup 2WD FFV	Standard Pick-up Trucks 2WD	382/432
Ford F150 Pickup 2WD FFV	Standard Pick-up Trucks 2WD	311/351
Ford F150 Pickup 4WD FFV	Standard Pick-up Trucks 4WD	358/405
Ford F150 Pickup 4WD FFV	Standard Pick-up Trucks 4WD	311/351
Ford Taurus AWD FFV	Large Cars	285
Ford Taurus FWD FFV	Large Cars	285
Ford Transit Connect Van FFV	Special Purpose Vehicle 2WD	300
Ford Transit Connect Wagon LWB FFV	Special Purpose Vehicle 2WD	300
Ford Transit T150 Wagon FFV	Vans, Passenger Type	276
GMC C10 Sierra 2WD	Standard Pick-up Trucks 2WD	312/368
GMC C1500 Yukon 2WD	Standard SUV 2WD	332
GMC C1500 Yukon XL 2WD	Standard SUV 2WD	413
GMC K10 Sierra 4WD	Standard Pick-up Trucks 4WD	288/340
GMC K1500 Yukon 4WD	Standard SUV 4WD	332
GMC K1500 Yukon XL 4WD	Standard SUV 4WD	382
Mercedes-Benz CLA 250 4MATIC	Compact Cars	300
Mercedes-Benz GLA 250 4MATIC	Small SUV 4WD	280
Nissan Frontier 2WD FFV	Small Pick-up Trucks 2WD	270
Nissan Frontier 4WD FFV	Small Pick-up Trucks 4WD	250
RAM 1500 Classic 4X2	Standard Pick-up Trucks 2WD	364/448
RAM 1500 Classic 4X4	Standard Pick-up Trucks 4WD	338/416
Toyota Tundra 4WD FFV	Standard Pick-up Trucks 4WD	264/380
Chevrolet C10 Silverado 2WD	Standard Pick-up Trucks 2WD	312/368
Chevrolet C1500 Suburban 2WD	Standard SUV 2WD	413
Chevrolet C1500 Tahoe 2WD	Standard SUV 2WD	332
Chevrolet Impala	Large Cars	298
Chevrolet K10 Silverado 4WD	Standard Pick-up Trucks 4WD	288/340
Chevrolet K1500 Suburban 4WD	Standard SUV 4WD	382
Chevrolet K1500 Tahoe 4WD	Standard SUV 4WD	332
Chrysler 300	Large Cars	314
Chrysler 300 AWD	Large Cars	296
Dodge Charger	Large Cars	314
Dodge Grand Caravan	Special Purpose Vehicle, minivan 2WD	280

Note: Vehicles with two ranges listed have two fuel tank size options.

Source:
U.S. Department of Energy and U.S. Environmental Protection Agency, Fuel Economy Website, Power Search www.fueleconomy.gov/feg/powerSearch.jsp. Data accessed: September 21, 2019.

Table 6.5
B20, CNG, and LPG Vehicles Available by Manufacturer, Model Year 2019

Model	Fuel[a]	EPA Size Class	Range (Miles)
Chevrolet Colorado 2WD	B20	Small Pick-up Trucks 2WD	483
Chevrolet Colorado 4WD	B20	Small Pick-up Trucks 4WD	462
Chevrolet Colorado ZR2 4WD	B20	Small Pick-up Trucks 4WD	399
Chevrolet Cruze	B20	Compact Cars	500
Chevrolet Cruze Hatchback	B20	Midsize Cars	472
Chevrolet Equinox AWD	B20	Small SUV 4WD	499
Chevrolet Equinox FWD	B20	Small SUV 2WD	477
Ford F150 2WD Base Payload LT Tire	B20	Standard Pick-up Trucks 2WD	552/864
Ford F150 4WD Base Payload LT Tire	B20	Standard Pick-up Trucks 4WD	506/792
Ford F150 Pickup 2WD	B20	Standard Pick-up Trucks 2WD	575/900
Ford F150 Pickup 4WD	B20	Standard Pick-up Trucks 4WD	506/792
Ford F150 Pickup 4WD XL/XLT	B20	Standard Pick-up Trucks 4WD	552/864
GMC Canyon 2WD	B20	Small Pick-up Trucks 2WD	483
GMC Canyon 4WD	B20	Small Pick-up Trucks 4WD	462
GMC Terrain AWD	B20	Small SUV 4WD	499
GMC Terrain FWD	B20	Small SUV 2WD	477
Jaguar F-Pace	B20	Small SUV 4WD	461
Jaguar XE	B20	Compact Cars	533
Jaguar XE AWD	B20	Compact Cars	503
Jaguar XF	B20	Midsize Cars	609
Jaguar XF AWD	B20	Midsize Cars	592
Jeep Grand Cherokee 4X4	B20	Standard SUV 4WD	[b]
Land Rover Discovery	B20	Standard SUV 4WD	518
Land Rover Range Rover Sport	B20	Standard SUV 4WD	545
Land Rover Range Rover SVA	B20	Standard SUV 4WD	655
Land Rover Range Rover Velar	B20	Small SUV 4WD	445
Mazda CX-5 2WD	B20	Small SUV 2WD	429
Mazda CX-5 4WD	B20	Small SUV 4WD	428
RAM 1500 Classic 4X2	B20	Standard Pick-up Trucks 2WD	[b]
RAM 1500 Classic 4X4	B20	Standard Pick-up Trucks 4WD	[b]
Chevrolet Colorado 2WD	B20	Small Pick-up Trucks 2WD	483
Chevrolet Colorado 4WD	B20	Small Pick-up Trucks 4WD	462
Chevrolet Colorado ZR2 4WD	B20	Small Pick-up Trucks 4WD	399
Chevrolet Cruze	B20	Compact Cars	500
Chevrolet Cruze Hatchback	B20	Midsize Cars	472
Chevrolet Equinox AWD	B20	Small SUV 4WD	499
No light vehicles fueled with CNG are available in 2018.			
No light vehicles fueled with LPG are available in 2018.			

Note: Vehicles with two ranges listed have two fuel tank size options.

Source:
U.S. Department of Energy and U.S. Environmental Protection Agency, Fuel Economy Website, Power Search www.fueleconomy.gov/feg/powerSearch.jsp. Data accessed September 21, 2019.

[a] All diesel vehicles are capable of using B20.
[b] Data are not available.

Table 6.6
Hybrid-Electric Vehicles Available by Manufacturer, Model Year 2019

Model	EPA Size Class	Range (Miles)
Acura NSX Hybrid	Two Seaters	328
Acura MDX AWD	Small SUV 4WD	524
Acura RLX	Midsize Cars	423
Audi A6 quattro	Midsize Cars	482
Audi A7 quattro	Midsize Cars	482
Audi A8L	Large Cars	477
Audi Q8	Standard SUV 4WD	428
Buick Lacrosse	Midsize Cars	458
Chevrolet Malibu	Midsize Cars	598
Ford Fusion Hybrid FWD	Midsize Cars	588
Ford Fusion Hybrid Taxi	Midsize Cars	574
Honda Accord	Large Cars	614
Honda Insight	Midsize Cars	551
Honda Insight Touring	Midsize Cars	509
Hyundai Ioniq	Large Cars	654
Hyundai Ioniq Blue	Large Cars	690
Hyundai Sonata Hybrid	Midsize Cars	652
Hyundai Sonata Hybrid SE	Midsize Cars	668
Jeep Wrangler 4X4	Small SUV 4WD	420
Jeep Wrangler Unlimited 4X4	Small SUV 4WD	473
Kia Niro	Small Station Wagons	583
Kia Niro FE	Small Station Wagons	595
Kia Niro Touring	Small Station Wagons	512
Kia Optima Hybrid	Midsize Cars	652
Lexus UX 250h	Compact Cars	445
Lexus UX 250h AWD	Compact Cars	413
Lexus ES 300h	Midsize Cars	581
Lexus LC 500h	Subcompact Cars	666
Lexus LS 500h	Midsize Cars	622
Lexus LS 500h AWD	Midsize Cars	577
Lexus NX 300h AWD	Small SUV 4WD	459
Lexus RX 450h AWD	Standard SUV 4WD	516
Lexus RX 450hL AWD	Standard SUV 4WD	499
Lincoln MKZ Hybrid FWD	Midsize Cars	554
Mercedes-Benz AMG E53 4MATIC+	Midsize Cars	485/506
Mercedes-Benz AMG GT 53 4MATIC+	Compact Cars	[a]
Mercedes-Benz CLS 450	Compact Cars	549
Mercedes-Benz CLS 450 4MATIC	Compact Cars	549
Mercedes-Benz AMG CLS53 4MATIC+	Compact Cars	485
Nissan Rogue AWD Hybrid	Small SUV 4WD	478
Nissan Rogue FWD Hybrid	Small SUV 2WD	493
RAM 1500 4X2 3.6L	Standard Pick-up Trucks 2WD	506/572
RAM 1500 4X2 5.7L	Standard Pick-up Trucks 2WD	437/494
RAM 1500 4X4 3.6L	Standard Pick-up Trucks 4WD	483/546
RAM 1500 4X4 5.7L	Standard Pick-up Trucks 4WD	437/494
RAM 1500 HFE 4X2	Standard Pick-up Trucks 2WD	[a]
Toyota Avalon Hybrid	Midsize Cars	568
Toyota Avalon Hybrid XLE	Midsize Cars	581
Toyota Camry Hybrid LE	Midsize Cars	676
Toyota Camry Hybrid XLE/SE	Midsize Cars	598
Toyota Highlander Hybrid AWD	Standard SUV 4WD	482
Toyota Highlander Hybrid AWD LE	Standard SUV 4WD	499
Toyota Prius	Midsize Cars	588
Toyota Prius AWD	Midsize Cars	530
TOYOTA PRIUS C	Compact Cars	437
Toyota Prius Eco	Midsize Cars	633
Toyota Rav4 Hybrid AWD	Small SUV 4WD	580

Note: Vehicles with two ranges listed have two fuel tank size options.

Source:
U.S. Department of Energy and U.S. Environmental Protection Agency, Fuel Economy Website, Power Search www.fueleconomy.gov/feg/powerSearch.jsp. Data accessed September 21, 2019.

[a] Data are not available.

Table 6.7
Plug-in Hybrid Vehicles Available by Manufacturer, Model Year 2019

Model	EPA Size Class	Range (Miles)
BMW 530e	Compact Cars	Elec 16 / Total 360
BMW 530e xDrive	Compact Cars	Elec 15 / Total 360
BMW 740e xDrive	Large Cars	Elec 14 / Total 340
BMW I3 with Range Extender	Subcompact Cars	Elec 126 / Total 200
BMW I3s with Range Extender	Subcompact Cars	Elec 126 / Total 200
BMW I8 Coupe	Subcompact Cars	Elec 18 / Total 320
BMW I8 Roadster	Two Seaters	Elec 18 / Total 320
Chevrolet Volt	Compact Cars	Elec 53 / Total 420
Chrysler Pacifica Hybrid	Minivan 2WD	Elec 32 / Total 520
Ford Fusion Energi Plug-in Hybrid FWD	Midsize Cars	Elec 26 / Total 610
Ford Fusion Special Service Vehicle PHEV	Midsize Cars	Elec 26 / Total 610
Honda Clarity	Midsize Cars	Elec 48 / Total 340
Hyundai Ioniq Plug-in Hybrid	Midsize Cars	Elec 29 / Total 630
Hyundai Sonata plug-in hybrid	Midsize Cars	Elec 28 / Total 600
Karma Revero	Subcompact Cars	Elec 37 / Total 240
Kia Niro Plug-in Hybrid	Small Station Wagons	Elec 26 / Total 560
Kia Optima plug-in hybrid	Midsize Cars	Elec 29 / Total 610
Mercedes-Benz GLC 350e 4MATIC	Small SUV 4WD	Elec 10 / Total 350
Mini Mini Cooper Se Countryman ALL4	Midsize Cars	Elec 12 / Total 270
Mitsubishi Outlander PHEV	Small SUV 4WD	Elec 22 / Total 310
Porsche Cayenne e-Hybrid	Standard SUV 4WD	Elec 13 / Total 450
Porsche Panamera 4 e-Hybrid	Large Cars	Elec 14 / Total 490
Porsche Panamera 4 e-Hybrid Executive	Large Cars	Elec 14 / Total 490
Porsche Panamera 4 e-Hybrid ST	Large Cars	Elec 14 / Total 490
Porsche Panamera Turbo S e-Hybrid	Large Cars	Elec 14 / Total 450
Porsche Panamera Turbo S e-Hybrid Executive	Large Cars	Elec 14 / Total 450
Porsche Panamera Turbo S e-Hybrid ST	Large Cars	Elec 14 / Total 450
Subaru Crosstrek Hybrid AWD	Small SUV 4WD	Elec 17 / Total 480
Toyota Prius Prime	Midsize Cars	Elec 25 / Total 640
Volvo S60 AWD	Compact Cars	Elec 22 / Total 520
Volvo S90 AWD	Midsize Cars	Elec 21 / Total 490
Volvo XC60 AWD	Small SUV 4WD	Elec 17 / Total 500
Volvo XC90 AWD	Standard SUV 4WD	Elec 17 / Total 490

Note: For Range, the term "Elec" refers to the charge depleting portion of operation where electricity is exclusively or primarily used.

Source:
U.S. Department of Energy and U.S. Environmental Protection Agency, Fuel Economy Website, Power Search www.fueleconomy.gov/feg/powerSearch.jsp. Data accessed: September 21, 2019.

Table 6.8
All-Electric and Fuel Cell Vehicles Available by Manufacturer, Model Year 2019

Model	Drive Type	EPA Size Class	Range (Miles)
Audi e-tron	EV	Standard SUV 4WD	204
BMW I3	EV	Subcompact Cars	153
BMW I3s	EV	Subcompact Cars	153
BYD e6	EV	Small SUV 2WD	187
Chevrolet BOLT EV	EV	Small Station Wagons	238
FIAT 500e	EV	Minicompact Cars	84
Honda Clarity	EV	Midsize Cars	89
HYUNDAI Ioniq Electric	EV	Midsize Cars	124
HYUNDAI Kona Electric	EV	Small SUV 2WD	258
Jaguar I-PACE	EV	Small SUV 4WD	234
KIA Niro Electric	EV	Small Station Wagons	239
KIA Soul Electric	EV	Small Station Wagons	111
Mercedes-Benz smart EQ fortwo (coupe)	EV	Two Seaters	58
Mercedes-Benz smart EQ fortwo (convertible)	EV	Two Seaters	57
NISSAN LEAF	EV	Midsize Cars	150
NISSAN LEAF	EV	Midsize Cars	226
NISSAN LEAF SV/SL	EV	Midsize Cars	215
Tesla Motors Model 3 Standard Range	EV	Midsize Cars	220
Tesla Motors Model 3 Standard Range Plus	EV	Midsize Cars	240
Tesla Motors Model 3 Mid-Range	EV	Midsize Cars	264
Tesla Motors Model 3 Long Range	EV	Midsize Cars	325
Tesla Motors Model 3 Long Range AWD	EV	Midsize Cars	310
Tesla Motors Model3 Long Range AWD Perf	EV	Midsize Cars	310
Tesla Motors Model S 75D	EV	Large Cars	259
Tesla Motors Model S 100D	EV	Large Cars	335
Tesla Motors Model S P100D	EV	Large Cars	315
Tesla Motors Model S Standard Range	EV	Large Cars	285
Tesla Motors Model S Long Range	EV	Large Cars	370
Tesla Motors Model S Performance (19" Wheels)	EV	Large Cars	345
Tesla Motors Model S Performance (21" Wheels)	EV	Large Cars	325
Tesla Motors Model X 75D	EV	Standard SUV 4WD	238
Tesla Motors Model X 100D	EV	Standard SUV 4WD	295
Tesla Motors Model X P100D	EV	Standard SUV 4WD	289
Tesla Motors Model X Long Range	EV	Standard SUV 4WD	325
Tesla Motors Model X Performance (22" Wheels)	EV	Standard SUV 4WD	270
Volkswagen e-Golf	EV	Compact Cars	125
Honda Clarity Fuel Cell	FCEV	Midsize Car	360
Hyundai Nexo	FCEV	Small SUV	354
Hyundai Nexo Blue	FCEV	Small SUV	380
Toyota Mirai	FCEV	Subcompact Car	312

Note: EV = electric vehicle; FCEV = hydrogen fuel cell vehicle.

Source:
U.S. Department of Energy and U.S. Environmental Protection Agency, Fuel Economy Website, Power Search www.fueleconomy.gov/feg/powerSearch.jsp. Data accessed September 21, 2019.

In 1991 there were only two alternative fuel vehicle (AFV) models on the market which were fueled by M85. In 2018 there were 128 different models of AFV on the market, with 44% of those are electric vehicles which include plug-in hybrid-electric vehicles. Another 42% of the models available in 2018 were fueled by E85.

Table 6.9
Number of Alternative Fuel Vehicle Models Available, 1991–2018
(number of models available)

Year	Propane[a]	CNG[a]	Ethanol (E85)	Methanol (M85)	Electric vehicle[b]	Hydrogen	Total
1991	0	0	0	2	0	0	2
1992	0	2	1	2	0	0	5
1993	0	2	1	4	0	0	7
1994	0	2	1	2	0	0	5
1995	0	10	0	2	1	0	13
1996	0	10	1	1	0	0	12
1997	3	9	1	1	3	0	17
1998	3	12	2	0	8	0	25
1999	5	16	6	0	16	0	43
2000	2	15	8	0	12	0	37
2001	5	16	11	0	10	0	42
2002	5	18	16	0	6	0	45
2003	1	16	22	0	5	0	44
2004	1	16	19	0	1	0	37
2005	0	5	24	0	0	0	29
2006	0	5	22	0	0	0	27
2007	0	1	31	0	0	0	32
2008	1	1	31	0	1	0	34
2009	1	1	36	0	1	0	39
2010	0	1	34	0	1	0	36
2011	0	1	72	0	2	0	75
2012	1	6	62	0	6	1	76
2013	6	11	84	0	15	1	117
2014	14	19	90	0	16	2	141
2015	10	17	84	0	27	3	141
2016	5	12	66	0	29	3	115
2017	9	8	45	0	46	3	111
2018	7	9	54	0	56	2	128
			Average annual percentage change				
1991-2018	[c]	[c]	[c]	-100.0%	[c]	[c]	16.7%
2008-2018	[c]	24.6%	5.7%	[c]	49.6%	[c]	14.2%

Note: Model count differs from data on Tables 6.4-6.7 because heavier vehicles, such as Ford F-250 or RAM 2500 are included.

Source:
U.S. Department of Energy, Alternative Fuels Data Center website, "Light-Duty AFV, HEV, and Diesel Model Offerings, By Fuel Type," www.afdc.energy.gov/data/10303, September 2016 and estimates for 2017 and 2018. (Additional resources: www.afdc.energy.gov)

[a] Dedicated and bi-fuel vehicles.
[b] Electric vehicles include plug-in hybrid-electric vehicles but do not include neighborhood electric vehicles, low-speed electric vehicles, or two-wheeled electric vehicles.
[c] Average annual percentage change cannot be calculated from zero.

Table 6.10
Hybrid-Electric Medium/Heavy Trucks and Buses Available by Manufacturer, 2019

Manufacturer - Model	Drive type	Truck type
Ford Transit Van/Wagon	Hybrid Electric	Van
Ford E350, E450 Cutaway	Hybrid Electric	Vocational/Cab Chassis
Ford E350, E450 Stripped Chassis	Hybrid Electric	Vocational/Cab Chassis
Ford F-59 Stripped Chassis	Hybrid Electric	Vocational/Cab Chassis
Ford Super Duty Chassis Cab F350, F450, F550	Hybrid Electric	Vocational/Cab Chassis
Ford Transit 250/350 Van/Wagon	Hybrid Electric	Van
Ford Transit CC-CA 250, 350	Hybrid Electric	Vocational/Cab Chassis
Hometown Trolley Villager	Hybrid - Diesel Electric	Shuttle Bus
Cummins Standard Low Floor	Hybrid - Diesel Electric	Transit Bus
ENC AXESS	Hybrid - Diesel Electric	Transit Bus
ENC E-Z RIDER II	Hybrid - Diesel Electric	Transit Bus
Gillig Low Floor BRT, Low Floor BRTPlus	Hybrid - Diesel Electric	Transit Bus
Gillig Low Floor Commuter	Hybrid - Diesel Electric	Transit Bus
Gillig Low Floor Trolley	Hybrid - Diesel Electric	Transit Bus
Gillig Standard Low Floor	Hybrid - Diesel Electric	Transit Bus
Global M4 Hybrid	Hybrid - Diesel Electric	Street Sweeper
Hino 195h, 195h-DC Hybrid COE	Hybrid - Diesel Electric	Vocational/Cab Chassis
Hometown Trolley Streetcar	Hybrid - Diesel Electric	Shuttle Bus
MCI D4500 CT Hybrid Commuter Coach	Hybrid - Diesel Electric	Transit Bus
New Flyer Xcelsior 35 foot	Hybrid - Diesel Electric	Transit Bus
New Flyer Xcelsior 40 foot	Hybrid - Diesel Electric	Transit Bus
New Flyer Xcelsior 60 foot	Hybrid - Diesel Electric	Transit Bus
Nova Bus LFS Artic HEV	Hybrid - Diesel Electric	Transit Bus
Nova Bus LFS HEV	Hybrid - Diesel Electric	Transit Bus
US Hybrid HySweep sweeper	Hybrid - Diesel Electric	Street Sweeper

Source:
U.S. Department of Energy, Alternative Fuels Data Center website, www.afdc.energy.gov/vehicles/search, September 2019. (Additional resources: www.afdc.energy.gov)

Table 6.11
Electric-Drive Medium/Heavy Trucks and Buses Available by Manufacturer, 2019

Manufacturer - Model	Drive type	Truck type
US Hybrid H2Cargo	Plug-in Hybrid Electric	Step Van
US Hybrid H2Ride 30	Plug-in Hybrid Electric	Shuttle Bus
US Hybrid H2Ride 32	Plug-in Hybrid Electric	Shuttle Bus
US Hybrid H2Truck drayage	Plug-in Hybrid Electric	Tractor
Workhorse E-Gen	Plug-in Hybrid Electric	Step Van
Ford Transit Van/Wagon	Electric	Van
Ford Transit Van/Wagon	Electric	Van
AVM EV22 Shuttle Van	Electric	Shuttle Bus
AVM EV27 Shuttle Van	Electric	Shuttle Bus
AVM EV33 Shuttle Van	Electric	Shuttle Bus
Blue Bird All American RE Electric	Electric	School Bus
Blue Bird Micro Bird 5G Electric	Electric	School Bus
Blue Bird Vision Electric	Electric	School Bus
BYD All-Electric Quantum Rear Loader	Electric	Refuse
BYD C10 45ft coach	Electric	Transit Bus
BYD C6 23ft coach	Electric	Transit Bus
BYD C9 40ft coach	Electric	Transit Bus
BYD K7 30ft transit	Electric	Transit Bus
BYD K9 40ft transit	Electric	Transit Bus
BYD K9S 35ft transit	Electric	Transit Bus
BYD Q1M Yard Truck	Electric	Tractor
BYD Step Van	Electric	Step Van
BYD T5	Electric	Vocational/Cab Chassis
BYD T7	Electric	Vocational/Cab Chassis
Chanje V8100 Panel Van	Electric	Van
eBus eBus22	Electric	Transit Bus
First Priority GreenFleet Medium Duty Truck	Electric	Vocational/Cab Chassis
First Priority GreenFleet Walk-In Van	Electric	Step Van
Ford E450 Cutaway	Electric	Vocational/Cab Chassis
Ford E450 Stripped Chassis	Electric	Vocational/Cab Chassis
Ford F-59 Stripped Chassis	Electric	Vocational/Cab Chassis
Ford Transit 350 Van/Wagon	Electric	Van
Ford Transit CC-CA 250, 350	Electric	Vocational/Cab Chassis
Global M3 SUPERCHARGED	Electric	Street Sweeper
Global M4 SUPERCHARGED	Electric	Street Sweeper
GreenPower Bus EV250	Electric	Transit Bus
GreenPower Bus EV300	Electric	Transit Bus
GreenPower Bus EV350	Electric	Transit Bus
GreenPower Bus EV400	Electric	Transit Bus
GreenPower Bus EV550	Electric	Transit Bus
GreenPower Bus EV Star	Electric	Shuttle Bus
GreenPower Bus Synapse 72 School	Electric	School Bus
GreenPower Bus Synapse Shuttle	Electric	Shuttle Bus
Lion Electric eLion A	Electric	School Bus
Lion Electric eLion C	Electric	School Bus
New Flyer Xcelsior CHARGE 35 foot	Electric	Transit Bus
New Flyer Xcelsior CHARGE 40 foot	Electric	Transit Bus
New Flyer Xcelsior CHARGE 60 foot	Electric	Transit Bus
Nova Bus LFSe	Electric	Transit Bus
Orange EV T Series terminal	Electric	Tractor

Table 6.11 (Continued)
Electric-Drive Medium/Heavy Trucks and Buses Available by Manufacturer, 2019

Proterra Catalyst 35 Foot E2 Series	Electric	Transit Bus
Proterra Catalyst 35 Foot FC Series	Electric	Transit Bus
Proterra Catalyst 35 Foot XR Series	Electric	Transit Bus
Proterra Catalyst 40 Foot E2 Series	Electric	Transit Bus
Proterra Catalyst 40 Foot FC Series	Electric	Transit Bus
Proterra Catalyst 40 Foot XR Series	Electric	Transit Bus
Thomas Built Saf-T-Liner C2 Jouley	Electric	School Bus
US Hybrid eCargo	Electric	Step Van
US Hybrid eTruck drayage	Electric	Tractor
Zenith Motors Cargo Van	Electric	Van
Zenith Motors Chassis Cab	Electric	Vocational/Cab Chassis
Zenith Motors Cutaway Cab	Electric	Vocational/Cab Chassis
Zenith Motors Shuttle Van	Electric	Shuttle Bus
Zenith Motors Step Van	Electric	Step Van
ZeroTruck ZeroTruck	Electric	Vocational/Cab Chassis
Manufacturer - Model	Drive type	Truck type
ENC AXESS	Hydrogen Fuel Cell	Transit Bus
US Hybrid H2Cargo	Hydrogen Fuel Cell	Step Van
US Hybrid H2Ride 30	Hydrogen Fuel Cell	Shuttle Bus
US Hybrid H2Ride 32	Hydrogen Fuel Cell	Shuttle Bus
US Hybrid H2Truck drayage	Hydrogen Fuel Cell	Tractor

Source:
U.S. Department of Energy, Alternative Fuels Data Center website, www.afdc.energy.gov/vehicles/search, September 2019. (Additional resources: www.afdc.energy.gov)

This list includes public and private refuel sites; therefore, not all of these sites are available to the public.

Table 6.12
Number of Alternative Refuel Sites by State and Fuel Type, 2019

State	B20 sites	CNG sites	E85 sites	Electric stations	Electric charging outlets	Hydrogen sites	LNG sites	LPG sites	Totals by State[a]
Alabama	10	30	35	202	470	0	2	73	620
Alaska	0	1	0	18	29	0	0	5	35
Arizona	76	30	24	510	1,356	0	8	78	1,572
Arkansas	3	16	48	94	234	0	1	37	339
California	28	320	178	6,205	25,298	46	44	273	26,187
Colorado	9	36	81	848	2,375	1	1	59	2,562
Connecticut	2	18	3	413	989	2	0	23	1,037
Delaware	1	2	1	58	180	1	0	9	194
Dist. of Columbia	7	2	3	158	471	1	0	0	484
Florida	11	59	90	1,478	4,079	0	3	138	4,380
Georgia	7	52	54	873	2,701	0	4	88	2,906
Hawaii	7	0	2	295	656	2	1	2	670
Idaho	0	11	4	97	214	0	0	30	259
Illinois	20	44	282	610	1,615	0	2	100	2,063
Indiana	4	32	227	255	614	0	1	61	939
Iowa	11	11	285	137	327	0	0	34	668
Kansas	1	20	38	225	885	0	1	37	982
Kentucky	3	10	75	131	276	0	2	34	400
Louisiana	2	23	14	107	246	0	1	59	345
Maine	4	2	1	180	355	0	0	13	375
Maryland	11	13	38	714	2,038	0	0	30	2,130
Massachusetts	10	17	6	738	2,145	2	1	29	2,210
Michigan	9	22	255	610	1,396	2	0	100	1,784
Minnesota	14	27	423	375	969	0	0	44	1,477
Mississippi	2	7	6	80	242	0	2	83	342
Missouri	2	20	105	442	1,823	0	1	73	2,024
Montana	3	1	1	56	127	0	0	41	173
Nebraska	3	9	95	90	223	0	1	28	359
Nevada	2	6	12	276	842	0	1	28	891
New Hampshire	2	4	0	134	245	0	0	27	278
New Jersey	4	28	6	379	1,073	0	0	16	1,127
New Mexico	3	11	14	87	239	0	1	62	330
New York	34	69	69	1,545	3,877	1	0	59	4,109
North Carolina	114	41	88	741	1,770	0	2	81	2,096
North Dakota	2	1	38	29	44	0	0	25	110
Ohio	13	60	179	545	1,296	1	5	90	1,644
Oklahoma	3	119	55	96	230	0	1	130	538
Oregon	47	16	9	726	1,762	0	2	57	1,893
Pennsylvania	5	86	125	560	1,310	0	3	108	1,637
Rhode Island	5	4	0	102	349	0	0	5	363
South Carolina	36	12	59	295	620	1	1	57	786
South Dakota	0	0	83	45	116	0	0	23	222
Tennessee	11	24	73	445	1,127	0	5	66	1,306
Texas	17	110	236	1,346	3,716	0	16	441	4,536
Utah	1	51	2	269	814	0	2	42	912
Vermont	2	3	0	235	598	0	0	1	604
Virginia	10	24	61	726	1,842	0	2	95	2,034
Washington	37	24	20	1,065	2,975	1	1	80	3,138
West Virginia	0	3	34	97	228	0	0	14	279
Wisconsin	5	52	233	339	645	0	1	72	1,008
Wyoming	0	8	11	59	156	0	0	25	200
Totals by Fuel	613	1,591	3,781	26,140	78,207	61	119	3,185	87,557

Source:
U.S. Department of Energy, Alternative Fuels Data Center website, www.afdc.energy.gov/afdc/fuels/stations_counts.html, September 2019. (Additional resources: www.afdc.energy.gov)

[a] Totals by State is the total number of fuel types available at stations. Stations are counted once for each type of fuel available. For electric, the number of charging outlets was used.

There were just over 3,000 propane stations in the United States in 1992 making up 89% of all alternative refueling stations. Electric vehicle stations, which after 2010 are counted by the number of plugs rather than by the geographic location, have the largest number of stations in 2019.

Table 6.13
Number of Alternative Refuel Stations, 1992–2019
(number of stations)

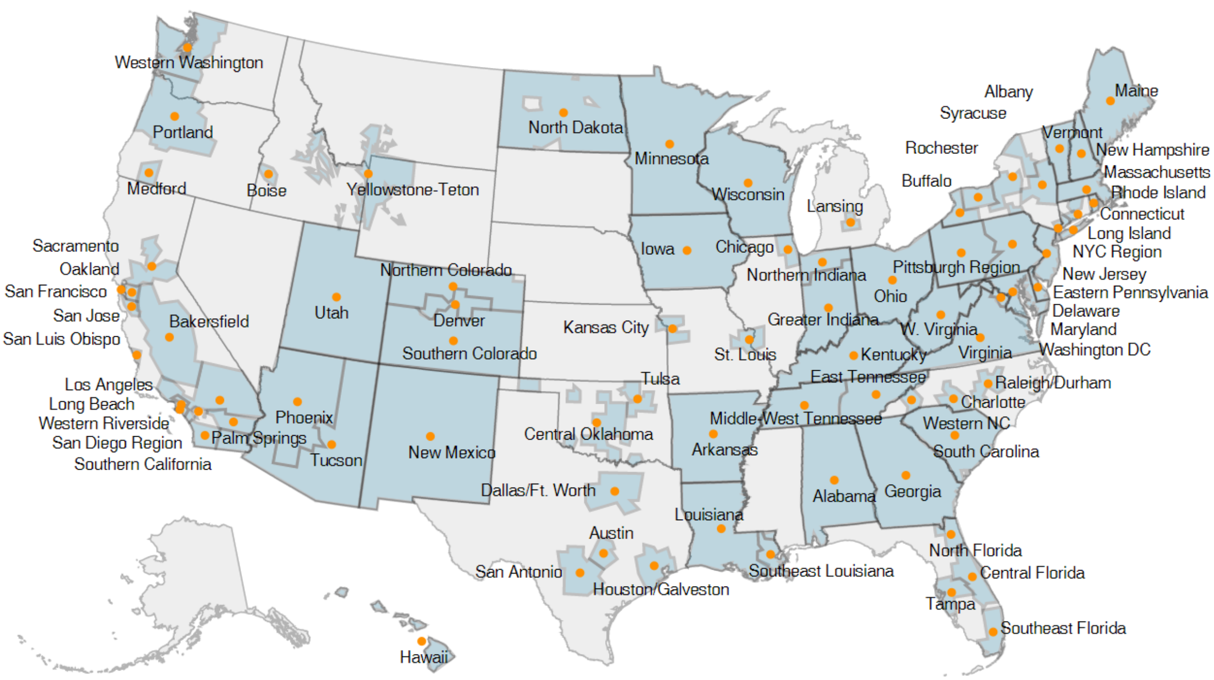
Year	Propane	CNG	LNG	Biodiesel[a]	Ethanol (E85)	Methanol (M85)	Electric vehicle[b]	Hydrogen	Total
1992	3,297	349	[c]	0	2	43	[c]	[c]	3,691
1993	3,297	497	[c]	0	7	50	[c]	[c]	3,851
1994	3,299	1,042	[c]	0	32	82	[c]	[c]	4,455
1995	3,299	1,065	[c]	0	37	88	188	[c]	4,677
1996	4,252	1,419	72	0	68	95	194	[c]	6,100
1997	4,255	1,426	71	0	71	106	310	[c]	6,239
1998	5,318	1,268	66	0	40	91	486	[c]	7,269
1999	4,153	1,267	46	0	49	51	490	[c]	6,056
2000	3,268	1,217	44	2	113	3	558	[c]	5,205
2001	3,403	1,232	44	16	154	0	693	[c]	5,542
2002	3,431	1,166	36	79	149	0	873	7	5,741
2003	3,966	1,035	62	142	188	0	830	7	6,230
2004	3,689	917	58	176	200	0	671	9	5,720
2005	2,995	787	40	304	436	0	588	14	5,164
2006	2,619	732	37	459	762	0	465	17	5,091
2007	2,371	721	35	742	1,208	0	442	32	5,551
2008	2,175	778	38	645	1,644	0	430	46	5,756
2009	2,468	772	36	679	1,928	0	465	63	6,411
2010	2,647	841	39	644	2,142	0	541	58	6,912
2011	2,597	910	45	627	2,442	0	3,394	56	10,071
2012	2,654	1,107	59	675	2,553	0	13,392	58	20,498
2013	2,956	1,263	81	757	2,639	0	19,410	53	27,159
2014	2,931	1,495	103	783	2,840	0	25,602	51	33,805
2015	3,594	1,563	111	721	2,990	0	30,945	39	39,963
2016	3,665	1,725	140	697	3,091	0	42,029	54	51,398
2017	3,541	1,697	131	702	3,322	0	50,627	64	60,053
2018	3,341	1,659	137	681	3,617	0	61,067	60	70,562
2019	3,185	1,591	119	613	3,781	0	78,207	61	87,557
				Average annual percentage change					
1992-2019	-0.1%	5.8%	[c]	[c]	32.2%	-100.0%	[c]	[c]	12.4%
2009-2019	2.6%	7.5%	12.7%	-1.0%	7.0%	[d]	[e]	-0.3%	29.9%

Source:
U.S. Department of Energy, Alternative Fuels Data Center website, "U.S. Alternative Fueling Stations by Fuel Type," www.afdc.energy.gov/data/10332. (Additional resources: www.afdc.energy.gov)

[a] Stations selling biodiesel blends less than B20 are included in the station count for years 2005-2007 only.
[b] Starting in 2011, electric stations are counted by the plug rather than by the geographical location. This is different from the other fuels, which count only the geographical location regardless of how many dispensers or nozzles are on site.
[c] Data are not available.
[d] Because data are not comparable from 2009 to 2019, an average annual percentage change is not provided.

Clean Cities is a locally-based government/industry partnership, coordinated by the U.S. Department of Energy to expand the use of alternatives to gasoline and diesel fuel. By combining the decision-making with voluntary action by partners, the "grass-roots" approach of Clean Cities departs from traditional "top-down" Federal programs.

Figure 6.1. Clean Cities Coalitions



Source:
U.S. Department of Energy, Clean Cities website, “Clean Cities Coalition Locations,” cleancities.energy.gov/coalitions/locations, September 2019. (Additional resources: cleancities.energy.gov)

The 2017 California Vehicle Survey

Data on vehicles operating in California are necessary for the California Energy Commission to forecast future state transportation needs. The California Vehicle Survey was begun two decades ago to meet those needs and has been conducted periodically since that time. The survey uses a multi-method sampling approach with samples stratified by the six regions defined across California (San Francisco, Sacramento, Central Valley, Los Angeles, San Diego, and the Rest of California). The survey includes both residential and commercial light vehicle owners, as well as an add-on survey for those who own or lease plug-in electric vehicles (PEV). The PEV owner survey asks questions related to vehicle refueling, charging, use, and incentives. Data from the California Vehicle Survey are shown in Tables 6.13-6.15 and Figures 6.2 and 6.3. Additional information on this survey can be found at: www.energy.ca.gov/data-reports/surveys/california-vehicle-survey.

In the 2017 California Vehicle Survey, plug-in hybrid electric vehicle owners were more likely to report charging daily than owners of all-electric vehicles. This is true in both residential and commercial settings though daily charging is most common for vehicles used commercially.

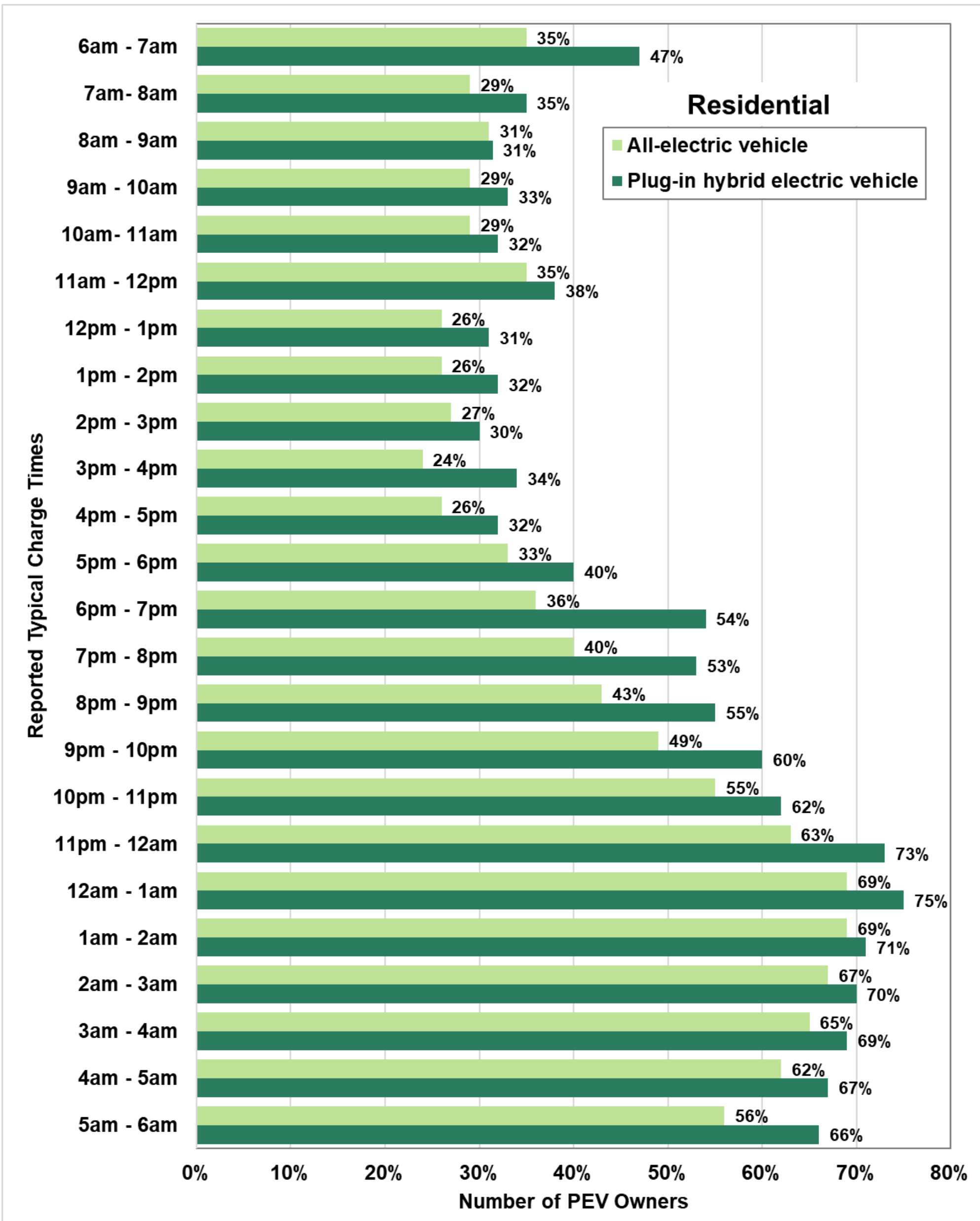
Table 6.14
Vehicle Charging Frequency Regardless of Location, 2017 California Vehicle Survey

Charging frequency	Plug-in hybrid electric vehicle owners		All-electric vehicle owners		Total	
	Count	Percent	Count	Percent	Count	Percent
	Residential Vehicle Owners					
Daily	94	60%	71	45%	165	52%
5 or 6 times a week	25	16%	34	21%	59	19%
3 or 4 times a week	22	14%	30	19%	52	17%
1 or 2 times a week	7	5%	19	12%	26	8%
Less than once a week	6	4%	5	3%	11	3%
Never	2	1%	0	0%	2	1%
Total	156	100%	159	100%	315	100%
	Commercial Vehicle Owners					
Daily	90	66%	92	62%	182	64%
5 or 6 times a week	23	17%	20	14%	43	15%
3 or 4 times a week	13	10%	25	17%	38	13%
1 or 2 times a week	6	4%	11	7%	17	6%
Less than once a week	3	2%	0	0%	3	1%
Never	1	1%	0	0%	1	0%
Total	136	100%	148	100%	284	100%

Source:
California Energy Commission, *2015-2017 California Vehicle Survey*, May 2018, CEC-200-2018-006. (Additional information: www.energy.ca.gov/data-reports/surveys/california-vehicle-survey)

Most California residential plug-in vehicle charging occurs between evening and the early morning hours. Some utilities offer lower rates for off-peak electricity usage which usually begins in the evening. Plug-in vehicle owners in those areas can schedule their charging to take advantage of lower rates.

Figure 6.2. Typical Daily Charging Times for Residential Plug-in Electric Vehicles, 2017 California Vehicle Survey

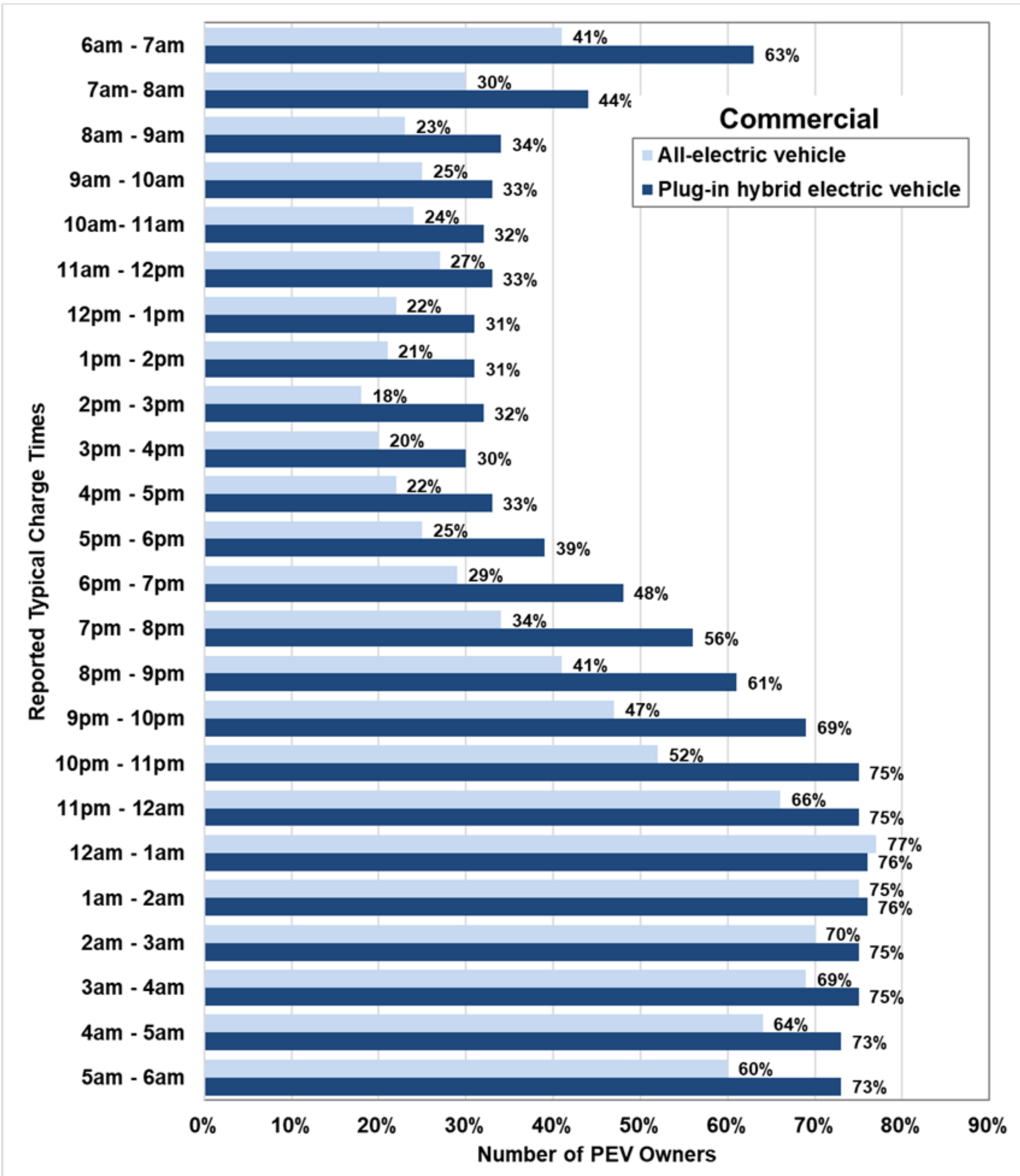


Note: Electric vehicles include both all-electric and plug-in hybrid electric vehicles. N=315.

Source:
California Energy Commission, *2015-2017 California Vehicle Survey*, May 2018, CEC-200-2018-006.
(Additional information: www.energy.ca.gov/data-reports/surveys/california-vehicle-survey)

California commercial plug-in vehicle patterns are very similar to residential charging patterns with most charging occurring from evening to the early morning hours. For most times of the day, plug-in hybrid vehicles were reported to be charging more often than all-electric vehicles.

Figure 6.3. Typical Daily Charging Times for Commercial Plug-in Electric Vehicles, 2017 California Vehicle Survey



Note: Electric vehicles include both all-electric and plug-in hybrid electric vehicles. N=315.

Source:
California Energy Commission, *2015-2017 California Vehicle Survey*, May 2018, CEC-200-2018-006. (Additional information: www.energy.ca.gov/data-reports/surveys/california-vehicle-survey)

The 2017 California Vehicle Survey revealed that state rebates and federal tax incentives were the two most important factors cited by owners in making it possible to buy or lease a plug-in vehicle.

Table 6.15
Ranking of Important Factors for Buying or Leasing an Electric Vehicle, 2017 California Vehicle Survey

How important were each of the following factors in making it possible for you to buy or lease your electric vehicle?	Share of PEV owners answering "extremely important" or "very important"
The California state vehicle rebate (up to $2,500)	65%
The federal tax incentives (up to $7,500)	63%
HOV lane access	42%
Having free charging locations available	38%
Manufacturer or dealer incentives (e.g. low interest rate, cash back)	38%
Special electricity rates for charging	33%
Attractive lease terms	32%
Parking incentives (employer, business, or government)	16%
The availability of carshare/car rental as part of purchase	10%

Source:
2017 California Vehicle Survey, Transportation Secure Data Center, National Renewable Energy Laboratory. Accessed September 5, 2019: www.nrel.gov/tsdc-california-vehicle-survey-2017.html

The 2017 California Vehicle Survey showed that the two most important reasons behind the decision to purchase a plug-in vehicle were reducing environmental impacts and saving money on fuel costs. Of those two reasons, all-electric vehicle owners were more likely to cite reducing environmental impacts while plug-in hybrid owners were more likely to cite saving money on fuel.

Table 6.16
Factors that were the Most Important Reasons for Deciding to Purchase an All-electric or Plug-in Hybrid Electric Vehicle, 2017 California Vehicle Survey

Which of the following factors were the most important reasons why you decided to purchase an electric vehicle? (Select up to five)	Share of California all-electric vehicle owners	Share of California plug-in hybrid electric vehicle owners
Reducing environmental impacts	74%	59%
Saving money on fuel costs	47%	62%
Politics of fossil fuels	38%	30%
Saving money overall	38%	26%
Vehicle performance	32%	18%
Carpool or High Occupancy Vehicle (HOV) lane access	31%	39%
Convenience of charging at home or work	31%	25%
A desire for the newest technology	31%	24%
Free charging at work or away from home	23%	6%
Vehicle styling, finish and comfort	18%	19%
Good lease terms & options	17%	19%
Special/low EV electricity rate at home	15%	21%
Manufacturer or dealer cash back	8%	17%
Brand name	6%	16%
Free or privileged parking space	4%	4%
Better finance/interest rate	3%	5%
Insurance discount	2%	3%
Other	9%	10%

Note: Respondents were able to select up to five important reasons.

Source:
2017 California Vehicle Survey, Transportation Secure Data Center, National Renewable Energy Laboratory. Accessed September 5, 2019: www.nrel.gov/tsdc-california-vehicle-survey-2017.html

Table 6.17
Properties of Conventional and Alternative Liquid Fuels

Property	Liquid Fuels			
	Gasoline	Low-sulfur diesel	Methanol	Ethanol (E100)
Standard chemical formula[a]	C_4 to C_{12}	C_8 to C_{25}	CH_3OH	CH_3CH_2OH
Physical state	Liquid	Liquid	Liquid	Liquid
Molecular weight	100–105	~200	32.04	46.07
Composition (weight %)				
Carbon	85–88	87	37.5	52.2
Hydrogen	12–15	13	12.6	13.1
Oxygen	0	0	49.9	34.7
Main fuel source(s)	Crude oil	Crude oil	Natural gas, coal, or woody biomass	Corn, grains, or agricultural waste
Gasoline gallon equivalent (GGE) (Fuel unit measured/GGE)	1.0 (E0 gasoline)	0.889 (Diesel gal/GGE)	2.04 Methanol gal/GGE)	1.20-1.37 (E85[b] gal/GGE) 1.03 (E10 gal/GGE)
Specific gravity (60˚ F/ 60˚ F)	0.72–0.78	0.85	0.796	0.794
Density (lb./gal @ 60˚ F)	6.0–6.5	7.079	6.63	6.61
Boiling temperature (F˚)	80–437	356–644	149	172
Freezing point (F˚)	-40	-40–30	-143.5	-173.2
Autoignition temperature (F˚)	495	~600	897	793
Reid vapor pressure (psi)	8–15	<0.2	4.6	2.3

Source:
U.S. Department of Energy, Alternative Fuels Data Center website, "Fuel Properties Comparison," www.afdc.energy.gov/fuels/fuel_comparison_chart.pdf, July 2015, and communication with George Mitchell, National Renewable Energy Laboratory, July 2015.

[a] Standard Chemical Formulas represent idealized fuels. Some table values are expressed in ranges to represent typical fuel variations that are encountered in the field.

[b] 1 gallon of E85 has 73% to 83% of the energy of one gallon of gasoline (variation due to ethanol content in E85).

Table 6.18
Properties of Conventional and Alternative Gaseous Fuels

Property	Gaseous Fuels		
	Propane (LPG)	CNG	Hydrogen
Standard chemical formula[a]	C_3H_8	CH_4	H_2
Physical state	Pressurized liquid	Compressed gas	Compressed gas or liquid
Molecular weight	44.1	16.04	2.02
Composition (weight %)			
Carbon	82	75	0
Hydrogen	18	25	100
Oxygen	n/a	n/a	0
Main fuel source(s)	Underground reserves	Underground reserves and renewable Bio-gas	Natural gas, methanol, electrolysis, and other energy sources
Gasoline gallon equivalent (GGE) (Fuel unit measured/GGE)	1.34-1.38 (LPG gal/GGE)	5.56-5.71 (lb. mass/GGE)[b]	0.991-1.017 (kg mass/GGE)
Diesel gallon equivalent (DGE) (Fuel unit measured/DGE)	1.54 (LPG gal/DGE)	6.38 (lb. mass/DGE)	n/a
Specific Gravity (60˚ F/60˚F)	1.55	0.60	0.069
Density (lb./cu ft @ 60˚F)	0.124	0.0458	0.0056
Freezing point (F˚)	-305.8	-296	-435
Boiling Point (˚F)	-44	-260	-423
Autoignition temperature (F˚)	850-950	1,004	1,050-1,080
Reid vapor pressure (psi)	208	n/a	n/a

Note: n/a = not applicable.

Source:
U.S. Department of Energy, Alternative Fuels Data Center website, "Fuel Properties Comparison," www.afdc.energy.gov/fuels/fuel_comparison_chart.pdf, July 2015, and communication with George Mitchell, National Renewable Energy Laboratory, July 2015.

[a] Standard Chemical Formulas represent idealized fuels.
[b] CNG: 1 Gasoline Gallon Equivalent = 5.66 lb. (as referenced by NIST Special Publication 854; Report of the 78th NCWM (1993); p. 326; NG data derived from field sampling of pipeline natural gas by IGT/GRI).

Chapter 7
Transit and Other Shared Mobility

Summary Statistics from Tables in this Chapter

Source		
	Passenger-miles	(millions)
Table 7.1	*Transit buses and trolleybuses, 2017*	*20,209*
Table 7.2	*Demand response vehicles, 2017*	*2,031*
Table 7.3	*Commuter rail, 2017*	*12,384*
Table 7.4	*Transit rail, 2017*	*20,169*
	Energy use	(trillion Btu)
Table 7.1	*Transit buses and trolleybuses, 2017*	*91.6*
Table 7.2	*Demand response vehicles, 2017*	*26.6*
Table 7.3	*Commuter rail, 2017*	*20.5*
Table 7.4	*Transit rail, 2017*	*15.9*
Table 7.5	Number of countries in which Uber operates, 2018	63
Table 7.5	Average Uber trips per day, 2018	14 million
Table 7.5	Cumulative number of Uber worldwide trips from 2010-2018	10 billion
Table 7.7	Share of Lyft riders who do not own or lease a personal vehicle, 2018	35%
Table 7.8	Carshare members, 2016	(millions)
	Asia	*8.7*
	Europe	*4.4*
	North America	*1.8*
	Oceania	*1.0*
	South America	*0.1*

In 2007, the data changed substantially due to improved estimation methodologies. Unfortunately, those data are no longer comparable to the rest of the historical series.

Table 7.1
Summary Statistics on Transit Buses and Trolleybuses, 1994–2017

Year	Number of active buses	Vehicle-miles (millions)	Passenger-miles (millions)	Btu/passenger-mile	Energy use (trillion Btu)
1994	68,766	2,176	19,019	4,225	80.4
1995	67,802	2,198	19,005	4,271	81.2
1996	72,353	2,234	19,280	4,315	83.2
1997	73,425	2,259	19,793	4,407	87.2
1998	72,788	2,188	20,542	4,374	89.9
1999	74,885	2,290	21,391	4,320	92.4
2000	75,665	2,329	21,433	4,506	96.6
2001	76,675	2,389	22,209	4,123	91.6
2002	76,806	2,425	22,029	4,110	90.5
2003	78,000	2,435	21,438	4,191	89.8
2004	81,630	2,484	21,550	4,342	93.6
2005	82,642	2,498	21,998	4,229	93.0
2006	83,689	2,507	22,985	4,297	93.0 [a]
2007	65,808	2,314	21,132	4,352	92.0
2008	67,096	2,388	21,918	4,328	94.9
2009	65,363	2,345	21,645	4,233	91.6
2010	66,810	2,425	21,172	4,107	86.9
2011	69,654	2,425	21,574	4,232	91.3
2012	70,757	2,417	21,251	4,023	89.5
2013	71,699	2,425	22,306	4,052	90.4
2014	71,603	2,445	22,614	3,810	86.2
2015	72,686	2,439	21,822	4,059	88.6
2016	72,557	2,495	21,452	4,283	91.9
2017	72,877	2,513	20,209	4,535	91.6
			Average annual percentage change		
1994-2017	0.3%	0.6%	0.3%	0.3%	0.6%
2007-2017	1.0%	0.8%	-0.4%	0.4%	0.0%

Source:
American Public Transportation Association, *2019 Public Transportation Fact Book*, Washington, DC, April 2019, Appendix A. (Additional resources: www.apta.com)

[a] Data are not continuous between 2006 and 2007 due to changes in estimation methodology. See source document for details.

Demand response vehicles (also called paratransit or dial-a-ride) are widely used by transit agencies. The vehicles do not operate over a fixed route or on a fixed schedule. The vehicle may be dispatched to pick up several passengers at different pick-up points before taking them to their respective destinations and may even be interrupted en route to these destinations to pick up other passengers. Demand response service is provided primarily by vans. In 2007, the data changed substantially due to improved estimation methodologies. Unfortunately, those data are no longer comparable to the rest of the historical series.

Table 7.2
Summary Statistics on Demand Response Vehicles, 1994–2017

Year	Number of agencies	Number of active vehicles	Vehicle-miles (millions)	Average annual miles per vehicle	Passenger-miles (millions)	Average load factor	Energy use (trillion Btu)
1994	5,214	28,729	464	16,140	577	[a]	9.5
1995	5,214	29,352	507	17,256	607	1.41	9.2
1996	5,214	30,804	548	17,800	656	1.21	9.9
1997	5,214	32,509	585	18,004	754	1.36	9.8
1998	5,214	29,646	671	22,630	735	1.21	10.4
1999	5,252	31,884	718	22,532	813	1.34	10.6
2000	5,252	33,080	759	22,941	839	1.30	10.8
2001	5,251	34,661	789	22,772	855	1.28	11.3
2002	5,251	34,699	803	23,130	853	1.24	11.6
2003	5,346	35,954	864	24,031	930	1.27	12.9
2004	5,960	37,078	890	23,990	962	1.25	13.3
2005	5,960	41,958	978	23,316	1,058	1.25	14.8
2006	5,960	43,509	1,013	23,283	1,078	1.24	15.5 [b]
2007	7,300	64,865	1,471	22,684	1,502	1.18	24.7
2008	7,200	65,799	1,495	22,724	1,412	1.09	24.7
2009	6,700	68,957	1,529	22,176	1,477	1.12	23.1
2010	6,741	68,621	1,694	24,680	1,494	1.03	22.8
2011	6,600	65,336	1,612	24,669	1,580	1.13	24.1
2012	6,511	68,632	1,618	23,576	1,756	1.24	24.8
2013	6,270	68,559	1,565	22,829	2,171	1.59	26.4
2014	6,370	71,359	1,595	22,353	2,267	1.65	32.0
2015	6,340	71,299	1,617	22,679	2,056	1.48	26.0
2016	6,532	68,059	1,692	24,855	1,976	1.35	25.8
2017	6,426	69,316	1,705	24,594	2,031	1.38	26.6
				Average annual percentage change			
1994-2017	0.9%	3.9%	5.8%	1.8%	5.6%	-0.1%	4.6%
2007-2017	-1.3%	0.7%	1.5%	0.8%	3.1%	1.6%	0.8%

Note: See Glossary for a detailed definition of demand response.

Source:
American Public Transportation Association, *2019 Public Transportation Fact Book,* Washington, DC, April 2019. (Additional resources: www.apta.com)

[a] Data are not available.

[b] Data are not continuous between 2006 and 2007 due to changes in estimation methodology. See source document for details.

Commuter rail, which is also known as regional rail or suburban rail, is long-haul rail passenger service operating between metropolitan and suburban areas, whether within or across state lines. Commuter rail lines usually have reduced fares for multiple rides and commutation tickets for regular, recurring riders.

Table 7.3
Summary Statistics for Commuter Rail Operations, 1984–2017

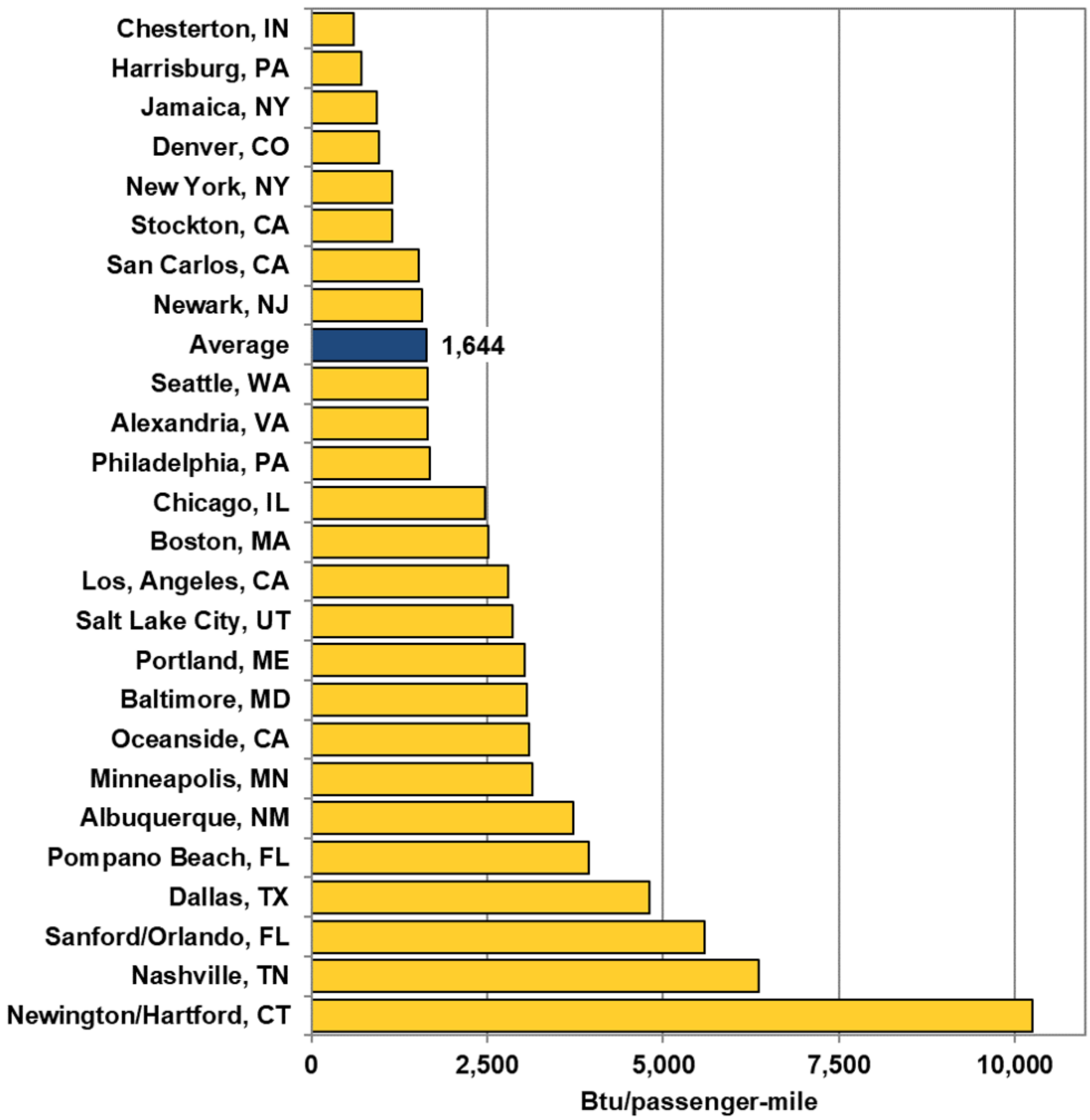
Year	Number of passenger vehicles	Vehicle-miles (millions)	Passenger trips (millions)	Passenger-miles (millions)	Average trip length (miles)	Energy intensity (Btu/passenger-mile) [a]	Energy use (trillion Btu) [a]
1984	4,075	167.9	267	6,207	23.2	1,798	11.2
1985	4,035	182.7	275	6,534	23.8	1,720	11.2
1990	4,982	212.7	328	7,082	21.6	1,622	11.5
1991	5,126	214.9	318	7,344	23.1	1,601	11.8
1992	5,164	218.8	314	7,320	23.3	1,565	11.5
1993	4,982	223.9	322	6,940	21.6	1,782	12.4
1994	5,126	230.8	339	7,996	23.6	1,605	12.8
1995	5,164	237.7	344	8,244	24.0	1,580	13.0
1996	5,240	241.9	352	8,351	23.7	1,541	12.9
1997	5,426	250.7	357	8,038	22.5	1,630	13.1
1998	5,536	259.5	381	8,704	22.8	1,612	14.0
1999	5,550	265.9	396	8,766	22.1	1,670	14.6
2000	5,498	270.9	413	9,402	22.8	1,542	14.5
2001	5,572	277.3	419	9,548	22.8	1,533	14.6
2002	5,724	283.7	414	9,504	22.9	1,542	14.7
2003	5,959	286.0	410	9,559	23.3	1,542	14.7
2004	6,228	294.7	414	9,719	23.5	1,536	14.9
2005	6,392	303.4	423	9,473	22.4	1,658	15.7
2006	6,403	314.7	441	10,361	23.5	1,539	15.9
2007	6,391	325.7	459	11,153	24.3	1,543	17.2
2008	6,617	310.2	472	11,049	23.4	1,579	17.4
2009	6,941	343.5	468	11,232	24.0	1,714	19.2
2010	6,927	345.3	464	10,874	23.4	1,753	19.1
2011	7,193	345.2	466	11,427	24.5	1,681	19.2
2012	7,059	346.4	471	11,181	23.7	1,703	19.0
2013	7,310	359.1	480	11,862	24.7	1,676	19.9
2014	7,337	370.8	490	11,718	23.9	1,638	19.2
2015	7,216	373.7	495	11,813	23.9	1,661	19.6
2016	7,350	376.0	504	11,899	23.6	1,705	20.3
2017	7,290	378.2	503	12,384	24.6	1,657	20.5
			Average annual percentage change				
1984–2017	1.8%	2.5%	1.9%	2.1%	0.2%	-0.2%	1.9%
2007–2017	1.3%	1.5%	0.9%	1.1%	0.1%	0.7%	1.8%

Source:
American Public Transportation Association, *2019 Public Transportation Fact Book*, Washington, DC, April 2019, Appendix A. (Additional resources: www.apta.com)

[a] Only end-use energy was counted for electricity. Before Edition 36, primary energy use (which included generation and distribution losses) was shown in this table.

The energy intensity of commuter rail systems, measured in Btu per passenger-mile, varies greatly. The average of all commuter rail systems in 2017 was 1,644 Btu/passenger-mile. Most of these 25 systems used diesel power, but nine systems used both diesel and electricity: Chesterton, IN; Harrisburg, PA; Jamaica, NY; Denver, CO; New York, NY; Newark, NJ; Philadelphia, PA; Chicago, IL; and Baltimore, MD.

Figure 7.1. Energy Intensity of Commuter Rail Systems[a], 2017



Note: Does not include systems classified as hybrid rail.

Source:
U.S. Department of Transportation, *2017 National Transit Database*, October 2018. (Additional resources: www.transit.dot.gov/ntd)

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[a] Electric railcar or diesel-propelled railway for urban passenger train service between a central city and adjacent suburbs. Only end-use energy was counted for electricity. Before Edition 36, primary energy use (which included generation and distribution losses) was shown in this figure.

The energy intensity of heavy rail systems, measured in Btu per passenger-mile, varies greatly. The average of all heavy rail systems in 2017 was 723 Btu/passenger-mile.

Figure 7.2. Energy Intensity of Heavy Rail Systems[a], 2017

Source:
U.S. Department of Transportation, *2017 National Transit Database*, October 2018. (Additional resources: www.transit.dot.gov/ntd)

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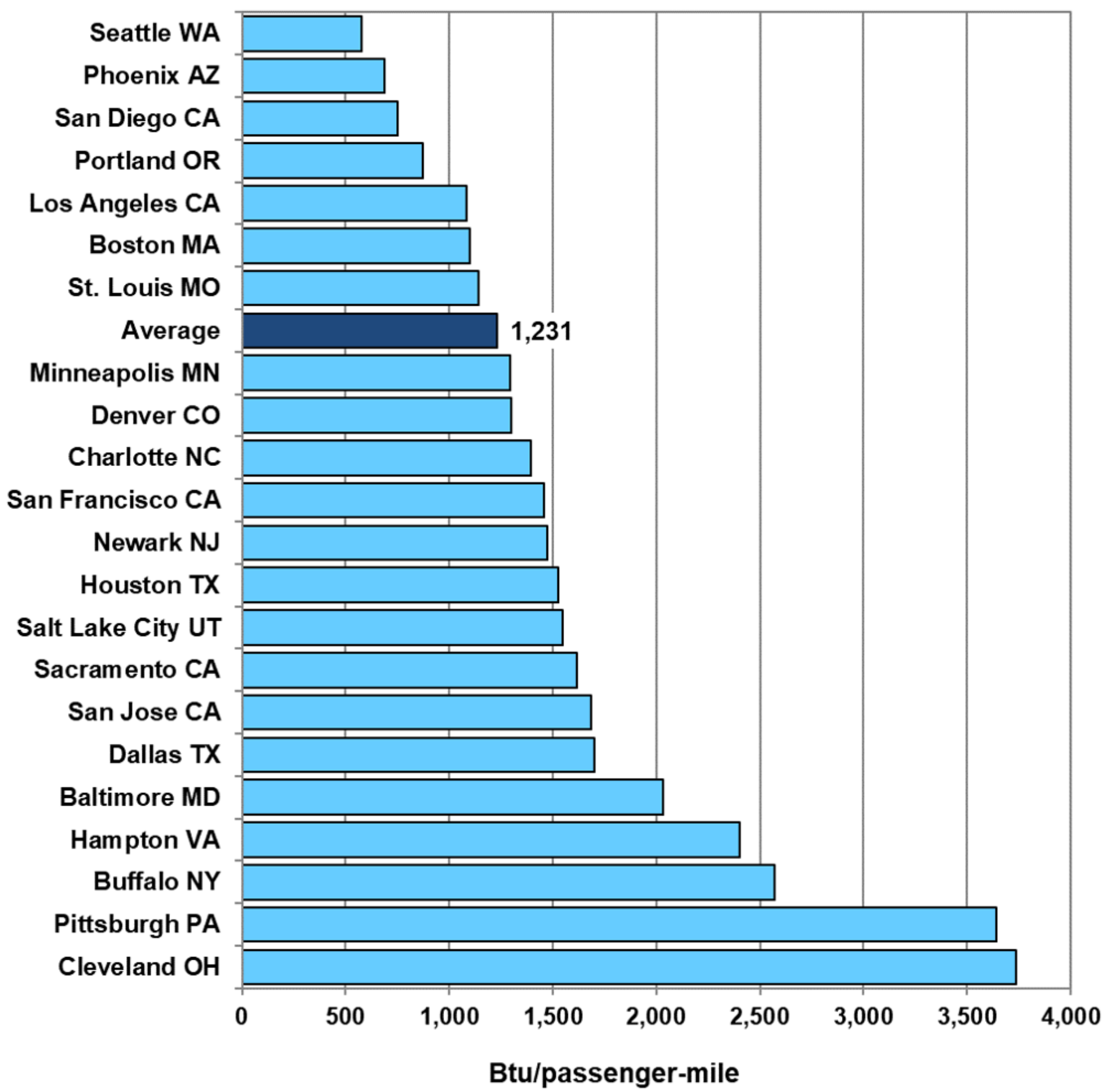
[a] An electric railway with the capacity for a heavy volume of traffic. Only end-use energy was counted for electricity. Before Edition 36, primary energy use (which included generation and distribution losses) was shown in this figure.

The energy intensity of light rail systems, measured in Btu per passenger-mile, varies greatly. The average of all light rail systems in 2017 was 1,231 Btu/passenger-mile.

Figure 7.3. Energy Intensity of Light Rail Transit Systems[a], 2017



Source:
U.S. Department of Transportation, *2017 National Transit Database*, October 2018. (Additional resources: www.transit.dot.gov/ntd)

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[a] An electric railway with a light volume traffic capacity with power drawn from an overhead electric line. Only end-use energy was counted for electricity. Before Edition 36, primary energy use (which included generation and distribution losses) was shown in this figure.

This table on transit rail operations includes data on light rail and heavy rail systems. Light rail vehicles are usually single vehicles driven electrically with power drawn from overhead wires. Heavy rail is characterized by high speed and rapid acceleration of rail cars operating on a separate right-of-way.

Table 7.4
Summary Statistics for Rail Transit Operations, 1970–2017[a]

Year	Number of passenger vehicles	Vehicle-miles (millions)	Passenger trips (millions)[b]	Passenger-miles (millions)[c]	Average trip length (miles)[d]	Energy intensity (Btu/passenger-mile)[e]	Energy use (trillion Btu)[e]
1970	10,548	440.8	2,116	12,273	[f]	712	8.7
1975	10,617	446.9	1,797	10,423	[f]	866	9.0
1980	10,654	402.2	2,241	10,939	4.9	763	8.3
1985	11,109	467.8	2,422	10,777	4.4	927	10.0
1990	11,332	560.9	2,521	12,046	4.8	998	12.0
1995	11,156	571.8	2,284	11,419	5.0	1,102	12.6
1996	11,341	580.7	2,418	12,487	5.2	996	12.4
1997	11,471	598.9	2,692	13,091	4.9	943	12.3
1998	11,521	609.5	2,669	13,412	5.0	931	12.5
1999	11,603	626.4	2,813	14,108	5.0	919	13.0
2000	12,168	648.0	2,952	15,200	5.1	923	14.0
2001	12,084	662.4	3,064	15,615	5.1	925	14.4
2002	12,479	681.9	3,025	15,095	5.0	948	14.3
2003	12,236	694.2	3,005	15,082	5.0	936	14.1
2004	12,480	709.7	3,098	15,930	5.1	907	14.5
2005	12,755	715.4	3,189	16,118	5.1	919	14.8
2006	12,853	726.4	3,334	16,587	5.0	893	14.8
2007	13,032	741.2	3,879	18,070	4.7	851	15.4
2008	13,346	762.8	4,001	18,941	4.7	832	15.8
2009	13,529	775.3	3,955	19,004	4.8	830	15.8
2010	13,614	759.6	4,007	18,580	4.6	832	15.5
2011	13,328	744.1	4,083	19,520	4.8	812	15.8
2012	12,455	749.5	4,192	19,835	4.7	791	15.7
2013	12,434	774.3	4,275	20,381	4.8	793	16.2
2014	12,608	780.9	4,411	20,829	4.7	786	16.4
2015	12,820	803.2	4,339	20,710	4.8	777	16.1
2016	12,912	810.2	4,346	20,922	4.8	761	15.9
2017	12,848	823.6	4,314	20,169	4.7	788	15.9
			Average annual percentage change				
1970–2017	0.4%	1.3%	1.5%	1.1%	-0.6%[g]	0.2%	1.3%
2007–2017	-0.1%	1.1%	1.1%	1.1%	0.0%	-0.8%	0.3%

Sources:
American Public Transportation Association, *2019 Public Transportation Fact Book*, Washington, DC, April 2019, Appendix A. (Additional resources: www.apta.com)
Energy use – See Appendix A for Rail Transit Energy Use.

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[a] Heavy rail and light rail. Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.

[b] 1970–79 data represents total passenger rides; after 1979, data represents unlinked passenger trips.

[c] Estimated for years 1970–76 based on an average trip length of 5.8 miles.

[d] Calculated as the ratio of passenger-miles to passenger trips.

[e] Only end-use energy was counted for electricity. Before Edition 36, primary energy use (which included generation and distribution losses) was shown in this table. Large system-to-system variations exist for energy intensities.

[f] Data are not available.

[g] Average annual percentage change is calculated for years 1977–2017.

Uber is the United States' largest transportation network company (TNC), which allows customers to hail a ride on demand via a phone app. The ride fare and tip are paid via credit card stored in the app and feedback is encouraged after each ride. Through the end of 2018, the Uber app has facilitated 10 billion trips worldwide.

Table 7.5
Uber Ride Hailing Statistics as of December 2018

First Uber trip taken	July 5, 2010
Countries in which Uber operates, 2018	63 countries
Cumulative number of worldwide trips from 2010-2015	1 billion
Cumulative number of worldwide trips from 2010-2018	10 billion
Trips completed per day, December 2018	14 million
Monthly active platform customers, 2018	91 million
Number of drivers, 2018	3.9 million
Number of company employees, 2018	22,000

Source:
Uber, Uber Newsroom, www.nber.org/papers/w22843.pdf, accessed September 9, 2019.

In December 2014, the Benenson Survey Group (BSG) conducted a web survey of Uber's driver-partners in 20 market areas that represented 85 percent of all of Uber's U.S. driver-partners. Jonathan V. Hall, an Uber employee, and Alan B. Krueger, an Uber consultant, compared the BSG Survey results to the 2012-2013 American Community Survey data from the U.S. Census Bureau, resulting in a Working Paper for the National Bureau of Economic Research.

Table 7.6
Characteristics of Uber's Driver-Partners, Taxi Drivers and All Workers

	Uber's Driver-Partners (2014 BSG Survey)	Taxi Drivers and Chauffeurs (2012-13 ACS)	All workers (2012-13 ACS)
Age 18-29	19%	9%	22%
30-39	30%	20%	23%
40-49	26%	27%	23%
50-64	22%	37%	27%
65+	3%	8%	5%
Male	86%	92%	53%
Female	14%	8%	47%
Less than HS	3%	16%	9%
High School	9%	36%	21%
Some College / Associate's	40%	29%	28%
College Degree	37%	15%	25%
Postgraduate Degree	11%	4%	16%
White Non-Hispanic	40%	26%	56%
Black Non-Hispanic	20%	32%	15%
Asian Non-Hispanic	17%	18%	8%
Other Non-Hispanic	6%	2%	2%
Hispanic	18%	22%	20%
Married	50%	59%	53%
Have Children at Home	46%	45%	42%
Currently Attending School	7%	5%	10%
Veteran	7%	5%	5%
Number of Observations	601	2,080	648,494

Notes: ACS data pertain to the same 20 markets as the BSG survey and are for 2012 and 2013. The 20 markets were: Atlanta, Austin, Baltimore, Boston, Chicago, Dallas, Denver, Houston, Los Angeles, Miami, Minneapolis, New Jersey, New York City, Orange County, Philadelphia, Phoenix, San Diego, San Francisco, Seattle, and Washington, DC.

Source:
National Bureau of Economic Research, *An Analysis of The Labor Market for Uber's Driver-Partners in the United States*, NBER Working Paper No. 22843, November 2016.

Lyft is the second-largest transportation network company (TNC) in the United States. As with Uber, a mobile app is used to hail a ride on demand. In 2018, 35% of Lyft riders did not own or lease a personal vehicle.

Table 7.7
Lyft Ride Hailing Statistics, 2018

Areas served by Lyft, 2018	All U.S. States, District of Columbia, and Toronto, Canada
Cumulative Driver Earnings, June 2012 - 2018	$10 billion
Share of drivers that are veterans, 2018	9%
Share of drivers that are female, 2018	27%
Share of drivers that are in a minority group, 2018	56%
Share of drivers that are over the age of 50, 2018	25%
Share of drivers that drive fewer than 20 hours per week, 2018	91%
Share of Lyft riders who do not own or lease a personal vehicle, 2018	35%
Share of Lyft riders that are in a minority group, 2018	41%
Share of U.S. population in a minority group, 2017	39%
Median annual household income of Lyft riders, 2018	$50,400
U.S. median annual household income, 2017	$57,700
Share of Lyft trips that start or end in a low-income area, 2018	44%

Source:
Lyft, Economic Impact Report 2019, National and Toronto, www.lyftimpact.com/stats/national, website accessed September 10, 2019.

Carshare programs provide one alternative to car ownership. Typically, a carshare program has membership requirements and hourly rates for use of a common fleet of vehicles located throughout an area. The carshare operator typically provides insurance, gasoline, parking, and maintenance.

Table 7.8
Carshare Members and Vehicles by World Region, 2006–2016

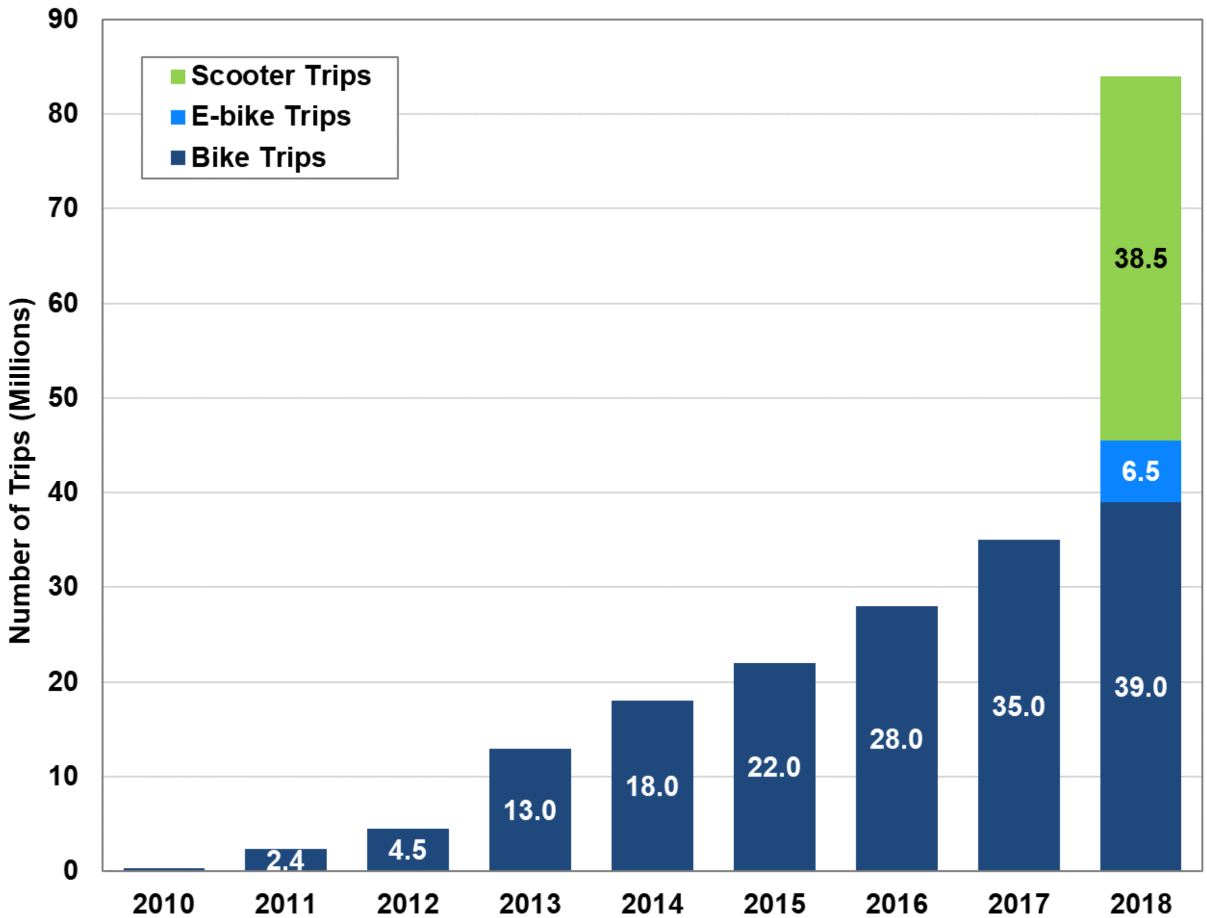
	2006	2008	2010	2012	2014	2016
			Asia			
Members	15,700	12,546	81,817	160,500	955,880	8,722,138
Vehicles	608	810	4,315	6,155	20,344	67,329
Member-Vehicle Ratio	25.8	15.5	19.0	26.1	47.0	129.5
			Europe			
Members	212,124	334,168	552,868	691,943	2,206,884	4,371,151
Vehicles	7,491	10,833	16,779	20,464	57,947	57,857
Member-Vehicle Ratio	28.3	30.8	32.9	33.8	38.1	75.6
			North America			
Members	117,656	318,898	516,100	908,584	1,625,652	1,837,854
Vehicles	3,337	7,505	10,420	15,795	24,210	26,691
Member-Vehicle Ratio	35.3	42.5	49.5	57.5	67.1	68.9
			Oceania			
Members	1,130	5,210	12,750	25,500	50,700	96,600
Vehicles	65	255	440	1,080	1,524	5,040
Member-Vehicle Ratio	17.4	20.4	29.0	23.6	33.3	19.2
			South America			
Members	0	0	110	1,500	3,500	7,350
Vehicles	0	0	13	60	100	120
Member-Vehicle Ratio	0	0	8.5	25	35	61.3

Note: Data are as of October of each year listed.

Source:
Transportation Sustainability Research Center, University of California, Berkeley, *Innovative Mobility: Carsharing Outlook*, Spring 2018. (Additional information: https://tsrc.berkeley.edu/research/shared-mobility)

Micromobility sharing services (bikes and scooters) have expanded rapidly in cities across the United States. The number of shared bike trips in the 100 largest U.S. cities has been estimated by the National Association of City Transportation Officials (NACTO). The number of bike trips increased from 321 thousand in 2010 to 39.0 million in 2018, with another 6.5 million electronic e-bike trips in addition. Shared scooter trips were added to the NACTO study in 2018. There were 38.5 million scooter trips in 2018 representing 46% of the 84 million shared micromobility trips taken.

Figure 7.4. Shared Micromobility Trips, 2010–2018

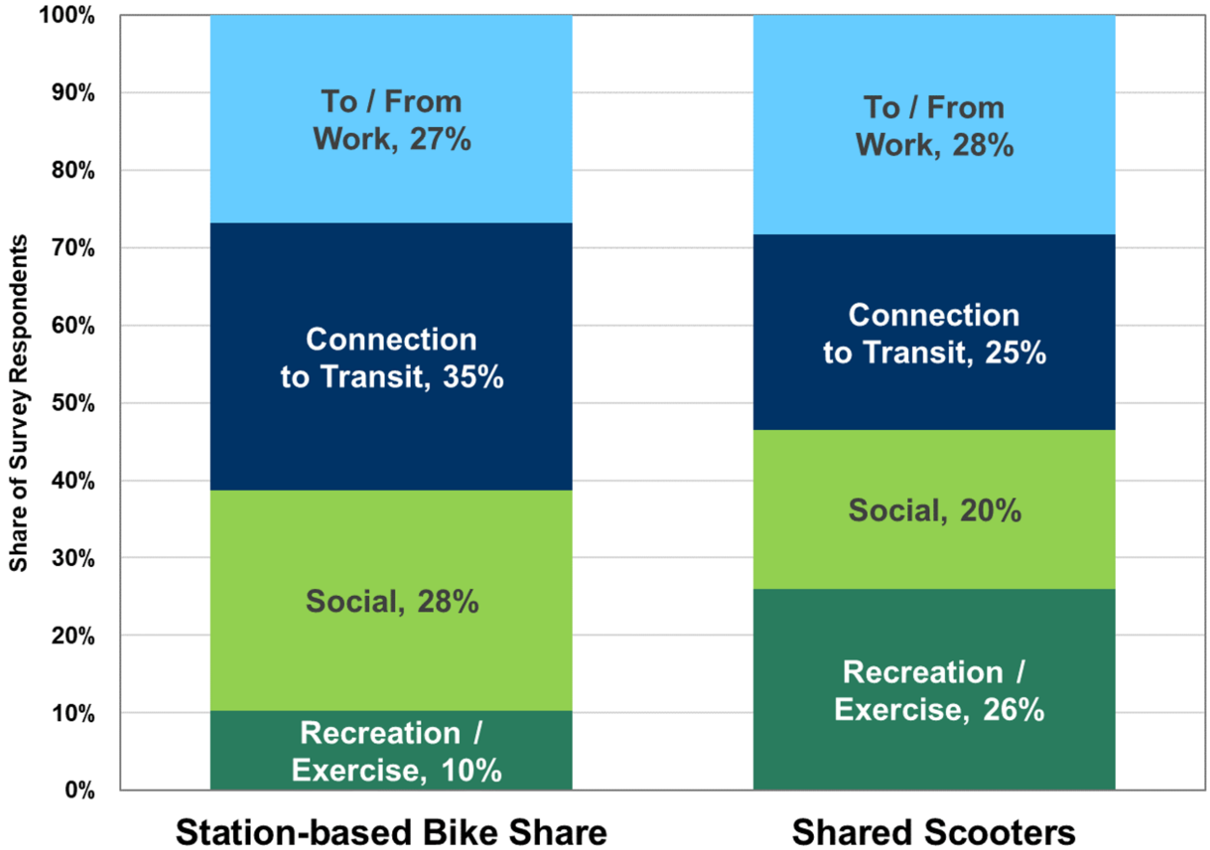


Notes: Includes systems with over 150 bikes or scooters and only includes data reported by the 100 largest cities by population. Does not include private or closed campus systems like those operating on university campuses. For more detail, see the full report.

Source:
National Association of City Transportation Officials (NACTO), *Shared Micromobility in the U.S.: 2018*, April 2019. (Additional information: nacto.org/2019/04/17/84-million-trips-on-shared-bikes-and-scooters)

The most common reasons cited for bike sharing trips were connecting to transit, social trips, and commuting to and from work. A higher percent of shared scooter trips was attributed to recreation/exercise. Connection to transit and social purposes were a greater percent of shared bike trips.

Figure 7.5. Reasons for Using Shared Bikes and Scooters, 2018

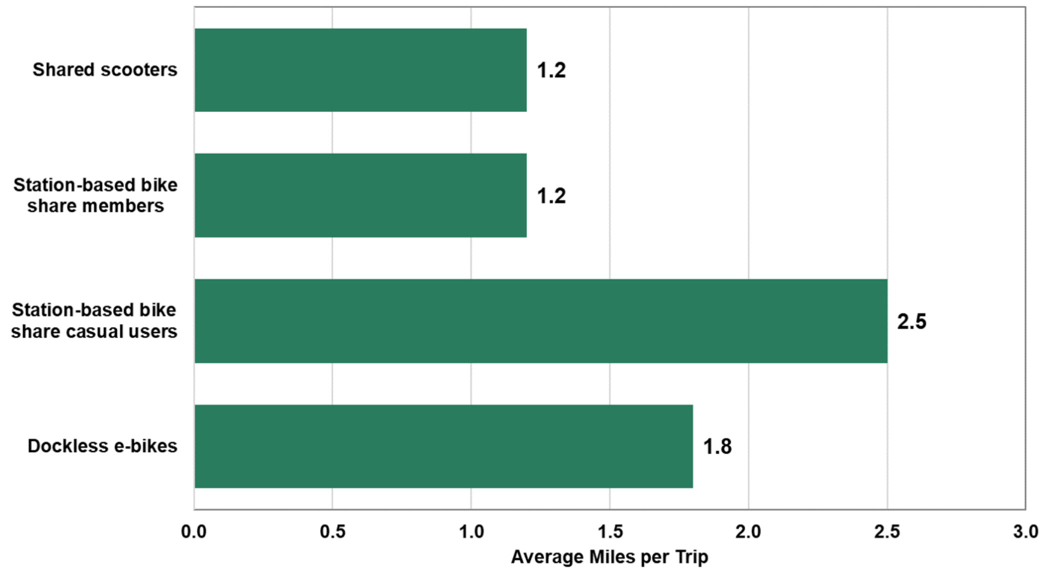


Notes: Data for scooters come from Denver, Portland, and Baltimore. Data for bike share come from Washington, DC, New York City, and Chicago. The social and recreation/exercise categories were only available from Washington, DC.

Source:
National Association of City Transportation Officials (NACTO), *Shared Micromobility in the U.S.: 2018*, April 2019. (Additional information: nacto.org/2019/04/17/84-million-trips-on-shared-bikes-and-scooters)

For shared bikes and scooters, casual users of station-based bikes travel the farthest and for the longest duration.

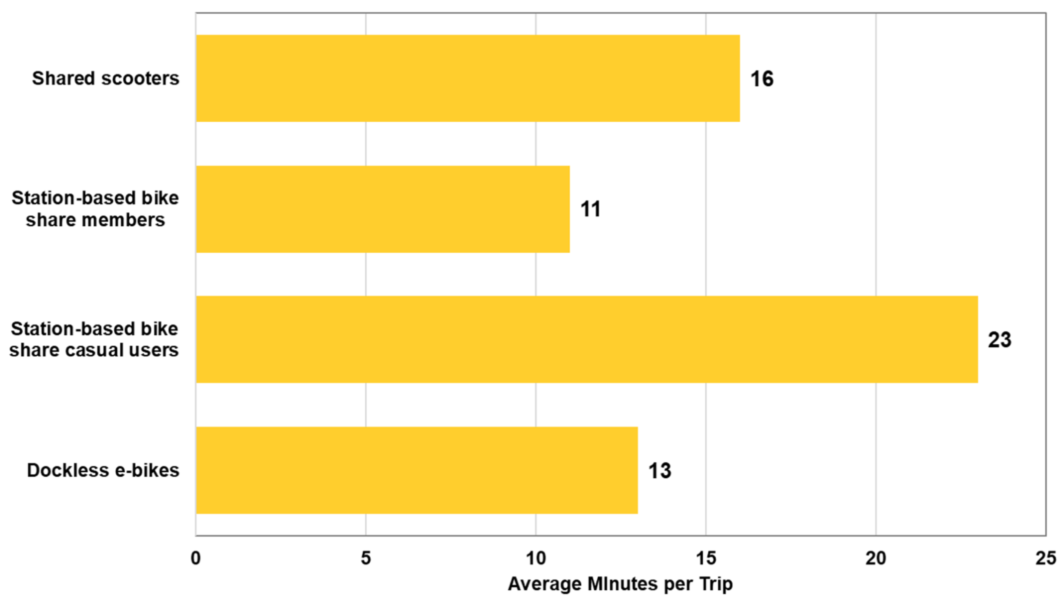
Figure 7.6. Average Miles per Trip for Shared Bikes and Scooters, 2018



Note: Station-based bike share data are based on data from Capital Bike Share, Bluebikes, Citi Bike, Divvy, and Ford GoBike, which are the five largest bike share systems.

Source:
National Association of City Transportation Officials (NACTO), *Shared Micromobility in the U.S.: 2018*, April 2019. (Additional information: nacto.org/2019/04/17/84-million-trips-on-shared-bikes-and-scooters)

Figure 7.7. Average Minutes per Trip for Shared Bikes and Scooters, 2018



Note: Station-based bike share data are based on data from Capital Bike Share, Bluebikes, Citi Bike, Divvy, and Ford GoBike, which are the five largest bike share systems.

Source:
National Association of City Transportation Officials (NACTO), *Shared Micromobility in the U.S.: 2018*, April 2019. (Additional information: nacto.org/2019/04/17/84-million-trips-on-shared-bikes-and-scooters)

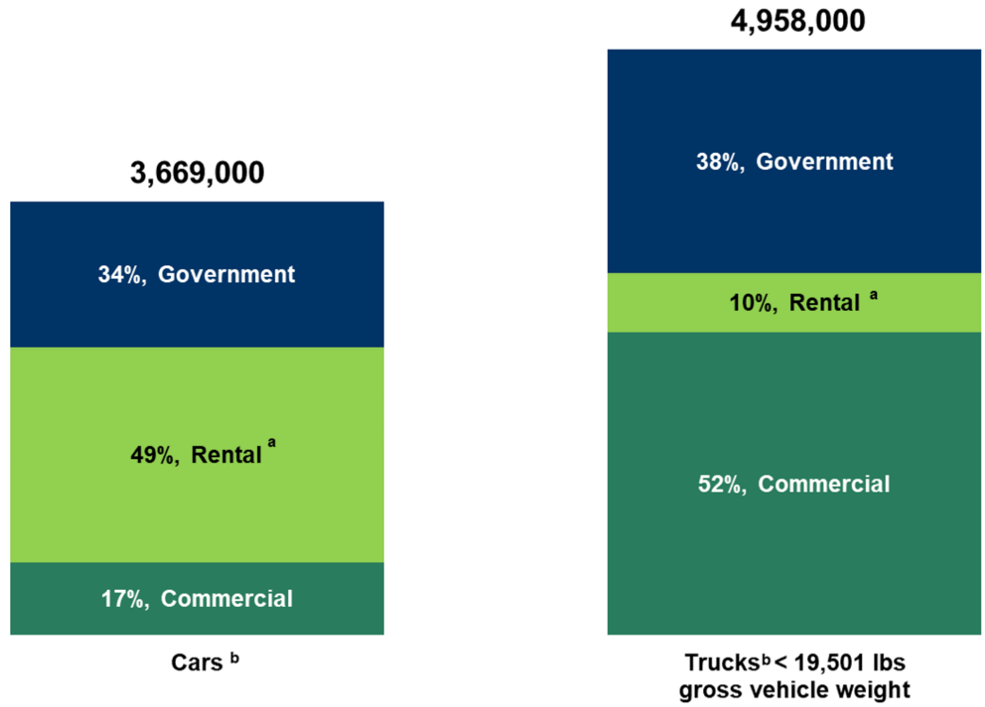
Chapter 8
Fleet Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Figure 8.1	Fleet cars, 2018	3,669,000
Figure 8.1	Fleet trucks ≤ 19,500 lbs. GVW, 2018	4,958,000
Table 8.3	Average annual miles per commercial fleet vehicle, 2018	
	SUVs	*22,800*
	Intermediate cars	*23,412*
	Pickup trucks	*23,340*
Figure 8.2	Average annual miles per Federal Government fleet vehicle, 2017	
	SUVs	*9,795*
	Sedans	*9,216*
	Passenger vans	*8,790*
	Buses	*8,424*
	Ambulances	*7,028*
	Heavy trucks	*6,929*
	Light trucks	*6,536*
	Medium trucks	*6,289*
Table 8.4	Federal government vehicles, FY 2017	640,918
	Light trucks (<8,500 lbs. GVW)	*273,650*
	Cars and other passenger vehicles	*225,981*
	Medium trucks (8,500–26,000 lbs. GVW)	*99,079*
	Heavy trucks (>26,000 lbs. GVW)	*33,585*
	Buses and ambulances	*8,623*

Vehicles in fleets of 15 or more are counted as fleet vehicles, as well as vehicles in fleets where five or more vehicles are purchased annually. There are more trucks in fleets than cars in 2018.

Figure 8.1. Fleet Vehicles in Service as of January 1, 2018



Source:
Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 2018*, Redondo Beach, CA, 2019.

[a] Rental category includes vans and sports utility vehicles under cars, not trucks.
[b] Fleets of 15 or more in operation or 5 or more fleet vehicles purchased annually. Taxi and police fleet data are not available.

Data for fleet vehicles (cars and trucks less than 19,501 pounds) show that rental fleets are the largest share of cars and commercial fleets are the largest share of trucks. Government fleets are the second largest share for both cars and trucks.

Table 8.1
Fleet Vehicles in Service, 2006-2018
(thousands of vehicles)

Year	Commercial	Rental[a]	Government	Police & Taxi[b]	Total
		Cars[c]			
2006	896.9	1,623.0	1,195.9	555.2	4,271.0
2007	911.8	1,650.0	1,215.8	564.5	4,342.0
2008	879.1	1,465.1	1,255.8	586.0	4,186.0
2009	791.0	1,289.0	1,299.0	607.0	3,986.0
2010	741.2	1,175.0	1,352.0	575.7	3,843.8
2011	803.9	1,553.2	1,330.0	578.6	4,265.7
2012	834.7	1,745.0	1,240.0	556.6	4,376.3
2013	727.7	1,850.0	1,290.0	570.6	4,438.3
2014	688.5	1,920.0	1,245.2	582.4	4,443.2
2015	659.2	2,040.0	1,325.0	595.8	4,620.0
2016	685.0	2,156.0	1,340.0	575.8	4,756.8
2017	628.2	1,930.0	1,278.0	[d]	3,836.2
2018	613.4	1,820.0	1,236.0	[d]	3,669.4
		Trucks[c] <19,501 lbs.			
2006	2,362.4	499.7	1,635.5	45.4	4,543.0
2007	2,383.2	560.8	1,682.3	46.7	4,673.0
2008	2,318.5	500.1	1,682.0	45.5	4,546.0
2009	2,224.0	381.0	1,701.0	59.0	4,365.0
2010	1,999.5	380.0	1,751.0	55.4	4,185.8
2011	2,136.3	391.0	1,684.0	58.4	4,269.7
2012	2,236.8	417.0	1,512.0	62.0	4,227.8
2013	2,186.9	465.0	1,560.0	66.5	4,278.4
2014	2,136.4	480.0	1,631.5	74.9	4,322.8
2015	2,231.8	535.0	1,727.4	77.4	4,571.6
2016	2,340.0	582.0	1,810.0	77.4	4,809.0
2017	2,377.7	542.0	1,807.0	[d]	4,726.7
2018	2,564.2	496.0	1,898.0	[d]	4,958.2

Source:
Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 2018*, and annual, Redondo Beach, CA, 2019. (Additional resources: www.fleet-central.com)

[a] Rental category includes vans and sports utility vehicles under cars, not trucks.
[b] Taxi category includes vans.
[c] Fleets of 15 or more in operation or 5 or more fleet vehicles purchased annually.
[d] Data are not available.

In commercial fleets, full size vans stay in service the longest—an average of 59 months in 2017. Commercial fleet vehicles averaged about 23,000 miles in 2017 and 2018.

Table 8.2
Average Length of Time Commercial Fleet Vehicles Are in Service, 2017 and 2018

	Average months in service	
Vehicle type	2017	2018
Compact cars	35	38
Intermediate cars	32	33
Pickup trucks	53	48
Minivans	38	46
Sport utility vehicles	31	33
Full-size vans	59	53

Note: Based on data collected from four leading Fleet Management companies.

Source:
Bobit Publishing Company, *Automotive Fleet*, Redondo Beach, CA, January 2018 and December 2018. (Additional resources: www.fleet-central.com)

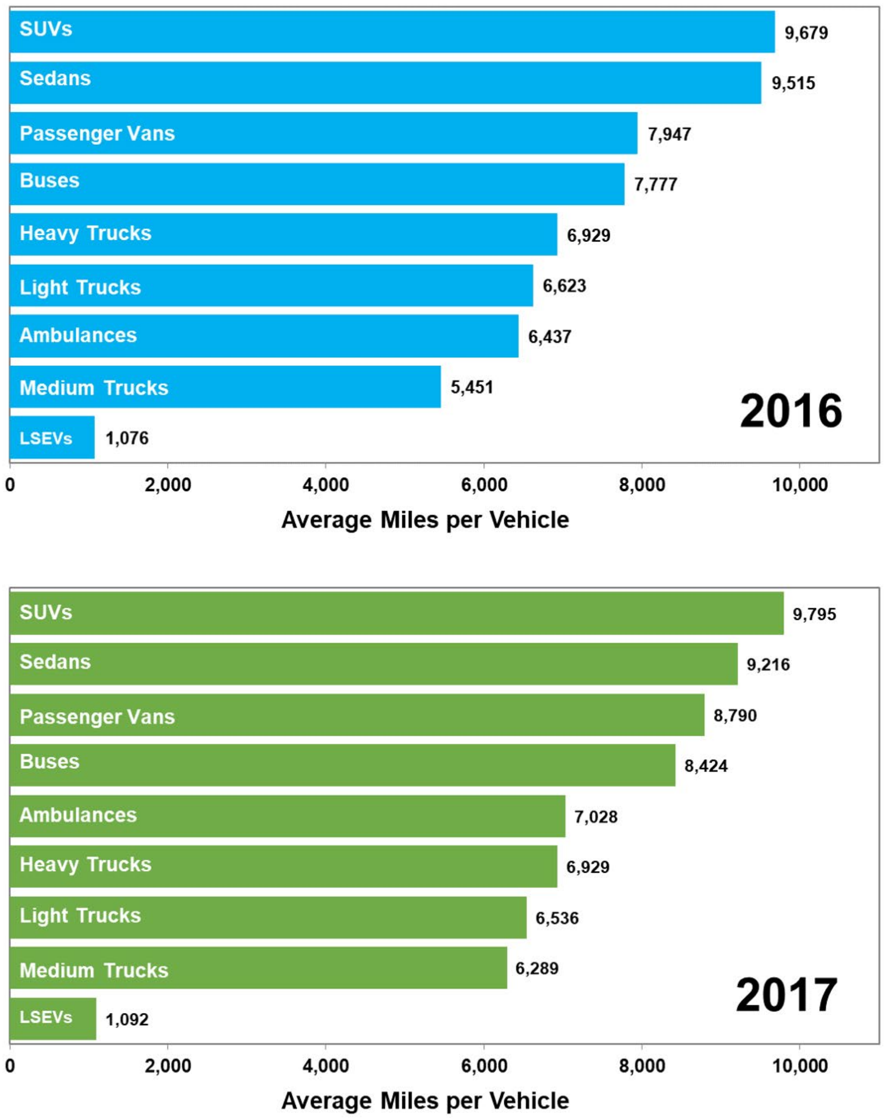
Table 8.3
Average Annual Vehicle-Miles of Travel for Commercial Fleet Vehicles, 2017 and 2018

	Average annual miles of travel	
Vehicle type	2017	2018
Compact cars	20,328	21,168
Intermediate cars	24,120	23,412
Pickup trucks	22,248	23,340
Minivans	24,384	23,940
Sport utility vehicles	25,356	22,800
Full-size vans	21,312	21,888

Source:
Bobit Publishing Company, *Automotive Fleet*, Redondo Beach, CA, January 2018 and December 2018. (Additional resources: www.fleet-central.com)

These data, which apply to domestic Federal fleet vehicles, indicate that sport utility vehicles (SUVs) have the highest average annual miles per vehicle, followed closely by sedans.

Figure 8.2. Average Miles per Domestic Federal Vehicle by Vehicle Type, 2016 and 2017



Note: Light trucks = less than 8,500 pounds gross vehicle weight (GVW).
Medium trucks = 8,501-23,999 pounds GVW.
Heavy trucks = 24,000 pounds GVW or more.
LSEVs = low-speed electric vehicles.

Source:
U.S. General Services Administration, Federal Vehicle Policy Division, *FY 2016 Federal Fleet Report* and *FY 2017 Federal Fleet Report*, Washington, DC, 2018, Table 4-2. (Additional resources: www.gsa.gov)

The Federal Government vehicle inventory includes 21% more light trucks than passenger vehicles.

Table 8.4
Federal Government Vehicle Inventory, FY 2001-2017

Vehicle Type	2001	2005	2010	2015	2016	2017
Passenger vehicles						
Low-speed electric vehicle	0	0	3,029	3,686	3,257	2,369
Subcompact	5,462	2,401	6,797	27,356	28,309	27,566
Compact	60,938	58,284	46,489	38,766	38,155	38,043
Midsize	36,921	36,656	48,242	24,775	24,442	24,558
Large	11,107	15,966	10,063	7,150	6,216	3,516
Limousines	116	191	412	83	85	52
Light duty passenger vans	56,563	42,109	41,676	37,448	36,620	32,379
Medium duty passenger vans	727	13,252	15,218	14,617	15,963	15,364
Light duty SUVs	40,842	50,445	66,316	73,203	75,614	75,850
Medium duty SUVs	0	6,096	11,117	8,235	8,170	6,284
Total passenger vehicles	**212,676**	**225,400**	**249,359**	**235,319**	**236,831**	**225,981**
Trucks and other vehicles						
Light trucks 4x2	227,937	243,477	241,011	232,914	233,189	223,558
Light trucks 4x4	29,975	35,417	40,105	49,079	53,143	50,092
Medium trucks	88,993	83,747	89,253	79,421	94,111	99,079
Heavy trucks	27,988	35,230	32,760	34,049	34,939	33,585
Ambulances	1,819	1,580	1,480	1,349	1,339	1,385
Buses	6,726	7,837	8,186	8,173	8,085	7,238
Total trucks and other vehicles	**383,438**	**407,288**	**412,795**	**404,985**	**424,806**	**414,937**
GRAND TOTAL ALL VEHICLES	**596,114**	**632,688**	**662,154**	**640,304**	**661,637**	**640,918**

Note: Light trucks = less than 8,500 pounds gross vehicle weight rating (GVWR).
Medium trucks = 8,501-23,999 pounds GVWR.
Heavy trucks = 24,000 pounds GVWR or more.

Source:
U.S. General Services Administration, Federal Supply Service, *FY 2017 Federal Fleet Report*, Washington, DC, 2018, Tables 2-5 and 2-6. (Additional resources: www.gsa.gov)

Table 8.5
Federal Fleet Vehicle Acquisitions
by Fuel Type, FY 2002–2017

Fuel type	2002	2005	2007	2010	2013	2015	2016	2017
Gasoline	44,850	41,247	32,089	26,547	15,994	17,080	30,349	24,257
Gasoline hybrid	[a]	222	458	4,853	1,364	2,500	3147	4475
Gasoline LGHG[b]	0	0	0	0	369	224	81	41
Gasoline plug-in hybrid	0	0	0	0	258	263	86	16
Diesel	8,107	6,049	5,809	4,136	4,625	6,215	6,136	5,626
Diesel hybrid	[c]	1	4	27	51	7	11	10
Diesel LGHG[b]	0	0	0	0	0	0	0	0
CNG	1,267	188	129	60	123	241	67	12
E-85	8,054	16,892	26,581	26,789	21,644	24,651	27,243	24,110
Electric	7	13	7	1,376	284	231	180	478
LNG	3	0	0	0	0	0	0	0
LPG	59	1	4	2	23	6	9	2
M-85	25	0	0	0	0	0	0	0
Hydrogen	0	0	0	4	2	0	0	0
Grand total	62,372	64,613	65,081	63,794	44,737	51,418	67,309	59,027

Source:
U.S. General Services Administration, Federal Vehicle Policy Division, *FY 2017 Federal Fleet Report*, Washington, DC, 2018, Table 5-4. (Additional resources: www.gsa.gov)

Table 8.6
Fuel Consumed by Federal Government Fleets, FY 2000–2017
(thousand gasoline equivalent gallons)

	2000	2005	2007	2009	2010	2013	2015	2016	2017
Gasoline	284,480	300,261	293,848	301,437	322,023	295,076	310,416	315,043	305,978
Diesel	70,181	53,363	74,806	76,456	75,329	67,332	66,736	69,990	72,351
CNG	865	1,245	889	499	504	369	400	397	357
Electricity	1	6	5	4	36	88	197	86	64
Biodiesel (B20)	569	8,052	9,515	7,393	8,258	5,619	4,722	4,404	4,206
Biodiesel (B100)[d]	0	0	0	5	0	358	11	0	155
Methanol/M-85	14	0	0	0	0	0	0	0	0
LPG	34	231	322	208	195	257	150	231	239
Ethanol/E-85	347	3,060	3,854	7,923	8,201	14,158	13,512	11,942	10,431
LNG	0	102	95	35	0	0	7	4	0
Hydrogen	0	0	0	0	1	0	0	0	0
Total	356,491	366,320	383,334	393,961	414,548	383,257	396,152	402,097	393,781

Source:
U.S. General Services Administration, Federal Vehicle Policy Division, *FY 2017 Federal Fleet Report*, Washington, DC, 2018, Table 5-1. (Additional resources: www.gsa.gov)

[a] Combined with gasoline.
[b] Low greenhouse gas emissions.
[c] Combined with diesel.
[d] B100 cannot be separated from B20 from 2000-2007.

The light truck category includes pickups, SUVs, and vans. Previously, this table included SUVs and vans with cars. The U.S. Postal Service owned 46.4% of all federal light trucks.

Table 8.7
Federal Government Vehicles by Agency, FY 2017

Department or agency	Cars	Light trucks	Medium trucks	Heavy trucks	Total
CIVILIAN					
American Battle Monuments Commission	25	12	7	0	44
Broadcasting Board of Governors	0	106	18	22	146
Consumer Product Safety Commission	65	27	2	0	94
Court Services and Offender Supervision Agency	53	21	0	0	74
Department of Agriculture	5,230	24,411	8,863	2,370	40,874
Department of Commerce	278	1,230	425	50	1,983
Department of Education	53	35	0	0	88
Department of Energy	847	7,273	3,933	2,430	14,483
Department of Health and Human Services	1,713	2,402	303	75	4,493
Department of Homeland Security	10,292	35,655	4,064	1,593	51,604
Department of Housing and Urban Development	255	76	0	0	331
Department of Justice	17,385	25,133	1,120	1,259	44,897
Department of Labor	1,007	2,230	229	331	3,797
Department of State	1,773	11,129	782	834	14,518
Department of the Interior	2,027	15,191	8,281	3,258	28,757
Department of the Treasury	1,682	1,346	50	9	3,087
Department of Transportation	1,253	3,541	1,090	150	6,034
Department of Veterans Affairs	7,512	9,478	1,630	1,872	20,492
Environmental Protection Agency	245	559	119	33	956
Equal Employment Opportunity Commission	70	12	0	0	82
Federal Communications Commission	0	85	0	0	85
Federal Housing Finance Agency	2	4	0	0	6
Federal Maritime Commission	7	0	0	0	7
General Services Administration	523	374	21	2	920
Government Printing Office	13	16	8	5	42
Library of Congress	5	4	0	4	13
National Aeronautics and Space Administration	419	1,386	607	401	2,813
National Archives & Records Administration	1	35	14	7	57
National Gallery of Art	0	6	2	3	11
National Labor Relations Board	29	3	0	0	32
National Science Foundation	27	222	208	103	560
National Transportation Safety Board	0	3	0	0	3
Nuclear Regulatory Commission	5	19	1	2	27
Office of Personnel Management	1,815	186	2	0	2,003
Peace Corps	48	627	0	13	688
Pretrial Services Agency for the District of Columbia	2	1	0	0	3
Small Business Administration	85	74	1	0	160
Smithsonian Institution	14	308	55	48	425
Social Security Administration	236	176	8	28	448
Tennessee Valley Authority	351	1,224	908	127	2,610
US Agency for International Development	78	464	43	16	601
US International Trade Commission	1	1	0	0	2
TOTAL CIVILIAN AGENCIES	**55,426**	**145,085**	**32,794**	**15,045**	**248,350**
MILITARY					
Corps of Engineers, Civil Works	622	4,109	1,827	688	7,246
Defense Agencies	1,941	2,793	547	733	6,014
Department of Air Force	4,508	17,828	14,921	6,939	44,196
Department of Army	13,550	25,521	13,109	7,135	59,315
Department of Navy	6,543	16,202	6,835	2,926	32,506
United States Marine Corps	3,271	4,875	1,877	1,652	11,675
TOTAL MILITARY AGENCIES	**30,435**	**71,328**	**39,116**	**20,073**	**160,952**
U. S. POSTAL SERVICE	**7,874**	**187,114**	**28,554**	**5,705**	**229,247**
TOTAL ALL FLEETS	**93,735**	**403,527**	**100,464**	**40,823**	**638,549**

Note: Light trucks include SUVs, vans, and pickups less than 8,500 lb gross vehicle weight (GVW). Medium trucks are 8,501-23,999 lb GVW and include ambulances. Heavy trucks are 24,000 lb GVW or more and include buses. Does not include low-speed vehicles.

Source:
U.S. General Services Administration, Federal Supply Service, *FY 2017 Federal Fleet Report*, Washington, DC, 2018, Table 2-1. (Additional resources: www.gsa.gov)

Chapter 9
Household Vehicles and Characteristics

Summary Statistics from Tables/Figures in this Chapter

Source		
Table 9.2	Vehicles per capita, 2017	0.848
	Vehicles per licensed driver, 2017	1.225
	Vehicles per household, 2017	2.187
Table 9.4	Share of households owning 3 or more vehicles	
	1960	*2.5%*
	1970	*5.5%*
	1980	*17.5%*
	1990	*17.3%*
	2000	*18.3%*
	2010	*19.5%*
	2017	*21.5%*
Figure 9.1	Average occupancy rates by vehicle type, 2017	
	Van	*2.44*
	Sport Utility Vehicle	*1.83*
	Car	*1.54*
	Pickup	*1.49*
Table 9.9	Average annual miles per household vehicle, 2017	10,200
Table 9.19	Share of workers who car pooled, 2017	9.2%
Table 9.20	Long-distance trips in the United States, 2001 (latest available data)	
	Person-trips	*2,554 million*
	Person-miles	*1,138 billion*

The number of vehicles in the United States is growing faster than the population. The growth in vehicle-miles has slowed to 0.6% per year from 2007-2017. See Table 9.2 for vehicles per capita and vehicle-miles per capita.

Table 9.1
Population and Vehicle Profile, 1950–2017

Year	Resident population[a] (thousands)	Total households (thousands)	Number of vehicles in operation (thousands)	Total vehicle-miles (millions)	Number of licensed drivers (thousands)	Number of civilian employed persons (thousands)
1950	151,868	43,554	43,501	458,246	62,194	58,920
1955	165,069	47,874	56,540	605,646	74,686	62,171
1960	179,979	52,799	67,906	718,762	87,253	65,778
1965	193,526	57,436	82,066	887,812	98,502	71,088
1970	205,052	63,401	98,136	1,109,724	111,543	78,628
1975	215,973	71,120	120,054	1,327,664	129,791	85,846
1980	227,226	80,776	139,831	1,527,295	145,295	99,303
1985	238,466	86,789	157,048	1,774,826	156,868	107,150
1990	250,132	93,347	179,299	2,144,362	167,015	118,793
1995	266,557	98,990	193,441	2,422,696	176,628	124,900
1996	269,667	99,627	198,294	2,485,848	179,539	126,708
1997	272,912	101,018	201,071	2,561,695	182,709	129,558
1998	276,115	102,528	205,043	2,631,522	184,980	131,463
1999	279,295	103,874	209,509	2,691,056	187,170	133,488
2000	282,385	104,705	213,300	2,746,925	190,625	136,891
2001	285,309	108,209	216,683	2,797,287	191,276	136,933
2002	288,105	109,297	221,027	2,855,508	194,296	136,485
2003	290,820	111,278	225,882	2,890,450	196,166	137,736
2004	293,463	112,000	232,167	2,964,788	198,889	139,252
2005	296,186	113,343	238,384	2,989,430	200,549	141,730
2006	298,996	114,384	244,643	3,014,371	202,810	144,427
2007	302,004	116,011	248,701	3,031,124	205,742	146,047
2008	304,798	116,783	249,813	2,976,528	208,321	145,362
2009	307,439	117,181	248,972	2,956,764	209,618	139,877
2010	309,347	117,538	248,231	2,967,266	210,115	139,064
2011	311,719	118,682	248,932	2,950,402	211,875	139,869
2012	314,103	121,084	251,497	2,969,433	211,815	142,469
2013	316,427	122,459	252,715	2,988,280	212,160	143,929
2014	318,907	123,027	258,027	3,025,656	214,092	146,305
2015	320,897	125,819	264,194	3,095,373	218,084	148,834
2016	323,406	126,819	270,566	3,174,408	221,712	151,436
2017	325,719	126,224	275,979	3,212,347	225,346	153,337
			Average annual percentage change			
1950-2017	1.1%	1.6%	2.8%	2.9%	1.9%	1.4%
2007-2017	0.8%	0.8%	1.0%	0.6%	0.9%	0.5%

Sources:

Resident population and civilian employed persons – U.S. Department of Commerce, Bureau of the Census, Online Data Retrieval*,* Washington, DC, 2018. (Additional resources: www.census.gov)

Vehicles in operation – IHS Automotive. Used with permission. FURTHER REPRODUCTION PROHIBITED. (Additional resources: https://www.ihs.com/industry/automotive.html)

Licensed drivers and vehicle-miles – U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2017*, Tables DL-20 and VM-1, and annual. (Additional resources: www.fhwa.dot.gov)

[a] Estimates as of July 1. Includes Armed Forces in the United States.

In 2017, vehicles per capita reached a new high of 0.847. Vehicle-miles per capita were over 10,000 miles from 2004 to 2007 but were 9,862 miles in 2017. There were 1.800 vehicles for every employed civilian in the United States in 2017.

Table 9.2
Vehicles and Vehicle-Miles per Capita, 1950–2017[a]

Year	Vehicles per capita	Vehicles per household	Vehicles per licensed driver	Vehicles per civilian employed persons	Vehicle-miles per capita	Vehicle-miles per licensed driver
1950	0.286	0.999	0.699	0.738	3,017	7,368
1955	0.343	1.181	0.757	0.909	3,669	8,109
1960	0.377	1.286	0.778	1.032	3,994	8,238
1965	0.424	1.429	0.833	1.154	4,588	9,013
1970	0.479	1.548	0.880	1.247	5,412	9,949
1975	0.556	1.688	0.925	1.398	6,147	10,229
1980	0.614	1.731	0.962	1.408	6,707	10,512
1985	0.659	1.810	1.001	1.466	7,443	11,314
1990	0.717	1.921	1.074	1.509	8,573	12,839
1995	0.726	1.954	1.095	1.549	9,089	13,716
1996	0.735	1.990	1.104	1.565	9,218	13,846
1997	0.737	1.990	1.100	1.552	9,387	14,021
1998	0.743	2.000	1.108	1.560	9,531	14,226
1999	0.750	2.017	1.119	1.569	9,635	14,378
2000	0.755	2.037	1.119	1.558	9,728	14,410
2001	0.759	2.002	1.133	1.582	9,804	14,624
2002	0.767	2.022	1.138	1.619	9,911	14,697
2003	0.777	2.030	1.151	1.640	9,939	14,735
2004	0.791	2.073	1.167	1.667	10,103	14,907
2005	0.805	2.103	1.189	1.682	10,093	14,906
2006	0.818	2.139	1.206	1.694	10,082	14,863
2007	0.824	2.144	1.209	1.703	10,037	14,733
2008	0.820	2.139	1.199	1.719	9,766	14,288
2009	0.810	2.125	1.188	1.780	9,617	14,105
2010	0.802	2.112	1.181	1.785	9,592	14,122
2011	0.799	2.097	1.175	1.780	9,467	13,925
2012	0.801	2.077	1.187	1.765	9,457	14,019
2013	0.799	2.064	1.191	1.756	9,450	14,085
2014	0.810	2.094	1.205	1.764	9,498	14,133
2015	0.823	2.100	1.211	1.775	9,646	14,193
2016	0.837	2.133	1.220	1.787	9,816	14,318
2017	0.847	2.186	1.225	1.800	9,862	14,255
			Average annual percentage change			
1950-2017	1.6%	1.2%	0.8%	1.3%	1.8%	1.0%
2007-2017	0.3%	0.2%	0.1%	0.6%	-0.2%	-0.3%

Sources:

Resident population and civilian employed persons – U.S. Department of Commerce, Bureau of the Census, Online Data Retrieval, Washington, DC, 2018. (Additional resources: www.census.gov)

Vehicles in operation – IHS Automotive. Used with permission. FURTHER REPRODUCTION PROHIBITED. (Additional resources: https://www.ihs.com/industry/automotive.html)

Vehicle-miles – U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2016*, Table VM-1 and annual. (Additional resources: www.fhwa.dot.gov)

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[a] Includes all vehicles (light and heavy).

In 1985 there was about one licensed driver for every vehicle in the United States. Since that time, there are more vehicles than licensed drivers. The average number of licensed drivers per household in 2017 was 1.785.

Table 9.3
Licensed Driver Statistics, 1950–2017[a]

Year	Licensed drivers per capita	Licensed drivers per capita 16 years old and up	Licensed drivers per household	Licensed drivers per vehicle	Licensed drivers per civilian employed persons
1950	0.410	[b]	1.428	1.430	1.056
1955	0.452	[b]	1.560	1.321	1.201
1960	0.485	[b]	1.653	1.285	1.326
1965	0.509	[b]	1.715	1.200	1.386
1970	0.544	[b]	1.759	1.137	1.418
1975	0.601	[b]	1.825	1.081	1.512
1980	0.638	[b]	1.799	1.039	1.463
1985	0.658	[b]	1.807	0.999	1.464
1990	0.668	0.861	1.789	0.931	1.406
1991	0.667	0.870	1.792	0.931	1.436
1992	0.674	0.885	1.810	0.954	1.461
1993	0.665	0.877	1.796	0.929	1.440
1994	0.666	0.880	1.806	0.929	1.425
1995	0.663	0.878	1.784	0.913	1.414
1996	0.666	0.881	1.802	0.905	1.417
1997	0.669	0.888	1.809	0.909	1.410
1998	0.670	0.888	1.804	0.902	1.407
1999	0.670	0.890	1.802	0.893	1.402
2000	0.675	0.886	1.821	0.894	1.393
2001	0.670	0.868	1.768	0.883	1.397
2002	0.674	0.869	1.778	0.879	1.424
2003	0.675	0.868	1.763	0.868	1.424
2004	0.678	0.870	1.776	0.857	1.428
2005	0.677	0.867	1.769	0.841	1.415
2006	0.678	0.866	1.773	0.829	1.404
2007	0.681	0.870	1.773	0.827	1.409
2008	0.683	0.873	1.784	0.834	1.433
2009	0.682	0.870	1.789	0.842	1.499
2010	0.679	0.861	1.788	0.846	1.511
2011	0.680	0.860	1.785	0.851	1.515
2012	0.675	0.852	1.749	0.842	1.487
2013	0.671	0.845	1.732	0.840	1.474
2014	0.672	0.845	1.737	0.830	1.463
2015	0.680	0.853	1.733	0.825	1.465
2016	0.686	0.859	1.748	0.819	1.464
2017	0.692	0.865	1.785	0.817	1.470
			Average annual percentage change		
1950–2017	0.8%	[b]	0.3%	-0.8%	0.5%
2007–2017	0.2%	-0.1%	0.1%	-0.1%	0.4%

Sources:

Resident population, population 16 years and older, and civilian employed persons – U.S. Department of Commerce, Bureau of the Census, Online Data Retrieval, Washington, DC, 2018. (Additional resources: www.census.gov)

Vehicles in operation – IHS Automotive. Used with permission. FURTHER REPRODUCTION PROHIBITED. (Additional resources: https://www.ihs.com/industry/automotive.html)

[a] Includes all vehicles (light and heavy).

[b] Data are not available.

Household vehicle ownership shows a dramatic increase from 1960 to 1990. In 1960, nearly 79% of households owned less than two vehicles; by 1990, it declined to 45%. Census data prior to 1990 indicated that the majority of households owned one vehicle; in 1990 that changed to two vehicles. Since 2000, less than 10% of households had no vehicles. The share of households with three or more vehicles has risen each year since 2011. The American Community Survey now collects these data on an annual basis, thus annual data are available after 2010.

Table 9.4
Household Vehicle Ownership, 1960–2017
(percentage)

	No vehicles	One vehicle	Two vehicles	Three or more vehicles
1960	21.5%	56.9%	19.0%	2.5%
1970	17.5%	47.7%	29.3%	5.5%
1980	12.9%	35.5%	34.0%	17.5%
1990	11.5%	33.7%	37.4%	17.3%
2000	9.4%	33.8%	38.6%	18.3%
2010	9.1%	33.8%	37.6%	19.5%
2011	9.3%	34.1%	37.5%	19.1%
2012	9.2%	34.1%	37.3%	19.3%
2013	9.1%	33.9%	37.3%	19.7%
2014	9.1%	33.7%	37.3%	19.9%
2015	8.9%	33.5%	37.2%	20.3%
2016	8.7%	33.2%	37.1%	21.0%
2017	8.6%	32.7%	37.3%	21.5%

Source:
U. S. Department of Transportation, Volpe National Transportation Systems Center, *Journey-to-Work Trends in the United States and its Major Metropolitan Area, 1960–1990*, Cambridge, MA, 1994, p. 2-2.
2000 data – U.S. Bureau of the Census, American Fact Finder, factfinder.census.gov, Table QT-04, August 2001. (Additional resources: www.census.gov)
2010-2017 data – U.S. Bureau of the Census, American Community Survey, 1-year estimates, Table CP04, 2019.

2017 National Household Travel Survey Daily Trip Data

The Department of Transportation (DOT) collected data on daily trips in 1969, 1977, 1983, 1990 and 1995 via the Nationwide Personal Transportation Survey (NPTS). For 2001, the DOT combined the collection of long trip and daily trip data into one survey – the 2001 National Household Travel Survey (NHTS). The long trip data were not included in the 2009 or 2017 NHTS.

The NHTS is the nation's inventory of daily travel. The survey includes demographic characteristics of households, people, vehicles, and detailed information on daily travel for all purposes by all modes. NHTS survey data are collected from a sample of U.S. households and expanded to provide national estimates of trips and miles by travel mode, trip purpose, and a host of household attributes.

The NHTS was designed to continue the NPTS series, but as with all data surveys, caution should be used when comparing statistics from one survey to another due to changes in terminology, survey procedures, and target population. The NHTS surveys collected data on trips of children under 5 years of age, while the previous NPTS did not. Improved methodologies first used in the collection of trip information in the 1995 NPTS make it difficult to compare these data with past NPTS survey data. Thus, the 1990 NPTS trip data have been adjusted to make it comparable with the later surveys.

In the 2017 survey, households were able to respond online as well as by phone. The online survey included a mapping feature that allowed more accurate trip distances to be collected. These derived trip distances appear to be about 10% shorter than self-reported trips.

A vehicle trip in the NHTS is defined as a one-way trip by a single privately-operated vehicle regardless of the number of persons in the vehicle. A person trip is defined as a movement in the public space between two identifiable points. Two household members traveling together in one car would be counted as two person trips and one vehicle trip. Trips made in other highway vehicles, such as buses, streetcars, taxis (including Uber/Lyft), and school buses are collected in the NHTS, but these are shown as person trips by those modes because there is no way to trace movement of those vehicles throughout the day.

Table 9.5
Demographic Statistics from the 1969, 1977, 1983, 1990, 1995 NPTS and 2001, 2009, 2017 NHTS

	1969	1977	1983	1990	1995	2001	2009	2017	Percent change 1969–2017
Persons per household	3.16	2.83	2.69	2.56	2.63	2.58	2.50	2.55	-19%
Vehicles per household	1.16	1.59	1.68	1.77	1.78	1.89	1.87	1.87	61%
Workers per household	1.21	1.23	1.21	1.27	1.33	1.35	1.34	1.33	10%
Licensed drivers per household	1.65	1.69	1.72	1.75	1.78	1.77	1.88	1.89	14%
Vehicles per worker	0.96	1.29	1.39	1.40	1.34	1.39	1.40	1.41	47%
Vehicles per licensed driver	0.70	0.94	0.98	1.01	1.00	1.06	1.00	0.99	42%
Average vehicle trip length (miles)	8.89	8.34	7.90	8.98	9.06	9.87	9.72	9.55	7%

Note: Average vehicle trip length for 1990 and 1995 is calculated using only those records with trip mileage information present. The 1969 survey does not include pickups and other light trucks as household vehicles. Data on vehicles per household and licensed drivers per household will not match Table 9.2 and 8.3 because they come from a different source.

Sources:
U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92-027, Washington, DC, March 1992, Table 2. Data for 1995, 2001, 2009, and 2017 were generated from the 2017 National Household Travel Survey website nhts.ornl.gov. (Additional resources: www.fhwa.dot.gov)

Due to methodology improvements in collecting trip information, the 2001 and 1995 data should be compared only to the 1990 adjusted data. The original 1990 data are comparable to all previous surveys; however, comparisons should always be made with caution because of differing survey methodologies.

Table 9.6
Average Annual Vehicle-Miles, Vehicle Trips, and Trip Length per Household
1969, 1977, 1983, 1990, 1995 NPTS and 2001, 2009, 2017 NHTS

	Journey-to-work[a]	All trips
Average annual vehicle-miles per household		
1969	4,183	12,423
1977	3,815	12,036
1983	3,538	11,739
1990 original	4,853	15,100
1990 adjusted	4,853	18,161
1995	6,492	20,895
2001	5,724	21,171
2009	5,513	19,850
2017	5,379	20,629
Average annual vehicle trips per household		
1969	445	1,396
1977	423	1,442
1983	414	1,486
1990 original	448	1,702
1990 adjusted	448	2,077
1995	553	2,321
2001	479	2,171
2009	457	2,068
2017	450	1,865
Average vehicle trip length (miles)		
1969	9.4	8.9
1977	9.0	8.4
1983	8.5	7.9
1990 original	11.0	9.0
1990 adjusted	11.0	8.9
1995	11.8	9.1
2001	12.2	9.9
2009	12.2	9.7
2017	12.0	9.6

Note: A vehicle trip is defined as one start and end movement from location to location in a single privately-operated vehicle regardless of the number of persons in the vehicle. The 2017 survey featured some online trip mapping which collected more accurate trip distances. The derived distances appear to be about 10% shorter than self-reported trips.

Sources:
U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92-027, Washington, DC, March 1992, Table 7. 1990 adjusted data – Oak Ridge National Laboratory, Oak Ridge, TN, August 1998. 1995 NPTS, 2001, 2009, 2017 NHTS data were generated from the 2017 National Household Travel Survey website nhts.ornl.gov. (Additional resources: www.fhwa.dot.gov, nhts.ornl.gov)

[a] It is believed that the methodology changes in the 1995 NPTS did not affect journey-to-work trips; therefore, no adjustment is necessary.

The number of drivers in a household makes a difference in vehicle miles of travel (vmt), as does the presence of children in the household. Households with children have 64% more vmt than households without children in 2017. Rural households have more vehicles, on average, than urban households.

Table 9.7
Average Number of Vehicles and Vehicle Travel per Household, 1990 NPTS and 2001, 2009, and 2017 NHTS

	Average number of vehicles per household				Average vehicle-miles traveled per household[a]			
Number of licensed drivers	**1990**	**2001**	**2009**	**2017**	**1990**	**2001**	**2009**	**2017**
1	1.5	1.2	1.1	1.2	15,200	9,700	8,800	11,700
2	2.1	2.2	2.2	2.2	22,900	25,800	23,500	24,500
3	2.9	3.0	3.0	3.1	29,400	37,900	37,700	35,900
4 or more	3.8	3.8	3.9	4.1	40,500	47,200	55,200	48,400
Household size								
1 person	1.2	1.0	1.0	1.0	11,400	7,500	7,100	9,300
2 persons	1.9	2.0	2.0	2.0	19,300	21,200	17,500	20,100
3 persons	2.2	2.3	2.3	2.3	23,700	28,400	27,900	26,800
4 persons	2.4	2.4	2.4	2.5	25,300	28,600	33,200	30,000
5 persons	2.4	2.4	2.4	2.6	24,900	33,200	33,700	32,500
6 or more persons	2.7	2.5	2.4	2.7	29,200	33,800	33,600	34,400
Household urban status								
Urban	1.9	1.8	1.7	1.8	19,000	19,300	17,600	19,200
Rural	2.1	2.3	2.4	2.5	22,200	28,400	27,700	27,100
Household composition								
With children	2.2	2.2	2.2	2.2	24,100	28,300	30,400	27,800
Without children	1.8	1.7	1.7	1.7	17,600	16,700	14,400	17,100
All households	**1.8**	**1.9**	**1.9**	**1.9**	**18,300**	**21,200**	**19,900**	20,600

Note: The 2017 survey featured some online trip mapping which collected more accurate trip distances. The derived distances appear to be about 10% shorter than self-reported trips.

Source:
Generated from the Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey Public Use Files, Washington, DC, 2000 and the 2017 National Household Travel Survey website nhts.ornl.gov. (Additional resources: nhts.ornl.gov)

[a] Average vehicle-miles traveled per household is the total movement in miles of all privately operated vehicles, regardless of the number of people in the vehicle, divided by the total number of households in the survey.

In 2017, 24% of vehicle trips were traveling to and from work. Another 20% of trips were for shopping which is down slightly from 2001. Shopping is done close to home, as the average trip length for shopping was only seven miles.

Table 9.8
Trip Statistics[a] by Trip Purpose, 2001 and 2017 NHTS

	Share of trips		Share of vehicle-miles traveled		Trip length (miles)		Trip length (minutes)	
Trip purpose	2001	2017	2001	2017	2001	2017	2001	2017
To/from work	22.1%	24.1%	27.0%	30.2%	12.1	12.0	22.3	25.0
Work-related business	4.1%	2.0%	8.4%	3.2%	20.3	15.2	30.9	28.1
Shopping	21.1%	19.9%	14.5%	14.7%	6.7	7.0	14.4	16.1
Other family/personal business	24.7%	20.9%	18.7%	14.3%	7.5	6.6	15.2	16.1
School/church	4.9%	5.2%	3.7%	5.4%	7.5	9.9	15.8	20.2
Medical/dental	2.2%	2.4%	2.2%	2.4%	9.9	9.5	20.7	23.1
Visit friends/relatives	6.3%	5.7%	9.4%	8.8%	14.9	14.6	24.4	26.8
Other social/recreational	13.7%	15.8%	13.2%	14.6%	9.6	8.8	18.2	19.4
Other	0.5%	3.8%	1.0%	6.4%	18.1	16.0	31.4	31.1
All	100.0%	100.0%	100.0%	100.0%	9.9	9.6	18.7	20.6

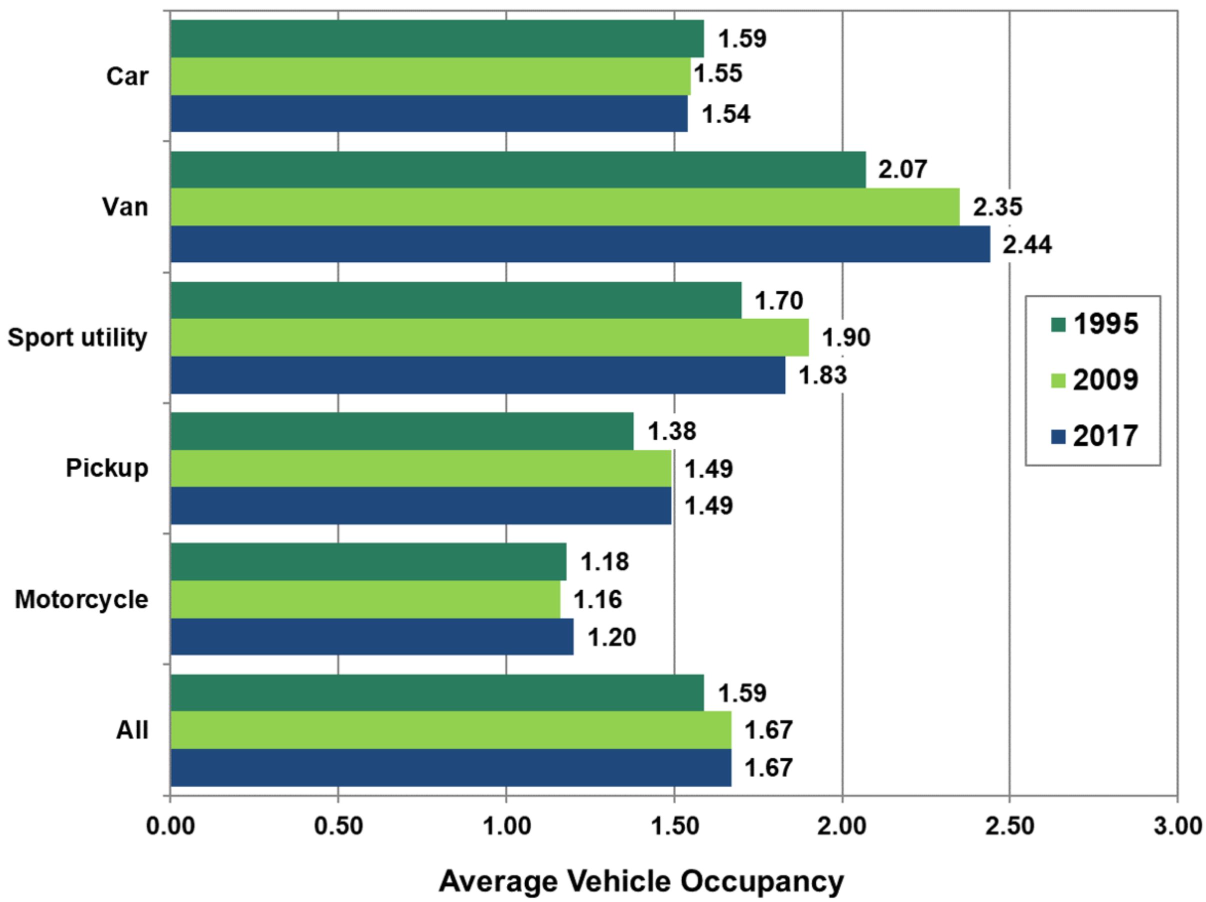
Note: The "All" category for average trip length and duration includes records for which trip purpose was not identified. The 2017 survey featured some online trip mapping which collected more accurate trip distances. The derived distances appear to be about 10% shorter than self-reported trips.

Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

[a] Percentages may not sum to totals due to rounding.

Overall, household vehicle occupancy remained the same in 2017 as in 2009. Sport utility vehicle occupancy declined from 1.90 to 1.83 from 2009 to 2017, while pickup truck occupancy stayed the same. Car occupancy was nearly the same in those years as well.

Figure 9.1. Average Household Vehicle Occupancy by Vehicle Type, 1995 NPTS and 2009, 2017 NHTS



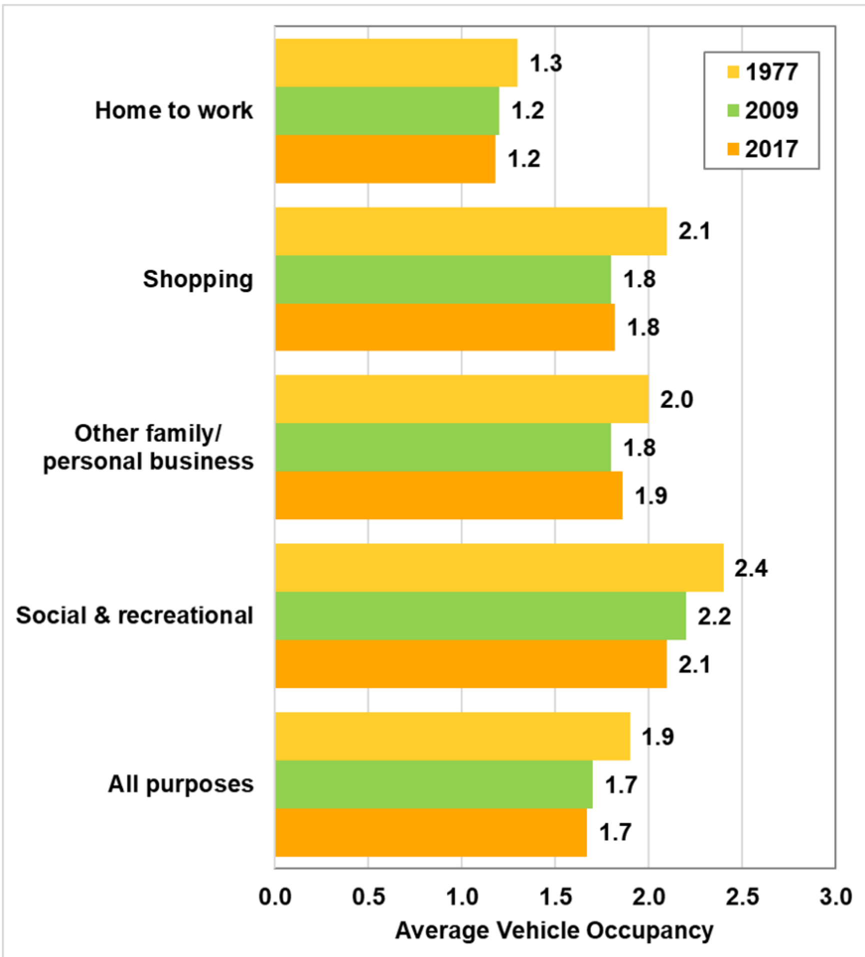
Note: Average vehicle occupancy is mileage-weighted and only includes privately operated household vehicles.

Sources:

Generated from the Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey Public Use Files, Washington, DC, 2000 and the 2017 National Household Travel Survey website nhts.ornl.gov. (Additional resources: nhts.ornl.gov)

The average vehicle occupancy, calculated as person-miles per vehicle-mile, is highest for social and recreational purposes. The highest vehicle occupancy levels for all purposes were in 1977. The increase in number of vehicles per household and the decrease in average household size could have contributed to the decline since then.

Figure 9.2. Average Household Vehicle Occupancy by Trip Purpose, 1977 NPTS and 2009, 2017 NHTS



Note: Average vehicle occupancy is mileage-weighted and only includes privately operated household vehicles. The "All purposes" category includes other purposes not shown above, such as trips to school, church, doctor, dentist, and work-related business.

Sources:

U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92027, Washington, DC, March 1992, Figure 6. Data from 2009 and 2017 NHTS were generated from the 2017 National Household Travel Survey website nhts.ornl.gov. (Additional resources: www.fhwa.dot.gov, nhts.ornl.gov)

The 1990 household survey reports the highest average annual miles per vehicle and the 2017 survey reports the lowest. These data show that younger vehicles are typically driven more miles than older vehicles.

Table 9.9
Average Annual Miles per Household Vehicle by Vehicle Age, 1983, 1990, 1995 NPTS and 2001, 2009, 2017 NHTS

Vehicle age (years)	1983 self-reported	1990 self-reported	1995 self-reported	2001 self-reported	2009 self-reported	2017 self-reported
Under 1	8,200	19,600	15,900	15,500	13,200	13,000
1	15,200	16,800	16,800	14,300	14,600	14,000
2	16,800	16,600	15,500	14,000	13,900	14,200
3	14,500	14,700	14,400	13,100	12,700	12,400
4	13,000	13,600	14,100	12,500	12,600	12,900
5	12,100	12,900	13,500	12,000	12,800	13,100
6	11,300	13,200	13,200	11,800	12,100	12,400
7	10,000	12,400	12,800	11,600	11,900	12,300
8	9,800	12,600	12,200	10,900	11,500	11,400
9	9,000	11,500	12,200	10,800	11,300	12,000
10 and older	7,300	9,200	8,900	7,400	9,300	9,400
All household vehicles	10,400	12,500	12,200	11,100	11,300	11,200

Note: Data include all household vehicles and have been rounded to the nearest hundred. The 2017 survey featured some online trip mapping which collected more accurate trip distances. The derived distances appear to be about 10% shorter than self-reported trips.

Sources:
Nationwide Personal Transportation Study—1983: D. Klinger and J. Richard Kuzmyak, COMSIS Corporation, *Personal Travel in the United States, Volume 1: 1983–84 Nationwide Personal Travel Study*, prepared for the U.S. Department of Transportation, Washington, DC, August 1986, Table 4-22, p. 4-21. 1990: Generated from the *1990 Nationwide Personal Transportation Study Public Use Tape*, March 1992. 1995, 2001, 2009, and 2017: Generated from the 2017 National Household Travel Survey website nhts.ornl.gov. (Additional resources: nhts.ornl.gov)

Historically, the data from the Nationwide Personal Transportation Survey (NPTS) are based on estimates reported by survey respondents. For the 1995 NPTS and the 2001 National Household Travel Survey (NHTS), odometer data were also collected. The 1995 data indicate that respondents overestimate the number of miles they drive in a year, but the 2001 data do not show that same trend.

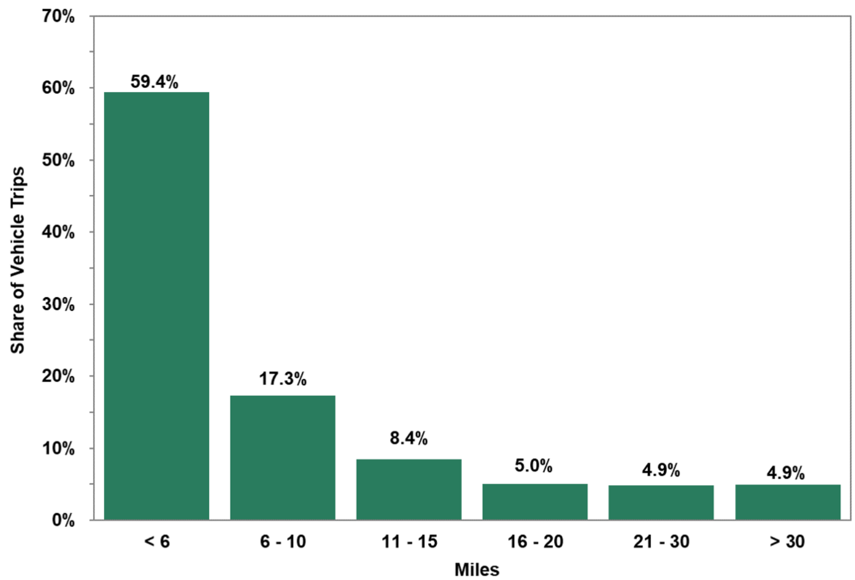
Table 9.10
Self-Reported vs. Odometer Average Annual Miles, 1995 NPTS and 2001 NHTS

Vehicle age (years)	1995 self-reported	1995 odometer	2001 self-reported	2001 odometer
Under 1	15,900	15,600	15,500	14,500
1	16,800	14,500	14,300	14,200
2	15,500	14,800	14,000	13,700
3	14,400	13,800	13,100	14,100
4	14,100	12,900	12,500	13,400
5	13,500	12,700	12,000	12,900
6	13,200	12,400	11,800	12,400
7	12,800	11,600	11,600	12,100
8	12,200	11,300	10,900	11,300
9	12,200	11,200	10,800	10,500
10 and older	8,900	9,000	7,400	8,100
All household vehicles	12,200	11,800	11,000	11,800

Note: The 2009 NHTS did not collect similar data. Survey methodology on odometer reading data differs from 1995 to 2001 data.

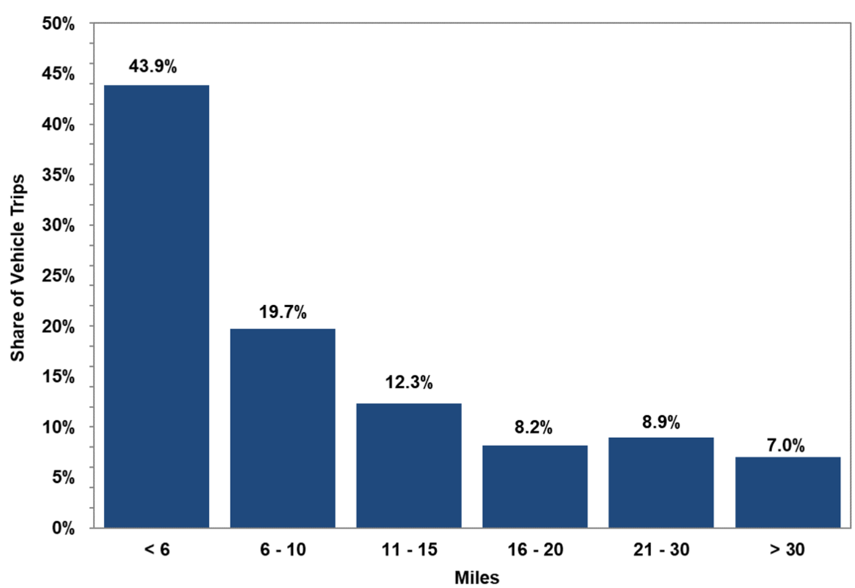
Source:
Generated from the 2009 National Household Travel Survey website nhts.ornl.gov and 2001 NHTS public use file.

Figure 9.3. Share of Vehicle Trips by Trip Distance, 2017 NHTS



Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

Figure 9.4. Share of Vehicle Trips to Work by Trip Distance, 2017 NHTS



Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

Fifteen percent of new vehicles (1-year-old and under) travel over 20,000 miles per year. Seventy-five percent of the vehicles over 20 years old travel less than 4,000 miles in a year.

Table 9.11
Share of Vehicles by Annual Miles of Travel and Vehicle Age, 2017 NHTS

	Vehicle age (years)						
Annual vehicle miles of travel	1 and under	2	3	4	5	6	7
< 1,000 miles	2%	2%	2%	3%	3%	3%	3%
1 - 2,000 miles	2%	2%	3%	3%	2%	3%	3%
2 - 4,000 miles	7%	8%	7%	6%	7%	7%	7%
4 - 6,000 miles	9%	11%	11%	8%	8%	9%	10%
6 - 8,000 miles	10%	10%	11%	10%	11%	11%	11%
8 - 10,000 miles	11%	13%	12%	12%	13%	12%	13%
10 - 12,000 miles	11%	11%	12%	11%	12%	12%	12%
12 - 15,000 miles	14%	13%	15%	15%	13%	15%	14%
15 - 20,000 miles	15%	15%	14%	17%	16%	13%	14%
20 - 30,000 miles	13%	10%	11%	11%	12%	11%	9%
>30,000 miles	6%	5%	3%	4%	4%	4%	4%
All	100%	100%	100%	100%	100%	100%	100%
	Vehicle age (years)						
	8	9	10	11-15	16-20	Over 20	
< 1,000 miles	5%	4%	4%	6%	9%	16%	
1 - 2,000 miles	3%	3%	4%	5%	8%	10%	
2 - 4,000 miles	9%	9%	8%	12%	15%	17%	
4 - 6,000 miles	10%	12%	11%	13%	16%	16%	
6 - 8,000 miles	13%	12%	12%	13%	13%	11%	
8 - 10,000 miles	12%	11%	12%	12%	10%	8%	
10 - 12,000 miles	10%	11%	10%	10%	8%	6%	
12 - 15,000 miles	13%	13%	13%	11%	7%	5%	
15 - 20,000 miles	12%	13%	12%	10%	7%	5%	
20 - 30,000 miles	9%	9%	10%	6%	5%	4%	
>30,000 miles	3%	4%	3%	3%	2%	1%	
All	100%	100%	100%	100%	100%	100%	

Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov. (Additional resources: nhts.ornl.gov)

The average driver made 2.7 trips per day with an average of 9.6 miles for each trip in 2017.

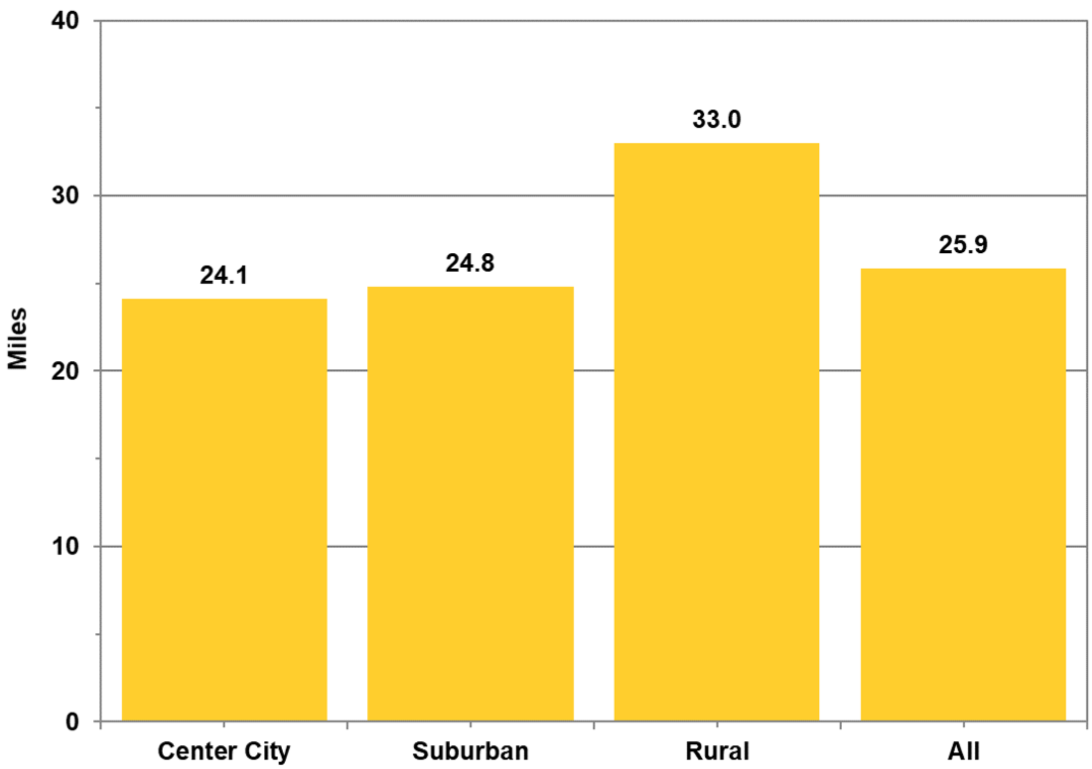
Table 9.12
Household Vehicle Trips, 1990, 1995 NPTS and 2001, 2009, 2017 NHTS

	Number of daily vehicle trips (per driver)	Average vehicle trip length (miles)	Daily vehicle miles of travel (per driver)
1990	3.3	8.9	28.5
1995	3.6	9.1	32.1
2001	3.4	9.9	32.7
2009	3.0	9.7	29.0
2017	2.7	9.6	25.9

Note: The 2017 survey featured some online trip mapping which collected more accurate trip distances. The derived distances appear to be about 10% shorter than self-reported trips.

Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

Figure 9.5. Average Daily Miles Driven (per Driver), 2017 NHTS



Note: Center city = urban area; suburban = urban cluster and area surrounded by urban areas; rural = not in urban area.

Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

Table 9.13
Daily Vehicle Miles of Travel (per Vehicle) by Number of Vehicles in the Household, 2001, 2009, and 2017 NHTS

Number of household vehicles	Daily miles per vehicle		
	2001	2009	2017
1	25.6	29.1	30.9
2	27.5	32.7	32.2
3	24.2	31.3	30.6
4	23.0	30.2	28.3
5	21.1	27.6	27.4
More than 5	18.4	27.2	24.7
All	25.2	31.1	30.5

Note: The 2017 survey featured some online trip mapping which collected more accurate trip distances. The derived distances appear to be about 10% shorter than self-reported trips.

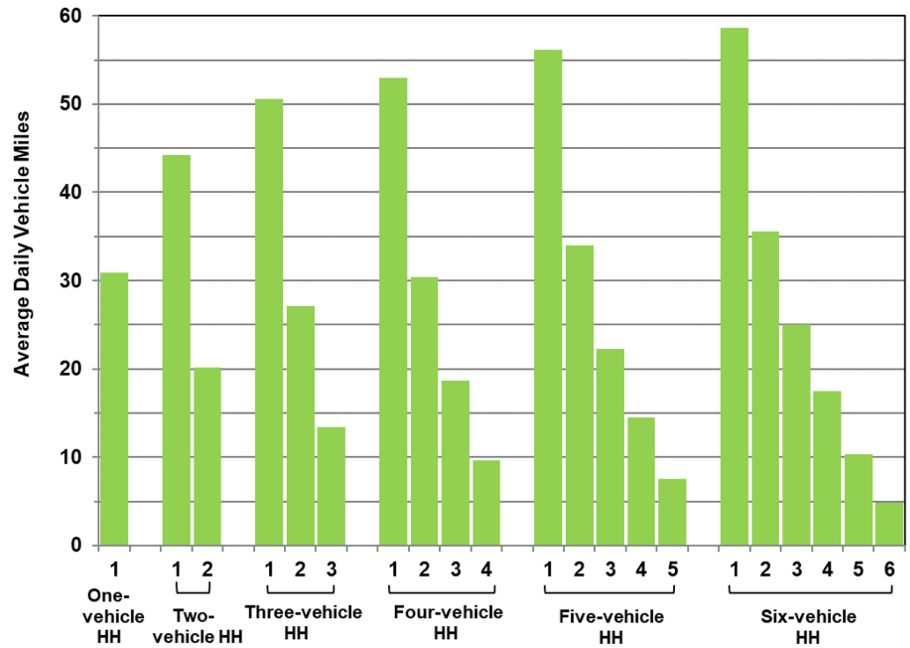
Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

Table 9.14
Daily and Annual Vehicle Miles of Travel and Average Age for Each Vehicle in a Household, 2017 NHTS

Vehicle number	Average daily miles	Average annual miles	Average age (years)
One-vehicle household			
1	31.0	11,300	9.3
Two-vehicle household			
1	44.1	16,100	8.2
2	20.3	7,400	9.8
Three-vehicle household			
1	50.7	18,500	9.0
2	27.1	9,900	10.3
3	13.4	4,900	13.1
Four-vehicle household			
1	52.9	19,300	9.6
2	30.4	11,100	11.0
3	18.6	6,800	12.4
4	9.6	3,500	14.9
Five-vehicle household			
1	56.2	20,500	9.9
2	34.0	12,400	11.6
3	22.2	8,100	13.3
4	14.5	5,300	14.2
5	7.7	2,800	15.9
Six-vehicle household			
1	58.6	21,400	10.6
2	35.6	13,000	12.0
3	24.9	9,100	13.4
4	17.5	6,400	15.7
5	10.4	3,800	16.9
6	4.9	1,800	18.0

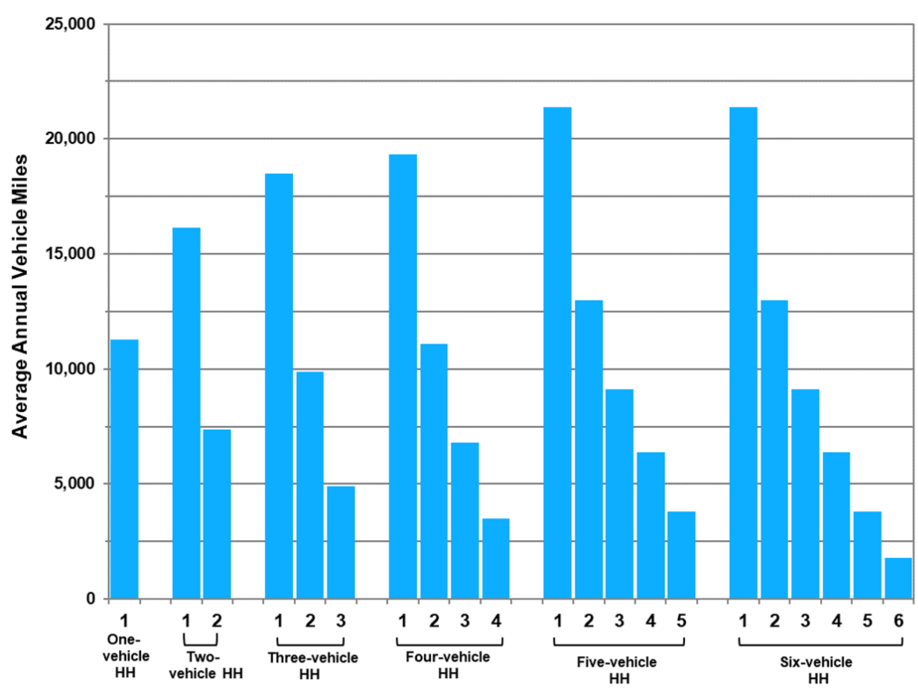
Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

Figure 9.6. Daily Vehicle Miles of Travel for Each Vehicle in a Household, 2017 NHTS



Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

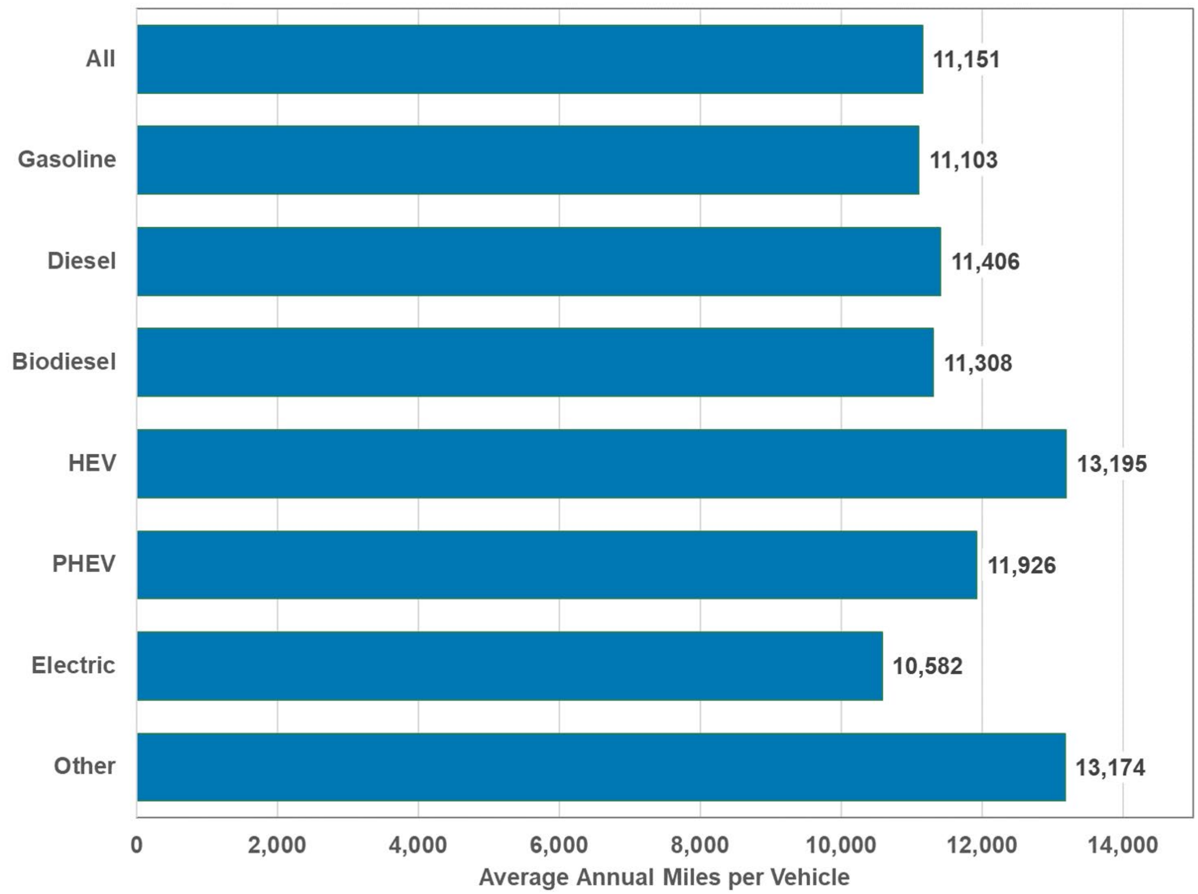
Figure 9.7. Annual Vehicle Miles of Travel for Each Vehicle in a Household, 2017 NHTS



Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

Household vehicles fueled with gasoline were driven an average of 11,103 miles in 2017, while electric vehicles were driven an average of 10,582.

Figure 9.8. Annual Vehicle Miles of Travel by Fuel Type, 2017 NHTS



Note: HEV = hybrid-electric vehicle. PHEV = plug-in hybrid vehicle. Includes household vehicles only.

Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

Table 9.15
Characteristics of U.S. Daily per Vehicle Driving by Housing Density, 2017 NHTS

Housing units per square mile[a]	Share of vehicles in density type	Hours per vehicle per day	Average vehicle speed (miles/hour)	Miles per vehicle per day
0–99	21.5%	0.79	34.1	26.8
100–499	19.7%	0.87	31.0	27.1
500–999	14.1%	0.90	29.1	26.0
1,000–1,999	19.8%	0.96	26.1	25.0
2,000–3,999	16.3%	1.05	24.0	25.3
4,000–9,999	6.3%	1.14	22.2	25.2
10,000–24,999	1.8%	1.31	16.7	21.8
25,000–999,999	0.6%	1.14	16.9	19.2
All	100.0%	0.93	27.9	25.9

Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

Table 9.16
Housing Unit Characteristics, 2017

	Share of occupied housing units	Percent with garage or carport
Housing unit age		
New construction (< 2 years)	0.7%	74.0%
New construction (2-5 years)	4.2%	71.8%
Older construction (6+ years)	95.1%	65.3%
Housing unit structure		
Single-unit dwelling	70.6%	80.3%
Multi-unit dwelling	23.9%	29.0%
Manufactured/mobile homes	5.5%	37.2%
Other	0.1%	20.0%
Housing unit geographic location (Census Region)		
Northeast	18.0%	52.1%
Midwest	22.0%	74.5%
South	37.5%	59.2%
West	22.5%	78.6%
Housing unit tenure		
Owner	63.8%	80.6%
Renter	36.2%	39.2%
All occupied units	121,200,000 units	65.6%

Note: The American Housing Survey is updated every two years.

Source:
U.S. Bureau of the Census, *2017 American Housing Survey*, Table Creator, accessed September 23, 2018. (Additional information: www.census.gov/programs-surveys/ahs)

[a] Housing units per square mile in the census block group of the household's home location.

Trips to and from work by 21 different modes averaged 11.45 miles and 26.58 minutes in 2017. Sixty-three percent of workers traveled less than 30 minutes to work in 2017.

Table 9.17
Average Length and Duration of Trips To and From Work by Mode, 2017 NHTS

Mode	Trip Length (miles)	Trip Duration (minutes)
Walk	1.19	15.26
Bicycle	2.72	21.79
Car	12.21	25.47
SUV	10.76	23.79
Van	10.73	23.33
Pickup truck	12.60	25.97
Golf cart / Segway	0.39	5.00
Motorcycle / Moped	10.12	22.53
RV (motor home, ATV, snowmobile)	5.37	16.19
School bus	5.78	36.03
Public or commuter bus	10.35	56.97
Paratransit / Dial-a-ride	8.63	41.51
Private / Charter / Tour / Shuttle bus	19.32	50.94
City-to-city bus (Greyhound, Megabus)	58.97	117.86
Amtrak / Commuter rail	25.57	78.13
Subway / elevated / light rail / street car	9.90	53.41
Taxi / limo (including Uber / Lyft)	5.91	22.54
Rental car (including Zipcar / Car2Go)	15.68	26.22
Airplane	718.69	134.83
Boat / ferry / water taxi	11.64	55.34
Something else	37.79	52.99
All	11.45	26.58

Note: A trip is defined as a movement in the public space between two identifiable points.

Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

Table 9.18
Workers by Commute Time, 1990, 2000, 2010, and 2017

Commute time (one-way)	1990	2000	2010	2017
Less than 15 minutes	32.5%	29.4%	28.6%	26.3%
15–29 minutes	37.0%	36.1%	36.2%	36.2%
30–39 minutes	15.2%	15.8%	16.1%	16.6%
40–59 minutes	9.2%	10.7%	11.1%	12.0%
60 minutes or more	6.1%	8.0%	8.0%	8.9%
Average travel time (minutes)	22.4	25.5	25.2	26.4

Sources:
1990-2000 – U.S. Bureau of the Census, *Journey to Work: 2000*, Tables 1 and 2, 1990-2000, March 2004.
2010-2017 – U.S. Bureau of the Census, *2013-2017 American Community Survey, 5-Year Estimates*, Tables S0802 and B08303. (Additional resources: www.census.gov)

According to the U.S. Census data, the share of workers who car pooled has dropped from 19.7% in 1980 to 9.2% in 2017. The share of workers using public transit declined from 6.2% to 5.1% in the same time period. Those driving alone and those working at home increased. The average travel time increased by 4.7 minutes from 1980 to 2017. The American Community Survey (ACS) now collects journey-to-work data on an annual basis. It shows the average commute time as 26.4 minutes in 2017.

Table 9.19
Means of Transportation to Work, 1980, 1990, 2000, and 2017

	1980 Census		1990 Census		2000 Census		2017 ACS	
Means of transportation	Number of workers (thousands)	Share	Number of workers (thousands)	Share	Number of workers (thousands)	Share	Number of workers (thousands)	Share
Private vehicle	81,258	84.1%	99,593	86.5%	112,737	87.9%	127,054	85.6%
Drove alone	*62,193*	*64.4%*	*84,215*	*73.2%*	*97,102*	*75.7%*	*113,465*	*76.4%*
Car pooled	*19,065*	*19.7%*	*15,378*	*13.4%*	*15,635*	*12.2%*	*13,589*	*9.2%*
Public transportation	6,008	6.2%	5,889	5.1%	5,868	4.6%	7,608	5.1%
Bus or trolley bus[a]	*3,925*	*4.1%*	*3,445*	*3.0%*	*3,207*	*2.5%*	*3,776*	*2.5%*
Streetcar or trolley car[a]	[b]	[b]	*78*	*0.1%*	*73*	*0.1%*	*88*	*0.1%*
Subway or elevated	*1,529*	*1.6%*	*1,755*	*1.5%*	*1,886*	*1.5%*	*2,821*	*1.9%*
Railroad	*554*	*0.6%*	*574*	*0.5%*	*658*	*0.5%*	*867*	*0.6%*
Ferryboat	[b]	[b]	*37*	*0.0%*	*44*	*0.0%*	*56*	*0.0%*
Taxicab	167	0.2%	179	0.2%	200	0.2%	206	0.1%
Motorcycle	419	0.4%	237	0.2%	142	0.1%	271	0.2%
Bicycle	468	0.5%	467	0.4%	488	0.4%	872	0.6%
Walked only	5,413	5.6%	4,489	3.9%	3,759	2.9%	4,049	2.7%
Other means	703	0.7%	809	0.7%	901	0.7%	1,345	0.9%
Worked at home	2,180	2.3%	3,406	3.0%	4,184	3.3%	7,027	4.7%
Total workers	96,616	100.0%	115,069	100.0%	128,279	100.0%	148,432	100.0%
Average travel time (minutes)	21.7		22.4		25.5		26.4	

Sources:

1980-1990 data – Provided by the Journey-to-Work and Migration Statistics Branch, Population Division, U.S. Bureau of the Census.

2000 data – U.S. Bureau of the Census, *Journey to Work: 2000*, Tables 1 and 2, 1990-2000, March 2004 (www.census.gov/population/www/socdemo/journey.html).

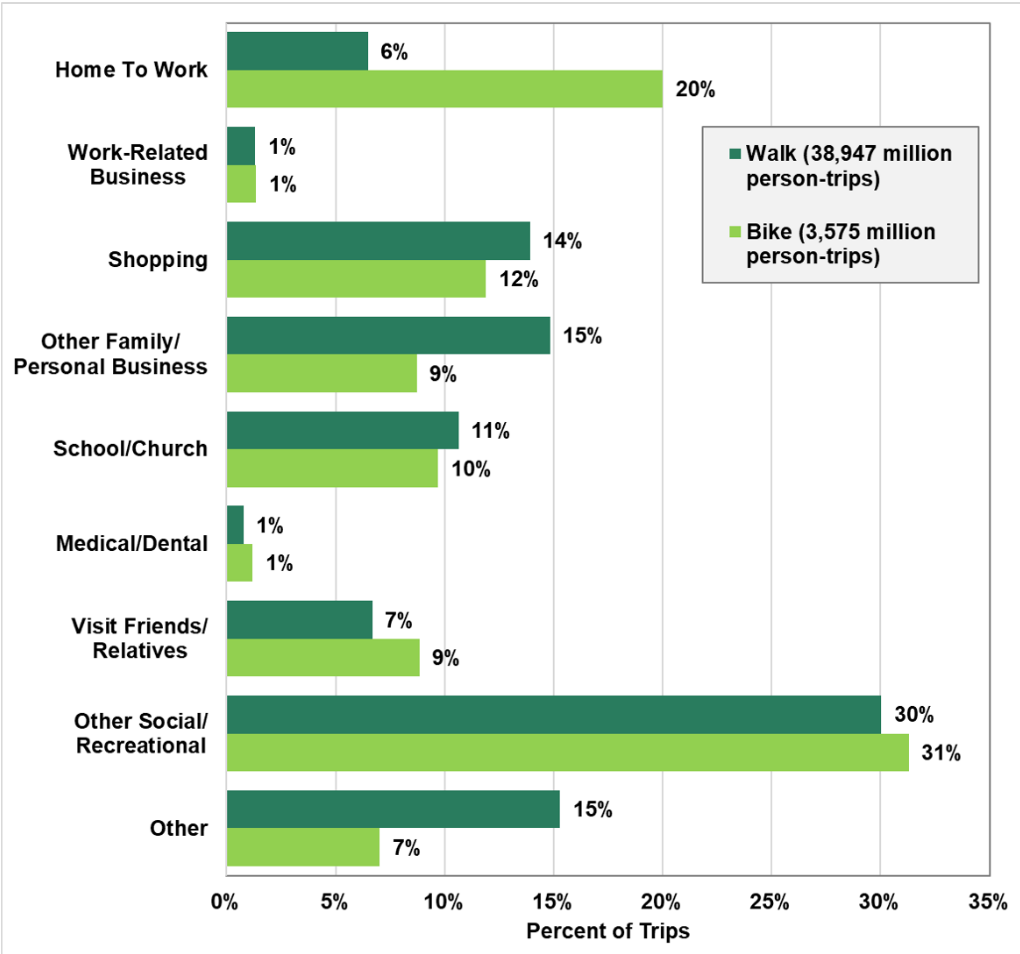
2017 data – U.S. Bureau of the Census, *2013-2017 American Community Survey Five-Year Estimates*, Tables B08301 and GCT0801. (Additional resources: www.census.gov)

[a] This category was "Bus or streetcar" in 1980.

[b] Data are not available.

In 2017, 6% of walk trips and 20% of bike trips were to/from work. Thirty-one percent of all bike trips were for social/recreational purposes. Fourteen percent of walk trips were shopping trips.

Figure 9.9. Walk and Bike Trips by Trip Purpose, 2017 NHTS



Note: Percentages may not sum to totals due to rounding.

Source:
Generated from the 2017 National Household Travel Survey website nhts.ornl.gov.

After 2001, only data on daily trips were collected in the NHTS. The 2001 data are still the latest available on long-distance trips.

Long Distance Trips – 2001 National Household Travel Survey

The 2001 National Household Travel Survey (NHTS) collected data on long-distance trips as well as everyday travel. The everyday travel data is a continuation of the Nationwide Personal Transportation Survey (NPTS), while the long-distance travel data is a continuation of the American Travel Survey (ATS) which was collected in 1977 and 1985. The survey collected trip-related data such as mode of transportation, duration, distance and purpose of trip. It also gathered demographic, geographic, and economic data for analysis purposes.

A long-distance trip is defined as a trip of 50 miles or more, one-way. Long-trip data from the 2001 NHTS were released in the summer of 2004. For additional information about the 2001 NHTS data, go to the following website: nhts.ornl.gov.

Table 9.20
Long-Distance Trip[a] Characteristics, 2001 NHTS

Trip characteristic	Person trips (thousands)	Person trips (percent)	Person miles (thousands)	Person miles (percent)
Total	2,554,068	100.0	1,138,322,697	100.0
Principal means of transportation:				
Personal use vehicles	2,310,376	90.5	735,882,255	64.7
Airplane	165,039	6.5	367,888,741	32.3
Commercial airplane	158,880	6.2	361,717,015	31.8
Bus[b]	52,962	2.1	23,747,433	2.1
Intercity bus	3,456	0.1	1,765,696	0.2
Charter, tour, or school bus	45,952	1.8	21,019,942	1.9
Train	20,672	0.8	9,266,373	0.8
Round trip distance:				
100 to 300 miles	1,688,358	66.1	284,586,370	25.0
300 to 499 miles	373,550	14.6	143,571,597	12.6
500 to 999 miles	261,802	10.3	180,669,482	15.9
1,000 to 1,999 miles	125,665	4.9	178,629,838	15.7
2,000 miles or more	104,694	4.1	350,865,409	30.8
Mean (miles)	446	[c]	[c]	[c]
Median (miles)	206	[c]	[c]	[c]
Calendar quarter:				
1st quarter	566,502	22.2	246,556,190	21.7
2nd quarter	653,310	25.6	298,154,812	26.2
3rd quarter	734,878	28.8	341,021,290	30.0
4th quarter	599,378	23.5	252,590,405	22.2
Main purpose of trip:				
Commuting	329,395	12.9	65,877,968	5.8
Other business	405,866	15.9	242,353,212	21.3
Personal/leisure	1,406,411	55.1	667,471,358	58.7
Personal business	322,645	12.6	130,020,982	11.4
Other	88,230	3.5	32,031,679	2.8
Nights away from home:				
None	1,454,847	57.0	304,469,524	26.8
1 to 3 nights	808,281	31.7	414,219,147	36.4
4 to 7 nights	214,464	8.4	269,265,597	23.7
8 or more nights	76,475	3.0	150,368,429	13.2
Destination:				
Within Census division	2,077,810	81.4	549,651,116	48.3
Across Census division, within Census	196,890	7.7	134,930,113	11.9
Across Census region	279,367	10.9	453,741,468	39.9

Note: Long-distance trips were not included in the 2009 or 2017 NHTS.

Source:
U.S. Bureau of Transportation Statistics and the U.S. Federal Highway Administration, *2001 National Household Transportation Survey*. (Additional resources: nhts.ornl.gov)

[a] A long-distance trip is defined as a trip of 50 miles or more, one-way.
[b] Includes other types of buses.
[c] Not applicable.

Chapter 10
Nonhighway Modes

Summary Statistics from Tables in this Chapter

Source		
	Passenger-miles	(millions)
Table 10.2	*Domestic and international air carrier, 2018*	*1,016,997*
Table 10.10	*Amtrak, 2017*	*6,563*
	Freight ton-miles	(millions)
Table 10.5	*Domestic waterborne commerce, 2017*	*489,000*
Table 10.8	*Class I railroad, 2017*	*1,674,784*
	Passenger energy use	(trillion Btu)
Table 10.2	*Domestic and international air carrier, 2018*	*2,530.9*
Table 10.3	*General aviation, 2017*	*232.2*
Table 10.6	*Recreational boats, 2016*	*246.8*
Table 10.10	*Amtrak, 2017*	*10.0*
	Freight energy use	(trillion Btus)
Table 10.8	*Class I railroad, 2017*	*490.5*

Nonhighway transportation modes accounted for 17.9% of total transportation energy use in 2017.

Table 10.1
Nonhighway Energy Use Shares, 1970–2017

	Share of transportation energy use					
Year	Air	Water	Pipeline	Rail	Nonhighway total	Transportation total (trillion Btu) [a]
1970	8.5%	5.5%	5.4%	3.5%	22.9%	15,192
1975	7.2%	5.4%	4.0%	3.1%	19.7%	17,204
1976	7.0%	5.9%	3.5%	3.1%	19.6%	18,266
1977	7.1%	6.2%	3.3%	3.0%	19.7%	18,951
1978	7.1%	6.9%	3.1%	2.9%	20.1%	19,922
1979	7.6%	5.9%	3.6%	3.0%	20.2%	19,473
1980	7.6%	7.4%	3.9%	3.0%	22.0%	18,760
1981	7.8%	6.8%	4.0%	2.9%	21.6%	18,558
1982	8.0%	5.9%	3.8%	2.5%	20.3%	18,055
1983	7.9%	5.4%	3.2%	2.5%	19.0%	18,188
1984	8.6%	5.1%	3.3%	2.7%	19.7%	18,773
1985	8.8%	4.6%	3.1%	2.5%	19.0%	19,017
1986	9.1%	6.6%	2.9%	2.3%	20.8%	20,086
1987	9.2%	6.7%	3.0%	2.3%	21.2%	20,578
1988	9.4%	6.7%	3.4%	2.3%	21.7%	21,131
1989	9.2%	7.1%	3.4%	2.2%	21.9%	21,487
1990	9.6%	6.7%	3.6%	2.2%	22.1%	21,383
1991	9.1%	7.3%	3.3%	2.1%	21.8%	20,985
1992	9.0%	7.4%	3.2%	2.1%	21.6%	21,646
1993	9.0%	6.5%	3.3%	2.1%	20.9%	22,125
1994	9.1%	6.1%	3.5%	2.2%	20.9%	22,729
1995	9.2%	6.3%	3.5%	2.2%	21.2%	23,263
1996	9.3%	5.9%	3.4%	2.3%	20.9%	23,773
1997	9.5%	5.2%	3.5%	2.2%	20.5%	24,126
1998	9.3%	5.0%	3.0%	2.2%	19.5%	24,461
1999	9.6%	5.3%	2.9%	2.2%	20.0%	25,760
2000	9.8%	5.6%	2.8%	2.1%	20.4%	26,071
2001	9.3%	4.6%	2.8%	2.2%	18.9%	25,741
2002	8.5%	4.7%	2.9%	2.1%	18.3%	26,329
2003	8.5%	4.0%	2.6%	2.2%	17.3%	26,509
2004	9.1%	4.8%	2.5%	2.3%	18.6%	26,965
2005	9.3%	5.0%	2.5%	2.2%	19.0%	27,373
2006	9.1%	5.2%	2.5%	2.3%	19.1%	27,546
2007	8.7%	5.3%	2.5%	2.1%	18.6%	29,004
2008	8.4%	5.1%	2.6%	2.1%	18.2%	28,365
2009	7.9%	4.9%	2.9%	1.8%	17.5%	26,878
2010	8.0%	5.4%	2.9%	2.0%	18.2%	26,949
2011	8.2%	5.2%	3.0%	2.1%	18.5%	26,357
2012	8.0%	4.4%	3.2%	2.1%	17.8%	25,966
2013	7.9%	3.9%	3.6%	2.2%	17.6%	25,868
2014	7.9%	3.4%	3.1%	2.3%	16.7%	25,949
2015	8.1%	3.9%	3.0%	2.2%	17.1%	26,084
2016	8.2%	4.2%	3.0%	2.0%	17.4%	26,485
2017	8.4%	4.3%	3.1%	2.0%	17.8%	26,592

Source:
See Appendix A, Section 2.3. Nonhighway Energy Use.

[a] Only end-use energy was counted for electricity. Before Edition 36, primary energy use (which included generation and distribution losses) was shown in this table. See Appendix C for this table with electricity generation and distribution losses included.

These data include ALL international and domestic certificated route air carrier statistics; therefore, the data are different than those in Chapter 2. Revenue aircraft-miles, passenger-miles, and seat-miles began to rise in 2010 and have continued to rise. Passenger load factor was 83.3% in 2018.

Table 10.2
Summary Statistics for U.S. Domestic and International Certificated Route Air Carriers (Combined Totals), 1970–2018[a]

Year	Revenue aircraft-miles (millions)	Revenue passenger-miles (millions)	Available seat-miles (millions)	Available seats per aircraft[b]	Passenger load factor (percentage)[c]	Revenue cargo ton-miles (millions)	Energy use (trillion Btu)[d]
1970	2,542	148,137	264,904	104	55.9%	3,755	1,363.4
1975	2,241	173,324	315,823	141	54.9%	5,062	1,283.4
1980	2,924	267,722	448,479	153	59.7%	7,885	1,386.0
1985	3,462	351,073	565,677	163	62.1%	9,048	1,701.4
1990	4,724	472,236	753,211	159	62.7%	16,403	2,180.2
1995	5,627	558,794	832,081	148	67.2%	23,375	2,338.6
1996	5,855	596,164	859,721	147	69.3%	24,892	2,409.1
1997	6,025	620,029	880,715	146	70.4%	27,610	2,513.6
1998	6,220	634,933	899,029	145	70.6%	28,015	2,459.5
1999	6,558	668,626	942,311	144	71.0%	25,147	2,665.0
2000	6,946	708,926	981,080	141	72.3%	30,221	2,750.4
2001	6,814	664,849	950,519	139	69.9%	27,882	2,592.5
2002	6,834	655,215	913,898	134	71.7%	30,507	2,430.1
2003	7,367	674,160	922,440	125	73.1%	32,446	2,470.6
2004	7,479	752,341	1,000,193	134	75.2%	37,958	2,657.2
2005	7,716	795,117	1,029,316	133	77.2%	39,286	2,693.3
2006	8,220	810,086	1,027,526	125	78.8%	38,251	2,661.1
2007	8,415	842,007	1,060,093	126	79.4%	38,433	2,684.6
2008	8,142	823,783	1,040,840	128	79.1%	35,227	2,547.8
2009	7,534	779,997	975,307	129	80.0%	30,317	2,303.2
2010	7,666	809,051	991,934	129	81.6%	35,209	2,335.3
2011	7,783	825,916	1,012,597	130	81.6%	35,713	2,370.3
2012	7,727	832,733	1,012,261	131	82.3%	34,937	2,287.7
2013	7,725	848,000	1,025,616	133	82.7%	33,561	2,271.3
2014	7,740	869,688	1,048,107	135	83.0%	34,471	2,265.3
2015	7,877	908,795	1,090,185	138	83.4%	35,011	2,342.1
2016	8,077	939,240	1,131,983	140	83.0%	35,920	2,385.2
2017	8,223	969,904	1,168,055	142	83.0%	39,867	2,433.9
2018	8,545	1,016,997	1,220,539	143	83.3%	42,629	2,530.9
			Average annual percentage change				
1970–2018	2.6%	4.1%	3.2%	0.7%	0.8%	5.2%	1.3%
2008–2018	0.5%	2.1%	1.6%	1.1%	0.5%	1.9%	-0.1%

Sources:

U.S. Department of Transportation, Bureau of Transportation Statistics, www.transtats.bts.gov. (Additional resources: www.bts.gov)

1970–76 Energy Use – Department of Transportation, Civil Aeronautics Board, *Fuel Cost and Consumption*, Washington, DC, 1981, and annual.

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[a] Data are for all U.S. air carriers reporting on Form 41.

[b] Available seats per aircraft is calculated as the ratio of available seat-miles to revenue aircraft-miles.

[c] Passenger load factor is calculated as the ratio of revenue passenger-miles to available seat-miles for scheduled and nonscheduled services.

[d] Energy use includes fuel purchased abroad for international flights.

General aviation includes: (1) aircraft operating under general operating and flight rules; (2) not-for-hire airplanes with a seating capacity of 20 or more or a maximum payload capacity of 6,000 lbs. or more; (3) rotorcraft external load operations; (4) on-demand and commuter operations not covered under Federal Aviation Regulations Part 121; and (5) agricultural aircraft operations.

Table 10.3
Summary Statistics for General Aviation, 1970–2017

Calendar year	Total number of aircraft	Aircraft hours flown (thousands)	Energy use (trillion Btu)
1970	131,700[a]	26,030[b]	94.3
1975	168,475	30,298	110.7
1980	211,045	41,016	165.9
1985	196,500	31,456	143.9
1986	205,300	31,782	147.9
1987	202,700	30,883	139.1
1988	196,200	31,114	148.5
1989	205,000	32,332	134.1
1990	198,000	32,096	131.8
1991	196,874	29,862	120.0
1992	185,650	26,747	103.7
1993	177,120	24,455	93.6
1994	172,935	24,092	95.3
1995	188,089	26,612	106.6
1996	191,129	26,909	111.0
1997	192,414	27,713	121.1
1998	204,710	28,100	147.4
1999	219,464	31,231	172.1
2000	217,533	29,960	175.2
2001	211,446	27,017	165.1
2002	211,244	27,040	141.5
2003	209,708	27,329	141.4
2004	219,426	28,126	175.9
2005	224,352	26,982	242.4
2006	221,943	27,705	256.3
2007	231,607	27,852	243.6
2008	228,663	26,009	265.7
2009	223,877	23,763	210.3
2010	223,370	24,802	221.2
2011	220,770	24,570	227.1
2012	209,034	24,403	228.8
2013	199,927	22,876	203.6
2014	204,408	23,271	221.0
2015	210,030	24,142	208.9
2016	211,793	24,833	217.8
2017	211,757	25,212	232.2
	Average annual percentage change		
1970–2017	1.0%	-0.1%	1.9%
2007–2017	-0.9%	-1.0%	-0.5%

Sources:
U.S. Department of Transportation, Federal Aviation Administration, *General Aviation and Part 135 Activity Surveys, CY 2017*, Tables 1.1, 1.4, 5.1, and annual. 2011 Data: *Aviation Forecasts*, Tables 28 and 29, May 2013. (Additional resources: www.faa.gov/data-research/aviation_data_statistics/general_aviation)

[a] Active fixed-wing general aviation aircraft only.
[b] Includes rotorcraft.

In the early seventies, domestic waterborne commerce accounted for over 60% of total tonnage on United States waterways, but by 1994 foreign tonnage grew to more than half of all waterborne tonnage. Total foreign and domestic tons shipped were about 2.39 billion tons in 2017, down from a peak of 2.59 billion tons in 2006.

Table 10.4
Tonnage Statistics for Domestic and International Waterborne Commerce, 1970–2017
(million tons shipped)

Year	Foreign and domestic total	Foreign total[a]	Domestic total[b]	Percent domestic of total
1970	1,532	581	951	62.1%
1975	1,695	749	946	55.8%
1980	1,999	921	1,077	53.9%
1985	1,788	774	1,014	56.7%
1990	2,164	1,042	1,122	51.8%
1991	2,092	1,014	1,079	51.6%
1992	2,132	1,037	1,095	51.4%
1993	2,128	1,060	1,068	50.2%
1994	2,215	1,116	1,099	49.6%
1995	2,240	1,147	1,093	48.8%
1996	2,284	1,183	1,101	48.2%
1997	2,333	1,221	1,113	47.7%
1998	2,340	1,245	1,094	46.8%
1999	2,323	1,261	1,062	45.7%
2000	2,425	1,355	1,070	44.1%
2001	2,393	1,351	1,042	43.5%
2002	2,340	1,319	1,021	43.6%
2003	2,394	1,378	1,016	42.4%
2004	2,552	1,505	1,050	41.0%
2005	2,527	1,499	1,029	40.7%
2006	2,588	1,565	1,028	39.5%
2007	2,564	1,543	1,022	39.9%
2008	2,477	1,521	956	38.6%
2009	2,211	1,354	858	38.8%
2010	2,335	1,441	894	38.3%
2011	2,368	1,480	892	37.5%
2012	2,307	1,422	890	38.4%
2013	2,274	1,383	891	39.2%
2014	2,346	1,409	937	39.9%
2015	2,279	1,374	905	39.7%
2016	2,292	1,415	877	38.3%
2017	2,385	1,512	873	36.6%
		Average annual percentage change		
1970–2017	0.9%	2.1%	-0.2%	
2007–2017	-0.7%	-0.2%	-1.6%	

Source:
1970-2016—U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 2016, Part 5—National Summaries*, 2017, Table 1-1. (Additional resources: www.navigationdatacenter.us/index.htm)
2017—U.S. Department of the Army, Corps of Engineers, The U.S. Waterway System, 2017 Transportation Facts and Information, New Orleans, LA, 2019.

[a] All movements between the United States and foreign countries and between Puerto Rico and the Virgin Islands and foreign countries are classified as foreign trade.

[b] All movements between U.S. ports, continental and noncontiguous, and on the inland rivers, canals, and connecting channels of the United States, Puerto Rico, and the Virgin Islands, excluding the Panama Canal. Beginning in 1996, fish was excluded for internal and intra-port domestic traffic.

The U.S. Army Corps of Engineers Navigation Data Center collects a wealth of waterborne commerce data. Energy use data, however, have never been collected as part of this effort. The average length of haul in domestic waterborne commerce was 560 miles in 2017.

Table 10.5
Summary Statistics for Domestic Waterborne Commerce, 1970–2017

Year	Number of vessels[a]	Ton-miles (billions)	Tons shipped[b] (millions)	Average length of haul (miles)
1970	25,832	596	949	628.2
1975	31,666	566	944	599.9
1980	38,792	922	1,074	856.4
1985	41,672	893	1,011	883.5
1990	41,119	834	1,118	745.7
1995	36,860	808	1,086	743.6
1996	37,945	765	1,093	699.4
1997	41,419	707	1,106	639.5
1998	42,032	673	1,087	618.9
1999	41,766	656	1,056	621.1
2000	40,665	646	1,064	606.8
2001	41,003	622	1,037	599.7
2002	41,002	612	1,016	602.5
2003	39,983	606	1,010	600.3
2004	40,290	621	1,045	596.7
2005	41,354	591	1,025	577.3
2006	40,104	563	1,022	551.3
2007	40,695	553	1,016	544.2
2008	40,301	521	952	546.7
2009	40,109	477	853	559.7
2010	39,883	502	889	565.0
2011	40,545	500	888	562.4
2012	40,530	475	888	535.0
2013	39,999	465	890	522.6
2014	40,381	505	936	539.1
2015	40,791	491	903	543.2
2016	42,674	478	875	546.1
2017	42,539	489	873	560.1
		Average annual percentage change		
1970–2017	1.1%	-0.4%	-0.2%	-0.2%
2007–2017	0.4%	-1.2%	-1.5%	0.3%

Sources:

Number of vessels 1970–92, 1995–2017 – U.S. Department of the Army, Corps of Engineers, *Waterborne Transportation Lines of the United States, 2017,* New Orleans, LA, 2018, Table 2 and annual. 1993–94 – U.S. Department of the Army, Corps of Engineers, *The U.S. Waterway System-Facts*, Navigation Data Center, New Orleans, Louisiana, January 1996.

Ton-miles, tons shipped, average length of haul. 1970-2016 – U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 2016, Part 5: National Summaries*, New Orleans, LA, 2017, Table 1-4 and annual. 2017 – U.S. Department of the Army, Corps of Engineers, The U.S. Waterway System, 2017 Transportation Facts and Information, New Orleans, LA, 2019. (Additional resources: www.navigationdatacenter.us/index.htm)

[a] Grand total for self-propelled and non-self-propelled.

[b] These figures are not consistent with the figures on Table 10.4 because intra-territory tons are not included in this table. Intra-territory traffic is traffic between ports in Puerto Rico and the Virgin Islands.

The data displayed in this table come from 1970 to 1998 are from the Environmental Protection Agency's MOVES2014a model. From 1999-on, the data are from the updated MOVES2014b model.

Table 10.6
Recreational Boat Energy Use, 1970–2017

Year	Number of boats (thousands)	Diesel fuel (trillion Btu)	Gasoline (trillion Btu)	Total energy use (trillion Btu)
1970	10,087	5.5	151.7	157.2
1975	10,337	10.7	156.4	167.1
1976	10,387	11.8	157.4	169.1
1977	10,437	12.8	158.3	171.1
1978	10,487	13.9	159.3	173.1
1979	10,537	14.9	160.2	175.1
1980	10,587	16.0	161.2	177.1
1981	10,637	17.0	162.1	179.1
1982	10,687	18.0	163.1	181.1
1983	10,737	19.1	164.0	183.1
1984	10,787	20.1	165.0	185.1
1985	10,837	21.2	165.9	187.1
1986	10,887	22.2	166.9	189.1
1987	10,937	23.3	167.8	191.1
1988	11,030	24.3	170.4	194.7
1989	11,122	25.4	172.9	198.3
1990	11,215	26.4	175.4	201.8
1991	11,327	27.5	178.7	206.2
1992	11,440	28.5	182.0	210.5
1993	11,553	29.5	185.3	214.8
1994	11,770	30.6	192.5	223.1
1995	11,988	31.6	199.7	231.3
1996	12,206	32.7	206.8	239.5
1997	12,244	33.7	207.2	240.9
1998	12,283	34.8	207.4	242.2
1999	12,358	38.0	207.6	245.6
2000	12,405	38.0	207.3	245.3
2001	12,465	38.1	207.1	245.2
2002	12,513	38.2	206.1	244.3
2003	12,573	38.3	204.9	243.2
2004	12,584	38.3	202.6	240.9
2005	12,777	38.7	202.7	241.5
2006	12,704	38.5	199.1	237.6
2007	12,776	38.7	197.6	236.3
2008	12,547	38.0	191.9	229.9
2009	12,583	38.1	190.0	228.1
2010	12,293	37.2	183.4	220.6
2011	12,064	36.6	177.7	214.2
2012	11,967	36.2	173.9	210.2
2013	11,907	36.0	171.0	207.0
2014	11,810	35.8	167.7	203.5
2015	11,978	37.6	168.0	205.6
2016	12,202	39.0	169.3	208.3
2017	12,397	39.9	170.4	210.3
		Average annual percentage change		
1970–2017	0.4%	4.3%	0.2%	0.6%
2007–2017	-0.3%	0.3%	-1.5%	-1.2%

Source:
1970-1998: U.S. Environmental Protection Agency, MOVES2014a model, www3.epa.gov/otaq/models/moves.
1999-on: U.S. Environmental Protection Agency, MOVES2014b model, www3.epa.gov/otaq/models/moves.

The Interstate Commerce Commission designates Class I railroads on the basis of annual gross revenues. In 2017, seven railroads were given this designation. The number of railroads designated as Class I has changed considerably in the last 30 years; in 1976 there were 52 railroads given Class I designation.

Table 10.7
Class I Railroad Freight Systems in the United States
Ranked by Revenue Ton-Miles, 2017

Railroad	Revenue ton-miles (billions)	Percent
Burlington Northern and Santa Fe Railway Company	666	39.8%
Union Pacific Railroad Company	467	27.9%
CSX Transportation	208	12.4%
Norfolk Southern Railway	201	12.0%
Canadian National, Grand Trunk Corporation	63	3.8%
Canadian Pacific Soo Railway	35	2.1%
Kansas City Southern Railway Company	35	2.1%
Total	**1,675**	**100.0%**

Source:
Association of American Railroads, *Railroad Facts*, *2018 Edition*, Washington, DC, November 2018, p. 64. (Additional resources: www.aar.org)

Revenue ton-miles for Class I freight railroads was over 1.6 trillion in 2017. Though there are many regional and local freight railroads, the Class I freight railroads accounted for 94% of the railroad industry's freight revenue in 2017 and 68% of the industry's mileage operated. The energy intensity of Class I railroads hit an all-time low of 289 Btu/ton-mile in 2010 and continued to be below 300 Btu/ton-mile in 2017.

Table 10.8
Summary Statistics for Class I Freight Railroads, 1970–2017

Year	Number of locomotives in service[a]	Number of freight cars (thousands)[b]	Train-miles (millions)	Car-miles (millions)	Tons originated[c] (millions)	Average length of haul (miles)	Revenue ton-miles (millions)	Energy intensity (Btu/ton-mile)	Energy use (trillion Btu)
1970	27,077[d]	1,424	427	29,890	1,485	515	764,809	691	528.1
1975	27,846	1,359	403	27,656	1,395	541	754,252	687	518.3
1980	28,094	1,168	428	29,277	1,492	616	918,958	597	548.7
1985	22,548	867	347	24,920	1,320	665	876,984	497	436.1
1986	20,790	799	347	24,414	1,306	664	867,722	486	421.5
1987	19,647	749	361	25,627	1,372	688	943,747	456	430.3
1988	19,364	725	379	26,339	1,430	697	996,182	443	441.4
1989	19,015	682	383	26,196	1,403	723	1,013,841	437	442.6
1990	18,835	659	380	26,159	1,425	726	1,033,969	420	434.7
1991	18,344	633	375	25,628	1,383	751	1,038,875	391	405.8
1992	18,004	605	390	26,128	1,399	763	1,066,781	393	419.2
1993	18,161	587	405	26,883	1,397	794	1,109,309	389	431.6
1994	18,505	591	441	28,485	1,470	817	1,200,701	388	465.4
1995	18,812	583	458	30,383	1,550	843	1,305,688	372	485.9
1996	19,269	571	469	31,715	1,611	842	1,355,975	368	499.4
1997	19,684	568	475	31,660	1,585	851	1,348,926	370	499.7
1998	20,261	576	475	32,657	1,649	835	1,376,802	365	502.0
1999	20,256	579	490	33,851	1,717	835	1,433,461	363	520.0
2000	20,028	560	504	34,590	1,738	843	1,465,960	352	516.0
2001	19,745	500	500	34,243	1,742	859	1,495,472	346	517.3
2002	20,506	478	500	34,680	1,767	853	1,507,011	345	520.3
2003	20,774	467	516	35,555	1,799	862	1,551,438	344	533.9
2004	22,015	474	535	37,071	1,844	902	1,662,598	341	566.2
2005	22,779	475	548	37,712	1,899	894	1,696,425	337	571.4
2006	23,732	475	563	38,995	1,957	906	1,771,897	330	584.5
2007	24,143	460	543	38,186	1,940	913	1,770,545	320	566.9
2008	24,003	450	524	37,226	1,934	919	1,777,236	305	542.5
2009	24,045	416	436	32,115	1,668	919	1,532,214	291	446.6
2010	23,893	398	476	35,541	1,851	914	1,691,004	289	488.1
2011	24,250	381	493	36,649	1,885	917	1,729,256	298	514.6
2012	24,707	381	500	36,525	1,760	973	1,712,567	294	504.0
2013	25,033	374	504	35,253	1,758	990	1,740,687	296	514.9
2014	25,916	372	518	37,193	1,840	1,006	1,851,229	292	540.5
2015	26,574	331	495	35,853	1,740	1,020	1,738,283	297	516.4
2016	26,716	315	453	32,572	1,554	1,021	1,585,440	299	474.2
2017	26,547	306	465	34,065	1,622	1,033	1,674,784	293	490.5
				Average annual percentage change					
1970–2017	0.0%	-3.2%	0.2%	0.3%	0.2%	1.5%	1.7%	-1.8%	-0.2%
2007–2017	1.0%	-4.0%	-1.5%	-1.1%	-1.8%	1.2%	-0.6%	-0.9%	-1.4%

Source:

Association of American Railroads, *Railroad Facts*, *2018 Edition*, Washington, DC, November 2018, pp. 30, 31, 36, 37, 39, 50, and 65. (Additional resources: www.aar.org)

[a] Does not include self-powered units.

[b] Does not include private or shipper-owned cars. Beginning in 2001, Canadian-owned U.S. railroads are excluded.

[c] Tons originated is a more accurate representation of total tonnage than revenue tons. Revenue tons often produces double-counting of loads switched between rail companies.

[d] Data represent total locomotives used in freight and passenger service. Separate estimates are not available.

According to the 2012 Commodity Flow Survey, 7% of all freight ton-miles are rail intermodal shipments (truck/rail or rail/water). See Table 5.16 for details. Containerization has increased in the last two decades, evidenced by the 455% increase in the number of containers from 1988 to 2017. The number of trailers moved by rail fell to an all-time low in 2016 but rose in 2017.

Table 10.9
Intermodal Rail Traffic, 1965–2017[a]

Year	Trailers & containers	Trailers	Containers
1965	1,664,929	[b]	[b]
1970	2,363,200	[b]	[b]
1975	2,238,117	[b]	[b]
1980	3,059,402	[b]	[b]
1985	4,590,952	[b]	[b]
1986	4,997,229	[b]	[b]
1987	5,503,819	[b]	[b]
1988	5,779,547	3,481,020	2,298,527
1989	5,987,355	3,496,262	2,491,093
1990	6,206,782	3,451,953	2,754,829
1991	6,246,134	3,201,560	3,044,574
1992	6,627,841	3,264,597	3,363,244
1993	7,156,628	3,464,126	3,692,502
1994	8,128,228	3,752,502	4,375,726
1995	7,936,172	3,492,463	4,443,709
1996	8,143,258	3,302,128	4,841,130
1997	8,698,308	3,453,907	5,244,401
1998	8,772,663	3,353,032	5,419,631
1999	8,907,626	3,207,407	5,700,219
2000	9,176,890	2,888,630	6,288,260
2001	8,935,444	2,603,423	6,332,021
2002	9,312,360	2,531,338	6,781,022
2003	9,955,605	2,625,837	7,329,768
2004	10,993,662	2,928,123	8,065,539
2005	11,693,512	2,979,906	8,713,606
2006	12,282,221	2,882,699	9,399,522
2007	12,026,631	2,600,635	9,425,996
2008	11,499,978	2,478,890	9,021,088
2009	9,875,967	1,639,603	8,236,364
2010	11,283,151	1,684,684	9,598,467
2011	11,892,418	1,698,615	10,193,803
2012	12,267,416	1,518,323	10,749,093
2013	12,831,311	1,483,938	11,347,373
2014	13,496,876	1,530,759	11,965,117
2015	13,710,662	1,467,913	12,242,749
2016	13,490,713	1,170,305	12,320,408
2017	14,011,834	1,258,932	12,752,902
	Average annual percentage change		
1965–2017	4.2%	[b]	[b]
2007–2017	1.5%	-7.0%	3.1%

Source:
Association of American Railroads, *Railroad Facts*, *2018 Edition*, Washington, DC, November 2018, p. 29. (Additional resources: www.aar.org)

[a] Beginning in 1995, the Grand Trunk Western Railroad and the Soo Line Railroad Company are excluded. Beginning in 1999, the Illinois Central data are excluded. Beginning in 2002, the Wisconsin Central data are excluded.
[b] Data are not available.

The National Railroad Passenger Corporation, known as Amtrak, began operation in 1971. Amtrak revenue passenger-miles have grown at an average annual rate of 2.6% from 1971 to 2017.

Table 10.10
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971–2017

Year	Number of locomotives in service	Number of passenger cars	Train-miles (thousands)	Car-miles (thousands)	Revenue passenger-miles (millions)	Average trip length (miles)	Energy intensity (Btu per revenue passenger-mile)	Energy use (trillion Btu) [a]
1971	[b]	1,165	16,537	140,147	1,993	188	[b]	[b]
1975	355	1,913	30,166	253,898	3,753	224	3,311	12.4
1980	448	2,128	29,487	235,235	4,503	217	2,859	12.9
1985	382	1,818	30,038	250,642	4,785	238	2,237	10.7
1990	318	1,863	33,000	300,996	6,057	273	2,052	12.4
1991	316	1,786	34,000	312,484	6,273	285	2,011	12.6
1992	336	1,796	34,000	307,282	6,091	286	2,117	12.9
1993	360	1,853	34,936	302,739	6,199	280	2,142	13.3 [c]
1994	411	1,874	34,940	305,600	5,869	276	1,917	11.3
1995	422	1,907	31,579	282,579	5,401	266	2,071	11.2
1996	348	1,501	30,542	277,750	5,066	257	2,194	11.1
1997	292	1,572	32,000	287,760	5,166	255	2,289	11.8
1998	362	1,347	32,926	315,823	5,325	251	2,246	12.0
1999	385	1,285	34,080	349,337	5,289	245	2,362	12.5
2000	385	1,891	35,404	371,215	5,574	243	2,651	14.8
2001	401	2,084	36,512	377,705	5,571	238	2,690	15.0
2002	372	2,896	37,624	378,542	5,314	228	2,537	13.5
2003	442	1,623	37,459	331,864	5,680	231	2,145	12.2
2004	276	1,211	37,159	308,437	5,511	219	2,068	11.4
2005	258	1,186	36,199	264,796	5,381	215	2,025	10.9
2006	319	1,191	36,083	263,908	5,410	220	1,948	10.5
2007	270	1,164	37,484	266,545	5,784	218	1,824	10.5
2008	278	1,177	37,736	271,762	6,179	215	1,745	10.8
2009	274	1,214	38,300	282,764	5,914	217	1,773	10.5
2010	282	1,274	37,453	294,820	6,420	220	1,668	10.7
2011	287	1,301	37,090	296,315	6,670	213	1,628	10.7
2012	485	2,090	37,640	319,088	6,804	218	1,561	10.6
2013	418	1,447	38,410	324,949	6,810	218	1,608	11.0
2014	428	1,419	38,013	324,683	6,675	218	1,629	10.9
2015	423	1,428	37,798	319,464	6,536	218	1,589	10.4
2016	434	1,402	37,808	316,384	6,520	208	1,551	10.1
2017	419	1,405	37,859	316,148	6,563	205	1,524	10.0
			Average annual percentage change					
1971–2017	[b]	0.4%	1.8%	1.8%	2.6%	0.2%	[b]	[b]
2007–2017	4.5%	1.9%	0.1%	1.7%	1.3%	-0.6%	-1.8%	-0.5%

Sources:

1971–83 – Association of American Railroads, Economics and Finance Department, *Statistics of Class I Railroads*, Washington, DC, and annual.

1984–88 – Association of American Railroads, *Railroad Facts*, 1988 Edition, Washington, DC, December 1989, p. 61, and annual.

1989–93 – Personal communication with the Corporate Accounting Office of Amtrak, Washington, DC.

1994–2017 – Number of locomotives in service, number of passenger cars, train-miles, car-miles, revenue passenger-miles, and average trip length - Association of American Railroads, *Railroad Facts*, *2018 Edition*, Washington, DC, 2018, p. 73.

Energy use – Personal communication with the Amtrak, Washington, DC. (Additional resources: www.amtrak.com, www.aar.org)

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[a] Only end-use energy was counted for electricity. Previous editions included primary energy use for electricity which included generation and distribution losses.

[b] Data are not available.

[c] Energy use for 1994 on is not directly comparable to earlier years. Some commuter rail energy use may have been inadvertently included in earlier years.

Chapter 11
Transportation and the Economy

Summary Statistics from Tables/Figures in this Chapter

Source		
Table 11.1	Average household transportation expenditures, 2017	15.9%
Figure 11.2	Share of gasoline cost attributed to taxes, 2017	
	Canada	*34%*
	France	*64%*
	Germany	*64%*
	Japan	*48%*
	Korea	*58%*
	United Kingdom	*65%*
	United States	*22%*
Table 11.13	Average price of a new car, 2018 (current dollars)	25,259
	Domestic	*23,498*
	Import	*31,106*
Table 11.14	Average price of a new light truck, 2018 (current dollars)	37,138
	Domestic	*38,459*
	Import	*32,740*
Table 11.15	Car operating costs, 2017	
	Variable costs (constant 2017 dollars per 10,000 miles)	*1,559*
	Fixed costs (constant 2017 dollars per 10,000 miles)	*4,965*
Table 11.19	Transportation sector share of total employment	
	1990	*10.6%*
	2000	*9.8%*
	2018	*8.7%*

Adjusting Dollar Amounts for Inflation

A dollar spent in 1970 does not have the purchasing power of a dollar spent in 2016 due to the inflation of prices for all goods and services. Thus, prices in a historical series must be adjusted in order to provide proper comparison. The term “current dollars” is used in this report for dollar amounts that were current as of the year listed – this can also be referred to as “nominal dollars.” The term “constant 2016 dollars” is used in this report for dollar amounts that have been adjusted to a constant purchasing power (2016, in this example) and thus the data are comparable historically – this can also be referred to as “real dollars.”

Appendix B, Table B.17 contains the Consumer Price Inflation Index and Table B.18 contains the Gross National Product Implicit Price Deflator for years 1970 to 2016. Tables in the report with constant dollars have a footnote indicating which of these inflation adjustment indices were used.

The Transportation Services Index (TSI) was created by the U.S. Department of Transportation Bureau of Transportation Statistics (BTS). It is an index that measures the movement of freight and passengers.

The Freight TSI consists of:

- *for-hire trucking (parcel services are not included);*
- *freight railroad services (including rail-based intermodal shipments such as containers on flat cars);*
- *inland waterway traffic;*
- *pipeline movements (including principally petroleum and petroleum products and natural gas); and*
- *air freight.*

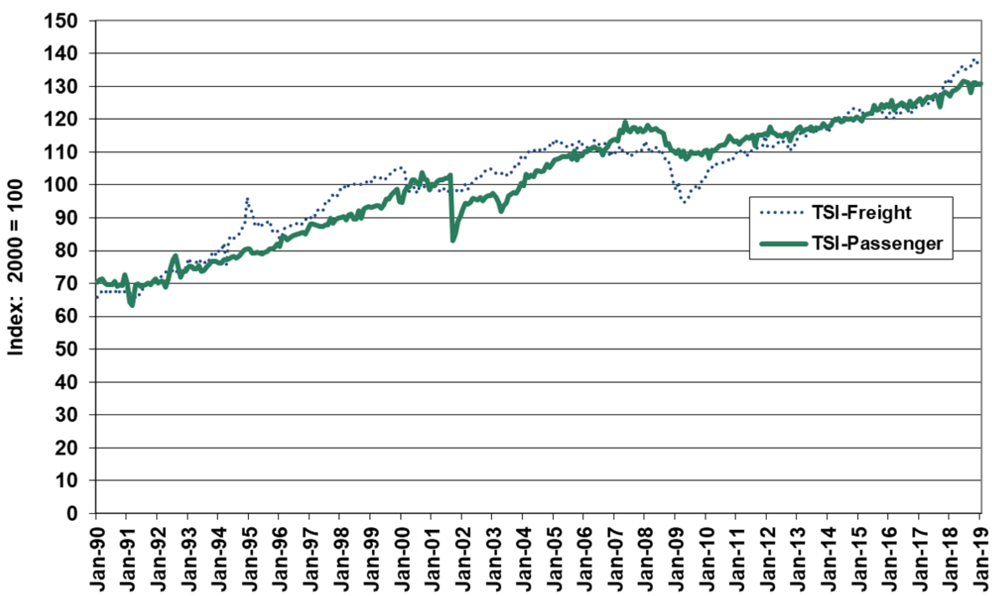
The index does not include international or coastal steamship movements, private trucking, courier services, or the United States Postal Services.

The Passenger TSI consists of:

- *local mass transit;*
- *intercity passenger rail; and*
- *passenger air transportation.*

The index does not include intercity bus, sightseeing services, taxi service, private car usage, or bicycling and other nonmotorized means of transportation.

Figure 11.1. Transportation Services Index, January 1990–January 2019



Source:

U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index website, www.transtats.bts.gov/OSEA/TSI/. (Additional resources: www.bts.gov)

Table 11.1
Average Annual Expenditures of Households by Income, 2017[a]

	All households	Income before taxes: Less than $15,000	$15,000–$29,999	$30,000–$39,999	$40,000–$49,999
Total expenditures	$60,060	$24,607	$33,300	$41,550	$46,258
		Percentage of total expenditures[b]			
Food[c]	13.8%	16.7%	15.0%	14.8%	15.1%
Housing	33.1%	39.8%	38.5%	35.1%	35.1%
Apparel and services	3.1%	3.6%	3.0%	3.2%	2.9%
Transportation	15.9%	13.8%	14.8%	17.3%	16.3%
Vehicle purchases (net outlay)	**6.7%**	**4.8%**	**5.9%**	**7.5%**	**5.6%**
Gasoline and motor oil	**3.3%**	**3.5%**	**3.7%**	**4.0%**	**3.9%**
Other vehicle expenditures	**4.7%**	**4.5%**	**4.4%**	**5.0%**	**5.8%**
Public transportation	**1.2%**	**1.0%**	**0.9%**	**0.9%**	**0.9%**
Health care	8.2%	8.9%	10.1%	10.2%	9.9%
Entertainment	5.3%	5.1%	4.7%	4.7%	4.6%
Personal Insurance & pensions	11.3%	2.2%	4.9%	6.6%	7.4%
Others[d]	9.4%	10.1%	9.0%	8.1%	8.8%
Households[e] (thousands)	130,001	16,887	22,385	13,039	10,655
Percentage of households	100.0%	13.0%	17.2%	10.0%	8.2%
Average number of vehicles in HH	1.9	0.9	1.3	1.7	1.8

	Income before taxes: $50,000–$69,999	$70,000–$99,999	$100,000–$149,999	$150,000–$199,999	$200,000 and over
Total expenditures	$54,216	$66,116	$86,170	$115,404	$161,247
	Percentage of total expenditures[b]				
Food[c]	14.6%	13.7%	13.7%	11.4%	11.2%
Housing	34.0%	33.2%	31.0%	30.8%	29.4%
Apparel and services	2.6%	3.0%	3.2%	3.0%	3.0%
Transportation	17.6%	16.3%	16.3%	16.3%	14.5%
Vehicle purchases (net outlay)	**7.8%**	**6.5%**	**7.4%**	**6.7%**	**7.0%**
Gasoline and motor oil	**3.8%**	**3.8%**	**3.3%**	**2.6%**	**2.0%**
Other vehicle expenditures	**5.1%**	**4.9%**	**4.4%**	**5.5%**	**3.8%**
Public transportation	**1.0%**	**1.1%**	**1.2%**	**1.5%**	**1.8%**
Health care	8.7%	8.5%	7.9%	6.4%	6.0%
Entertainment	5.1%	5.2%	5.4%	6.2%	5.9%
Personal Insurance & pensions	9.4%	12.2%	14.1%	16.0%	16.5%
Others[d]	7.9%	8.0%	8.4%	10.0%	13.5%
Households[e] (thousands)	17,068	19,324	16,501	6,947	7,195
Percentage of households	13.1%	14.9%	12.7%	5.3%	5.5%
Average number of vehicles in HH	2.0	2.3	2.6	2.8	2.9

Source:
U.S. Department of Labor, Bureau of Labor Statistics, website: www.bls.gov/cex, 2019. (Additional resources: www.bls.gov)

[a] Public assistance monies are included in reported income. Data for those reporting incomes.
[b] Percentages may not sum to totals due to rounding.
[c] Includes alcoholic beverages.
[d] Includes personal care, reading, education, tobacco and smoking supplies, cash contributions, and miscellaneous items.
[e] The term household refers to a "consumer unit," which is defined differently than households on Table 8.1.

The average amount of money that a household spends in a year has grown about 10% between 1985 and 2017 in constant dollar terms. Expenditures on transportation were 19.4% of the total in 1985 but were only 15.9% in 2017. Vehicle purchases made up about 42% of transportation expenditures in 2017, while gas and oil were 21%.

Table 11.2
Annual Household Expenditures for Transportation, 1985-2017
(constant 2017 dollars[a])

	Transportation expenditures					Average annual household expenditures	Transportation share of annual expenditures
Year	Vehicle purchases	Gas & Oil	Other vehicle expenses[b]	Public transportation	Total transportation		
1985	4,700	2,383	2,907	604	10,591	54,619	19.4%
1986	5,229	2,064	3,073	559	10,925	54,658	20.0%
1987	4,350	1,901	3,088	559	9,900	53,460	18.5%
1988	4,948	1,935	3,218	551	10,650	54,679	19.5%
1989	4,641	1,951	3,289	550	10,431	55,988	18.6%
1990	4,072	1,977	3,128	568	9,745	54,504	17.9%
1991	3,877	1,796	3,196	554	9,421	54,868	17.2%
1992	3,786	1,700	3,155	501	9,141	53,334	17.1%
1993	3,925	1,657	3,203	539	9,323	53,326	17.5%
1994	4,471	1,637	3,290	650	10,050	54,151	18.6%
1995	4,304	1,631	3,318	590	9,845	54,037	18.2%
1996	4,565	1,728	3,354	669	10,314	55,603	18.5%
1997	4,362	1,695	3,531	596	10,185	55,203	18.5%
1998	4,576	1,549	3,436	642	10,203	56,032	18.2%
1999	5,013	1,576	3,436	600	10,626	57,591	18.5%
2000	4,934	1,873	3,338	628	10,773	57,277	18.8%
2001	5,229	1,785	3,387	561	10,961	57,294	19.1%
2002	5,148	1,706	3,474	550	10,878	57,985	18.8%
2003	5,157	1,802	3,219	533	10,712	56,940	18.8%
2004	4,408	2,074	3,069	572	10,123	56,310	18.0%
2005	4,448	2,527	2,936	562	10,473	58,248	18.0%
2006	4,160	2,708	2,863	614	10,345	58,846	17.6%
2007	3,835	2,818	3,064	636	10,354	58,682	17.6%
2008	3,137	3,091	2,984	584	9,796	57,478	17.0%
2009	3,036	2,269	2,898	547	8,750	56,062	15.6%
2010	2,909	2,397	2,770	554	8,630	54,080	16.0%
2011	2,908	2,893	2,674	562	9,037	54,164	16.7%
2012	3,427	2,942	2,658	579	9,606	54,921	17.5%
2013	3,442	2,747	2,719	565	9,474	53,768	17.6%
2014	3,418	2,555	2,819	602	9,394	55,390	17.0%
2015	4,134	2,161	2,850	684	9,828	57,892	17.0%
2016	3,711	1,950	2,945	636	9,242	58,532	15.8%
2017	4,054	1,968	2,842	712	9,576	60,060	15.9%
			Average annual percentage change				
1985-2017	-0.5%	-0.6%	-0.1%	0.5%	-0.3%	0.3%	
2007-2017	0.6%	-3.5%	-0.8%	1.1%	-0.8%	0.2%	

Source:
U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey, www.bls.gov/cex, September 2018. (Additional resources: www.bls.gov)

[a] Adjusted using the U.S. Consumer Price Inflation Index.
[a] Other vehicle expenses include vehicle finance charges, maintenance and repairs, insurance, licenses, and other vehicle charges.

The United States prices are the lowest of these listed countries. Those in France, the United Kingdom, and Germany paid, on average, over $5 per gallon in 2018. Data for China and India have been discontinued by the International Energy Agency.

Table 11.3
Gasoline Prices[a] for Selected Countries, 1990–2018

	Current dollars per gallon							Average annual percentage change
	1990	1995	2000	2005	2010	2015	2018	1990–2018
China	[b]	1.03	b	1.70	3.71	[b]	[b]	[b]
Japan	3.16	4.43	3.65	4.28	5.73	4.30	5.27	1.8%
India	[b]	[b]	[b]	3.71	4.29	[b]	[b]	[b]
South Korea	[b]	[b]	[b]	5.28	5.60	5.05	[b]	[b]
France[c]	3.63	4.26	3.80	5.46	6.74	5.68	6.28	2.0%
United Kingdom[c]	2.82	3.21	4.58	5.97	6.83	6.43	5.91	2.7%
Germany[c]	2.65	3.96	3.45	5.75	7.11	5.88	6.10	3.0%
Canada	1.87	1.53	1.86	2.89	3.80	3.22	3.67	2.4%
United States[d]	1.16	1.15	1.51	2.27	2.78	2.43	2.72	3.1%
	Constant 2018 dollars[e] per gallon							Average annual percentage change
	1990	1995	2000	2005	2010	2015	2018	1990–2018
China	[b]	1.70	[b]	2.19	4.27	[b]	[b]	[b]
Japan	6.07	7.30	5.32	5.50	6.60	4.56	5.27	-0.5%
India	[b]	[b]	[b]	4.77	4.94	[b]	[b]	[b]
South Korea	[b]	[b]	[b]	6.78	6.45	5.35	[b]	[b]
France[c]	6.97	7.02	5.54	7.02	7.76	6.02	6.28	-0.4%
United Kingdom[c]	5.42	5.29	6.68	7.67	7.87	6.81	5.91	0.3%
Germany[c]	5.09	6.52	5.03	7.39	8.18	6.23	6.10	0.6%
Canada	3.59	2.52	2.71	3.71	4.38	3.41	3.67	0.1%
United States[d]	2.23	1.89	2.20	2.92	3.20	2.57	2.72	0.7%

Note: Comparisons between prices and price trends in different countries require care. They are of limited validity because of fluctuations in exchange rates; differences in product quality, marketing practices, and market structures; and the extent to which the standard categories of sales are representative of total national sales for a given period.

Source:
International Energy Agency, *Monthly Oil Price Statistics, April 2019*, Paris, France, 2019. (Additional resources: www.iea.org)

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[a] Prices represent the retail prices (including taxes) for regular unleaded gasoline, except for Korea, France, Germany and the United Kingdom which are premium unleaded gasoline.
[b] Data are not available.
[c] Premium gasoline.
[d] These estimates are international comparisons only and do not necessarily correspond to gasoline price estimates in other sections of the book.
[e] Adjusted by the U.S. Consumer Price Inflation Index.

Of these selected countries, the United Kingdom had the highest diesel fuel price average in 2018, while the United States had the lowest. All of the countries listed except the United States had diesel prices over $4 per gallon in 2018.

Table 11.4
Diesel Fuel Prices[a] for Selected Countries, 1990–2018

	Current dollars per gallon						Average annual percentage change
	1990	2000	2005	2010	2015	2018	1990–2018
China	b	b	1.69	3.65	b	b	b
Japan	1.75	2.85	3.44	4.86	3.66	4.52	3.4%
South Korea	b	2.05	3.98	4.92	4.35	b	b
France	1.78	2.95	4.81	5.74	4.83	5.99	4.4%
United Kingdom	2.04	4.66	6.25	6.97	6.65	6.14	4.0%
Germany	2.72	2.79	5.01	6.15	4.99	5.49	2.5%
United States[c]	0.99	1.50	2.40	2.99	2.71	3.18	4.3%
	Constant 2018 dollars[d] per gallon						Average annual percentage change
	1990	2000	2005	2010	2015	2018	1990–2018
China	b	b	2.18	4.21	b	b	b
Japan	3.36	4.16	4.43	5.60	3.88	4.52	1.1%
South Korea	b	2.99	5.12	5.67	4.61	b	b
France	3.42	4.30	6.19	6.61	5.12	5.99	2.2%
United Kingdom	3.92	6.79	8.04	8.03	7.04	6.14	1.6%
Germany	5.23	4.07	6.44	7.08	5.29	5.49	0.2%
United States[c]	1.90	2.18	3.08	3.45	2.87	3.18	1.9%

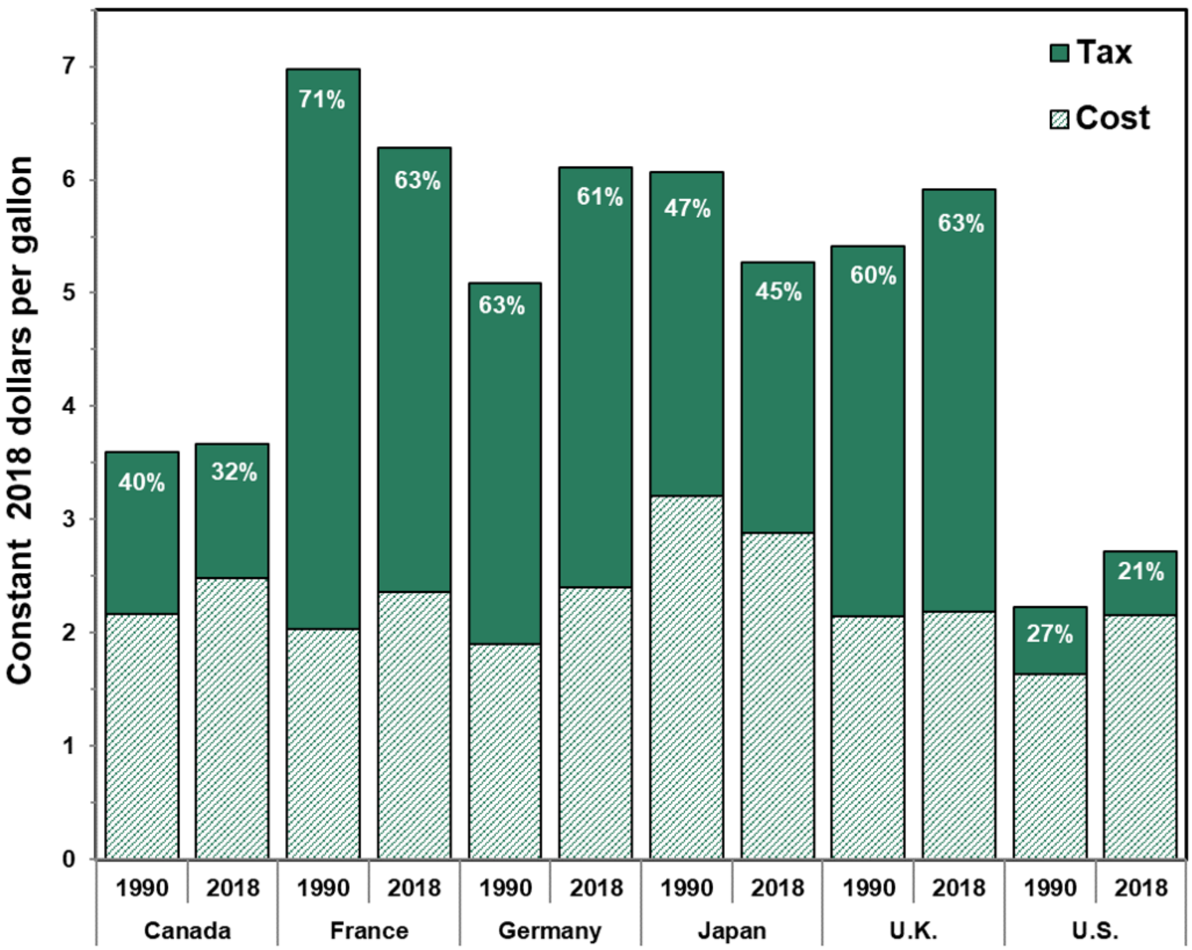
Note: Comparisons between prices and price trends in different countries require care. They are of limited validity because of fluctuations in exchange rates; differences in product quality, marketing practices, and market structures; and the extent to which the standard categories of sales are representative of total national sales for a given period.

Source:
International Energy Agency, *Monthly Oil Price Statistics, April 2019*, Paris, France, 2019. (Additional resources: www.iea.org)

[a] Prices represent the retail prices (including taxes) for car diesel fuel for non-commercial (household) use.
[b] Data are not available.
[c] These estimates are for international comparisons only and do not necessarily correspond to gasoline price estimates in other sections of the book.
[d] Adjusted by the U.S. Consumer Price Inflation Index.

In 2018 over sixty percent of the cost of gasoline in France, Germany, and the United Kingdom went for taxes. Of the listed countries, the United States has the lowest percentage of taxes.

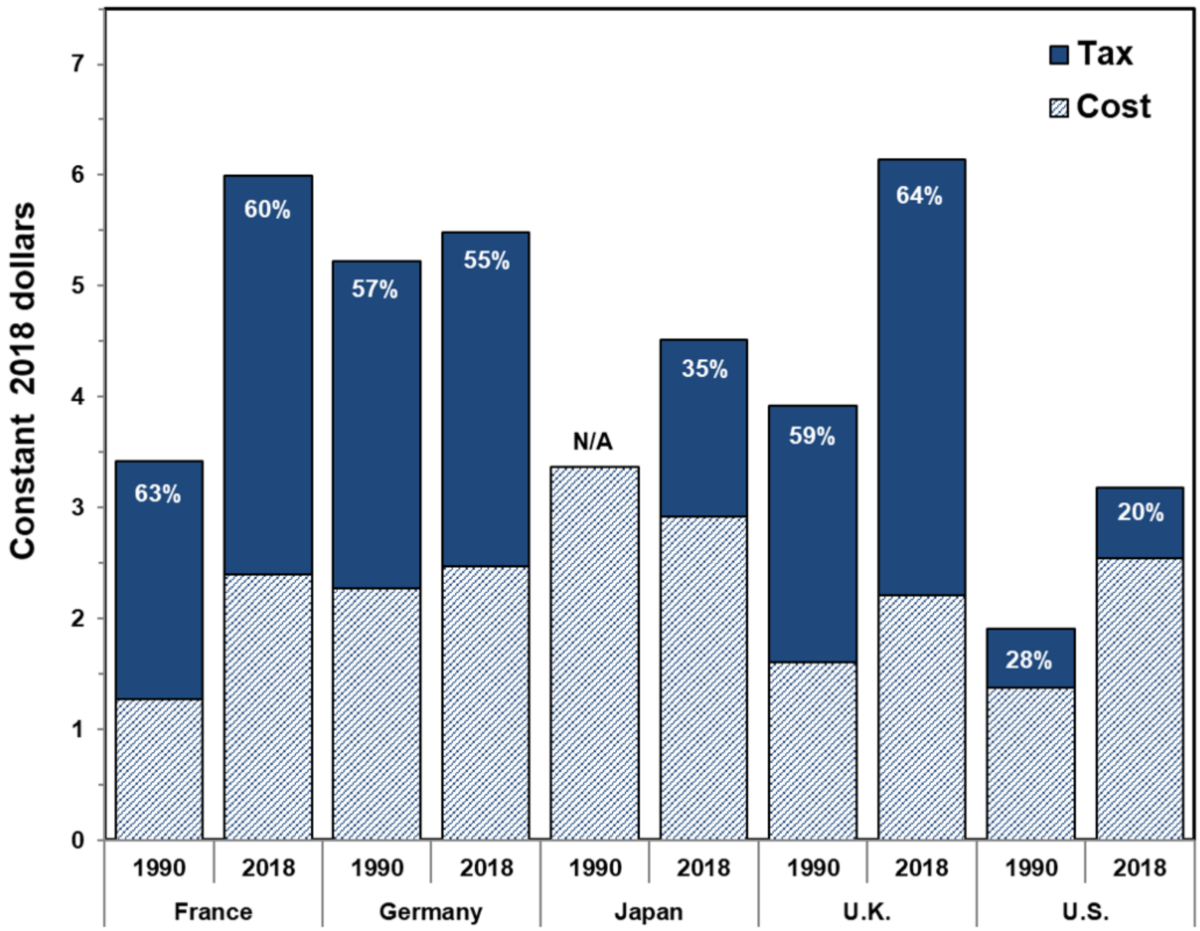
Figure 11.2. Gasoline Prices for Selected Countries, 1990 and 2018



Source:
Table 11.3 and International Energy Agency, *Monthly Oil Price Statistics, April 2019*, Paris, France, 2019. (Additional resources: www.iea.org)

Diesel fuel is taxed heavily in the European countries shown here. The U.S. diesel fuel tax share is the lowest of the listed countries.

Figure 11.3. Diesel Prices for Selected Countries, 1990 and 2018



Note: Data for Canada are not available.

Source:
Table 11.4 and International Energy Agency, *Monthly Oil Price Statistics, April 2019*, Paris, France, 2019. (Additional resources: www.iea.org)

The cost of crude oil influences the price of gasoline, but it is not the only factor which determines the price at the pump. Refining cost, transportation cost, marketing cost, and taxes also play a part of the cost of a gallon of gasoline. The average price of a barrel of crude oil (in constant 2018 dollars) increased by 56% from 2000 to 2018, while the average price of a gallon of gasoline increased 23% in this same time period.

Table 11.5
Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978–2018

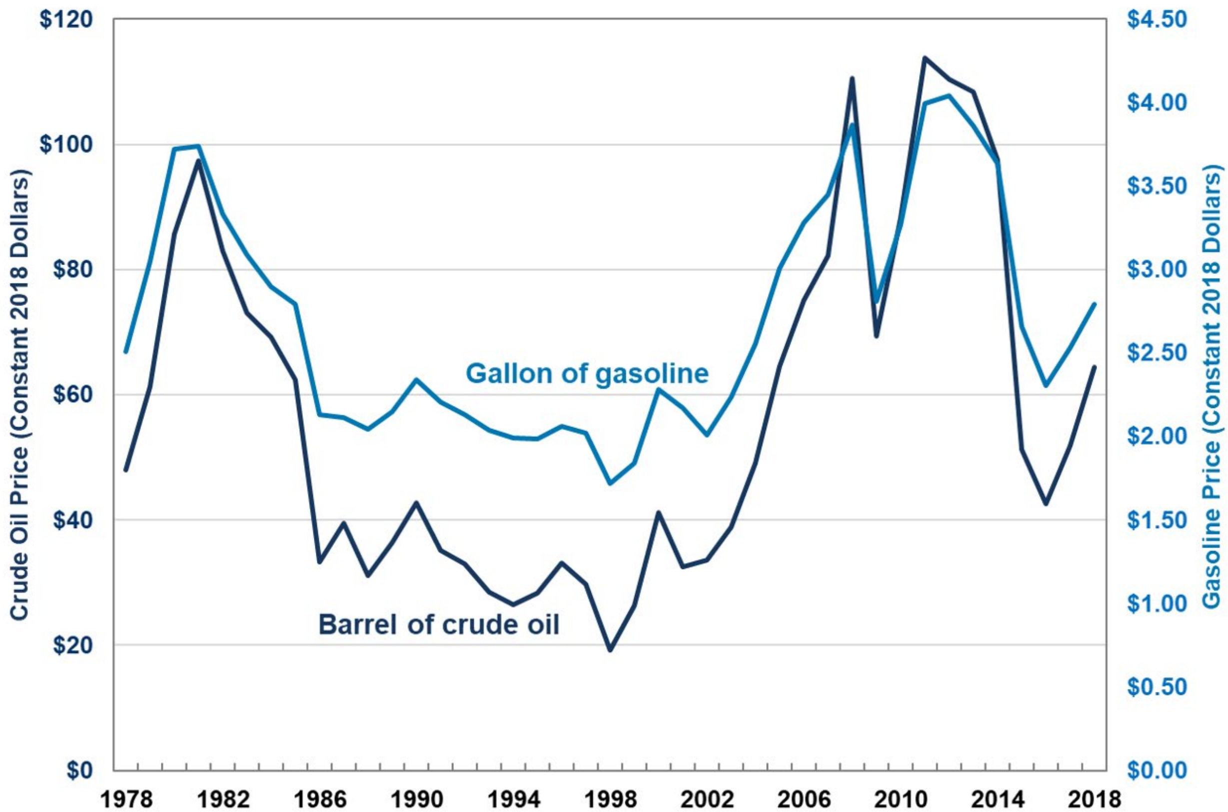
Year	Crude oil[a] (dollars per barrel) Current	Crude oil[a] (dollars per barrel) Constant 2018[c]	Gasoline[b] (dollars per gallon) Current	Gasoline[b] (dollars per gallon) Constant 2018[c]	Ratio of gasoline price to crude oil price
1978	12.5	48.0	0.65	2.51	2.2
1980	28.1	85.5	1.22	3.72	1.8
1985	26.8	62.4	1.20	2.79	1.9
1990	22.2	42.7	1.22	2.34	2.3
1991	19.1	35.1	1.20	2.21	2.6
1992	18.4	33.0	1.19	2.13	2.7
1993	16.4	28.5	1.17	2.04	3.0
1994	15.6	26.4	1.17	1.99	3.2
1995	17.2	28.4	1.21	1.99	2.9
1996	20.7	33.1	1.29	2.06	2.6
1997	19.0	29.8	1.29	2.02	2.8
1998	12.5	19.3	1.12	1.72	3.7
1999	17.5	26.4	1.22	1.84	2.9
2000	28.3	41.2	1.56	2.28	2.3
2001	23.0	32.5	1.53	2.17	2.8
2002	24.1	33.6	1.44	2.01	2.5
2003	28.5	38.9	1.64	2.24	2.4
2004	37.0	49.2	1.92	2.56	2.2
2005	50.2	64.6	2.34	3.01	2.0
2006	60.2	75.0	2.64	3.28	1.8
2007	67.9	82.3	2.85	3.45	1.8
2008	94.7	110.5	3.32	3.87	1.5
2009	59.3	69.4	2.40	2.81	1.7
2010	76.7	88.3	2.84	3.27	1.6
2011	101.9	113.7	3.58	3.99	1.5
2012	100.9	110.4	3.70	4.04	1.5
2013	100.5	108.3	3.58	3.86	1.5
2014	92.0	97.6	3.43	3.63	1.6
2015	48.4	51.3	2.51	2.66	2.2
2016	40.7	42.5	2.20	2.31	2.3
2017	50.7	51.9	2.47	2.53	2.0
2018	64.4	64.4	2.79	2.79	1.8
		Average annual percentage change			
1978-2018	4.2%	0.7%	3.7%	0.3%	
2008-2018	-3.8%	-5.3%	-1.7%	-3.2%	

Sources:
Crude oil – U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review,* March 2019, Washington, DC, Table 9.1.
Gasoline – U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review,* March 2019, Washington, DC, Table 9.4. (Additional resources: www.eia.doe.gov)

[a] Refiner acquisition cost of composite (domestic and imported) crude oil.
[b] Average for all types. These prices were collected from a sample of service stations in 85 urban areas selected to represent all urban consumers. Urban consumers make up about 80% of the total U.S. population.
[c] Adjusted by the Consumer Price Inflation Index.

Because crude oil is the main cost component for gasoline, the prices of a barrel of crude oil and a gallon of gasoline show similar trends.

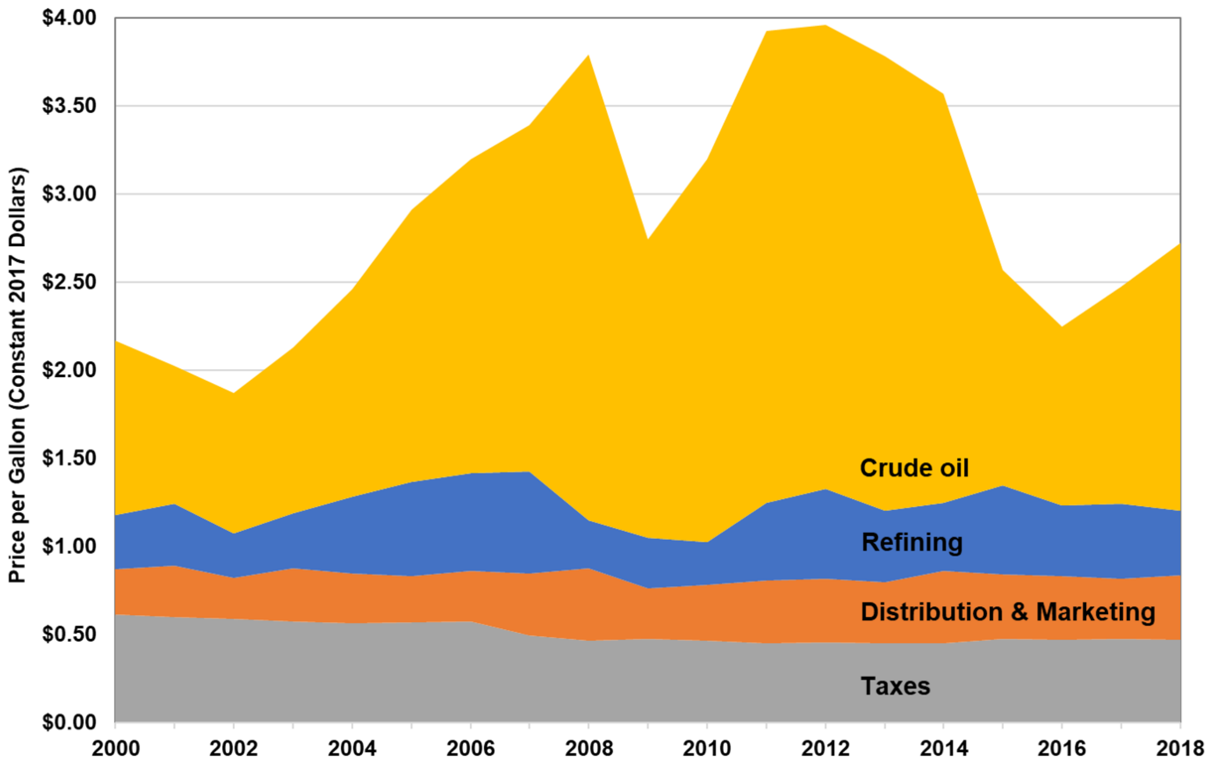
Figure 11.4. Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978–2018 (constant 2018 dollars)



Source:
Table 10.5.

The price of a gallon of gasoline changes depending on different price components, including taxes, distribution and marketing, refining, and crude oil. The largest component of gasoline price is crude oil. The cost of refining and the cost of crude oil are the most variable over the series.

Figure 11.5. Gasoline Price Components, 2000–2018



Note: Based on regular motor gasoline in all areas. Annual averages were created from monthly component price data.

Source:
Energy Information Administration, Gasoline and Diesel Fuel Update, Gasoline Pump Components History, https://www.eia.gov/petroleum/gasdiesel/gaspump_hist.php.
(Additional resources: www.eia.gov/petroleum/gasdiesel)

The price of diesel fuel has been consistently higher than regular gasoline (in constant dollars) since 2005. Premium gasoline in 2018 averaged 54 cents higher than regular gasoline. Prices for diesel and gasoline declined substantially in 2016 but rose again in 2017 and 2018.

Table 11.6
Retail Prices for Motor Fuel, 1978–2018
(dollars per gallon, including tax)

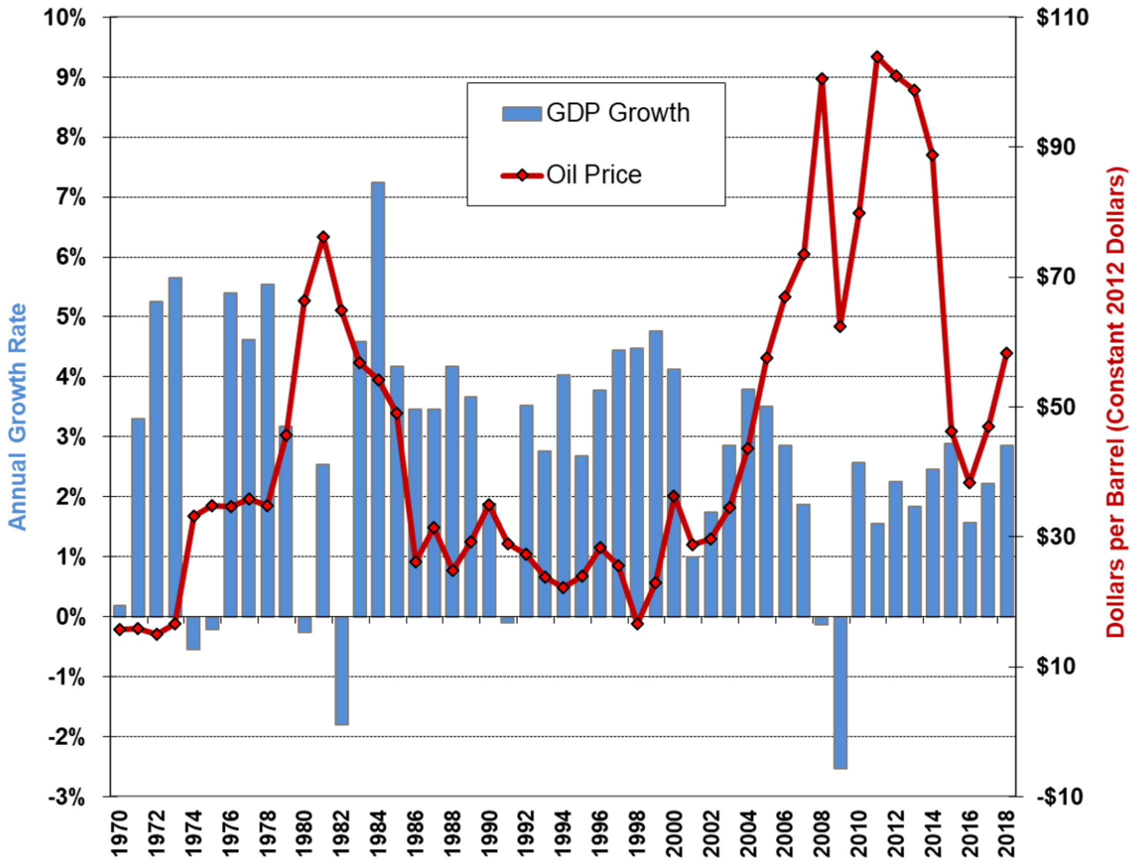
	Diesel fuel[a]		Unleaded regular gasoline		Unleaded premium gasoline	
Year	Current	Constant 2018[b]	Current	Constant 2018[b]	Current	Constant 2018[b]
1978	[c]	[c]	0.67	2.58	[c]	[c]
1980	1.01	3.08	1.25	3.79	[c]	[c]
1985	1.22	2.85	1.20	2.81	1.34	3.13
1990	1.07	2.06	1.16	2.24	1.35	2.59
1991	0.91	1.68	1.14	2.10	1.32	2.44
1992	1.06	1.90	1.13	2.02	1.32	2.36
1993	0.98	1.70	1.11	1.93	1.30	2.26
1994	1.11	1.89	1.11	1.88	1.31	2.21
1995	1.11	1.83	1.15	1.89	1.34	2.20
1996	1.24	1.98	1.23	1.97	1.41	2.26
1997	1.20	1.87	1.23	1.93	1.42	2.22
1998	1.04	1.61	1.06	1.63	1.25	1.93
1999	1.12	1.69	1.17	1.76	1.36	2.05
2000	1.49	2.17	1.51	2.20	1.69	2.47
2001	1.40	1.99	1.46	2.07	1.66	2.35
2002	1.32	1.84	1.36	1.90	1.56	2.17
2003	1.51	2.06	1.59	2.17	1.78	2.43
2004	1.81	2.41	1.88	2.50	2.07	2.75
2005	2.40	3.09	2.30	2.95	2.49	3.20
2006	2.71	3.37	2.59	3.22	2.81	3.49
2007	2.89	3.49	2.80	3.39	3.03	3.67
2008	3.80	4.44	3.27	3.81	3.52	4.10
2009	2.47	2.89	2.35	2.75	2.61	3.05
2010	2.99	3.45	2.79	3.21	3.05	3.51
2011	3.84	4.29	3.53	3.94	3.79	4.23
2012	3.97	4.34	3.64	3.99	3.92	4.29
2013	3.92	4.23	3.53	3.80	3.84	4.14
2014	3.83	4.06	3.37	3.57	3.71	3.94
2015	2.71	2.87	2.45	2.59	2.87	3.04
2016	2.30	2.41	2.14	2.24	2.61	2.73
2017	2.65	2.71	2.41	2.47	2.91	2.98
2018	3.18	3.18	2.74	2.74	3.27	3.27
	Average annual percentage change					
1978-2018	3.1%[d]	0.1%[d]	3.3%	-0.1%	2.5%	-0.1%[d]
2008-2018	-1.8%	-3.3%	-1.8%	-3.3%	-0.7%	-2.2%

Sources:
Gasoline – U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2019, Washington, DC, Table 9.4.
Diesel – 1980-1994 U.S. Department of Energy, Energy Information Administration, *International Energy Annual 2004*, Washington, DC, June 2004, Table 7.2. 1995–2018 from *Monthly Energy Review*, March 2019, Table 9.4. (Additional resources: www.eia.doe.gov)

[a] 1980-1993: Collected from a survey of prices on January 1 of the current year. 1994-on: Annual average.
[b] Adjusted by the Consumer Price Inflation Index.
[c] Data are not available.
[d] Average annual percentage change is from the earliest year possible to 2018.

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

Figure 11.6. Oil Price and Economic Growth, 1970–2018

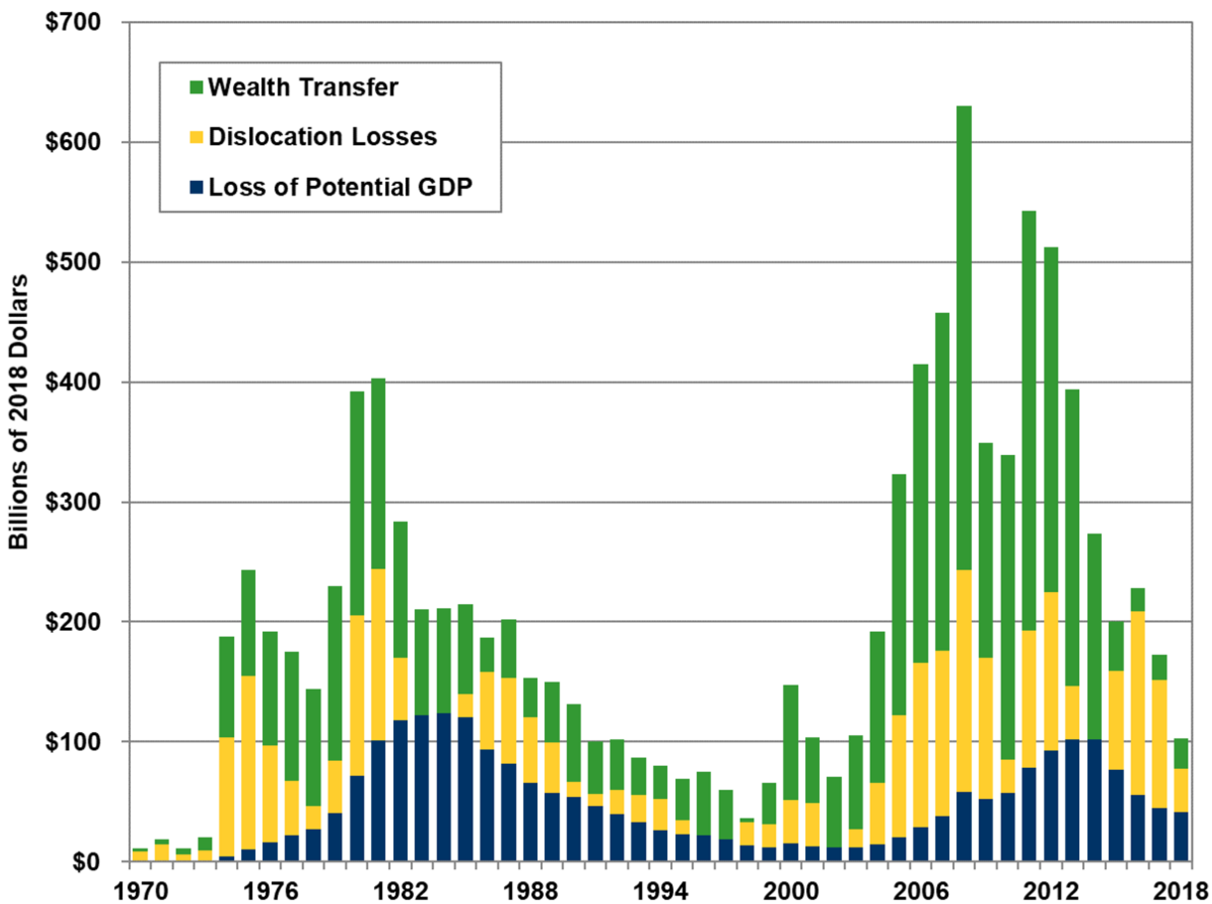


Source:

Greene, D.L. and N. I. Tishchishyna, *Costs of Oil Dependence: A 2000 Update*, Oak Ridge National Laboratory, ORNL/TM-2000/152, Oak Ridge, TN, 2000, and data updates, 2019.

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 nearly 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 2018, the total cost was about $100 billion (in 2018 dollars).

Figure 11.7. Costs of Oil Dependence to the U.S. Economy, 1970–2018



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 Gross Domestic Product (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 the ORNL Transportation Energy Evolution Modeling Team.

*The fuel prices shown here are **refiner sales prices** of transportation fuels to end users, excluding tax. Sales to end users are those made directly to the ultimate consumer, including bulk consumers. Bulk sales to utility, industrial, and commercial accounts previously included in the wholesale category are now counted as sales to end users. Both propane and diesel prices fell drastically in 2015. Although both fuels experienced price increases from 2016 to 2018, they continue to be lower than 2014 prices.*

Table 11.7
Refiner Sales Prices for Propane and No. 2 Diesel, 1978–2018
(dollars per gallon, excluding tax)

	Propane[a]		No 2. diesel fuel	
Year	Current	Constant 2018[b]	Current	Constant 2018[b]
1978	0.34	1.29	0.38	1.45
1980	0.48	1.47	0.82	2.49
1985	0.72	1.67	0.79	1.84
1986	0.75	1.71	0.48	1.10
1987	0.70	1.55	0.55	1.22
1988	0.71	1.52	0.50	1.06
1989	0.62	1.25	0.59	1.18
1990	0.75	1.43	0.73	1.39
1991	0.73	1.35	0.65	1.19
1992	0.64	1.15	0.62	1.11
1993	0.67	1.17	0.60	1.05
1994	0.53	0.90	0.55	0.94
1995	0.49	0.81	0.56	0.92
1996	0.61	0.97	0.68	1.09
1997	0.55	0.86	0.64	1.00
1998	0.41	0.62	0.49	0.76
1999	0.46	0.69	0.58	0.88
2000	0.60	0.88	0.94	1.36
2001	0.51	0.72	0.84	1.19
2002	0.42	0.58	0.76	1.06
2003	0.58	0.79	0.94	1.29
2004	0.84	1.12	1.24	1.65
2005	1.09	1.40	1.79	2.30
2006	1.36	1.69	2.10	2.61
2007	1.49	1.80	2.27	2.75
2008	1.89	2.21	3.15	3.67
2009	1.22	1.43	1.83	2.15
2010	1.48	1.71	2.13	2.46
2011	1.71	1.91	3.12	3.48
2012	1.14	1.25	3.20	3.50
2013	1.03	1.11	3.12	3.37
2014	1.10	1.16	2.92	3.10
2015	0.48	0.51	1.82	1.93
2016	0.50	0.52	1.51	1.58
2017	0.77	0.79	1.81	1.86
2018	0.93	0.93	2.26	2.26
		Average annual percentage change		
1978-2018	2.6%	-0.8%	4.6%	1.1%
2008-2018	-6.9%	-8.3%	-3.3%	-4.8%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, Washington, DC, April 2019, Table 9.7. (Additional resources: www.eia.doe.gov)

[a] Consumer grade.
[b] Adjusted by the Consumer Price Inflation Index.

Prices of finished aviation gasoline (current dollars) dropped in 2009 but then began to climb. In 2012 kerosene-type jet fuel reached its all-time high.

Table 11.8
Refiner Sales Prices for Aviation Gasoline and Jet Fuel, 1978–2018
(dollars per gallon, excluding tax)

	Finished aviation gasoline		Kerosene-type jet fuel	
Year	Current	Constant 2018[a]	Current	Constant 2018[a]
1978	0.52	1.99	0.39	1.49
1980	1.08	3.30	0.87	2.65
1985	1.20	2.80	0.80	1.86
1986	1.01	2.32	0.53	1.21
1987	0.91	2.00	0.54	1.20
1988	0.89	1.89	0.51	1.09
1989	1.00	2.01	0.59	1.20
1990	1.12	2.15	0.77	1.47
1991	1.05	1.93	0.65	1.20
1992	1.03	1.84	0.61	1.09
1993	0.99	1.72	0.58	1.01
1994	0.96	1.62	0.53	0.90
1995	1.01	1.66	0.54	0.89
1996	1.12	1.79	0.65	1.04
1997	1.13	1.76	0.61	0.96
1998	0.96	1.47	0.45	0.70
1999	1.06	1.60	0.54	0.82
2000	1.31	1.90	0.90	1.31
2001	1.32	1.88	0.78	1.10
2002	1.29	1.80	0.72	1.01
2003	1.49	2.04	0.87	1.19
2004	1.82	2.42	1.21	1.60
2005	2.23	2.87	1.74	2.23
2006	2.68	3.34	2.00	2.49
2007	2.85	3.45	2.17	2.62
2008	3.27	3.82	3.05	3.56
2009	2.44	2.86	1.70	1.99
2010	3.03	3.49	2.20	2.53
2011	3.80	4.25	3.05	3.41
2012	3.97	4.34	3.10	3.39
2013	3.93	4.24	2.98	3.21
2014	3.99	4.23	2.77	2.94
2015	[b]	[b]	1.63	1.73
2016	[b]	[b]	1.32	1.38
2017	[b]	[b]	1.63	1.67
2018	[b]	[b]	2.12	2.12
	Average annual percentage change			
1978-2018	5.8%[c]	2.1%[c]	4.3%	0.9%
2008-2018	3.3%[c]	1.7%[c]	-3.6%	-5.1%

Source:
U.S. Department of Energy, Energy Information Administration, Petroleum Data Analysis Tools, *Refiner Petroleum Product Prices by Sales Type*, April 2019, Washington, DC. (Additional resources: www.eia.doe.gov)

[a] Adjusted by the Consumer Price Inflation Index.
[b] EIA withheld value to avoid disclosure of individual company data.
[c] Data through 2014.

The federal government taxes highway motor fuel and uses the money to pay for roadway upkeep and improvement, as well as other related expenditures. Compressed natural gas (CNG) and liquefied petroleum gas (LPG) taxes are calculated per energy equivalent of a gallon of gasoline, while liquified natural gas tax is calculated per energy equivalent of diesel.

Table 11.9
Federal Excise Taxes on Motor Fuels, 2017

Fuel	Cents per gallon	Effective Date
Gasoline	18.4	October 1, 1997
Diesel and kerosene	24.4	October 1, 1997
Gasohol[a]	18.4	January 1, 2005
CNG	18.3[c]	October 1, 2006
LNG	24.3[d]	January 1, 2016
LPG	18.3[c]	January 1, 2016
Other alternative fuels[b]	18.4	October 1, 1997

Sources:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2017*, Washington, DC, 2018, Table FE-21B. (Additional resources: www.fhwa.dot.gov)
Public Law 114-41, July 31, 2015. (Additional resources: www.congress.gov/bill/114th-congress/house-bill/3236)

[a] All gasohol blends are taxed at the same rate.
[b] Includes benzol, benzene, naphtha, and other liquids used as a motor fuel.
[c] Compressed natural gas and liquefied petroleum gas are 18.3 cents per energy equivalent of a gallon of gasoline.
[d] Liquefied natural gas is 24.3 cents per energy equivalent of a gallon of diesel.

In addition to the 18.4 cents per gallon federal gasoline tax, the states also tax gasoline at varying rates. Some states have sales and/or use taxes added to gasoline excise taxes while others have inspection fees, environmental fees, leaking underground storage tank taxes, etc. The Energy Information Administration has compiled gasoline excise taxes, along with other state taxes and fees, to arrive at an estimate of the amount of state taxes consumers are paying per gallon.

Table 11.10
State Gasoline Tax Rates, February 2019
(cents per gallon)

State	Tax Rate	State	Tax Rate
Alabama	19.0	Montana	32.3
Alaska	9.0	Nebraska	30.5
Arizona	19.0	Nevada	23.8
Arkansas	21.8	New Hampshire	23.8
California	49.9	New Jersey	41.5
Colorado	22.9	New Mexico	18.9
Connecticut	25.0	New York	34.1
Delaware	23.0	North Carolina	36.5
District of Columbia	23.5	North Dakota	23.0
Florida	34.1	Ohio	28.0
Georgia	28.0	Oklahoma	20.0
Hawaii	18.5	Oregon	34.0
Idaho	33.0	Pennsylvania	58.7
Illinois	36.1	Rhode Island	34.1
Indiana	42.0	South Carolina	20.8
Iowa	30.7	South Dakota	30.0
Kansas	25.0	Tennessee	26.4
Kentucky	26.0	Texas	20.0
Louisiana	20.9	Utah	30.7
Maine	31.4	Vermont	31.2
Maryland	35.5	Virginia	16.8
Massachusetts	26.8	Washington	49.5
Michigan	40.2	West Virginia	35.7
Minnesota	28.6	Wisconsin	32.9
Mississippi	18.4	Wyoming	24.0
Missouri	17.4		

Note: Includes gasoline tax plus other per gallon fees, such as leaking underground storage tank fees. See source for additional specifics on individual state rates.

Source:
Energy Information Administration, Petroleum Supply Monthly, Federal and state motor fuels taxes, accessed April 15, 2019. (Additional resources: https://www.eia.gov/petroleum/marketing/monthly/xls/fueltaxes.xls)

Federal, state, and local jurisdictions have laws and incentives for alternative fuels production use.

Table 11.11
Federal, State, and Local Alternative Fuel Incentives, 2018
(number of incentives)

State (including jurisdictions in the State)	Biodiesel	Ethanol	Natural Gas	Liquefied petroleum gas (LPG)	Electric vehicles (EVs)	Neighborhood electric vehicles (NEVs)	Hydrogen fuel cells	Aftermarket conversions
Federal	28	24	27	26	25	3	22	6
Alabama	2	2	5	4	3	0	1	2
Alaska	1	2	1	1	1	1	1	1
Arizona	4	4	15	14	18	1	12	0
Arkansas	4	3	6	5	3	0	2	2
California	17	15	31	19	66	3	32	6
Colorado	11	8	19	14	21	1	9	2
Connecticut	3	4	5	4	16	0	6	4
Delaware	2	2	4	5	7	1	1	1
Dist. of Columbia	2	3	4	4	4	0	4	1
Florida	7	6	6	5	13	1	2	1
Georgia	4	4	4	3	7	0	3	1
Hawaii	8	8	4	4	8	2	7	0
Idaho	3	1	2	2	5	2	1	0
Illinois	11	8	7	6	13	1	4	3
Indiana	12	11	12	9	7	1	5	3
Iowa	7	10	5	4	7	1	2	1
Kansas	7	11	6	3	1	1	0	3
Kentucky	8	8	5	4	1	1	2	1
Louisiana	5	4	6	6	2	1	0	2
Maine	5	4	4	4	5	3	2	1
Maryland	2	2	4	4	12	2	2	2
Massachusetts	5	4	5	4	16	1	5	1
Michigan	2	1	7	5	7	0	5	0
Minnesota	7	9	5	2	13	4	1	0
Mississippi	2	2	6	5	1	0	1	2
Missouri	7	6	9	9	7	1	5	0
Montana	6	5	3	3	2	2	1	1
Nebraska	2	4	6	3	2	1	1	1
Nevada	6	4	7	7	11	2	6	1
New Hampshire	4	1	3	3	6	2	1	2
New Jersey	3	2	5	4	9	1	2	1
New Mexico	8	4	5	4	5	1	5	0
New York	3	3	8	2	17	1	5	2
North Carolina	10	9	8	6	12	0	5	1
North Dakota	11	9	3	2	1	1	2	0
Ohio	6	6	10	8	7	0	4	2
Oklahoma	8	10	15	8	6	1	6	7
Oregon	10	9	10	8	19	1	7	1
Pennsylvania	3	3	3	3	8	0	4	3
Rhode Island	4	3	5	3	11	2	5	2
South Carolina	8	6	5	5	5	1	7	2
South Dakota	5	7	2	2	0	0	0	0
Tennessee	5	6	7	3	2	1	1	1
Texas	5	6	15	8	10	1	6	4
Utah	2	1	15	8	14	1	7	2
Vermont	4	3	5	4	12	2	5	2
Virginia	14	11	16	10	13	1	11	3
Washington	10	7	7	4	18	1	3	1
West Virginia	4	4	6	5	5	1	5	0
Wisconsin	10	7	7	7	8	1	5	0
Wyoming	3	4	6	4	5	0	1	0
Totals	**330**	**300**	**396**	**299**	**497**	**57**	**242**	**85**

Source:
U.S. Department of Energy, Energy Efficiency and Renewable Energy, Alternative Fuels Data Center. Data downloaded August 2018. (Additional resources: www.eere.energy.gov/afdc/laws/matrix/tech)

Table 11.12
Federal, State, and Local Advanced Technology Incentives, 2018
(number of incentives)

State (including jurisdictions in the State)	Hybrid electric vehicles (HEV)	Plug-in hybrid vehicles (PHEVs)	Fuel economy or efficiency	Idle reduction	Other[a]
Federal	11	25	12	7	6
Alabama	1	3	1	4	0
Alaska	0	1	1	1	0
Arizona	2	16	0	2	0
Arkansas	0	3	0	1	1
California	15	62	7	5	11
Colorado	6	19	2	3	3
Connecticut	2	15	1	2	1
Delaware	1	6	2	2	1
Dist. of Columbia	1	4	3	1	1
Florida	1	13	1	1	0
Georgia	2	7	0	2	1
Hawaii	3	8	1	1	1
Idaho	2	5	0	0	0
Illinois	2	10	3	5	0
Indiana	3	6	3	4	3
Iowa	0	7	0	1	0
Kansas	0	0	0	1	0
Kentucky	0	1	0	0	1
Louisiana	1	2	1	0	0
Maine	1	5	2	3	2
Maryland	1	10	1	3	2
Massachusetts	2	13	0	3	2
Michigan	1	6	0	0	0
Minnesota	1	12	2	3	1
Mississippi	1	1	1	1	0
Missouri	1	5	0	1	0
Montana	0	2	1	0	0
Nebraska	0	2	0	1	0
Nevada	3	8	0	1	0
New Hampshire	0	5	2	5	3
New Jersey	4	6	4	1	5
New Mexico	2	4	2	1	1
New York	5	14	3	3	4
North Carolina	3	10	1	3	1
North Dakota	0	0	0	0	0
Ohio	1	4	0	2	0
Oklahoma	1	6	0	1	3
Oregon	2	17	1	3	2
Pennsylvania	1	6	4	4	2
Rhode Island	3	8	3	4	7
South Carolina	5	6	0	2	0
South Dakota	0	0	0	0	1
Tennessee	2	1	1	1	1
Texas	3	10	1	3	2
Utah	2	11	3	3	4
Vermont	2	9	2	5	1
Virginia	4	11	2	2	2
Washington	1	15	2	1	1
West Virginia	0	5	0	2	1
Wisconsin	2	8	0	1	1
Wyoming	0	5	0	1	0
Totals	107	438	76	107	79

Source:
U.S. Department of Energy, Energy Efficiency and Renewable Energy, Alternative Fuels Data Center. Data downloaded August 2018. (Additional resources: www.eere.energy.gov/afdc/laws/matrix/tech)

[a] Includes Clean Fuel Initiatives and Pollution Prevention.

In current dollars, import cars, on average, were less expensive than domestic cars until 1982. Since then, import prices have more than tripled, while domestic prices have more than doubled (current dollars). When adjusted for inflation, the average price for domestic cars was less expensive in 2018 than any year since 1979.

Table 11.13
Average Price of a New Car (Domestic and Import), 1970–2018

	Domestic[a]		Import		Total	
Year	Current dollars	Constant 2018 dollars[b]	Current dollars	Constant 2018 dollars[b]	Current dollars	Constant 2018 dollars[b]
1970	3,706	23,982	2,649	17,146	3,543	22,929
1975	5,096	23,784	4,367	20,381	4,961	23,157
1980	7,591	23,134	7,468	22,758	7,557	23,030
1985	11,576	27,016	12,843	29,971	11,835	27,619
1986	12,316	28,217	13,710	31,412	12,655	28,993
1987	12,906	28,528	14,459	31,961	13,385	29,587
1988	13,415	28,476	15,227	32,322	13,930	29,568
1989	13,927	28,203	15,491	31,369	14,357	29,074
1990	14,483	27,826	16,615	31,922	15,033	28,882
1991	15,188	28,001	16,343	30,131	15,476	28,532
1992	15,635	27,984	18,589	33,270	16,331	29,228
1993	15,936	27,693	20,230	35,155	16,833	29,252
1994	16,817	28,494	21,885	37,081	17,798	30,156
1995	16,797	27,676	23,069	38,010	17,892	29,480
1996	17,180	27,495	26,049	41,690	18,504	29,614
1997	17,532	27,430	27,682	43,310	19,182	30,011
1998	18,488	28,481	28,708	44,225	20,238	31,177
1999	19,006	28,646	27,485	41,427	20,701	31,201
2000	19,559	28,521	26,008	37,925	21,030	30,666
2001	19,995	28,350	25,854	36,658	21,464	30,433
2002	20,436	28,525	25,616	35,755	21,866	30,521
2003	19,956	27,234	26,150	35,688	21,663	29,564
2004	20,500	27,251	25,954	34,502	22,068	29,336
2005	21,568	27,731	26,635	34,246	23,012	29,588
2006	22,126	27,560	27,019	33,655	23,611	29,409
2007	22,255	26,953	27,466	33,263	23,883	28,925
2008	22,191	25,881	25,854	30,154	23,431	27,327
2009	22,039	25,796	25,166	29,456	23,108	27,048
2010	23,769	27,372	27,250	31,380	24,907	28,682
2011	24,158	26,968	28,269	31,558	25,471	28,434
2012	24,116	26,376	28,974	31,689	25,536	27,929
2013	23,916	25,780	29,285	31,566	25,441	27,424
2014	23,765	25,208	27,941	29,637	24,904	26,416
2015	24,057	25,487	27,496	29,130	24,937	26,420
2016	24,437	25,567	27,737	29,020	25,259	26,427
2017	23,836	24,418	30,022	30,755	25,330	25,948
2018	23,498	23,498	31,106	31,106	25,259	25,259
			Average annual percentage change			
1970-2018	3.9%	0.0%	5.3%	1.2%	4.2%	0.2%
2008-2018	0.6%	-1.0%	1.9%	0.3%	0.8%	-0.8%

Note: These data are based on an average car and do not include prices for pickups, vans, or sport utility vehicles.

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, *Average Transaction Price per New Car*, Washington, DC, 2019. (Additional resources: www.bea.gov)

[a] Includes all vehicles produced in the United States regardless of manufacturer.
[b] Adjusted by the Consumer Price Inflation Index.

The average price of a new light truck grew 42% from 1990-2018 in constant dollars terms, and by 173% when not adjusted for inflation. From the earliest available estimates in 2002, average prices for import light trucks were slightly higher than domestic prices until 2009. By 2018, domestic light truck prices averaged nearly $6,000 higher than import prices.

Table 11.14
Average Price of a New Light Truck[a] (Domestic and Import), 1990-2018

	Domestic[b]		Import		Total	
Year	Current dollars	Constant 2018 dollars[c]	Current dollars	Constant 2018 dollars[c]	Current dollars	Constant 2018 dollars[c]
1990	d	d	d	d	13,592	26,115
1991	d	d	d	d	14,124	26,040
1992	d	d	d	d	15,032	26,904
1993	d	d	d	d	15,611	27,129
1994	d	d	d	d	16,821	28,501
1995	d	d	d	d	17,725	29,205
1996	d	d	d	d	19,574	31,327
1997	d	d	d	d	21,777	34,072
1998	d	d	d	d	22,787	35,104
1999	d	d	d	d	23,626	35,611
2000	d	d	d	d	23,363	34,068
2001	d	d	d	d	24,391	34,584
2002	26,066	36,383	26,753	37,343	26,149	36,500
2003	26,420	36,055	28,604	39,036	26,715	36,458
2004	26,950	35,825	28,760	38,232	27,190	36,144
2005	27,296	35,096	29,543	37,985	27,590	35,474
2006	27,999	34,875	29,611	36,883	28,248	35,185
2007	29,158	35,312	29,817	36,111	29,265	35,442
2008	28,267	32,967	29,958	34,940	28,555	33,304
2009	29,447	34,466	29,072	34,028	29,381	34,389
2010	32,327	37,227	32,305	37,202	32,324	37,223
2011	33,373	37,255	33,317	37,193	33,365	37,246
2012	34,040	37,230	34,136	37,335	34,054	37,245
2013	34,773	37,482	33,766	36,397	34,616	37,313
2014	35,793	37,966	34,204	36,280	35,546	37,704
2015	36,817	39,006	33,675	35,677	36,251	38,406
2016	37,514	39,249	33,408	34,953	36,678	38,374
2017	38,135	39,066	33,357	34,172	37,096	38,002
2018	38,459	38,459	32,740	32,740	37,138	37,138
			Average Annual Percentage Change			
1990-2018	d	d	d	d	3.7%	1.3%
2008-2018	3.1%	1.6%	0.9%	-0.6%	2.7%	1.1%

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, Underlying Detail, Motor Vehicle Output, March 2019 and Ward's Communications, www.wardsauto.com.

[a] Light trucks in this table are 14,000 lb and less.
[b] Includes all vehicles produced in the United States regardless of manufacturer.
[c] Adjusted by the Consumer Price Inflation Index.
[d] Data are not available.

The total cost of operating a car is the sum of the fixed cost (depreciation, insurance, finance charge, and license fee) and the variable cost (gas and oil, tires, and maintenance), which is related to the amount of travel. The gas and oil share of total cost was 12.5% in 2018 which is down from 18.4% in 2012.

Table 11.15
Car Operating Cost per Mile, 1985–2018

Model year	Constant 2018 dollars per 10,000 miles[a]			Total cost per mile[b] (constant 2018 cents[a])	Percentage gas and oil of total cost
	Variable cost	Fixed cost	Total cost		
1985	1,732	4,810	6,541	65.41	19.9%
1986	1,494	5,286	6,779	67.79	15.1%
1987	1,481	5,146	6,627	66.27	14.7%
1988	1,677	6,432	8,108	81.08	13.6%
1989	1,620	5,913	7,533	75.33	14.2%
1990	1,614	6,256	7,869	78.69	13.2%
1991	1,788	6,575	8,363	83.63	14.6%
1992	1,611	6,773	8,383	83.83	12.6%
1993	1,599	6,468	8,067	80.67	12.7%
1994	1,542	6,500	8,042	80.42	11.8%
1995	1,582	6,599	8,181	81.81	11.7%
1996	1,536	6,711	8,247	82.47	10.9%
1997	1,690	6,803	8,492	84.92	12.2%
1998	1,648	6,976	8,624	86.24	11.1%
1999	1,598	7,024	8,621	86.21	9.8%
2000	1,779	6,889	8,668	86.68	11.6%
2001	1,928	6,552	8,480	84.80	13.2%
2002	1,647	6,803	8,450	84.50	9.7%
2003	1,788	6,665	8,453	84.53	11.6%
2004	1,675	7,488	9,163	91.63	9.4%
2005	1,813	6,958	8,771	87.71	12.0%
2006	1,881	5,837	7,718	77.18	15.3%
2007	1,756	5,771	7,527	75.27	14.3%
2008	1,978	6,297	8,275	82.75	16.4%
2009	1,805	6,468	8,273	82.73	14.3%
2010	1,927	6,586	8,512	85.12	15.4%
2011	1,980	6,538	8,519	85.19	16.2%
2012	2,148	6,284	8,432	84.32	18.4%
2013	2,201	6,243	8,444	84.44	18.4%
2014	2,019	6,126	8,144	81.44	16.9%
2015	1,833	6,199	8,032	80.32	14.8%
2016	1,541	6,353	7,894	78.94	11.2%
2017	1,597	5,086	6,683	66.83	12.6%
2018	1,664	5,344	7,008	70.08	12.5%
		Average annual percentage change			
1985–2018	-0.1%	0.3%	0.2%	0.2%	
2008–2018	-1.7%	-1.6%	-1.6%	-1.6%	

Source:
Ward's Communications, *Motor Vehicle Facts and Figures 2018*, Southfield, Michigan, 2018, and annual. Original data from AAA "Your Driving Costs." (Additional resources: newsroom.aaa.com)

[a] Adjusted by the U.S. Consumer Price Inflation Index. Can be converted to constant dollars using Table B.17.
[b] Based on 10,000 miles per year.

While the previous table shows costs per mile, this table presents costs per year for fixed costs associated with car operation. For 2018 model year cars, the fixed cost is $14.64 per day per vehicle.

Table 11.16
Fixed Car Operating Costs per Year, 1975–2018
(constant 2018 dollars)[a]

Model year	Insurance[b]	License, registration & taxes	Depreciation	Finance charge	Total	Average fixed cost per day
1975	1,788	140	3,608	[c]	5,536	15.17
1980	1,522	250	3,163	[c]	6,195	16.97
1981	1,431	243	3,555	[c]	6,561	17.98
1982	1,177	141	3,529	[c]	6,240	17.10
1983	1,190	245	3,272	[c]	6,036	16.54
1984	1,229	256	2,917	[c]	5,670	15.54
1985	1,091	257	2,945	1,246	5,533	15.17
1986	1,170	298	3,024	1,459	5,948	16.29
1987	1,190	283	3,302	1,163	5,931	16.25
1988	1,224	295	3,787	1,199	6,497	17.81
1989	1,316	292	4,087	1,191	6,875	18.83
1990	1,304	317	4,528	1,306	7,445	20.40
1991	1,314	310	4,617	490	6,722	18.42
1992	1,415	311	4,863	1,425	8,008	21.94
1993	1,299	309	4,918	1,164	7,684	21.06
1994	1,308	329	4,981	1,098	7,711	21.13
1995	1,296	334	5,063	1,130	7,818	21.42
1996	1,359	344	5,073	1,149	7,919	21.70
1997	1,329	338	5,119	1,202	7,984	21.87
1998	1,390	348	5,182	1,252	8,169	22.38
1999	1,467	341	5,179	1,248	8,230	22.55
2000	1,422	325	5,092	1,238	8,070	22.11
2001	1,412	295	5,031	1,228	7,959	21.81
2002	1,419	281	5,194	1,156	8,045	22.04
2003	1,510	280	5,101	1,015	7,900	21.64
2004	2,131	552	5,027	985	8,695	23.82
2005	1,656	500	4,987	950	8,094	22.17
2006	1,153	666	4,225	892	6,937	19.00
2007	1,193	652	4,108	888	6,840	18.74
2008	1,100	646	3,873	884	6,503	17.82
2009	1,142	664	4,051	912	6,769	18.54
2010	1,187	674	4,093	928	6,882	18.85
2011	1,081	664	4,162	919	6,825	18.70
2012	1,095	667	3,876	925	6,563	17.98
2013	1,109	659	3,849	914	6,531	17.89
2014	1,085	680	3,723	898	6,387	17.50
2015	1,181	705	3,871	709	6,466	17.71
2016	1,279	719	3,933	715	6,645	18.20
2017	1,276	563	2,734	512	5,086	13.93
2018	1,273	558	2,922	569	5,322	14.64
			Average annual percentage change			
1975–2018	-0.8%	3.3%	-0.5%	[c]	-0.1%	-0.1%
2008–2018	1.5%	-1.5%	-2.8%	-4.3%	-2.0%	-1.9%

Source:
Ward's Communications, *Motor Vehicle Facts and Figures 2018*, Southfield, Michigan, 2018, and annual. Original data from AAA "Your Driving Costs." (Additional resources: newsroom.aaa.com)

[a] Adjusted by the U.S. Consumer Price Inflation Index. Can be converted to constant dollars using Table B.17.
[b] Fire & Theft: $50 deductible 1975 through 1977; $100 deductible 1978 through 1992; $250 deductible for 1993 – 2003; $100 deductible 2004-2015. Collision: $100 deductible through 1979; $250 deductible 1980-1992; $500 deductible for 1993 – on. Property Damage & Liability: coverage = $100,000/$300,000.
[c] Data are not available.

Table 11.17
Personal Consumption Expenditures, 1970–2018
(billion dollars)

	Personal consumption expenditures		Transportation personal consumption expenditures		
Year	Current	Constant 2018[a]	Current	Constant 2018[a]	Transportation PCE as a percent of PCE
1970	646.7	3,296.6	80.8	411.9	12.5%
1975	1,030.5	3,814.5	132.6	490.8	12.9%
1980	1,750.7	4,574.8	241.7	631.6	13.8%
1981	1,934.0	4,616.6	266.2	635.4	13.8%
1982	2,071.3	4,656.7	270.1	607.2	13.0%
1983	2,281.6	4,935.7	298.3	645.3	13.1%
1984	2,492.3	5,203.7	335.4	700.3	13.5%
1985	2,712.8	5,490.4	370.7	750.3	13.7%
1986	2,886.3	5,725.7	373.7	741.3	12.9%
1987	3,076.3	5,953.7	387.7	750.3	12.6%
1988	3,330.0	6,224.8	416.3	778.2	12.5%
1989	3,576.8	6,433.2	440.0	791.4	12.3%
1990	3,809.0	6,602.5	455.7	789.9	12.0%
1991	3,943.4	6,610.7	430.5	721.7	10.9%
1992	4,197.6	6,880.2	463.4	759.5	11.0%
1993	4,452.0	7,128.5	497.3	796.3	11.2%
1994	4,721.0	7,401.4	540.0	846.6	11.4%
1995	4,962.6	7,619.6	565.5	868.3	11.4%
1996	5,244.6	7,907.5	610.9	921.1	11.6%
1997	5,536.8	8,206.5	652.6	967.3	11.8%
1998	5,877.2	8,613.8	677.8	993.4	11.5%
1999	6,279.1	9,072.1	738.5	1,067.0	11.8%
2000	6,762.1	9,556.5	809.0	1,143.3	12.0%
2001	7,065.6	9,771.2	821.1	1,135.5	11.6%
2002	7,342.7	9,996.3	821.1	1,117.8	11.2%
2003	7,723.1	10,322.2	857.5	1,146.1	11.1%
2004	8,212.7	10,688.9	913.2	1,188.5	11.1%
2005	8,747.1	11,040.4	977.7	1,234.0	11.2%
2006	9,260.3	11,344.7	1,011.7	1,239.4	10.9%
2007	9,706.4	11,580.1	1,053.7	1,257.1	10.9%
2008	9,976.3	11,673.8	1,047.1	1,225.3	10.5%
2009	9,842.2	11,428.5	903.0	1,048.5	9.2%
2010	10,185.8	11,691.5	986.4	1,132.2	9.7%
2011	10,641.1	11,963.1	1,107.4	1,245.0	10.4%
2012	11,006.8	12,141.4	1,159.6	1,279.1	10.5%
2013	11,317.2	12,268.6	1,195.6	1,296.1	10.6%
2014	11,824.0	12,581.5	1,228.8	1,307.5	10.4%
2015	12,294.5	12,946.2	1,182.4	1,245.1	9.6%
2016	12,766.9	13,297.9	1,176.4	1,225.3	9.2%
2017	13,321.4	13,618.3	1,242.2	1,269.9	9.3%
2018	13,948.5	13,948.5	1,307.5	1,307.5	9.4%
		Average annual percentage change			
1970-2018	6.6%	3.1%	6.0%	2.4%	
2008-2018	3.4%	1.8%	2.2%	0.7%	

Note: Transportation PCE includes the following categories: transportation, motor vehicles and parts, and gasoline and oil.

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, Table 2.3.5, www.bea.gov

[a] Adjusted by the GNP price deflator.

Table 11.18
Consumer Price Indices, 1970–2018
(1970 = 1.000)

Year	Consumer price index	Transportation consumer price index[a]	New car consumer price index	Used car consumer price index	Gross national product index
1970	1.000	1.000	1.000	1.000	1.000
1975	1.387	1.336	1.186	1.404	1.573
1976	1.466	1.469	1.262	1.612	1.751
1977	1.562	1.573	1.328	1.753	1.947
1978	1.680	1.645	1.429	1.788	2.198
1979	1.871	1.880	1.542	1.929	2.463
1980	2.124	2.216	1.667	1.997	2.678
1981	2.343	2.485	1.768	2.465	3.001
1982	2.487	2.587	1.836	2.846	3.131
1983	2.567	2.648	1.881	3.163	3.400
1984	2.678	2.765	1.932	3.606	3.773
1985	2.773	2.837	1.998	3.644	4.042
1986	2.825	2.728	2.083	3.487	4.257
1987	2.928	2.811	2.154	3.625	4.513
1988	3.049	2.899	2.194	3.782	4.871
1989	3.196	3.043	2.245	3.859	5.248
1990	3.369	3.213	2.286	3.769	5.555
1991	3.510	3.301	2.373	3.785	5.733
1992	3.616	3.373	2.433	3.949	6.068
1993	3.724	3.477	2.499	4.292	6.381
1994	3.820	3.581	2.591	4.542	6.771
1995	3.928	3.709	2.655	5.016	7.102
1996	4.044	3.813	2.706	5.032	7.506
1997	4.137	3.848	2.718	4.843	7.966
1998	4.201	3.776	2.701	4.827	8.410
1999	4.294	3.851	2.691	4.872	8.943
2000	4.438	4.088	2.689	4.994	9.528
2001	4.564	4.115	2.676	5.087	9.846
2002	4.637	4.077	2.637	4.872	10.171
2003	4.742	4.203	2.597	4.580	10.666
2004	4.869	4.349	2.582	4.272	11.385
2005	5.034	4.637	2.597	4.468	12.147
2006	5.196	4.824	2.591	4.487	12.842
2007	5.344	4.925	2.566	4.351	13.486
2008	5.549	5.215	2.527	4.293	13.770
2009	5.529	4.780	2.554	4.070	13.514
2010	5.620	5.157	2.599	4.587	14.067
2011	5.797	5.663	2.672	4.776	14.614
2012	5.917	5.796	2.716	4.818	15.217
2013	6.004	5.798	2.745	4.804	15.760
2014	6.101	5.758	2.755	4.779	16.452
2015	6.109	5.308	2.771	4.715	17.084
2016	6.186	5.197	2.775	4.599	17.526
2017	6.318	5.375	2.768	4.431	18.273
2018	6.472	5.618	2.755	4.435	19.223

Sources:
Bureau of Labor Statistics, Consumer Price Index, All Urban Consumers, Multi-screen data search, www.bls.gov/data. (Additional resources: www.bls.gov)
GNP – U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, Table 1.7.5. (Additional resources: www.bea.gov)

[a] Transportation Consumer Price Index includes new and used cars, gasoline, car insurance rates, intracity mass transit, intracity bus fare, and airline fares.

The data below were summarized from the Bureau of Labor Statistics (BLS) Current Employment Statistics Survey data using the North American Industry Classification System (NAICS). Transportation-related employment was 8.7% of total employment in 2018.

Table 11.19
Transportation-Related Employment, 1990, 2000, and 2018[a]
(thousands)

	1990	2000	2018	Percent change 1990-2018
Truck transportation (includes drivers)	1,122.6	1,406.1	1,491.9	32.9%
Transit and ground transportation	274.2	372.1	487.5	77.8%
Air transportation	529.2	614.4	501.3	-5.3%
Rail transportation	271.8	231.7	214.1	-21.2%
Water transportation	56.8	56.0	64.8	14.1%
Pipeline transportation	59.8	46.0	48.5	-18.9%
Motor vehicle and parts - retail	1,494.4	1,846.9	2,021.2	35.3%
Motor vehicles and parts - wholesale	313.8	360.8	348.7	11.1%
Gasoline stations - retail	910.2	935.7	934.0	2.6%
Automotive repair and maintenance	659.4	888.1	937.8	42.2%
Automotive equipment rental and leasing	163.2	208.3	219.9	34.7%
Manufacturing (subtotal)	2,224.9	2,143.9	1,759.8	-20.9%
Cars and light trucks	*238.8*	*237.4*	*201.6*	*-15.6%*
Heavy-duty trucks	*32.7*	*54.0*	*32.0*	*-2.1%*
Motor vehicle bodies and trailers	*129.8*	*182.7*	*165.3*	*27.3%*
Motor vehicle parts	*653.0*	*839.5*	*597.1*	*-8.6%*
Aerospace products and parts	*840.7*	*516.7*	*509.4*	*-39.4%*
Railroad rolling stock	*65.9*	*72.7*	*57.6*	*-12.6%*
Ship & boat building	*173.7*	*154.1*	*139.4*	*-19.7%*
Tires	*90.3*	*86.8*	*57.4*	*-36.4%*
Oil and gas pipeline construction	86.0	72.2	167.6	94.9%
Highway street and bridge construction	288.5	340.1	343.9	19.2%
Scenic & sightseeing	15.7	27.5	34.2	117.8%
Support activities for transportation	364.1	537.4	711.8	95.5%
Couriers and messengers	375.0	605.0	725.4	93.4%
Travel arrangement and reservation services	250.0	298.6	219.0	-12.4%
Total transportation-related employment	**11,684.5**	**13,134.7**	**12,991.2**	**11.2%**
Total nonfarm employment	109,976.0	133,555.0	149,074.0	37.5%
Transportation-related to total employment	10.6%	9.8%	8.7%	

Source:
Tabulated from the U.S. Department of Labor, Bureau of Labor Statistics, Current Employment Statistics, www.bls.gov/ces/data.htm, April 2019. (Additional resources: www.bls.gov)

[a] Not seasonally adjusted.

The total number of employees involved in the manufacture of motor vehicles decreased by 14% from 1990 to 2018 and by 9% for those involved in the manufacture of motor vehicle parts. The total number of employees and production workers has risen each year since 2009. Beginning in 2008, the share of production workers fell below 80% for manufacturers of both vehicles and parts and remained below 80% for motor vehicle parts.

Table 11.20
U.S. Employment for Motor Vehicles and Motor Vehicle Parts Manufacturing, 1990–2018[a]

Year	All employees (thousands)	Production workers (thousands)	Share of production workers to total employees
	Motor vehicles		
1990	271.4	243.4	89.7%
1995	294.7	273.7	92.9%
2000	291.4	251.0	86.1%
2001	278.7	236.4	84.8%
2002	265.4	220.8	83.2%
2003	264.6	217.1	82.0%
2004	255.9	208.0	81.3%
2005	247.6	198.6	80.2%
2006	236.5	191.8	81.1%
2007	220.0	177.3	80.6%
2008	191.6	151.1	78.9%
2009	146.4	114.2	78.0%
2010	152.6	120.7	79.1%
2011	157.9	124.7	79.0%
2012	167.6	134.7	80.4%
2013	181.5	150.1	82.7%
2014	194.0	160.8	82.9%
2015	200.8	161.6	80.5%
2016	211.8	168.9	79.7%
2017	218.9	173.8	79.4%
2018	233.6	187.0	80.1%
	Motor vehicle parts		
1990	653.0	527.4	80.8%
1995	786.9	647.7	82.3%
2000	839.5	676.7	80.6%
2001	774.7	624.9	80.7%
2002	733.6	590.9	80.5%
2003	707.8	567.6	80.2%
2004	692.1	561.6	81.1%
2005	678.1	553.9	81.7%
2006	654.7	533.7	81.5%
2007	607.9	488.9	80.4%
2008	543.7	430.6	79.2%
2009	413.7	317.8	76.8%
2010	418.9	323.3	77.2%
2011	445.5	345.0	77.4%
2012	482.8	365.3	75.7%
2013	508.7	385.2	75.7%
2014	537.0	415.9	77.4%
2015	564.9	436.7	77.3%
2016	581.2	448.6	77.2%
2017	589.2	453.3	76.9%
2018	597.1	457.4	76.6%

Source:
Tabulated from the U.S. Department of Labor, Bureau of Labor Statistics, Current Employment Statistics, www.bls.gov/ces/data.htm, April 2019. (Additional resources: www.bls.gov)

[a] Not seasonally adjusted.

Chapter 12
Greenhouse Gas Emissions

Summary Statistics from Tables/Figures in this Chapter

Source			
Table 12.1	Carbon dioxide emissions (million metric tons)	1990	2018
	United States	*4,989*	*5,211*
	OECD Europe	*4,149*	*3,972*
	China	*2,293*	*10,194*
	Russia	*2,393*	*1,623*
	Japan	*1,054*	*1,121*
	Non-OECD Europe and Eurasia	*4,246*	*2,664*
	India	*573*	*2,251*
Table 12.5	Transportation share of U.S. carbon dioxide emissions from fossil fuel consumption		
	1990		*31.2%*
	2007		*32.6%*
	2017		*37.1%*
Table 12.7	Motor gasoline share of transportation carbon dioxide emissions, 2017		60.5%
Table 12.11	Average annual carbon footprint, 2018 (metric tons of CO_2)		
	New cars		*5.7*
	New light trucks		*7.8*

The U.S. accounted for 23% of the World's carbon dioxide emissions in 1990, 21% in 2005, and only 15% in 2018. About 45% of the U.S. carbon emissions are from oil use.

Table 12.1
World Carbon Dioxide Emissions, 1990, 2005, and 2018

	1990		2005		2018	
Country/Region	Million metric tons	Percent of emissions from oil use	Million metric tons	Percent of emissions from oil use	Million metric tons	Percent of emissions from oil use
OECD[a] Americas						
United States	4,989	44%	5,985	44%	5,211	45%
Canada	471	48%	620	49%	600	49%
Mexico/Chile	302	77%	461	66%	500	57%
Total	5,762	46%	7,066	46%	6,310	47%
OECD[a] Europe	4,149	45%	4,488	49%	3,972	48%
OECD[a] Asia						
Japan	1,054	65%	1,241	52%	1,121	41%
Australia/New Zealand	298	38%	438	55%	413	41%
Other	243	59%	494	30%	692	44%
Total	1,595	59%	2,173	47%	2,225	42%
Non-OECD Europe & Eurasia						
Russia	2,393	33%	1,548	25%	1,623	31%
Other	1,853	32%	1,120	26%	1,041	28%
Total	4,246	32%	2,668	25%	2,664	30%
Non-OECD Asia						
China	2,293	15%	5,490	16%	10,194	17%
India	573	28%	1,182	27%	2,251	28%
Other	811	57%	1,665	53%	2,572	49%
Total	3,677	26%	8,337	25%	15,016	24%
Other Non-OECD						
Middle East	704	70%	1,333	59%	2,062	57%
Africa	659	46%	978	43%	1,369	47%
Central & South America	695	76%	1,011	72%	1,236	69%
Total	2,058	64%	3,322	58%	4,666	113%
Total World	21,487	42%	28,054	40%	34,854	37%

Note: The *International Energy Agency Outlook 2018* does not include world carbon dioxide emissions. The 2018 forecast from the 2017 report was used.

Source:
U.S. Department of Energy, Energy Information Administration, International Energy Statistics Databases, and *International Energy Outlook 2017*, Washington, DC, September 2017. (Additional resources: www.eia.doe.gov)

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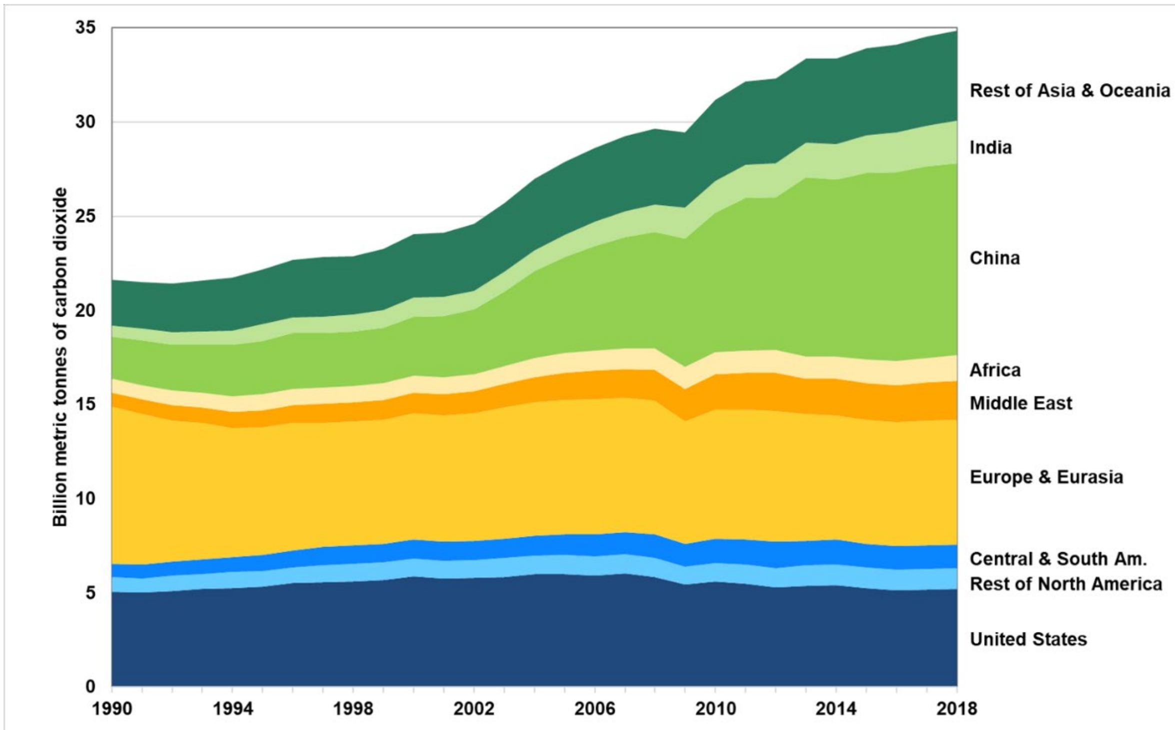
[a] OECD is the Organization for Economic Cooperation and Development. See Glossary for included countries.

Since 1990, China shows the greatest increase of carbon dioxide (CO_2) emissions. The Americas have increased CO_2 emissions by only 10% from 1990 to 2018. Europe and Eurasia have fewer CO_2 emissions in 2018 than 1990.

Figure 12.1. World Carbon Dioxide Emissions, 1990–2018



Source:
1990–2012: U.S. Department of Energy, Energy Information Administration, *International Energy Statistics*, Total Carbon Dioxide Emissions from the Consumption of Energy, www.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm, September 2016.
2013–2018: U.S. Department of Energy, Energy Information Administration, *International Energy Outlook 2017*, www.eia.gov/forecasts/ieo/index.cfm, accessed August 2019. (Additional resources: www.eia.doe.gov)

Global Warming Potentials (GWP) were developed to allow comparison of the ability of each greenhouse gas to trap heat in the atmosphere relative to carbon dioxide. Extensive research has been performed and it has been discovered that the effects of various gases on global warming are too complex to be precisely summarized by a single number. Further understanding of the subject also causes frequent changes to estimates. Despite that, the scientific community has developed approximations, the latest of which are shown below. Most analysts use the 100-year time horizon.

Table 12.2
Numerical Estimates of Global Warming Potentials Compared with Carbon Dioxide
(kilogram of gas per kilogram of carbon dioxide)

Gas	Lifetime (years)	Global warming potential direct effect for time horizons of	
		20 years	100 years
Carbon Dioxide (CO_2)	5-200[a]	1	1
Methane (CH_4)[b]	12.4	86	34
Tetrafluoroethane (HFC-134a)	13.4	3,790	1,550
Trichlorofluoromethane (CFC-11)	45	7,020	5,350
Nitrous Oxide (N_2O)	121	268	298
Perfluoromethane (CF_4)	50,000	4,950	7,350

Note: Includes climate-carbon feedbacks.

Source:

Myhre, G., D. Shindell, F.-M. Breon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forcing. In: *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, R.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Zia, V. Bex and P.M. Midgley (eds)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[a] No single lifetime can be defined for carbon dioxide due to different rates of uptake by different removal processes.

[b] These values do not include carbon dioxide from methane oxidation. Perturbation lifetime is used in the calculation of metrics.

Carbon dioxide emissions in 2017 were 3% higher than in 1990, but down from the highest annual emissions of this data series in 2007. Carbon dioxide accounts for the majority (81%) of greenhouse gases.

Table 12.3
U.S. Emissions of Greenhouse Gases, Based on Global Warming Potential, 1990–2017
(million metric tons of carbon dioxide equivalent[a])

Year	Carbon dioxide	Methane	Nitrous oxide	High GWP gases[b]	Total
1990	5,088.0	779.7	370.1	99.6	6,337.4
1995	5,396.4	767.8	388.3	117.0	6,669.5
1996	5,584.9	759.5	395.5	127.6	6,867.5
1997	5,660.2	745.0	386.7	134.9	6,926.8
1998	5,707.9	729.6	402.5	150.6	6,990.6
1999	5,779.6	717.5	376.9	147.4	7,021.4
2000	5,951.7	709.2	376.9	148.4	7,186.2
2001	5,846.9	703.8	377.9	135.0	7,063.6
2002	5,890.7	694.7	376.2	142.8	7,104.4
2003	5,933.4	695.3	380.0	132.7	7,141.4
2004	6,046.1	687.4	400.1	139.8	7,273.4
2005	6,072.8	691.4	375.8	141.3	7,281.3
2006	5,991.7	691.9	384.4	143.5	7,211.5
2007	6,076.1	694.4	393.0	154.3	7,317.8
2008	5,878.9	702.1	374.4	155.6	7,111.0
2009	5,446.4	692.5	373.1	149.8	6,661.8
2010	5,653.7	697.4	382.7	158.1	6,891.9
2011	5,526.8	675.5	375.0	164.2	6,741.5
2012	5,323.6	665.3	348.9	159.9	6,497.7
2013	5,474.8	662.9	365.4	158.9	6,662.0
2014	5,525.6	662.1	362.7	163.1	6,713.5
2015	5,376.5	661.3	374.1	165.3	6,577.2
2016	5,260.0	654.7	364.4	166.3	6,445.4
2017	5,224.3	656.3	360.5	169.1	6,410.2
		Average annual percent change			
1990-2017	0.1%	-0.6%	-0.1%	2.0%	0.0%
2007-2017	-1.5%	-0.6%	-0.9%	0.9%	-1.3%

Note: This greenhouse gas emissions inventory includes fossil fuel combustion, use of fluorinated gases and other transportation categories.

Source:
U.S. Environmental Protection Agency, *Inventory of U. S. Greenhouse Gas Emissions and Sinks: 1990-2017,* April 11, 2019, EPA 430-R-19-001. (Additional resources: www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2017)

[a] Carbon dioxide equivalents are computed by multiplying the weight of the gas being measured by its estimated Global Warming Potential (See Table 12.2).

[b] GWP = Global warming potential. Includes HFC-hydrofluorocarbons; PFC-perfluorocarbons; and SF_6-sulfur hexaflouride.

The transportation sector accounted for 34.7% of carbon dioxide emissions and 29.2% of all greenhouse gas emissions in 2017. The industrial sector is the only sector that accounts for more greenhouse gas emissions than the transportation sector.

Table 12.4
Total U.S. Greenhouse Gas Emissions by End-Use Sector, 2017
(million metric tons of carbon dioxide equivalent[a])

	Carbon dioxide	Methane	Nitrous oxide	Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride	Total greenhouse gas emissions
Residential	917.2	4.2	9.7	33.4	964.5
Commercial	844.7	125.7	16.0	52.1	1,038.5
Agricultural	85.7	248.8	286.3	0.1	620.9
Industrial	1,562.2	276.2	33.9	43.4	1,915.7
Transportation	1,814.5	1.4	14.6	40.1	1,870.6
Total greenhouse gas emissions	**5,224.3**	**656.3**	**360.5**	**169.1**	**6,410.2**
Transportation share of total	34.7%	0.2%	4.0%	23.7%	29.2%

Note: Does not include U.S. territories. Totals may not sum due to rounding.

Source:
U.S. Environmental Protection Agency, *Inventory of U. S. Greenhouse Gas Emissions and Sinks: 1990-2017,* April 11, 2019, EPA 430-R-19-001. (Additional resources: www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2017)

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[a] Carbon dioxide equivalents are computed by multiplying the weight of the gas being measured by its estimated Global Warming Potential (See Table 12.2).

The transportation sector accounts for approximately one-third of carbon dioxide emissions. The commercial sector accounts for the lowest share of carbon dioxide emissions.

Table 12.5
U.S. Carbon Emissions from Fossil Fuel Consumption by End-Use Sector, 1990–2017[a]
(million metric tons of carbon dioxide)

	End use sector				Transportation	CO_2 from
	Residential	Commercial	Industrial	Transportation	percentage	all sectors
1990	930.9	764.3	1,543.9	1,472.1	31.2%	4,711.2
1991	948.9	769.5	1,514.1	1,425.5	30.6%	4,658.0
1992	944.9	763.3	1,570.2	1,480.7	31.1%	4,759.1
1993	997.5	784.9	1,582.3	1,511.7	31.0%	4,876.4
1994	988.8	796.9	1,605.7	1,556.9	31.5%	4,948.3
1995	994.5	814.4	1,610.9	1,583.5	31.6%	5,003.3
1996	1,055.3	846.1	1,666.7	1,630.2	31.4%	5,198.3
1997	1,044.9	886.9	1,682.7	1,646.4	31.3%	5,260.9
1998	1,049.5	905.2	1,660.8	1,681.8	31.7%	5,297.3
1999	1,070.3	914.6	1,629.7	1,749.2	32.6%	5,363.8
2000	1,133.0	977.2	1,661.5	1,782.8	32.1%	5,554.5
2001	1,124.7	983.6	1,603.6	1,762.1	32.2%	5,474.0
2002	1,151.8	982.4	1,578.3	1,803.3	32.7%	5,515.8
2003	1,181.8	993.9	1,596.7	1,796.8	32.3%	5,569.2
2004	1,179.3	1,010.5	1,623.6	1,841.7	32.6%	5,655.1
2005	1,213.9	1,029.7	1,589.7	1,861.7	32.7%	5,695.0
2006	1,151.4	1,010.1	1,589.1	1,857.3	33.1%	5,607.9
2007	1,204.3	1,051.8	1,586.4	1,859.9	32.6%	5,702.4
2008	1,190.3	1,043.2	1,522.5	1,764.9	32.0%	5,520.9
2009	1,122.8	981.3	1,351.8	1,692.0	32.9%	5,147.9
2010	1,175.0	997.8	1,441.3	1,701.9	32.0%	5,316.0
2011	1,117.1	963.1	1,425.8	1,681.5	32.4%	5,187.5
2012	1,008.0	901.2	1,403.5	1,670.5	33.5%	4,983.2
2013	1,064.1	929.1	1,434.8	1,686.9	33.0%	5,114.9
2014	1,080.9	938.5	1,412.5	1,726.0	33.5%	5,157.9
2015	1,001.6	908.5	1,357.4	1,738.2	34.7%	5,005.7
2016	946.3	865.8	1,325.2	1,783.2	36.2%	4,920.5
2017	911.5	839.1	1,315.1	1,804.9	37.1%	4,870.6
	Average annual percentage change					
1990-2017	-0.1%	0.3%	-0.6%	0.8%		0.1%
2007-2017	-2.7%	-2.2%	-1.9%	-0.3%		-1.6%

Note: The CO_2 from all sectors does not match Table 11.3 since it is only from fossil fuel consumption and does not include the use of fluorinated gases and other transportation categories. U.S. territories are not included.

Source:
U.S. Environmental Protection Agency, *Inventory of U. S. Greenhouse Gas Emissions and Sinks: 1990-2017,* April 11, 2019, EPA 430-R-19-001. (Additional resources: www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2017)

[a] Includes energy from petroleum, coal, and natural gas. Electric utility emissions are distributed across consumption sectors.

This report has typically displayed carbon and carbon dioxide data from the Environmental Protection Agency (EPA). However, the Energy Information Administration's (EIA's) Monthly Energy Review *also includes carbon dioxide emission data. The differences in the two-data series have been about 5-7%, but as high as 8.5% in 1991. Reasons for the differences include the treatment of international bunker fuel, nonfuel use of fossil fuels, and the agencies' use of different fuel consumption control totals.*

Table 12.6
Transportation Sector Carbon Dioxide Emissions from Energy Consumption, 1973-2018
(million metric tons of carbon dioxide)

Year	Energy Information Administration's *Monthly Energy Review*	Environmental Protection Agency's Greenhouse Gas Inventory Report	Percentage difference
1973	1,315.2	[a]	[a]
1975	1,291.6	[a]	[a]
1980	1,400.2	[a]	[a]
1985	1,421.2	[a]	[a]
1990	1,587.6	1,484.0	6.5%
1991	1,567.9	1,436.1	8.4%
1992	1,591.6	1,491.6	6.3%
1993	1,604.2	1,522.8	5.1%
1994	1,644.1	1,568.4	4.6%
1995	1,678.5	1,594.9	5.0%
1996	1,723.8	1,641.2	4.8%
1997	1,742.2	1,658.0	4.8%
1998	1,779.4	1,693.9	4.8%
1999	1,825.6	1,761.5	3.5%
2000	1,869.7	1,795.0	4.0%
2001	1,849.1	1,773.2	4.1%
2002	1,889.8	1,814.3	4.0%
2003	1,890.7	1,806.9	4.4%
2004	1,957.4	1,852.0	5.4%
2005	1,984.2	1,872.0	5.7%
2006	2,012.3	1,867.3	7.2%
2007	2,017.9	1,870.2	7.3%
2008	1,893.3	1,774.4	6.3%
2009	1,824.5	1,700.5	6.8%
2010	1,842.9	1,712.3	7.1%
2011	1,809.0	1,691.6	6.5%
2012	1,773.4	1,679.7	5.3%
2013	1,796.4	1,696.6	5.6%
2014	1,814.9	1,736.1	4.3%
2015	1,838.8	1,749.2	4.9%
2016	1,871.0	1,793.6	4.1%
2017	1,887.5	1,814.5	3.9%
2018	1,915.2	[a]	[a]

Sources:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, July 2019, Washington, DC, Table 11.5.
U.S. Environmental Protection Agency, *Inventory of U. S. Greenhouse Gas Emissions and Sinks: 1990-2017,* April 11, 2019, EPA 430-R-19-001. (Additional resources: www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2017)

[a] Data are not available.

Most U.S. transportation sector carbon dioxide emissions come from petroleum fuels. Motor gasoline has been responsible for 60%-65% of U.S. carbon dioxide emissions over the last 27 years.

Table 12.7
U.S. Carbon Emissions from Fossil Fuel Combustion in the Transportation End-Use Sector, 1990–2017
(million metric tons of carbon dioxide equivalent)

Year	Motor gasoline	LPG[a]	Jet fuel	Distillate fuel	Residual fuel	Aviation gas	Natural gas	Electricity[b]	Total
1990	958.9	1.4	184.3	262.9	22.6	3.1	36.0	3.0	1,472.2
1991	944.6	1.3	168.8	255.2	16.9	2.9	32.9	3.0	1,425.6
1992	973.7	1.2	166.6	271.1	30.0	2.8	32.2	3.0	1,480.6
1993	987.2	1.2	168.2	287.6	27.6	2.7	34.2	3.0	1,511.7
1994	999.7	2.1	175.5	309.4	26.9	2.6	37.6	3.1	1,556.9
1995	1,013.1	1.1	172.2	323.9	29.1	2.7	38.4	3.1	1,583.6
1996	1,036.5	1.0	184.5	339.9	23.6	2.6	39.1	3.1	1,630.3
1997	1,048.8	0.9	184.5	354.8	10.3	2.7	41.4	3.1	1,646.5
1998	1,079.4	1.1	188.4	366.0	5.9	2.5	35.3	3.2	1,681.8
1999	1,113.0	0.9	192.4	387.9	13.2	2.7	35.8	3.2	1,749.1
2000	1,110.1	0.7	194.9	402.1	33.3	2.5	35.7	3.4	1,782.7
2001	1,118.4	0.8	189.6	400.3	12.0	2.4	34.9	3.6	1,762.0
2002	1,143.7	0.9	185.3	413.4	17.1	2.3	37.1	3.5	1,803.3
2003	1,147.4	1.1	179.3	422.0	7.4	2.1	33.3	4.3	1,796.9
2004	1,164.1	1.2	186.6	437.1	14.0	2.2	31.9	4.5	1,841.6
2005	1,153.6	1.7	189.4	457.5	19.3	2.4	33.1	4.7	1,861.7
2006	1,141.9	1.7	182.3	468.6	23.0	2.3	33.1	4.5	1,857.4
2007	1,134.8	1.4	179.5	472.8	29.0	2.2	35.2	5.1	1,860.0
2008	1,077.6	2.5	173.1	448.1	20.4	2.0	36.7	4.7	1,765.1
2009	1,072.0	1.7	154.1	406.0	13.9	1.8	37.9	4.5	1,691.9
2010	1,062.9	0.6	151.5	422.0	20.4	1.9	38.2	4.5	1,702.0
2011	1,039.8	0.6	146.6	430.0	19.4	1.9	38.9	4.3	1,681.5
2012	1,036.1	0.6	143.4	427.5	15.8	1.7	41.4	4.0	1,670.5
2013	1,037.4	0.6	147.1	433.9	15.1	1.5	47.0	4.3	1,686.9
2014	1,077.4	0.6	148.4	447.7	5.8	1.5	40.2	4.5	1,726.1
2015	1,070.0	0.6	157.6	460.8	4.2	1.5	39.4	4.3	1,738.4
2016	1,095.3	0.6	166.1	462.6	12.9	1.4	40.1	4.2	1,783.2
2017	1,092.3	0.6	171.7	475.8	16.5	1.4	42.3	4.3	1,804.9
				Average annual percentage change					
1990-2017	0.5%	-3.1%	-0.3%	2.2%	-1.2%	-2.9%	0.6%	1.3%	0.8%
2007-2017	-0.4%	-8.1%	-0.4%	0.1%	-5.5%	-4.4%	1.9%	-1.7%	-0.3%

Note: Emissions from U.S. Territories are not included. Emissions from International Bunker Fuels are not included.

Source:
U.S. Environmental Protection Agency, *Inventory of U. S. Greenhouse Gas Emissions and Sinks: 1990-2017,* April 11, 2019, EPA 430-R-19-001. (Additional resources: www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2017)

[a] Liquefied petroleum gas.
[b] Share of total electric utility carbon dioxide emissions weighted by sales to the transportation sector.

Highway vehicles are responsible for the majority of greenhouse gas emissions in the transportation sector.

Table 12.8
Transportation Carbon Dioxide Emissions by Mode, 1990–2017
(Million metric tons of carbon dioxide equivalent)

Year	Passenger Vehicles	Heavy Trucks	Highway Total	Water	Air	Rail	Pipeline	Total
1990	926.2	237.7	1,163.9	46.4	187.4	38.5	36.0	1,472.2
1991	911.3	232.2	1,143.5	41.1	171.7	36.4	32.9	1,425.6
1992	942.7	242.8	1,185.5	56.3	169.4	37.4	32.2	1,480.8
1993	959.4	255.8	1,215.2	53.1	170.9	38.3	34.2	1,511.7
1994	972.6	272.8	1,245.4	54.6	178.1	41.2	37.6	1,556.9
1995	986.4	283.2	1,269.6	58.0	174.9	42.7	38.4	1,583.6
1996	1,010.2	295.5	1,305.7	55.0	187.1	43.4	39.1	1,630.3
1997	1,023.2	309.5	1,332.7	41.7	187.2	43.5	41.4	1,646.5
1998	1,053.8	322.9	1,376.7	35.1	190.9	43.9	35.2	1,681.8
1999	1,087.3	341.7	1,429.0	43.9	195.1	45.4	35.7	1,749.1
2000	1,084.3	355.7	1,440.0	64.4	197.4	45.5	35.5	1,782.8
2001	1,094.3	353.6	1,447.9	41.8	192.0	45.8	34.6	1,762.1
2002	1,120.3	366.8	1,487.1	46.5	187.6	45.4	36.7	1,803.3
2003	1,134.9	364.2	1,499.1	36.5	181.4	47.1	32.8	1,796.9
2004	1,153.1	379.5	1,532.6	39.1	188.8	49.6	31.3	1,841.4
2005	1,135.9	407.1	1,543.0	44.3	191.8	50.2	32.4	1,861.7
2006	1,124.8	416.1	1,540.9	47.2	184.6	52.2	32.4	1,857.3
2007	1,094.0	444.8	1,538.8	53.6	181.7	51.3	34.4	1,859.8
2008	1,035.5	426.7	1,462.2	44.2	175.1	47.6	35.9	1,765.0
2009	1,033.6	387.3	1,420.9	37.6	155.9	40.4	37.1	1,691.9
2010	1,025.7	399.3	1,425.0	43.1	153.4	43.1	37.3	1,701.9
2011	1,007.2	398.6	1,405.8	44.4	148.5	44.7	38.1	1,681.5
2012	1,003.9	399.7	1,403.6	38.0	145.1	43.4	40.6	1,670.7
2013	1,004.6	406.1	1,410.7	37.2	148.6	44.1	46.2	1,686.8
2014	1,044.7	420.1	1,464.8	26.4	149.9	45.6	39.4	1,726.1
2015	1,038.1	428.3	1,466.4	30.8	159.1	43.6	38.5	1,738.4
2016	1,062.8	436.0	1,498.8	37.5	167.5	40.2	39.2	1,783.2
2017	1,059.0	449.7	1,508.7	40.2	173.1	41.3	41.4	1,804.7
			Average annual percentage change					
1990-2017	0.5%	2.4%	1.0%	-0.5%	-0.3%	0.3%	0.5%	0.8%
2007-2017	-0.3%	0.1%	-0.2%	-2.8%	-0.5%	-2.1%	1.9%	-0.3%

Note: Emissions from U.S. Territories are not included. Emissions from International Bunker Fuels are not included. Passenger vehicles include cars, light trucks and motorcycles. Heavy trucks include medium and heavy trucks and buses.

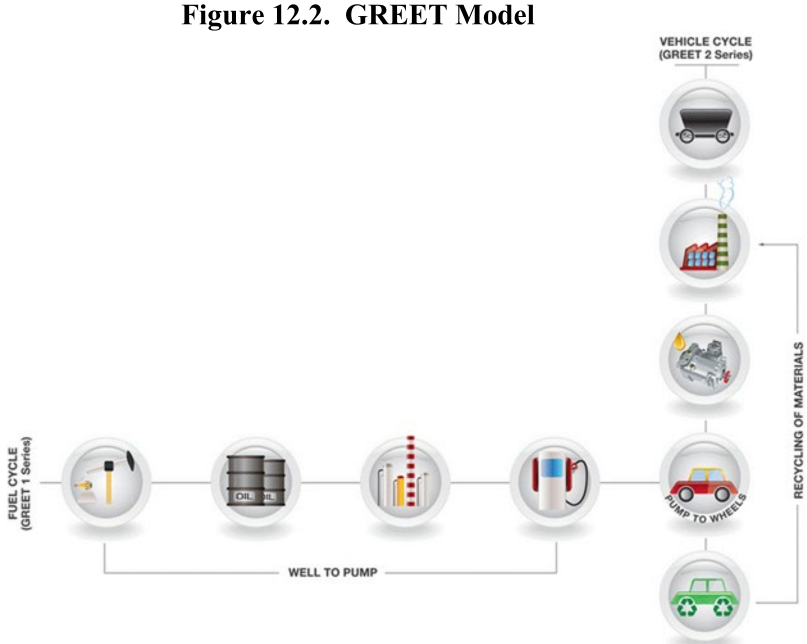
Source:
U.S. Environmental Protection Agency, *Inventory of U. S. Greenhouse Gas Emissions and Sinks: 1990-2017,* April 11, 2019, EPA 430-R-19-001. (Additional resources: www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2017)

The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model

greet.es.anl.gov

Sponsored by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE), Argonne has developed a full life-cycle model called GREET® (Greenhouse gases, Regulated Emissions, and Energy use in Transportation). It allows researchers and analysts to evaluate energy and environmental impacts of various vehicle and fuel combinations on a life-cycle basis. The first version of GREET was released in 1996. Since then, Argonne has continued to update and expand the model. The most recent GREET versions are GREET 1 2018 version for fuel-cycle analysis and GREET 2 2018 version for vehicle-cycle analysis.

Figure 12.2. GREET Model



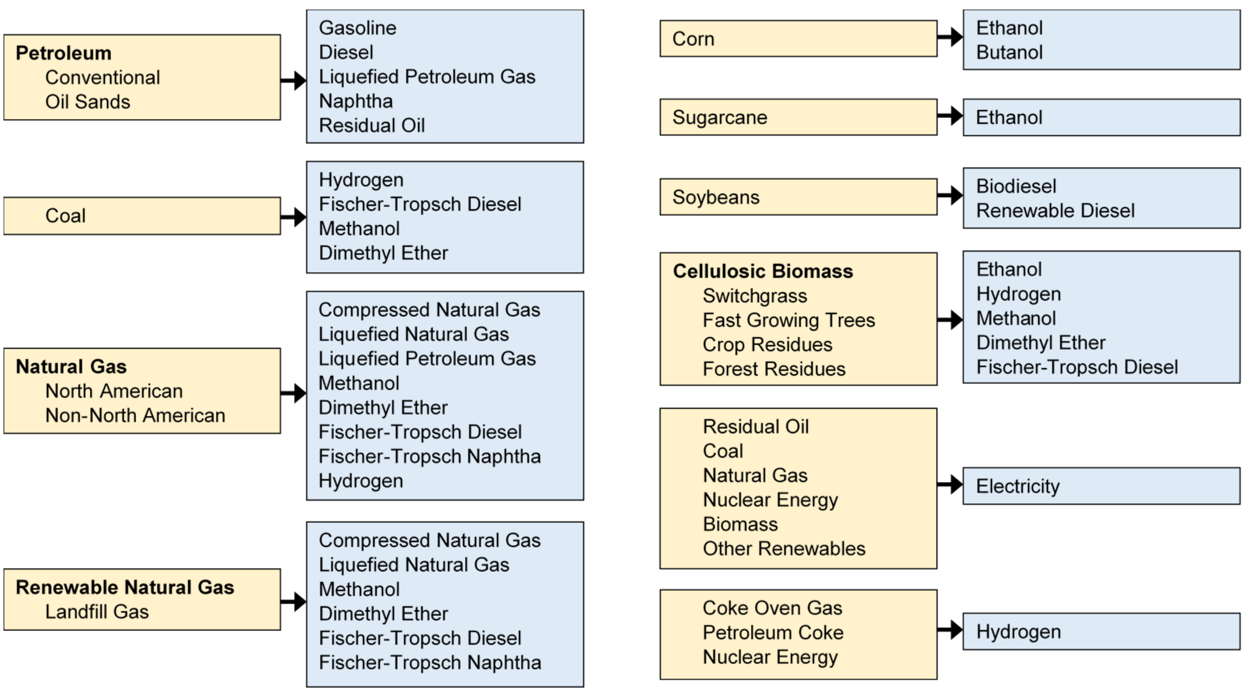
For a given vehicle and fuel system, GREET separately calculates the following:

- Consumption of total resources (energy in non-renewable and renewable sources), fossil fuels (petroleum, natural gas, and coal together), petroleum, coal, natural gas, and water.
- Emissions of CO_2-equivalent greenhouse gases - primarily carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

- Emissions of seven criteria pollutants: volatile organic compounds (VOCs), carbon monoxide (CO), nitrogen oxide (NOx), particulate matter with size smaller than 10 micron (PM_{10}), particulate matter with size smaller than 2.5 micron ($PM_{2.5}$), black carbon (BC) and sulfur oxides (SOx).

GREET includes more than 100 fuel production pathways and more than 80 vehicle/fuel systems. These vehicle/fuel systems cover current and advanced vehicle technologies such as conventional spark-ignition engine vehicles, compression-ignition engine vehicles, hybrid electric vehicles, plug-in hybrid electric vehicles, battery-powered electric vehicles and fuel-cell electric vehicles. GREET also evaluates transportation modes other than light-duty vehicles, such as heavy-duty vehicles, aviation, rail and marine.

Figure 12.3. GREET Model Feedstocks and Fuels

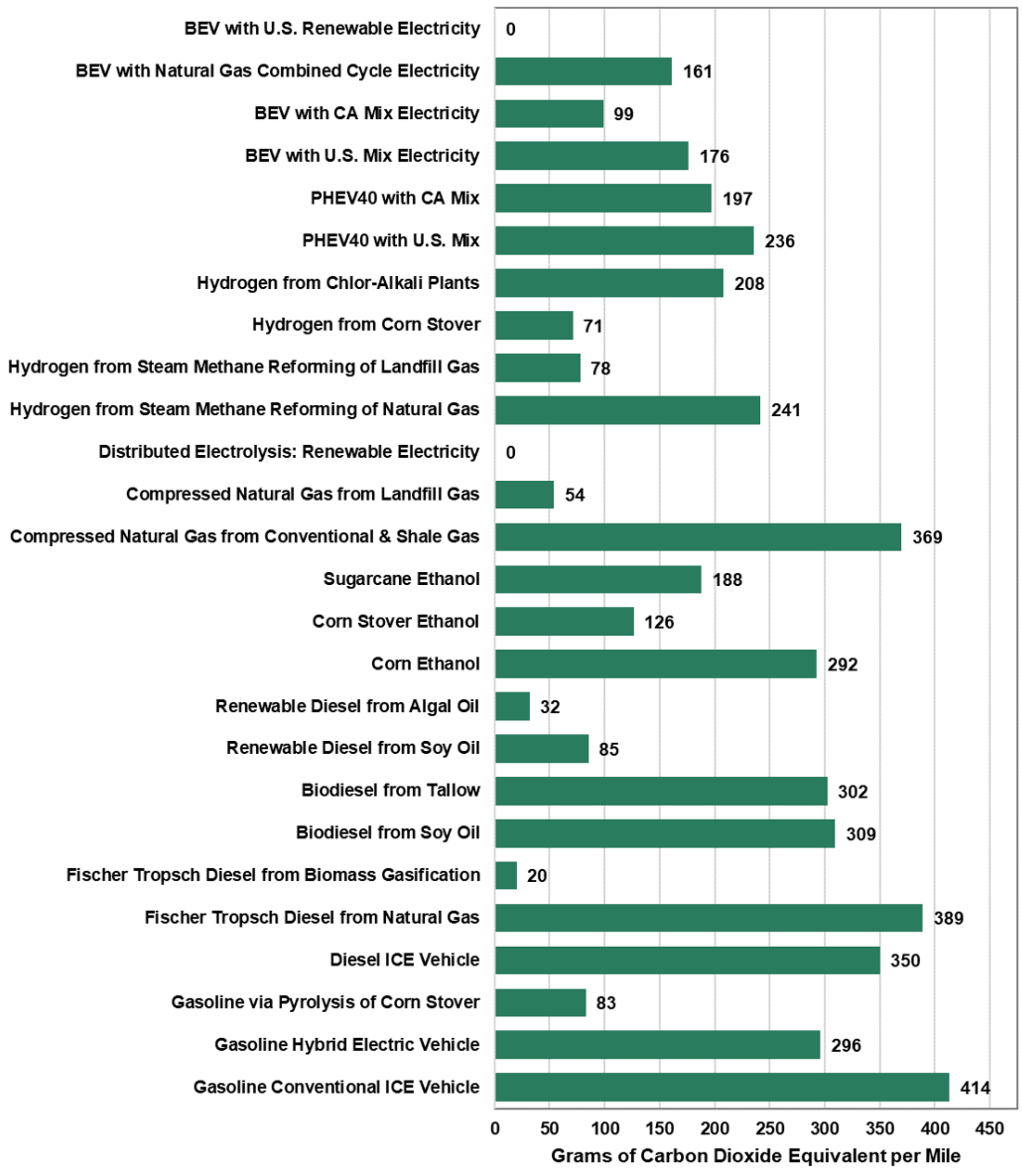


To address technology improvements over time, GREET 2018 simulates current and future vehicle/fuel systems up to year 2050.

For additional information about the GREET model and associated documentation, please visit the GREET website www.greet.es.anl.gov, or contact greet@anl.gov.

Results from the GREET 1 2018 model on emissions of carbon dioxide equivalents per mile are shown for various fuels and vehicle technologies. A full description of the model is on the preceding pages.

Figure 12.4. Well-to-Wheel Emissions for Various Fuels and Vehicle Technologies

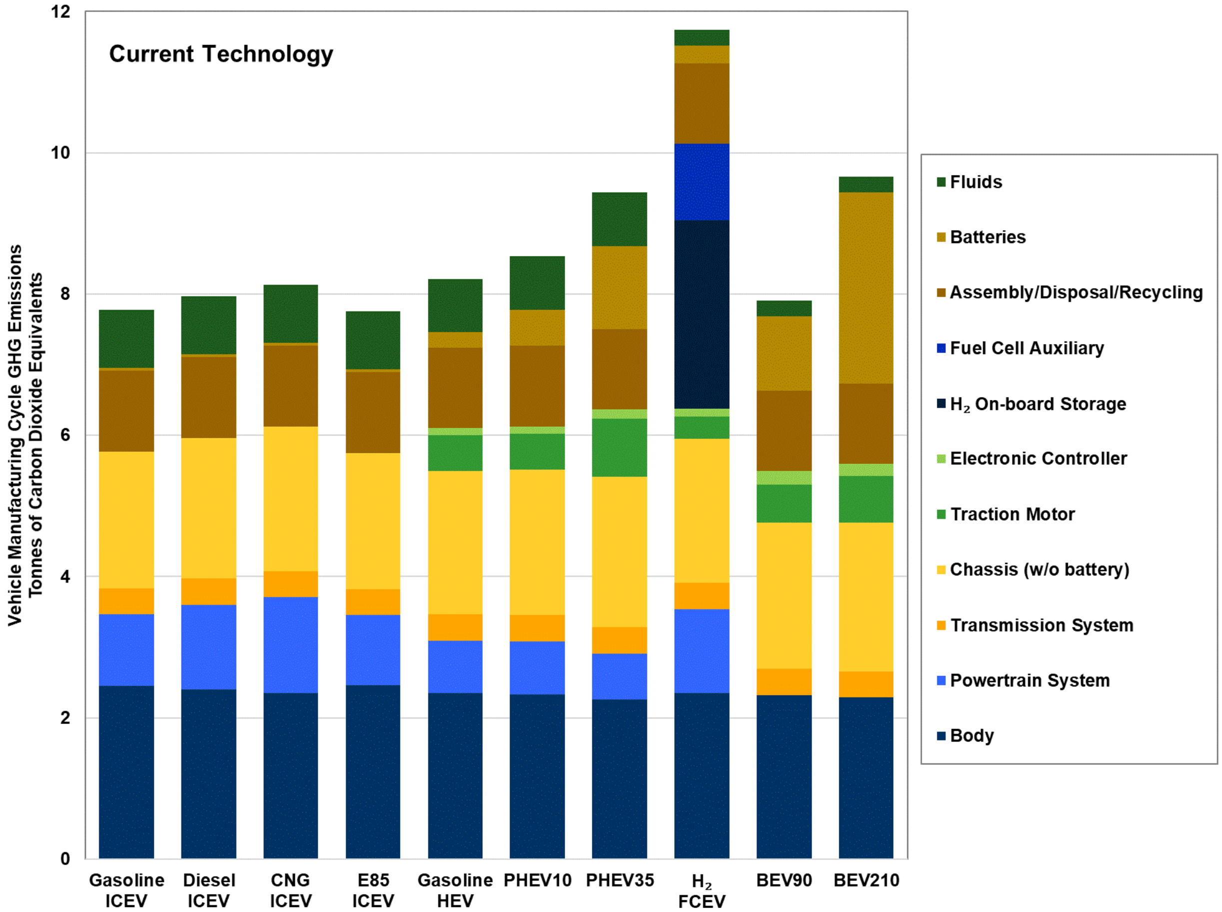


Note: BEV = Battery-electric vehicle. PHEV40 = Plug-in hybrid electric vehicle with 40-mile electric range.

Source:
Argonne National Laboratory, GREET WTW Calculator and Sample Results from GREET 1 2018, greet.es.anl.gov/results. (Additional resources: greet.es.anl.gov)

Greenhouse gas emissions associated with vehicle manufacturing (current technology) were estimated using the GREET model. Emissions from manufacturing the vehicle body are just over two tonnes of carbon dioxide equivalent for each of the vehicle types. Emissions from the manufacture of the hydrogen on-board storage and fuel cell auxiliary cause the total emissions associated with the manufacture of a hydrogen fuel cell vehicle to be higher than the other vehicle types.

Figure 12.5. Vehicle Manufacturing Cycle Greenhouse Gas Emissions by Vehicle Component



Note: GHG = greenhouse gases. ICEV = internal combustion engine vehicle. CNG = compressed natural gas. E-85 = fuel with approximately 85% ethanol and 15% gasoline. HEV = hybrid-electric vehicle. PHEV10 = Plug-in electric vehicle with 10-mile electric range. PHEV35 = Plug-in hybrid electric vehicle with 35-mile electric range. H_2FCEV = Hydrogen fuel cell electric vehicle. BEV90 = Battery-electric vehicle with a 90-mile range. BEV210 = Battery-electric vehicle with a 210-mile range.

Source:
Argonne National Laboratory, *Cradle-to-Grave Lifecycle Analysis of U.S. Light-Duty Vehicle-Fuel Pathways: A Greenhouse Gas Emissions and Economic Assessment of Current (2015) and Future (2025-2030) Technologies*, June 01, 2016, p. 143. (Additional resources: greet.es.anl.gov)

Carbon Footprint

The carbon footprint measures a vehicle's impact on climate change in tons of carbon dioxide (CO_2) emitted annually. The following three tables show the carbon footprint for various vehicle classes. The sales-weighted average fuel economy rating for each vehicle class, based on 45% highway and 55% city driving, is used to determine the average annual carbon footprint for vehicles in the class. An estimate of 15,000 annual miles is used for each vehicle class and for each year in the series.

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

where:

CO_2 = (Tailpipe CO_2 + Upstream Greenhouse Gases) in grams per million Btu

LHV = Lower (or net) Heating Value in million Btu <u>per gallon</u>

CH_4 = Tailpipe <u>CO_2 equivalent</u> methane in grams per mile

N_2O = Tailpipe <u>CO_2 equivalent</u> nitrous oxide in grams per mile

Note: The Environmental Protection Agency publishes tailpipe emissions in terms of grams of CO_2 per mile in the *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 through 2017*, www.epa.gov/fueleconomy/trends-report.

The production-weighted average annual carbon footprint for cars and car SUVs declined by about 2% annually between 1975 and 2018.

Table 12.9
Production-Weighted Annual Carbon Footprint of New Domestic and Import Cars
Model Years 1975–2018[a]
(metric tons of CO_2)

Model Year	Car	Car SUV[b]
1975	12.6	15.2
1980	8.5	11.6
1985	7.4	8.4
1986	7.1	8.9
1987	7.1	8.7
1988	7.0	8.8
1989	7.2	8.9
1990	7.3	9.0
1991	7.2	9.3
1992	7.3	9.5
1993	7.2	9.9
1994	7.3	9.4
1995	7.2	9.5
1996	7.3	9.2
1997	7.3	8.8
1998	7.3	9.3
1999	7.4	9.1
2000	7.4	9.5
2001	7.4	9.0
2002	7.3	8.8
2003	7.3	8.5
2004	7.3	8.5
2005	7.2	8.4
2006	7.3	8.3
2007	7.0	8.2
2008	7.0	8.0
2009	6.7	7.7
2010	6.5	7.4
2011	6.6	7.2
2012	6.2	7.3
2013	6.0	7.0
2014	6.0	6.9
2015	5.9	6.7
2016	5.8	6.5
2017	5.6	6.5
2018	5.5	6.3
Average annual percentage change		
1975–2018	-1.9%	-2.0%
2008–2018	-2.3%	-2.3%

Source:
Calculated using fuel economy from the U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. See page 11-15 for details. (Additional resources: https://www.epa.gov/automotive-trends)

[a] Annual carbon footprint is based on 15,000 miles of annual driving. Includes tailpipe plus upstream emissions.
[b] Car SUV category is defined in Table 4.9.

The production-weighted average annual footprint of pickups, vans, and truck SUVs decreased from 1975 to 2018. Truck SUVs experienced the greatest decline from 2008 to 2018.

Table 12.10
Production-Weighted Annual Carbon Footprint of New Domestic and Import Trucks
Model Years 1975–2018[a]
(metric tons of CO_2)

Model Year	Pickup	Van	Truck SUV[b]
1975	14.2	15.2	15.3
1980	10.2	12.0	12.8
1985	9.3	10.2	10.2
1990	9.7	9.5	10.3
1991	9.3	9.4	10.1
1992	9.7	9.4	10.4
1993	9.6	9.3	10.4
1994	9.7	9.5	10.6
1995	10.0	9.4	10.6
1996	9.9	9.2	10.4
1997	10.0	9.3	10.5
1998	10.0	9.1	10.5
1999	10.4	9.3	10.5
2000	10.2	9.1	10.6
2001	10.6	9.4	10.3
2002	10.7	9.1	10.4
2003	10.5	8.9	10.3
2004	10.7	8.8	10.3
2005	10.7	8.8	10.1
2006	10.5	8.7	9.9
2007	10.5	8.7	9.6
2008	10.3	8.5	9.3
2009	10.0	8.4	8.8
2010	10.0	8.4	8.6
2011	9.8	8.1	8.5
2012	9.8	8.0	8.5
2013	9.7	8.0	8.1
2014	9.4	8.0	7.8
2015	9.0	7.8	7.7
2016	8.9	7.8	7.6
2017	8.9	7.6	7.6
2018	8.8	7.4	7.4
Average annual percentage change			
1975–2018	-1.1%	-1.7%	-1.7%
2008–2018	-1.6%	-1.4%	-2.3%

Note: Light truck data include pickups, vans, and truck SUVs less than 8,500 lb. Beginning with 2011, SUV and passenger vans up to 10,000 lb were also included.

Source:
Calculated using fuel economy from the U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. See page 11-15 for details. (Additional resources: https://www.epa.gov/automotive-trends)

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[a] Annual carbon footprint is based on 15,000 miles of annual driving. Includes tailpipe plus upstream emissions.
[b] Truck SUV category includes all SUV not in the Car SUV category. Car SUV category is defined in Table 4.9.

Between 1975 and 2018, the production-weighted average annual carbon footprint for new light vehicles dropped dramatically. Total new cars experienced a decrease of 54.8% while the carbon footprint for light trucks decreased by 46.5%.

Table 12.11
Average Annual Carbon Footprint of New Vehicles by Vehicle Classification, Model Years 1975 and 2018[a]
(metric tons of CO_2)

Vehicle class	Production share: Model year 1975	Production share: Model year 2018	Carbon footprint: Model year 1975	Carbon footprint: Model year 2018	Percent change 1975 - 2018
Cars					
Car	80.6%	42.0%	12.6	5.5	-56.0%
Car SUV[b]	0.1%	9.7%	15.2	6.3	-58.2%
Total cars	80.7%	51.7%	12.6	5.7	-54.8%
Light trucks					
Van	4.5%	3.3%	15.2	7.4	-51.4%
Truck SUV[b]	1.7%	31.7%	15.3	7.4	-51.8%
Pickup	13.1%	13.3%	14.2	8.8	-38.1%
Total light trucks	19.3%	48.3%	14.5	7.8	-46.5%

Note: Light truck data include pickups, vans, and truck SUVs less than 8,500 lb. Beginning with 2011, SUV and passenger vans up to 10,000 lb were also included.

Source:
Calculated using fuel economy from the U.S. Environmental Protection Agency, *The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975*, EPA-420-R-19-002, March 2019. See page 11-15 for details. (Additional resources: https://www.epa.gov/automotive-trends)

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[a] Annual carbon footprint is based on 15,000 miles of annual driving. Includes tailpipe and upstream emissions.
[b] Car SUV category is defined in Table 4.9. Truck SUV category includes all SUVs not in the Car SUV category.

The average carbon content of 11 different transportation fuels comes from the GREET Model. Residual oil (used in ships) has the highest carbon content of those listed. Ethanol has the lowest carbon content per gallon.

Table 12.12
Carbon Content of Transportation Fuels

Fuel Type	Density (grams/gallon)	Carbon ratio (grams of carbon per grams of fuel)	Carbon content (grams/gallon)	Carbon content[a] (grams per Btu)
Gasoline blendstock	2,819	0.863	2,433	0.0196
Ethanol	2,988	0.522	1,560	0.0185
Gasoline (E10)	2,836	0.828	2,347	0.0195
U.S. conventional diesel	3,167	0.865	2,739	0.0199
Low-sulfur diesel	3,206	0.871	2,792	0.0202
Conventional jet fuel	3,036	0.862	2,617	0.0197
Ultra low-sulfur jet fuel	2,998	0.860	2,578	0.0196
Residual oil	3,752	0.868	3,257	0.0217
Liquefied petroleum gas (LPG)	1,923	0.820	1,577	0.0173
Methyl ester (biodiesel, BD)	3,361	0.776	2,608	0.0204

Source:
Argonne National Laboratory, GREET 1 2015 Model.

[a] Based on higher (gross) heating values.

Chapter 13
Criteria Air Pollutants

Summary Statistics from Tables in this Chapter

Source		
Table 13.1	Transportation's share of U.S. emissions, 2018	
	CO	*52.1%*
	NO_X	*57.6%*
	VOC	*20.2%*
	PM-2.5	*5.4%*
	PM-10	*2.4%*
	SO_2	*3.5%*

Transportation accounts for the majority of carbon monoxide and nitrogen oxide emissions. Highway vehicles are responsible for the largest share of transportation emissions.

Table 13.1
Total National Emissions of Criteria Air Pollutants by Sector, 2018
(millions of short tons/percentage)

Sector	CO	NOx	VOC	PM-10	PM-2.5	SO_2
Highway vehicles	**17.05**	**3.30**	**1.61**	**0.25**	**0.12**	**0.03**
	29.3%	*32.0%*	*10.1%*	*1.4%*	*2.2%*	*1.0%*
Other off-highway	**13.27**	**2.65**	**1.62**	**0.18**	**0.17**	**0.07**
	22.8%	*25.7%*	*10.2%*	*1.0%*	*3.3%*	*2.5%*
Transportation total	**30.32**	**5.95**	**3.23**	**0.43**	**0.29**	**0.10**
	52.1%	*57.6%*	*20.2%*	*2.4%*	*5.4%*	*3.5%*
Stationary source fuel combustion	**4.06**	**2.80**	**0.52**	**0.87**	**0.75**	**1.96**
	7.0%	*27.1%*	*3.3%*	*4.8%*	*14.0%*	*71.5%*
Industrial processes	**2.03**	**1.17**	**7.32**	**0.83**	**0.37**	**0.50**
	3.5%	*11.3%*	*45.8%*	*4.6%*	*7.0%*	*18.4%*
Waste disposal and recycling total	**1.97**	**0.11**	**0.23**	**0.28**	**0.23**	**0.03**
	3.4%	*1.1%*	*1.5%*	*1.5%*	*4.3%*	*1.2%*
Miscellaneous	**19.77**	**0.29**	**4.67**	**15.71**	**3.69**	**0.15**
	34.0%	*2.9%*	*29.2%*	*86.7%*	*69.2%*	*5.5%*
Total of all sources	**58.15**	**10.33**	**15.97**	**18.12**	**5.33**	**2.74**
	100.0%	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Note: CO = Carbon monoxide. NO_x = Nitrogen oxides. VOC = Volatile organic compounds. PM-10 = Particulate matter less than 10 microns. PM-2.5 = Particulate matter less than 2.5 microns. SO_2 = Sulfur dioxide.

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

The transportation sector accounted for more than 52% of the nation's carbon monoxide (CO) emissions in 2018. Highway vehicles are by far the source of the greatest amount of CO. For details on the highway emissions of CO, see Table 13.3.

Table 13.2
Total National Emissions of Carbon Monoxide, 1970–2018[a]
(million short tons)

Source category	1970	1980	1990	2000	2010	2018	Percent of total, 2018
Highway vehicles	163.23	143.83	110.26	68.06	28.24	17.05	29.3%
Other off-highway	11.37	16.69	21.45	24.18	15.35	13.27	22.8%
Transportation total	174.60	160.52	131.71	92.24	43.59	30.32	52.1%
Stationary fuel combustion total	4.63	7.30	5.51	4.78	4.52	4.06	7.0%
Industrial processes total	9.84	6.95	4.77	2.63	1.90	2.03	3.5%
Waste disposal and recycling total	7.06	2.30	1.08	1.85	1.20	1.97	3.4%
Miscellaneous total	7.91	8.34	11.12	12.96	22.56	19.77	34.0%
Total of all sources	**204.04**	**185.41**	**154.19**	**114.46**	**73.77**	**58.15**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

[a] The sums of subcategories may not equal total due to rounding.

Though gasoline-powered light vehicles continue to be responsible for the majority of carbon monoxide emissions from highway vehicles, the total pollution from light vehicles in 2005 is less than a fifth of what it was in 1970. This is despite the fact that there were many more light vehicles on the road in 2005. Between 2005 and 2011 the Environmental Protection Agency updated their source from the MOBILE 6.2 emissions model to the MOVES emission model. MOVES results typically show higher emissions, especially for heavy trucks. The 2014 data are the latest available.

Table 13.3
Emissions of Carbon Monoxide from Highway Vehicles, 1970–2014[a]
(million short tons)

Source category	1970	1980	1990	2000	2005	2011[b]	2014[b]	Percent of total, 2014
Gasoline powered								
Light vehicles & motorcycles	119.14	98.21	67.24	36.40	24.19	[c]	[c]	[c]
Light trucks[d]	22.27	28.83	32.23	27.04	21.19	[c]	[c]	[c]
Subtotal light vehicles	*141.41*	*127.04*	*99.47*	*63.44*	*45.38*	*25.34*	*20.03*	*91.7%*
Heavy vehicles	21.27	15.35	8.92	3.42	1.97	0.86	0.90	4.1%
Subtotal gasoline vehicles	*162.68*	*142.39*	*108.39*	*66.86*	*47.35*	*26.20*	*20.93*	*95.8%*
Diesel powered								
Light vehicles	0.01	0.03	0.04	0.01	0.01	[c]	[c]	[c]
Light trucks[d]	0.06	0.05	0.03	0.01	0.01	[c]	[c]	[c]
Subtotal light vehicles	*0.07*	*0.08*	*0.07*	*0.02*	*0.02*	*0.38*	*0.24*	*1.1%*
Heavy vehicles	0.49	1.36	1.81	1.19	0.85	0.77	0.67	3.1%
Subtotal diesel vehicles	*0.56*	*1.43*	*1.87*	*1.20*	*0.87*	*1.15*	*0.91*	*4.2%*
Total								
Highway vehicle total	**163.23**	**143.83**	**110.26**	**68.06**	**48.22**	**27.36**	**21.84**	**100.0%**
Percent diesel	0.3%	1.0%	1.7%	1.8%	1.8%	4.2%	4.2%	

Source:

U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

[a] The sums of subcategories may not equal total due to rounding.

[b] These data are not directly comparable to the older data due to the change in source from the MOBILE emissions model to the MOVES emissions model.

[c] Data are not available.

[d] Less than 8,500 pounds.

The transportation sector accounted for almost 58% of the nation's nitrogen oxide (NOx) emissions in 2018, with the majority coming from highway vehicles. For details on the highway emissions of NOx, see Table 13.5.

Table 13.4
Total National Emissions of Nitrogen Oxides, 1970–2018[a]
(million short tons)

Source category	1970	1980	1990	2000	2010	2018	Percent of total, 2018
Highway vehicles	12.62	11.49	9.59	8.39	5.70	3.30	32.0%
Other off-highway	2.65	3.35	3.78	4.17	3.32	2.65	25.7%
Transportation total	15.27	14.84	13.37	12.56	9.02	5.95	57.6%
Stationary fuel combustion total	10.06	11.32	10.89	8.82	4.33	2.80	27.1%
Industrial processes total	0.78	0.56	0.80	0.81	1.12	1.17	11.3%
Waste disposal and recycling total	0.44	0.11	0.09	0.13	0.09	0.11	1.1%
Miscellaneous total	0.33	0.25	0.37	0.28	0.29	0.29	2.9%
Total of all sources	**26.88**	**27.08**	**25.52**	**22.60**	**14.85**	**10.33**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

[a] The sums of subcategories may not equal total due to rounding.

Diesel-powered vehicles were responsible for nearly one-half (49%) of highway vehicle nitrogen oxide emissions in 2014, while light gasoline vehicles were responsible for the rest. Between 2005 and 2011 the Environmental Protection Agency updated their source from the MOBILE 6.2 emissions model to the MOVES emission model. MOVES results typically show higher emissions, especially for heavy trucks. The 2014 data are the latest available.

Table 13.5
Emissions of Nitrogen Oxides from Highway Vehicles, 1970–2014[a]
(million short tons)

Source category	1970	1980	1990	2000	2005	2011[b]	2014[b]	Percent of total, 2014
				Gasoline powered				
Light vehicles & motorcycles	8.54	6.63	4.26	2.31	1.63	[c]	[c]	[c]
Light trucks[d]	1.54	1.58	1.50	1.44	1.56	[c]	[c]	[c]
Subtotal light vehicles	*10.08*	*8.21*	*5.76*	*3.75*	*3.19*	*3.09*	*2.29*	*49.1%*
Heavy vehicles	0.72	0.62	0.57	0.45	0.38	0.09	0.09	1.9%
Subtotal gasoline vehicles	*10.81*	*8.83*	*6.33*	*4.20*	*3.57*	*3.18*	*2.38*	*51.0%*
				Diesel powered				
Light vehicles	0.00	0.03	0.04	0.01	0.00	[c]	[c]	[c]
Light trucks[d]	0.07	0.05	0.02	0.01	0.01	[c]	[c]	[c]
Subtotal light vehicles	*0.07*	*0.08*	*0.06*	*0.02*	*0.01*	*0.13*	*0.11*	*2.4%*
Heavy vehicles	1.76	2.59	3.19	4.18	2.81	2.56	2.17	46.6%
Subtotal diesel vehicles	*1.83*	*2.66*	*3.26*	*4.19*	*2.82*	*2.69*	*2.28*	*49.0%*
				Total				
Highway vehicle total	**12.64**	**11.49**	**9.59**	**8.39**	**6.39**	**5.87**	**4.67**	**100.0%**
Percent diesel	14.5%	23.1%	34.0%	49.9%	44.1%	45.8%	49.0%	

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

[a] The sums of subcategories may not equal total due to rounding.
[b] These data are not directly comparable to the older data due to the change in source from the MOBILE emissions model to the MOVES emissions model.
[c] Data are not available.
[d] Less than 8,500 pounds.

The transportation sector accounted for about 20% of the nation's volatile organic compound (VOC) emissions in 2018, with the majority coming from highway vehicles. For details on the highway emissions of VOC, see Table 13.7.

Table 13.6
Total National Emissions of Volatile Organic Compounds, 1970–2018[a]
(million short tons)

Source category	1970	1980	1990	2000	2010	2018	Percent of total, 2018
Highway vehicles	16.91	13.87	9.39	5.33	2.77	1.61	10.1%
Off-highway	1.62	2.19	2.66	2.64	2.30	1.62	10.2%
Transportation total	18.53	16.06	12.05	7.97	5.06	3.23	20.2%
Stationary fuel combustion total	0.72	1.05	1.01	1.18	0.60	0.52	3.3%
Industrial processes total	12.33	12.10	9.01	7.21	6.96	7.32	45.8%
Waste disposal and recycling total	1.98	0.76	0.99	0.42	0.15	0.23	1.5%
Miscellaneous total	1.10	1.13	1.06	0.73	5.06	4.67	29.2%
Total of all sources	**34.66**	**31.10**	**24.12**	**17.51**	**17.84**	**15.97**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

[a] The sum of subcategories may not equal total due to rounding. The EPA's definition of volatile organic compounds excludes methane, ethane, and certain other nonphotochemically reactive organic compounds.

Gasoline-powered vehicles are responsible for over 90% of highway vehicle emissions of volatile organic compounds. VOC emissions from highway vehicles in 2014 were less than one-quarter of the 1990 level. Between 2005 and 2011 the Environmental Protection Agency updated their source from the MOBILE 6.2 emissions model to the MOVES emission model. MOVES results typically show higher emissions, especially for heavy trucks. The 2014 data are the latest available.

Table 13.7
Emissions of Volatile Organic Compounds from Highway Vehicles, 1970–2014[a]
(thousand short tons)

Source category	1970	1980	1990	2000	2005	2011[b]	2014[b]	Percent of total, 2014
				Gasoline powered				
Light vehicles & motorcycles	11,996	9,304	5,690	2,903	2,111	[c]	[c]	[c]
Light trucks[d]	2,776	2,864	2,617	1,929	1,629	[c]	[c]	[c]
Subtotal light vehicles	*14,772*	*12,168*	*8,307*	*4,832*	*3,740*	*2,345*	*1,811*	*88.2%*
Heavy vehicles	1,679	1,198	633	256	171	40	41	2.0%
Subtotal gasoline vehicles	*16,451*	*13,366*	*8,940*	*5,088*	*3,911*	*2,386*	*1,853*	*90.3%*
				Diesel powered				
Light vehicles	8	16	18	3	2	[c]	[c]	[c]
Light trucks[d]	41	28	15	4	6	[c]	[c]	[c]
Subtotal light vehicles	*49*	*44*	*33*	*7*	*8*	*43*	*26*	*1.3%*
Heavy vehicles	411	459	415	230	159	213	174	8.4%
Subtotal diesel vehicles	*460*	*503*	*448*	*238*	*167*	*256*	*200*	*9.7%*
				Total				
Highway vehicle total	**16,911**	**13,869**	**9,388**	**5,326**	**4,078**	**2,642**	**2,053**	100.0%
Percent diesel	2.7%	3.6%	4.8%	4.5%	4.1%	9.7%	9.7%	

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

[a] The sums of subcategories may not equal total due to rounding.
[b] These data are not directly comparable to the older data due to the change in source from the MOBILE emissions model to the MOVES emissions model.
[c] Data are not available.
[d] Less than 8,500 pounds.

The transportation sector accounted for less than 3% of the nation's particulate matter (PM-10) emissions in 2018. For details on the highway emissions of PM-10, see Table 13.9.

Table 13.8
Total National Emissions of Particulate Matter (PM-10), 1970–2018[a]
(million short tons)

Source category	1970	1980	1990	2000	2010	2018	Percent of total, 2018
Highway vehicles	0.48	0.43	0.39	0.23	0.28	0.25	1.4%
Off-highway	0.16	0.26	0.33	0.32	0.23	0.18	1.0%
Transportation total	0.64	0.69	0.72	0.55	0.51	0.43	2.4%
Stationary fuel combustion total	2.87	2.45	1.20	1.47	0.98	0.87	4.8%
Industrial processes total	7.67	2.75	1.04	0.71	1.05	0.83	4.6%
Waste disposal and recycling total	1.00	0.27	0.27	0.36	0.21	0.28	1.5%
Miscellaneous total	0.84	0.85	24.54	20.65	18.08	15.71	86.7%
Total of all sources	**13.02**	**7.01**	**27.75**	**23.75**	**20.82**	**18.12**	**100.0%**

Note: Because PM-10 is fine particulate matter less than 10 microns, it also includes PM-2.5. Specific data for PM-2.5 are shown on Tables 13.10 and 13.11.

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

[a] Fine particulate matter less than 10 microns. The sums of subcategories may not equal total due to rounding.

In 2014, diesel-powered vehicles were responsible for 45% of highway vehicle emissions of particulate matter (PM-10); in 1990 diesels were responsible for 73.4%. Between 2005 and 2011 the Environmental Protection Agency updated their source from the MOBILE 6.2 emissions model to the MOVES emission model. MOVES results typically show higher emissions, especially for heavy trucks. The 2014 data are the latest available.

Table 13.9
Emissions of Particulate Matter (PM-10) from Highway Vehicles, 1970–2014[a]
(thousand short tons)

Source category	1970	1980	1990	2000	2005	2011[b]	2014[b]	Percent of total, 2014
				Gasoline powered				
Light vehicles & motorcycles	249	141	56	51	46	[c]	[c]	[c]
Light trucks[d]	74	49	31	31	35	[c]	[c]	[c]
Subtotal light vehicles	323	190	87	82	81	199	166	53.5%
Heavy vehicles	44	30	17	10	8	3	5	1.5%
Subtotal gasoline vehicles	367	220	104	92	89	203	171	55.0%
				Diesel powered				
Light vehicles	2	9	11	1	1	[c]	[c]	[c]
Light trucks[d]	19	12	5	1	1	[c]	[c]	[c]
Subtotal light vehicles	21	21	16	2	2	10	7	2.2%
Heavy vehicles	92	191	268	135	92	159	133	42.8%
Subtotal diesel vehicles	113	212	284	137	94	168	140	45.0%
				Total				
Highway vehicle total	480	432	387	230	183	371	311	100.0%
Percent diesel	23.5%	49.1%	73.4%	59.6%	51.4%	45.3%	45.0%	

Note: Because PM-10 is fine particulate matter less than 10 microns, it also includes PM-2.5. Specific data for PM-2.5 are shown on Tables 13.10 and 13.11.

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

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[a] The sums of subcategories may not equal total due to rounding.
[b] These data are not directly comparable to the older data due to the change in source from the MOBILE emissions model to the MOVES emissions model.
[c] Data are not available.
[d] Less than 8,500 pounds.

The transportation sector accounted for about 5% of the nation's particulate matter (PM-2.5) emissions in 2018. For details on the highway emissions of PM-2.5, see Table 13.11.

Table 13.10
Total National Emissions of Particulate Matter (PM-2.5), 1990–2018[a]
(million short tons)

Source category	1990	1995	2000	2005	2010	2018	Percent of total, 2018
Highway vehicles	0.32	0.25	0.17	0.31	0.20	0.10	1.9%
Off-highway	0.30	0.31	0.30	0.29	0.21	0.17	3.3%
Transportation total	0.62	0.56	0.47	0.60	0.41	0.27	5.1%
Stationary fuel combustion total	0.91	0.90	1.29	1.13	0.84	0.75	14.1%
Industrial processes total	0.56	0.50	0.50	0.53	0.40	0.37	7.0%
Waste disposal and recycling total	0.23	0.25	0.33	0.27	0.18	0.23	4.3%
Miscellaneous total	5.23	4.73	4.69	3.07	4.11	3.69	69.4%
Total of all sources	**7.56**	**6.93**	**7.29**	**5.59**	**5.96**	**5.31**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

[a] The sums of subcategories may not equal total due to rounding.

Diesel vehicles are responsible for the majority of highway vehicle PM-2.5 emissions. Nearly two-thirds of the highway vehicles' PM-2.5 emissions are from heavy diesel trucks. Between 2005 and 2011 the Environmental Protection Agency updated their source from the MOBILE 6.2 emissions model to the MOVES emission model. MOVES results typically show higher emissions, especially for heavy trucks. The 2014 data are the latest available.

Table 13.11
Emissions of Particulate Matter (PM-2.5) from Highway Vehicles, 1990–2014[a]
(thousand short tons)

Source category	1990	1995	2000	2005	2011[b]	2014[b]	Percent of total, 2014
				Gasoline powered			
Light vehicles & motorcycles	35	30	27	23	c	c	c
Light trucks[d]	21	20	18	18	c	c	c
Subtotal light vehicles	*56*	*50*	*45*	*41*	*68*	*59*	*37.2%*
Heavy vehicles	11	9	7	6	2	2	1.1%
Subtotal gasoline vehicles	*67*	*59*	*52*	*47*	*70*	*61*	*38.3%*
				Diesel powered			
Light vehicles	9	4	1	1	c	c	c
Light trucks[d]	4	2	1	1	c	c	c
Subtotal light vehicles	*13*	*6*	*2*	*2*	*6*	*4*	*2.8%*
Heavy vehicles	243	179	119	79	120	93	58.9%
Subtotal diesel vehicles	*256*	*185*	*121*	*81*	*126*	*97*	*61.7%*
				Total			
Highway vehicle total	**323**	**244**	**173**	**128**	**196**	**159**	**100.0%**
Percent diesel	79.3%	75.8%	69.9%	63.3%	64.6%	61.7%	

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei. (Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

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[a] The sums of subcategories may not equal total due to rounding.
[b] These data are not directly comparable to the older data due to the change in source from the MOBILE emissions model to the MOVES emissions model. The 2011 data include condensable plus filterable PM-2.5.
[c] Data are not available.
[d] Less than 8,500 pounds.

The transportation sector accounted for less than 4% of the nation's sulfur dioxide (SO_2) emissions in 2018, with off-highway vehicles responsible for most of the emissions. Stationary fuel combustion (e.g. electricity generation) was responsible for about 72% of all SO_2 emissions in 2018.

Table 13.12
Total National Emissions of Sulfur Dioxide, 1970–2018[a]
(million short tons)

Source category	1970	1980	1990	2000	2010	2018	Percent of total, 2018
Highway vehicles	0.27	0.39	0.50	0.26	0.04	0.03	1.0%
Other off-highway	0.28	0.32	0.37	0.44	0.12	0.07	2.5%
Transportation total	0.55	0.72	0.87	0.70	0.16	0.10	3.5%
Stationary fuel combustion total	23.46	21.39	20.21	14.16	6.75	1.96	71.5%
Industrial processes total	7.10	3.81	1.90	1.42	0.68	0.50	18.4%
Waste disposal and recycling total	0.01	0.03	0.04	0.03	0.02	0.03	1.2%
Miscellaneous total	0.11	0.01	0.01	0.07	0.16	0.15	5.5%
Total of all sources	**31.22**	**25.93**	**23.08**	**16.35**	**7.73**	**2.74**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data.
(Additional resources: www.epa.gov/air-emissions-inventories/national-emissions-inventory)

[a] The sums of subcategories may not equal total due to rounding.

EMISSION STANDARDS

The U.S. Environmental Protection Agency (EPA) regulates emissions from mobile sources including vehicles, engines, and motorized equipment that produce exhaust and evaporative emissions. Mobile sources contribute to four main air pollutants: carbon monoxide, hydrocarbons, nitrogen oxides, and particulate matter. The EPA not only sets standards for the vehicles, engines, and equipment, but also the fuels that they use. Tables 12.13 through Table 12.30 contain summaries of the current standards.

Acronyms Used on Tables 12.13 through Table 12.30

ABT	Averaging, banking, and credit trading program
ATV	All-terrain vehicle
bhp	Brake horsepower-hour
CFR	Code of Federal Regulations
CI	Compression-ignition
CO	Carbon Monoxide
DE	Diesel engine
EPA	Environmental Protection Agency
FEL	Family emission limit
FTP	Federal test procedure
g	Gram
g/kN	Grams per kilonewton
g/kW-hr	Grams per kilowatt-hour
g/mi	Grams per mile
GPA	Geographic Phase-in Area
GVW	Gross vehicle weight
HC	Hydrocarbons
HCHO	Formaldehyde
HLDT	Heavy light-duty truck
Hp-hr	Horsepower-hour
ICAO	International Civil Aviation Organization
kN	Kilonewton
kW	Kilowatt
kW-hr	Kilowatt-hour
LDT	Light-duty truck
LDV	Light-duty vehicle
LEV	Low-emission vehicle
LLDT	Light light-duty truck
LPG	Liquefied petroleum gas
LVW	Loaded vehicle weight
MDPV	Medium-duty passenger vehicle (8,500-10,000 lbs. GVWR)
MDV	Medium-duty vehicle
MY	Model year
NMHC	Non-methane hydrocarbon
NMOG	Non-methane organic gases
NR	Nonroad
NRLM	Nonroad, locomotive and marine
NOx	Nitrogen oxides
NTE	Not-to-exceed
OEM	Original equipment manufacturer
PM	Particulate matter
ppm	Parts per million
PWC	Personal watercraft
rO	Rated output
rPR	Rated pressure ratio
SI	Spark-ignition
SULEV	Super-ultra-low-emission vehicle
THC	Total hydrocarbons
THCE	Total hydrocarbon equivalent
ULEV	Ultra-low-emission vehicle
ULSD	Ultra-low sulfur diesel
ZEV	Zero-emission vehicle

The Environmental Protection Agency issued final Tier 3 emission standards in 2014. The combined emissions of non-methane organic gases (NMOG) and nitrogen oxides (NOx) that new gasoline engines are allowed to produce from model years 2017 to 2025 are regulated in these new standards. These standards apply to a corporate average, meaning that some vehicles produced in those model years will emit more than the standard, while others will emit less, so long as the average for each Original Equipment Manufacturer (OEM) product offerings meets the standard.

Table 13.13
Tier 3 Non-Methane Organic Gases and Nitrogen Oxide Standards
(milligrams per mile)

Model Year	Light-duty vehicles and LDT1	LDT2, 3, 4, and medium-duty passenger vehicles	Class 2b trucks	Class 3 trucks
2016	[a]	[a]	333[b]	548[b]
2017	86	101	310[b]	508[b]
2018	79	92	278	451
2019	72	83	253	400
2020	65	74	228	349
2021	58	65	203	298
2022	51	56	178	247
2023	44	47	178	247
2024	37	38	178	247
2025 and later	30	30	178	247

Notes: Standards are for the Federal Test Procedure. Different standards apply for the Supplemental Federal Test Procedure. For vehicles over 6,000 lbs. gross vehicle weight rating (GVWR), the standards apply beginning in MY 2018.
LDT1 = Light trucks less than 6,000 lbs. GVWR and less than 3,750 lbs. loaded vehicle weight (LVW).
LDT2, 3, 4 = Light trucks less than 8,500 lbs. GVWR and more than 3,750 lbs. LVW.
Class 2b trucks = trucks 8,501-10,000 lbs. GVWR.
Class 3 trucks = trucks 10,001-14,000 lbs. GVWR.

Source:
Federal Register Vol. 79, No. 81, Monday, April 28, 2014.

[a] Not applicable.
[b] Voluntary standard.

Table 13.14
Tier 3 Particulate Matter Emission Standards for Light Gasoline Vehicles, MY 2017 and Beyond (milligrams per mile)

Model Year	Certification standard (milligrams per mile)	In-use standard (milligrams per mile)	Phase-in (percent of U.S. sales)
2017	3	6	20[a]
2018	3	6	20
2019	3	6	40
2020	3	6	70
2021	3	6	100
2022-on	3	3	100

Note: Standards are for the Federal Test Procedure. The standards apply to all light-duty vehicles, light-duty trucks, and medium-duty passenger vehicles. For vehicles over 6,000 lbs. gross vehicle weight rating, the standards apply beginning in MY 2018.

Source:
Federal Register Vol. 79, No. 81, Monday, April 28, 2014.

Table 13.15
Tier 3 Evaporative Emission Standards (grams per test)

Vehicle class	Highest hot soak + diurnal level (over both 2-day and 3-day diurnal tests)
Light-duty vehicles and LDT1	0.3
LDT2	0.4
LDT3, LT4, and medium-duty passenger vehicles	0.5
Heavy-duty gasoline vehicles	0.6

Note: LDT1 = Light trucks less than 6,000 lbs. gross vehicle weight rating (GVWR) and less than 3,750 lbs. loaded vehicle weight (LVW).
LDT2 = Light trucks less than 6,000 lbs. GVWR and less than 3,750 lbs. LVW.
LDT3, 4 = Light trucks less than 8,500 lbs. GVWR and more than 3,750 lbs. LVW.
Heavy-duty gasoline vehicles = trucks over 10,000 lbs. GVWR.

Source:
Federal Register Vol. 79, No. 81, Monday, April 28, 2014.

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[a] Manufacturers comply with 20% of their light-duty truck fleet under 6,000 lbs. gross vehicle weight, alternatively with 10% of their total light-duty vehicles, light-duty trucks and medium-duty passenger vehicle fleet.

These exhaust emission standards were phased-in from 2004 to 2010.

Table 13.16
Light-Duty Vehicle, Light-Duty Truck, and Medium-Duty Passenger Vehicle – Tier 2 Exhaust Emission Standards

	Standard	Emission limits at 50,000 miles					Emission limits at full useful life (120,000 miles)[a]				
		NOx (g/mi)	NMOG (g/mi)	CO (g/mi)	PM (g/mi)	HCHO (g/mi)	NOx (g/mi)	NMOG (g/mi)	CO (g/mi)	PM (g/mi)	HCHO (g/mi)
Federal	Bin 1	-	-	-	-	-	0	0	0	0	0
	Bin 2	-	-	-	-	-	0.02	0.01	2.1	0.01	0.004
	Bin 3	-	-	-	-	-	0.03	0.055	2.1	0.01	0.011
	Bin 4	-	-	-	-	-	0.04	0.07	2.1	0.01	0.011
	Bin 5	0.05	0.075	3.4	-	0.015	0.07	0.09	4.2	0.01	0.018
	Bin 6	0.08	0.075	3.4	-	0.015	0.1	0.09	4.2	0.01	0.018
	Bin 7	0.11	0.075	3.4	-	0.015	0.15	0.09	4.2	0.02	0.018
	Bin 8	0.14	0.100 / 0.125[c]	3.4	-	0.015	0.2	0.125 / 0.156	4.2	0.02	0.018
	Bin 9[b]	0.2	0.075 / 0.140	3.4	-	0.015	0.3	0.090 / 0.180	4.2	0.06	0.018
	Bin 10[b]	0.4	0.125 / 0.160	3.4 / 4.4	-	0.015 / 0.018	0.6	0.156 / 0.230	4.2 / 6.4	0.08	0.018 / 0.027
	Bin 11[b]	0.6	0.195	5	-	0.022	0.9	0.28	7.3	0.12	0.032

Note: Tests Covered: Federal Test Procedure (FTP), cold carbon monoxide, highway, and idle. Definitions of acronyms are on page 12-14.

Source:
40 CR 86 Subpart S. (Additional resources: www.epa.gov/emission-standards-reference-guide/light-duty-vehicles-and-trucks-emission-standards)

[a] In lieu of intermediate useful life standards (50,000 miles) or to gain additional nitrogen oxides credit, manufacturers may optionally certify to the Tier 2 exhaust emission standards with a useful life of 150,000 miles.

[b] Bins 9-11 expired in 2006 for light-duty vehicles and light light-duty trucks and 2008 for heavy light-duty trucks and medium-duty passenger vehicles.

[c] Pollutants with two numbers have a separate certification standard (1st number) and in-use standard (2nd number).

Table 13.17
Light-Duty Vehicle, Light-Duty Truck, and Medium-Duty Passenger Vehicle – Tier 2 Evaporative Emission Standards

	Vehicle type	Model year	3 Day diurnal + hot soak (g/test)	Supplemental 2 day diurnal + hot soak (g/test)	Running loss (g/mi)
Federal	LDV/LLDTs[a]	2004	0.95	1.20	0.05
	HLDTs[b]	2004	1.20	1.50	0.05
	MDPVs[a, b]	2004	1.40	1.75	0.05
	LDV[a]	2009	0.50	0.65	0.05
	LLDT[a]	2009	0.65	0.85	0.05
	HLDT[b]	2010	0.90	1.15	0.05
	MDPV[a, b]	2010	1.00	1.25	0.05

Note: Multi-fuel vehicle phase-in applies. Definitions of acronyms are on page 12-14.

Source:
40 CR 86 Subpart S. (Additional resources: www.epa.gov/emission-standards-reference-guide/light-duty-vehicles-and-trucks-emission-standards)

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[a] For liquefied petroleum gas-fueled light-duty vehicles (LDV), light-duty trucks (LDT), and medium-duty passenger vehicles (MDPV): 0.15 grams hydrocarbon per gallon (0.04 grams per liter) of fuel dispensed.

[b] Refueling standards for heavy light-duty trucks (HLDT) are subject to phase-in requirements. MDPVs must also comply with the phase-in requirement and must be grouped with HLDTs to determine phase-in compliance.

Table 13.18
Heavy-Duty Highway Compression-Ignition Engines and Urban Buses – Exhaust Emission Standards

	Year	HC (g/bhp-hr)	NMHC (g/bhp-hr)	NMHC + NOx (g/bhp-hr)	NOx (g/bhp-hr)	PM (g/bhp-hr)	CO (g/bhp-hr)	Idle CO (percent Exhaust gas flow)	Smoke[a] (percentage)	Useful life (hours/years/miles)
Federal[b]	1974-78	-	-	16	-	-	40	-	20 / 15 / 50	-
	1979-84	1.5	-	10	-	-	25	-	20 / 15 / 50	-
	1985-87	1.3	-	-	10.7	-	15.5	-	20 / 15 / 50	LHDDE: - / 8 / 110,000 MHDDE: - / 8 / 185,000 HHDDE: - / 8 / 290,000
	1988-89	1.3[d]	-	-	10.7	0.6	15.5	0.5[c]	20 / 15 / 50	1990-97 and 1998+ for HC, CO, and PM: LHDDE: - / 8 / 110,000 MHDDE: - / 8 / 185,000 HHDDE: - / 8 / 290,000 1994+ urban buses for PM only: LHDDE: - / 10 / 110,000 1998+ for NOx: LHDDE: - / 10 / 110,000 MHDDE: - / 10 / 185,000 HHDDE: - / 10 / 290,000
	1990	1.3[d]	-	-	6.0	0.6	15.5	0.5[c]	20 / 15 / 50	
	1991-93	1.3	-	-	5.0 [ABT]	0.25 [ABT] 0.10[e]	15.5	0.5[c]	20 / 15 / 50	
	1994-97	1.3	-	-	5.0 [ABT]	0.1 [ABT] 0.07[f],0.05[g]	15.5	0.5[c]	20 / 15 / 50	
	1998-2003	1.3	-	-	4.0 [ABT]	0.1 [ABT] 0.05[g]	15.5	0.5[c]	20 / 15 / 50	
	2004-2006[h]	-	-	2.4 (or 2.5 with a limit of 0.5 on NMHC)[o] [ABT[i,j]]	-	0.1 0.05[g]	15.5	0.5	20 / 15 / 50	For all pollutants:[p] LHDDE: - / 10 / 110,000 MHDDE: - / 10 / 185,000 HHDDE: 22,000 / 10 / 435,000
	2007+[h,k,l,m,n]	-	0.14[o]	2.4 (or 2.5 with a limit of 0.5 on NMHC) [ABT]	0.2[o]	0.01	15.5	0.5	20 / 15 / 50	

Note: The test procedures are the EPA Transient Test Procedure and the EPA Smoke Test Procedure. Definitions of acronyms are on page 12-14.

Sources:
40 CFR 86.099-11 Emission standards for 1999 and later model year diesel heavy-duty engines and vehicles.
40 CFR 86.004-11 Emission standards for 2004 and later model year diesel heavy-duty engines and vehicles.
40 CFR 86.007-11 Emission standards and supplemental requirements for 2007 and later model year diesel heavy-duty engines and vehicles. (Additional resources: www.epa.gov/emission-standards-reference-guide/light-duty-vehicles-and-trucks-emission-standards)

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[a] Percentages apply to smoke opacity at acceleration/lug/peak modes.

[b] Standards for 1990 apply only to diesel-fueled heavy-duty engines (HDE). Standards for 1991+ apply to both diesel- and methanol-fueled HDEs. Standards that apply to urban buses specifically are footnoted.

[c] This standard applies to the following fueled engines for the following model years: methanol - 1990+, natural gas and liquefied petroleum gas (LPG) - 1994+.

[d] For petroleum-fueled engines, the standard is for hydrocarbons (HC). For methanol-fueled engines, the standard is for total hydrocarbon equivalent (THCE).

[e] Certification standard for urban buses for 1993.

[f] Certification standard for urban buses from 1994-95.

[g] Certification standard for urban buses from 1996 and later. The in-use standard is 0.07.

[h] Load Response Test certification data submittal requirements take effect for heavy-duty diesel engines beginning in model year 2004. The following requirements take effect with the 2007 model year: steady-state test requirement and Not-to-Exceed (NTE) test procedures for testing of in-use engines. On-board diagnostic requirements applicable to heavy-duty diesel vehicles and engines up to 14,000 pounds gross vehicle weight rating (GVWR) phase in from the 2005 through 2007 model years.

Table 13.18 (continued)
Heavy-Duty Highway Compression-Ignition Engines and Urban Buses – Exhaust Emission Standards

[i] The modified averaging, banking, and trading program for 1998 and later model year engines applies only to diesel cycle engines. Credits generated under the modified program may be used only in 2004 and later model years.

[j] For heavy-duty diesel engines, there are three options to the measurement procedures currently in place for alternative fueled engines: (1) use a THC measurement in place of an non-methane hydrocarbon (NMHC) measurement; (2) use a measurement procedure specified by the manufacturer with prior approval of the Administrator; or (3) subtract two percent from the measured THC value to obtain an NMHC value. The methodology must be specified at time of certification and will remain the same for the engine family throughout the engines' useful life. For natural gas vehicles, EPA allows the option of measuring NMHC through direct quantification of individual species by gas chromatography.

[k] Starting in 2006, refiners must begin producing highway diesel fuel that meets a maximum sulfur standard of 15 parts per million (ppm).

[l] Subject to a Supplemental Emission Test (1.0 x Federal Test Procedure [FTP] standard (or Family Emission Limit [FEL]) for nitrogen oxides [NOx], NMHC, and particulate matter [PM]) and a NTE test (1.5 x FTP standard [or FEL] for NOx, NMHC, and PM).

[m] EPA adopted the lab-testing and field-testing specifications in 40 CFR Part 1065 for heavy-duty highway engines, including both diesel and Otto-cycle engines. These procedures replace those previously published in 40 Code of Federal Regulations (CFR) Part 86, Subpart N. Any new testing for 2010 and later model years must be done using the 40 CFR Part 1065 procedures.

[n] Two-phase in-use NTE testing program for heavy-duty diesel vehicles. The program begins with the 2007 model year for gaseous pollutants and 2008 for PM. The requirements apply to diesel engines certified for use in heavy-duty vehicles (including buses) with GVWRs greater than 8,500 pounds. However, the requirements do not apply to any heavy-duty diesel vehicle that was certified using a chassis dynamometer, including medium-duty passenger vehicles with GVWRs of between 8,500 and 10,000 pounds.

[o] NOx and NMHC standards will be phased in together between 2007 and 2010. The phase-in will be on a percent-of-sales basis: 50 percent from 2007 to 2009 and 100 percent in 2010.

[p] Note that for an individual engine, if the useful life hours interval is reached before the engine reaches 10 years or 100,000 miles, the useful life shall become 10 years or 100,000 miles, whichever occurs first, as required under Clean Air Act section 202(d).

Table 13.19
Heavy-Duty Highway Spark-Ignition Engines – Exhaust Emission Standards

	Engine or vehicle	Year	Gross vehicle weight (lbs)	HC[a] (g/bhp-hr)	NMHC[b] (g/bhp-hr)	NOx (g/bhp-hr)	NOx + NMHC[c] (g/bhp-hr)	PM (g/bhp-hr)	CO (g/bhp-hr)	Idle CO (% exhaust gas flow)	Formaldehyde (g/mile)	Useful life (years / miles)
Federal	Heavy duty engines[d]	Prior to Control	-	12.7	-	-	6.86	-	155	-	-	5 / 50,000
		1970-73	-	275 ppm	-	-	-	-	1.50%	-	-	
		1974-78	-	-	-	16	-	-	40	-	-	
		1979-84	-	1.5	-	10	-	-	25	-	-	
		1985-86	-	1.9	-	-	10.6	-	37.1	-	-	
		1987	≤ 14,000	1.1	-	-	10.6	-	14.4	0.5	-	
			> 14,000	1.9	-	-	10.6	-	37.1		-	
		1988-90	≤ 14,000	1.1	-	-	6.0	-	14.4	-	-	
			> 14,000	1.9	-	-	6.0	-	37.1	-	-	
		1990[e]	≤ 14,000	1.1	-	-	6.0	-	14.4	0.5[j]	-	8 / 110,000[k]
			> 14,000	1.9	-	-	6.0	-	37.1		-	
		1991-97[f]	≤ 14,000	1.1[g]	-	-	5.0	-	14.4		-	
			> 14,000	1.9[h]	-	-	5.0	-	37.1		-	
		1998-2004[f]	≤ 14,000	1.1[g]	-	-	4.0[i]	-	14.4		-	
			> 14,000	1.9[h]	-	-		-	37.1		-	
		2005-2007[f]	≤ 14,000	1.1[g]	-	1.0[l]	-	-	14.4		-	10 / 110,000
			> 14,000	1.9[h]	-		-	-	37.1		-	
		2008+	All	-	0.14	0.2	-	0.01	14.4			
	Complete heavy-duty vehicles[n, q]	2005-2007	8,500 - 10,000	-	0.280[m]	-	0.9	-	7.3		-	11 / 110,000
			10,000 - 14,000	-	0.330[m]	-	1.0	-	8.1		-	
		2008+[p]	8,500 - 10,000	-	0.195[o]	-	0.2	0.02	7.3		0.032	
			10,000 - 14,000	-	0.230[o]	-	0.4	0.02	8.1		0.04	

Note: Definitions of acronyms are on page 12-14.

Sources:
40 CFR 86.1816-05, 86.1816-08 Emission standards for complete heavy-duty vehicles
40 CFR 86.1806-01, 86.1806-04, 86.1806-05 Onboard diagnostics requirements
40 CFR 86.1817-05, 86.1817-08 Complete heavy-duty vehicle averaging, banking, and trading program
40 CFR 86.091-10 Heavy-duty engine averaging, banking, and trading program for 1991 and later - Not available in the e-CFR
40 CFR Part 86 Subpart B Vehicle test procedures (Additional resources: www.epa.gov/emission-standards-reference-guide/light-duty-vehicles-and-trucks-emission-standards)

[a] For methanol-fueled engines, the standard is for total hydrocarbon equivalent (THCE).
[b] For methanol and alcohol fueled vehicles the standard is for non-methane hydrocarbon equivalent (NMHCE).
[c] For methanol fueled engines the standard is for nitrogen oxides (NOx) plus NMHCE.
[d] Standards for heavy-duty engines are expressed in grams per brake horsepower-hour (g/bhp-hr). Starting with the 1998 model year, crankcase emissions are not allowed.
[e] Standards for 1990 apply to gasoline and methanol-fueled engines.
[f] Standards for 1991 and later apply to gasoline and methanol engines and are optional for natural gas and Liquefied Petroleum Gas-fueled engines through the 1996 model year.
[g] For natural gas fueled engines the standard is 0.9 g/bhp-hr non-methane hydrocarbon (NMHC).

Table 13.19 (continued)
Heavy-Duty Highway Spark-Ignition Engines – Exhaust Emission Standards

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[h] For natural gas fueled engines the standard is 1.7 g/bhp-hr NMHC.

[i] The NOx standard is 5.0 for all natural gas-fueled engines.

[j] This standard applies to the following engines utilizing aftertreatment technology (except for methanol) for the following model years: gasoline/1990+; natural gas and LPG/1991+; methanol/1990+. Starting in 2005, engines certified to on-board diagnostics requirements are not required to meet the idle carbon monoxide (CO) standard.

[k] Useful life is expressed in years or miles, whichever comes first. Useful life for the 1998 and later NOx standard and for all 2004 standards is 10 years or 110,000 miles, whichever comes first.

[l] Manufacturers can choose this standard or one of the following options: (1) a standard of 1.5 g/bhp-hr NMHC+NOX that applies to the 2004 through 2007 model years, with complete heavy-duty vehicle standards taking effect in 2005; or (2) a standard of 1.5 g/bhp-hr NMHC + NOX that would apply to the 2003 through 2007 heavy-duty engines and optionally to 2003 through 2006 complete heavy-duty vehicles.

[m] Standard is expressed as non-methane organic gas, but compliance can optionally be shown using measurement of NMHC or total hydrocarbon (THC).

[n] Complete heavy-duty vehicles have the primary load-carrying container or device attached. Incomplete heavy-duty vehicles are certified to heavy-duty engine standards. Standards for complete heavy-duty vehicles are expressed in grams per mile (g/mi). Starting in 2005 (or 2003 or 2004 depending on the selected phase in option; see footnote l), complete heavy-duty vehicles under 14,000 lbs gross vehicle weight are tested on chassis-based rather than engine-based procedures and must meet these complete heavy-duty vehicle standards.

[o] Although expressed as NMHC, compliance can optionally be shown using measurement of NMOG or THC.

[p] At least 50 percent of a manufacturer's sales must meet these standards in 2008, with 100 percent required in 2009.

[q] Gross vehicle weight ranges are more accurately specified as follows: $8{,}500 \leq GVW \leq 10{,}000$ and $10{,}000 < GVW < 14{,}000$.

Table 13.20
Heavy-Duty Highway Compression-Ignition and Spark-Ignition Engines – Evaporative Emission Standards

	Engine type	Year	Gross vehicle weight (lbs)	Conventional diurnal + hot soak (g/test)[a]	Three-diurnal test sequence (g/test)[b]	Supplemental two-diurnal test sequence (g/test)[c]	Running loss (g/mi)[c]	Spitback (g/test)[c]	Useful life[d]
Federal	SI	1991-95	≤ 14,000	3.0	-	-	-	-	8 / 110,000
			> 14,000[e]	4.0	-	-	-	-	
		1996-2007 (Enhanced)[f]	≤ 14,000	-	3.0	3.5	0.05	1.0	10 / 120,000
			> 14,000[e]	-	4.0	4.5		-	
		2008+ (Enhanced)	8500-14,000	-	1.4	1.75		1.0	11 / 110,000
			> 14,000[e]	-	1.9	2.3		-	
	CI	1996-97	≤ 14,000	-	3.0	-	-	-	MHDDE: 8 / 185,000 HHDDE: 8 / 290,000 MHDDE: 8 / 185,000 HHDDE: 8 / 290,000
			> 14,000[e]	-	4.0	-	-	-	
		1998+ (Enhanced)[g]	≤ 14,000	-	3.0	3.5	0.05	1.0	
			> 14,000[e]	-	4.0	4.5		-	

Note: Definitions of acronyms are on page 12-14.

Sources:
40 CFR 86.099-11 Emission standards for 1999 and later model year diesel heavy-duty engines and vehicles.
40 CFR 86.004-11 Emission standards for 2004 and later model year diesel heavy-duty engines and vehicles.
CFR 86.007-11 Emission standards and supplemental requirements for 2007 and later model year diesel heavy-duty engines and vehicles. (Additional resources: www.epa.gov/emission-standards-reference-guide/light-duty-vehicles-and-trucks-emission-standards)

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[a] Applies to gasoline and methanol engines. Standard is hydrocarbon (HC) for gasoline engines, total hydrocarbon equivalent (THCE) for methanol engines.

[b] For spark-ignition (SI) engines, standard applies to gasoline, methanol, natural gas, and liquefied petroleum gas engines. For compression-ignition (CI) engines, standard applies to methanol, natural gas, and liquefied petroleum gas engines. Standard is THCE for methanol engines, HC for others.

[c] For SI engines, standard applies to gasoline and methanol engines. For CI engines, standard applies to methanol engines. Standard is THCE for methanol engines, HC for others.

[d] Useful life is expressed in years or miles, whichever comes first.

[e] Vehicles over 26,000 pounds gross vehicle weight may demonstrate compliance with an engineering design evaluation in lieu of testing.

[f] A new enhanced evaporative test procedure applies, which is considerably more stringent than the previous test procedure despite the fact that the standard values do not change from prior years. Gasoline and methanol engines are phased in at the following rates of a manufacturer's sales for the specified model year: 1996: 20 percent; 1997: 40 percent; 1998: 90 percent; 1999: 100 percent.

[g] A new enhanced evaporative test procedure applies, which is considerably more stringent than the previous test procedure despite the fact that the standard values do not change from prior years. Methanol-fueled vehicles are phased in at a rate of 90 percent of a manufacturer's production in 1998 and 100 percent in 1999.

The LEV III exhaust standards apply to new cars, light trucks, and medium vehicles, including fuel-flexible, bi-fuel, and dual-fuel vehicles from model year 2015-on.

Table 13.21
California New Car, Light Truck and Medium Truck Emission Certification Standards, Model Year 2015-On

Vehicle type	Vehicle emission category	Non-methane organic gases + nitrogen oxides (g/mi)	Carbon monoxide (g/mi)	Formaldehyde (mg/mi)	Particulates (g/mi)
All passenger cars; LDTs 8,500 lbs. GVW or less; All MDPVs; Vehicles in this category are tested at their loaded vehicle weight	LEV160	0.16	4.2	4	0.01
	ULEV125	0.125	2.1	4	0.01
	ULEV70	0.07	1.7	4	0.01
	ULEV50	0.05	1.7	4	0.01
	SULEV30	0.03	1.0	4	0.01
	SULEV20	0.02	1.0	4	0.01
MDVs 8,501-10,000 lbs. GVW; Vehicles in this category are tested at their adjusted loaded vehicle weight	LEV395	0.395	6.4	6	0.12
	ULEV340	0.34	6.4	6	0.06
	ULEV250	0.25	6.4	6	0.06
	ULEV200	0.2	4.2	6	0.06
	SULEV170	0.17	4.2	6	0.06
	SULEV150	0.15	3.2	6	0.06
MDVs 10,000-14,000 lbs. GVW; Vehicles in this category are tested at their adjusted loaded vehicle weight	LEV630	0.63	7.3	6	0.12
	ULEV570	0.57	7.3	6	0.06
	ULEV400	0.4	7.3	6	0.06
	ULEV270	0.27	4.2	6	0.06
	SULEV230	0.23	4.2	6	0.06
	SULEV200	0.2	3.7	6	0.06

Note: Definitions of acronyms are on page 12-14. These standards would also apply to states that adopted California emissions regulations.

Source:
California LEV III Regulations with amendments effective January 1, 2016, www.arb.ca.gov/msprog/levprog/cleandoc/cleancomplete%201ev-ghg%20regs%201-16.pdf. (Additional resources: www.arb.ca.gov)

These exhaust emission standards apply to commercial aircraft engines.

Table 13.22
Aircraft – Exhaust Emission Standards

	Year	Pressure ratio (PR)	Applicability[a]	HC (g/kN)	NOx	CO (g/kN)	Smoke
Federal[b]	1974+	-	T8	-	-	-	30
	1976+	-	TF with rO[c] ≥ 129 kN	-	-	-	$83.6(rO)^{-0.274}$
	1978+	-	T3[d]	-	-	-	25
	1983+	-	TF with rO < 26.7 kN	-	-	-	$83.6(rO)^{-0.274}$ NTE max of SN=50
	1984+	-	T3, T8, TF with rO ≥ 26.7 kN	19.6	-	-	$83.6(rO)^{-0.274}$ NTE max of SN=50
		-	TSS	$140(.92)^{rPR}$	-	-	$83.6(rO)^{-0.274}$ NTE max of SN=50
		-	TSS with rO ≥ 26.7 kN	$140(.92)^{rPR}$	-	-	$83.6(rO)^{-0.274}$ NTE max of SN=50
		-	TP with rO ≥ 1,000 kW	-	-	-	$187(rO)^{-0.168}$
	1997+	-	T3, T8, TF with rO > 26.7 kN	19.6	40+2(rPR)	118	$83.6(rO)^{-0.274}$ NTE max of SN=50
		-	T3, T8, TF newly certified with rO > 26.7 kN	19.6	32+1.6(rPR)	118	$83.6(rO)^{-0.274}$ NTE max of SN=50
	2000+	-	T3, T8, TF newly manufactured with rO > 26.7 kN	19.6	32+1.6(rPR)	118	$83.6(rO)^{-0.274}$ NTE max of SN=50
	2005+	PR ≤ 30	T3, T8, TF newly certified with rO > 89 kN	-	19+1.6(rPR)	-	-
			T3, T8, TF newly certified with 26.7 kN < rO ≤ 89 kN	-	37.572+1.6(rPR)-0.2087(rO)	-	-
		30 < PR < 62.5	T3, T8, TF newly certified with rO>89 kN	-	7+2.0(rPR)	-	-
			T3, T8, TF newly certified with 26.7kN < r0 ≤ 89kN	-	42.71+1.4286(rPR)-0.4013(rO)+0.00642(rPR)(rO)	-	-
		PR ≤ 62.5	T3, T8, TF	-	32+1.6(rPR)	-	-

Note: The test procedures are the International Civil Aviation Organization (ICAO) Smoke Emission Test Procedure and the ICAO Gaseous Emissions Test Procedure. There is no useful life or warranty period for purposes of compliance with aircraft emissions standards. Definitions of acronyms are on page 12-14.

Source:
40 CFR Part 87, Aircraft emission standards, test procedures, certification requirements (Additional resources: www.epa.gov/emission-standards-reference-guide/nonroad-engines-and-vehicles-emission-standards)

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[a] T8=all aircraft gas turbine engines of the JT8D model family
TF=all turbofan and turbojet aircraft engines except engines of Class T3, T8, and TSS
T3=all aircraft gas turbine engines of the JT3D model family
TSS=all aircraft gas turbine engines for aircraft operations at supersonic flight speeds
TP=all aircraft turboprop engines
[b] Federal standards apply to planes operating in the United States, regardless of where they were manufactured.
[c] Rated output (rO) is the maximum power/thrust available for takeoff.
[d] T3 engines are no longer manufactured but are in the existing fleet.

These standards apply to construction and agricultural equipment, such as excavators, paving equipment, tractors, combines, bulldozers, and skidders.

Table 13.23
Nonroad Compression-Ignition Engines – Exhaust Emission Standards

	Rated power (kW)	Tier	Model year	NMHC (g/kW -hr)	NMHC + NOx (g/kW -hr)	NOx (g/kW -hr)	PM (g/kW -hr)	CO (g/kW -hr)	Smoke[a] percentage	Useful life (hours/years)[b]
Federal	kW < 8	1	2000-2004	--	10.5	--	1.0	8.0	20 / 15 / 50	3,000 / 5
		2	2005-2007	--	7.5	--	0.80	8.0		
		4	2008+	--	7.5	--	0.40[c]	8.0		
	8 ≤ kW < 19	1	2000-2004	--	9.5	--	0.80	6.6		3,000 / 5
		2	2005-2007	--	7.5	--	0.80	6.6		
		4	2008+	--	7.5	--	0.40	6.6		
	19 ≤ kW < 37	1	1999-2003	--	9.5	--	0.80	5.5		5,000 / 7[d]
		2	2004-2007	--	7.5	--	0.60	5.5		
		4	2008-2012	--	7.5	--	0.30	5.5		
			2013+	--	4.7	--	0.03	5.5		
	37 ≤ kW < 56	1	1998-2003	--	--	9.2	--	--		8,000 / 10
		2	2004-2007	--	7.5	--	0.40	5.0		
		3[e]	2008-2011	--	4.7	--	0.40	5.0		
		4 (Option 1)[f]	2008-2012	--	4.7	--	0.30	5.0		
		4 (Option 2)[f]	2012	--	4.7	--	0.03	5.0		
		4	2013+	--	4.7	--	0.03	5.0		
	56 ≤ kW < 75	1	1998-2003	--	--	9.2	--	--		
		2	2004-2007	--	7.5	--	0.40	5.0		
		3	2008-2011	--	4.7	--	0.40	5.0		
		4	2012-2103[g]	--	4.7	--	0.02	5.0		
			2014+[h]	0.19	--	0.4	0.02	5.0		
	75 ≤ kW < 130	1	1997-2002	--	--	9.2	--	--		
		2	2003-2006	--	6.6	--	0.3	5.0		
		3	2007-2011	--	4.0	--	0.3	5.0		
		4	2012-2013[g]	--	4.0	--	0.02	5.0		
			2014+	0.19	--	0.4	0.02	5.0		
	130 ≤ kW < 225	1	1996-2002	1.3[i]	--	9.2	0.54	11.4		
		2	2003-2005	--	6.6	--	0.20	3.5		
		3	2006-2010	--	4.0	--	0.20	3.5		
		4	2011-2013[g]	--	4.0	--	0.02	3.5		
			2014+[h]	0.19	--	0.4	0.02	3.5		
	225 ≤ kW < 450	1	1996-2000	1.3[i]	--	9.2	0.54	11.4		
		2	2001-2005	--	6.4	--	0.20	3.5		
		3	2006-2010	--	4.0	--	0.20	3.5		
		4	2011-2013[g]	--	4.0	--	0.02	3.5		
			2014+[h]	0.19	--	0.4	0.02	3.5		
	450 ≤ kW < 560	1	1996-2001	1.3[i]	--	9.2	0.54	11.4		
		2	2002-2005	--	6.4	--	0.20	3.5		
		3	2006-2010	--	4.0	--	0.20	3.5		
		4	2011-2013[g]	--	4.0	--	0.02	3.5		
			2014+[h]	0.19	--	0.4	0.02	3.5		
	560 ≤ kW < 900	1	2000-2005	1.3[i]	--	9.2	0.54	11.4		
		2	2006-2010	--	6.4	--	0.20	3.5		
		4	2011-2014	0.4	--	3.5	0.10	3.5		
			2015+[h]	0.19	--	3.5[j]	0.04[k]	3.5		

Table 13.23 (continued)
Nonroad Compression-Ignition Engines – Exhaust Emission Standards

	Rated power (kW)	Tier	Model year	NMHC (g/kW-hr)	NMHC + NOx (g/kW-hr)	NOx (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)	Smoke[a] percentage	Useful life (hours/years)[b]
Federal	kW > 900	1	2000-2005	1.3[i]	--	9.2	0.54	11.4	20 / 15 / 50	8,000 / 10
		2	2006-2010	--	6.4	--	0.20	3.5		
		4	2011-2014	0.4	--	3.5[j]	0.10	3.5		
			2015+[h]	0.19	--	3.5[j]	0.04[k]	3.5		

Note: Definitions of acronyms are on page 12-14.

Sources:
40 CFR 98.112 = Exhaust emission standards
40 CFR 1039.101 = Exhaust emission standards for after 2014 model year
40 CFR 1039.102 = Exhaust emission standards for model year 2014 and earlier
40 CFR 1039 Subpart F = Exhaust emissions transient and steady state test procedures
40 CFR 86 Subpart I = Smoke emission test procedures
40 CFR 1065 = Test equipment and emissions measurement procedures (Additional resources: www.epa.gov/emission-standards-reference-guide/nonroad-engines-and-vehicles-emission-standards)

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[a] Smoke emissions may not exceed 20 percent during the acceleration mode, 15 percent during the lugging mode, and 50 percent during the peaks in either mode. Smoke emission standards do not apply to single-cylinder engines, constant-speed engines, or engines certified to a PM emission standard of 0.07 grams per kilowatt-hour (g/kW-hr) or lower. Smoke emissions are measured using procedures in 40 CFR Part 86 Subpart I.

[b] Useful life and warranty period are expressed hours and years, whichever comes first.

[c] Hand-startable air-cooled direct injection engines may optionally meet a PM standard of 0.60 g/kW-hr. These engines may optionally meet Tier 2 standards through the 2009 model years. In 2010 these engines are required to meet a PM standard of 0.60 g/kW-hr.

[d] Useful life for constant speed engines with rated speed 3,000 revolutions per minute (rpm) or higher is 5 years or 3,000 hours, whichever comes first.

[e] These Tier 3 standards apply only to manufacturers selecting Tier 4 Option 2. Manufacturers selecting Tier 4 Option 1 will be meeting those standards in lieu of Tier 3 standards.

[f] A manufacturer may certify all their engines to either Option 1 or Option 2 sets of standards starting in the indicated model year. Manufacturers selecting Option 2 must meet Tier 3 standards in the 2008-2011 model years.

[g] These standards are phase-out standards. Not more than 50 percent of a manufacturer's engine production is allowed to meet these standards in each model year of the phase out period. Engines not meeting these standards must meet the final Tier 4 standards.

[h] These standards are phased in during the indicated years. At least 50 percent of a manufacturer's engine production must meet these standards during each year of the phase in. Engines not meeting these standards must meet the applicable phase-out standards.

[i] For Tier 1 engines the standard is for total hydrocarbons.

[j] The NOx standard for generator sets is 0.67 g/kW-hr.

[k] The PM standard for generator sets is 0.03 g/kW-hr.

These standards apply to gasoline and propane industrial equipment such as forklifts, generators, airport service equipment, compressors and ice-grooming machines.

Table 13.24
Nonroad Large Spark-Ignition Engines – Exhaust and Evaporative Emission Standards

<table>
<tr><th rowspan="2"></th><th rowspan="2">Tier</th><th rowspan="2">Year</th><th colspan="2">General duty-cycle standards</th><th colspan="2">Alternative standards for severe-duty engines</th><th colspan="2">Field testing standards</th><th rowspan="2">Useful life (years/hours)</th></tr>
<tr><th>HC+NOx[a] (g/kW-hr)</th><th>CO (g/kW-hr)</th><th>HC+NOx[a] (g/kW-hr)</th><th>CO (g/kW-hr)</th><th>HC+NOx[a] (g/kW-hr)</th><th>CO (g/kW-hr)</th></tr>
<tr><td rowspan="6">Federal[b]</td><td>1[c]</td><td>2004-2006</td><td>4.0[d]</td><td>50.0</td><td>4.0[d]</td><td>130.0</td><td>-</td><td>-</td><td>7 / 5,000[e]</td></tr>
<tr><td rowspan="5">2[f]</td><td rowspan="5">2007+</td><td>2.7[f]</td><td>4.4[f]</td><td>2.7</td><td>130.0</td><td>3.8[f]</td><td>6.5[f]</td><td>7 / 5,000[e]</td></tr>
<tr><td colspan="7">Evaporative emission standards (for engines fueled by a volatile liquid fuel)</td></tr>
<tr><td>Fuel line permeation</td><td colspan="5">Nonmetallic fuel lines must meet the permeation specifications of SAE J2260 (November 1996)</td><td rowspan="3">5 / -</td></tr>
<tr><td>Diurnal emissions</td><td colspan="5">Evaporative HC emissions may not exceed 0.2 grams per gallon of fuel tank capacity</td></tr>
<tr><td>Running loss</td><td colspan="5">Liquid fuel in the fuel tank may not reach boiling during continuous engine operation in the final installation at an ambient temperature of 30°C</td></tr>
</table>

Sources:
40 CFR 1048.101 = Exhaust emission standards
40 CFR 1048.105 = Evaporative emission standards
40 CFR 1048.110 = Engine diagnostic requirements (Additional resources: www.epa.gov/emission-standards-reference-guide/nonroad-engines-and-vehicles-emission-standards)

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[a] The numerical emission standards for hydrocarbons (HC) must be met based on the following types of hydrocarbon emissions for engines powered by the following fuels: (1) non-methane hydrocarbons (NMHC) for natural gas; (2) total hydrocarbon equivalent (THCE) for alcohol; and (3) total hydrocarbons (THC) for other fuels.

[b] Voluntary Blue Sky standards for large spark-ignition (SI) engines are available. Engines with displacement at or below 1,000 cubic centimeters (cc) and maximum power at or below 30 kilowatts (kW) may be certified under the program for small SI engines.

[c] Emission standards are based on testing over a steady-state duty-cycle.

[d] The Tier 1 HC plus nitrogen oxides (NOx) emission standard for in-use testing is 5.4 grams per kW-hour (g/kW-hr).

[e] Useful life is expressed in years and hours, whichever comes first. These are the minimum useful life requirements. For severe-duty engines, the minimum useful life is seven years or 1,500 hours of operation, whichever comes first. A longer useful life in hours is required if: (a) the engine is designed to operate longer than the minimum useful life based on the recommended rebuild interval; or (b) the basic mechanical warranty is longer than the minimum useful life.

[f] Optional engine certification is allowed according to the following formula: $(HC+NOx) \times CO^{0.784} \leq 8.57$. The HC+NOx and carbon monoxide (CO) emission levels selected to satisfy this formula, rounded to the nearest 0.1 g/kW-hr, become the emission standards that apply for those engines. One may not select an HC+NOx emission standard higher than 2.7 g/kW-hr or a CO emission standard higher than 20.6 g/kW-hr.

Table 13.25
Locomotives – Exhaust Emission Standards

	Duty-cycle[b]	Tier	Year[c]	HC[i] (g/hp-hr)	NOx (g/bhp-hr)	PM (g/bhp-hr)	CO (g/bhp-hr)	Smoke (percentage)[m]	Minimum useful life (hours / years / miles)[n]
Federal[a]	Line-haul	Tier 0	1973-1992[d,e]	1.0	9.5 [ABT]	0.22 [ABT]	5.0	30 / 40 / 50	(7.5 x hp) / 10 / 750,000[o]
		Tier 1	1993-2004[d,e]	0.55	7.4 [ABT]	0.22 [ABT]	2.2	25 / 40 / 50	(7.5 x hp) / 10 / 750,000[o] (7.5 x hp) / 10 / -
		Tier 2	2005-2011[d]	0.30	5.5 [ABT]	0.10[k] [ABT]	1.5	20 / 40 / 50	(7.5 x hp) / 10 / -
		Tier 3	2012-2014[f]	0.30	5.5 [ABT]	0.10 [ABT]	1.5	20 / 40 / 50	(7.5 x hp) / 10 / -
		Tier 4	2015+[g]	0.14	1.3 [ABT]	0.03 [ABT]	1.5	-	(7.5 x hp) / 10 / -
	Switch	Tier 0	1973-2001	2.10	11.8 [ABT]	0.26 [ABT]	8.0	30 / 40 / 50	(7.5 x hp) / 10 / 750,000[o]
		Tier 1	2002-2004[h]	1.20	11.0 [ABT]	0.26 [ABT]	2.5	25 / 40 / 50	(7.5 x hp) / 10 / -
		Tier 2	2005-2010[h]	0.60	8.1 [ABT]	0.13[l] [ABT]	2.4	20 / 40 / 50	(7.5 x hp) / 10 / -
		Tier 3	2011-2014	0.60	5.0 [ABT]	0.10 [ABT]	2.4	20 / 40 / 50	(7.5 x hp) / 10 / -
		Tier 4	2015+	0.14[j]	1.3[j][ABT]	0.03 [ABT]	2.4	-	(7.5 x hp) / 10 / -

Source:
40 CFR 1033.101 = Emission Standards and Useful Life. (Additional resources: www.epa.gov/emission-standards-reference-guide/nonroad-engines-and-vehicles-emission-standards)

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[a] These standards apply to locomotives that are propelled by engines with total rated horsepower (hp) of 750 kilowatts (kW) (1006 hp) or more, unless the owner chooses to have the equipment certified to meet the requirements of locomotives. This does not include vehicles propelled by engines with total rated horsepower of less than 750 kW (1006 hp); see the requirements in 40 Code of Federal Regulations (CFR) Parts 86, 89 and 1039. The test procedures specify chassis-based testing of locomotives. These test procedures include certification testing, production line testing, and in-use testing using the Federal Test Procedure (FTP) when the locomotive has reached between 50-70 percent of its useful life.

[b] Line-haul locomotives are powered by an engine with a maximum rated power (or a combination of engines having a total rated power) greater than 2300 hp. Switch locomotives are powered by an engine with a maximum rated power (or a combination of engines having a total rated power) of 2300 hp or less.

[c] The Tier 0 standards apply to locomotives manufactured after 1972 when they are manufactured or remanufactured. Note that interim standards may apply for Tier 0 or Tier 1 locomotives remanufactured in 2008 or 2009, or for Tier 2 locomotives manufactured or remanufactured in 2008-2012.

[d] Line-haul locomotives subject to the Tier 0 through Tier 2 emission standards must also meet switch standards of the same tier.

[e] The Tier 0 standards apply for 1993-2001 locomotives not originally manufactured with a separate loop intake air cooling system.

[f] Tier 3 line-haul locomotives must also meet Tier 2 switch standards.

[g] Manufacturers using credits may elect to meet a combined nitrogen oxides (NOx) plus hydrocarbon (HC) standard of 1.4 grams per brakehorsepower-hour (g/bhp-hr) instead of the otherwise applicable Tier 4 NOx and HC standards.

[h] Tier 1 and Tier 2 switch locomotives must also meet line-haul standards of the same tier.

[i] The numerical emission standards for HC must be met based on the following types of hydrocarbon emissions for locomotives powered by the following fuels: (1) alcohol: total hydrocarbon equivalent (THCE) emissions for Tier 3 and earlier locomotives, and non-methane hydrocarbon equivalent (NMHCE) for Tier 4; (2) natural gas and liquefied petroleum gas: non-methane hydrocarbon (NMHC) emissions; and (3) diesel: total hydrocarbon (THC) emissions for Tier 3 and earlier locomotives, and NMHC for Tier 4.

Table 13.25 (continued)
Locomotives – Exhaust Emission Standards

[j] Manufacturers may elect to meet a combined NOx+HC standard of 1.4 g/bhp-hr instead of the otherwise applicable Tier 4 NOx and HC standards.

[k] The line-haul particulate matter (PM) standard for newly remanufactured Tier 2 locomotives is 0.20 g/bhp-hr until January 1, 2013, except as specified in 40 CFR Part 1033.150(a).

[l] The switch PM standard for new Tier 2 locomotives is 0.24 g/bhp-hr until January 1, 2013, except as specified in 40 CFR Part 1033.150(a).

[m] The smoke opacity standards apply only for locomotives certified to one or more PM standards or Family Emission Limits (FEL) greater than 0.05 g/bhp-hr. Percentages apply to smoke opacity at steady state/30-second peak/3-second peak, as measured continuously during testing.

[n] Useful life and warranty period are expressed in megawatt-hours (MW-hr), years, or miles, whichever comes first. Manufacturers are required to certify to longer useful lives if their locomotives are designed to last longer between overhauls than the minimum useful life value.

[o] For locomotives originally manufactured before January 1, 2000, and not equipped with MW-hr meters.

These standards apply to auxiliary and propulsion engines used by all types of recreational and commercial vessels, from small fishing boats to ocean-going ships.

Table 13.26
Marine Compression-Ignition (CI) Engines – Exhaust Emission Standards

	Category [a, b]	Tier	Displacement (L/cylinder)	Power [c] (kW)	Speed (rpm)	Model Year	NOx (g/kW-hr)	HC (g/kW-hr)	HC+NOx [d] (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)	Useful Life[e] (years/hours)
Federal[g]	C1 Commercial	1	≥ 2.5	≥ 37	rpm < 130	2004[h]	17.0	-	-	-	-	10 / 10,000
					130 ≤rpm < 2000		45.0 x $N^{-0.20}$ [i]	-	-	-	-	
					rpm ≥2000		9.8	-	-	-	-	
		2	disp. < 0.9	≥ 37	-	2005[h]	-	-	7.5 (ABT)	0.40 (ABT)	5.0	10 / 10,000
			0.9 ≤ disp < 1.2	all	-	2004 [h]	-	-	7.2 (ABT)	0.30 (ABT)	5.0	
			1.2 ≤ disp < 2.5		-	2004 [h]	-	-	7.2 (ABT)	0.20 (ABT)	5.0	
			2.5 ≤ disp < 5.0		-	2007 [h]	-	-	7.2 (ABT)	0.20 (ABT)	5.0	
	C1 Commercial & Recreational	1	≥ 2.5	≥ 37	rpm < 130	2004	17.0	-	-	-	-	10/ 1,000
					130 ≤ rpm < 2000		45.0 x $N^{-0.20}$ [i]	-	-	-	-	
					rpm ≥ 2000		9.8	-	-	-	-	
		2	disp < 0.9	≥ 37	-	2007	-	-	7.5 (ABT)	0.40 (ABT)	5.0	10 / 1,000
			0.9 ≤ disp < 1.2	all	-	2006	-	-	7.2 (ABT)	0.30 (ABT)	5.0	
			1.2 ≤ disp < 2.5		-	2006	-	-	7.2 (ABT)	0.20 (ABT)	5.0	
			2.5 ≤ disp < 5.0		-	2009	-	-	7.2 (ABT)	0.20 (ABT)	5.0	
	C1 Commercial & Recreational < 75 kW	3	< 0.9	< 8	-	2009+	-	-	7.5 (ABT)	0.40 (ABT)	8.0	5 / 3,000; 10 / 1,000 for CI Recreational
				8 ≤ kW < 19	-	2009+	-	-	7.5 (ABT)	0.40 (ABT)	6.6	
				19 ≤ kW < 37	-	2009-2013	-	-	7.5 [j] (ABT)	0.30 [j] (ABT)	5.5	7 / 5,000
					-	2014+	-	-	4.7 [j] (ABT)	0.20 (ABT)	5.0	
				37 ≤ kW < 75	-	2009-2013	-	-	7.5 [j] (ABT)	0.30 [j] (ABT)	5.0	10 / 10,000
					-	2014+	-	-	4.7 [j] (ABT)		5.0	
	C1 Commercial Engines with ≤ 35 kW/L power density [k]	3 [l]	< 0.9	-	-	2012+	-	-	5.4 (ABT)	0.14 (ABT)	8.0 for < 8 kW	5 / 3,000 for commercial engines < 19 kW
			0.9 ≤ disp < 1.2	All	-	2013+	-	-	5.4 (ABT)	0.12 (ABT)	6.6 for 8 ≤ kW < 19	7 / 5,000 for commercial engines 19 ≤ kW < 37
			1.2 ≤ disp < 2.5	< 600	-	2014-2017	-	-	5.6 (ABT)	0.11 (ABT)	5.5 for 19 ≤ kW < 37	10 / 10,000 for C1 Commercial ≤ 37 kW
					-	2018+	-			0.10 (ABT)	5.0 for ≤ 37 kW	
				≥ 600	-	2014+	-	-	5.6 (ABT)	0.11 (ABT)		
			2.5 ≤ disp < 3.5	< 600	-	2013-2017	-	-	5.6 (ABT)	0.11 (ABT)		
					-	2018+	-			0.10 (ABT)		
				≥ 600	-	2013+	-	-	5.6 (ABT)	0.11 (ABT)		
			3.5 ≤ disp < 7.0	< 600	-	2012-2017	-	-	5.8 (ABT)	0.11 (ABT)		
					-	2018+	-			0.10 (ABT)		
				≥ 600	-	2012+	-	-	5.8 (ABT)	0.11 (ABT)		
	C1 Commercial engines with > 35 kW/L power density & All Recreational Engines [k]	3 [l]	< 0.9	≥ 75	-	2012+	-	-	5.8 (ABT)	0.15 (ABT)	8.0 for < 8 kW	5 / 3,000 for commercial engines < 19 kW
			0.9 ≤ disp < 1.2	All	-	2013+	-	-	5.8 (ABT)	0.14 (ABT)	6.6 for 8 ≤ kW < 19	7 / 5,000 for commercial engines 19 ≤ kW < 37
			1.2 ≤ disp < 2.5		-	2014+	-	-	5.8 (ABT)	0.14 (ABT)	5.5 for 19 ≤ kW < 37	10 / 10,000 for C1 Commercial ≥ 37 kW
			2.5 ≤ disp < 3.5		-	2013+	-	-	5.8 (ABT)	0.12 (ABT)	5.0 for ≥ 37 kW	10 / 1,000 for CI Recreational
			3.5 ≤ disp < 7.0		-	2012+	-	-	5.8 (ABT)	0.11 (ABT)		

(Continued on next page)

Table 13.26 (continued)
Marine Compression-Ignition (CI) Engines – Exhaust Emission Standards

	Category [a, b]	Tier	Displacement (L/cylinder)	Power [c] (kW)	Speed (rpm)	Model Year	NOx (g/kW-hr)	HC (g/kW-hr)	HC+NOx [d] (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)	Useful Life[e] (years/hours)
Federal[g]	C1 Commercial > 600 kW	4[m]	All	600 ≤ kW < 1,400	-	2017+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)	5.0	10 / 10,000
			All	1,400 ≤ kW < 2,000	-	2016+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)		
			All	2,000 ≤ kW < 3,700	-	2014+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)		
			< 7.0	≥ 3,700	-	2014-2015	1.8 (ABT)	-	0.19 HC[n]	0.12 (ABT)		
					-	2016+	1.8 (ABT)	-	0.19 HC[n]	0.06 (ABT)		
	C2	1	≥ 2.5	≥ 37	rpm < 130	2004	17.0	-	-	-	-	10 / 20,000
					130 ≤ rpm < 2,000		45.0 x $N^{-0.20}$ [i]	-	-	-	-	
					rpm ≥ 2,000		9.8	-	-	-	-	
		2	5.0 ≤ disp < 15.0	all	-	2007	-	-	7.8 (ABT)	0.27 (ABT)	5.0	10 / 20,000
			15.0 ≤ disp < 20.0	< 3,300	-		-	-	8.7 (ABT)	0.50 (ABT)	5.0	
			15.0 ≤ disp < 20.0	≥ 3,300	-		-	-	9.8 (ABT)	0.50 (ABT)	5.0	
			20.0 ≤ disp < 25.0	all	-		-	-	9.8 (ABT)	0.50 (ABT)	5.0	
			25.0 ≤ disp < 30.0	all	-		-	-	11.0 (ABT)	0.50 (ABT)	5.0	
		3[o,p]	7.0 ≤ disp < 15.0	< 2,000	-	2013+	-	-	6.2 (ABT)	0.14 (ABT)	5.0	10 / 20,000
				2,000 ≤ kW < 3,700	-		-	-	7.8 (ABT)	0.14 (ABT)	5.0	
			15.0 ≤ disp < 20.0	< 2,000	-	2014+	-	-	7.0 (ABT)	0.34 (ABT)	5.0	
			20.0 ≤ disp < 25.0	< 2,000	-		-	-	9.8 (ABT)	0.27 (ABT)	5.0	
			25.0 ≤ disp < 30.0	< 2,000	-		-	-	11.0 (ABT)	0.27 (ABT)	5.0	
		4[m,p]	All	600 ≤ kW < 1,400	-	2017+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)		10 / 20,000
			All	1400 ≤ kW < 2,000	-	2016+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)		
			All	2,000 ≤ kW < 3,700[q]	-	2014+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)		
			< 15.0	≥ 3,700	-	2014-2015	1.8 (ABT)	-	0.19 HC[n]	0.12 (ABT)		
			15.0 ≤ disp < 30.0		-	2014-2015	1.8 (ABT)	-	0.19 HC[n]	0.25 (ABT)		
			All		-	2016+	1.8 (ABT)	-	0.19 HC[n]	0.06 (ABT)	5.0	
	C3	1	≥30.0	All	rpm < 130	2004	17.0	-	-	-	-	3 / 10,000
					130 ≤ rpm < 2,000		45.0 × $N^{-0.20}$ [i]	-	-	-	-	
					rpm ≥ 2,000		9.8	-	-	-	-	
		2	≥30.0	All	rpm < 130	2011	14.4	2.0	-	-	5.0	3 / 10,000
					130 ≤ rpm < 2,000		44.0 × $N^{-0.23}$ [i]		-	-		
					rpm ≥ 2,000		7.7		-	-		
		3	≥ 30.0	All	rpm < 130	2016	3.4	2.0	-	-	5.0	3 / 10,000
					130 ≤ rpm < 2,000		9.0 × $N^{-0.20}$ [i]		-	-		
					rpm ≥ 2,000		2.0		-	-		

Sources:
40 CFR 89.104 = Tiers 1 and 2 useful life & warranty period for marine CI engines less than 37 kW
40 CFR 89.112 = Tiers 1 and 2 emission standards for marine CI engines less than 37 kW
40 CFR 89 Subpart E = Tiers 1 and 2 test procedures for marine CI engines less than 37 kW
40 CFR 94.8 = Tiers 1 and 2 emission standards for C1 (both commercial & recreational), C2 and C3 engines
40 CFR 94.9 = Tiers 1 and 2 useful life for C1 (both commercial & recreational), C2 and C3 engines
40 CFR 94 Subpart B = Tiers 1 and 2 test procedures for C1 (both commercial & recreational), C2 and C3 engines
40 CFR 1042.101 = Tiers 3 and 4 exhaust emission standards and useful life

Table 13.26 (continued)
Marine Compression-Ignition (CI) Engines – Exhaust Emission Standards

Sources (continued):
40 CFR 1042.107 = Tiers 3 and 4 evaporative emission standards engines using a volatile liquid fuel (e.g., methanol)
40 CFR 1042.120 = Tiers 3 and 4 warranty period
40 CFR 1042 Subpart F = Tiers 3 and 4 test procedures (Additional resources: www.epa.gov/emission-standards-reference-guide/nonroad-engines-and-vehicles-emission-standards)

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[a] For Tiers 1 and 2, Category 1 marine engines are greater than or equal to 37 kilowatts (kW) and have a displacement less than 5.0 liters per cylinder (L/cylinder); Category 2 marine engines have a displacement greater than or equal to 5.0 L/cylinder and less than 30 L/cylinder; and Category 3 marine engines have a displacement greater than or equal to 30.0 L/cylinder. For Tiers 3 and 4, Category 1 represents engines up to 7 L/cylinder displacement; and Category 2 includes engines from 7 to 30 L/cylinder. The definition of Category 3 marine engines remains the same.

[b] Tiers 1 and 2 for marine engines less than 37 kW are subject to the same emission standards as for land-based engines. See Table 1 in 40 Code of Federal Regulations (CFR) Part 89.112 and 40 CFR Part 89.104.

[c] For Tiers 1 and 2, this refers to the rated power; for Tiers 3 and 4, this refers to the maximum engine power.

[d] Total hydrocarbon (THC) plus nitrogen oxides (NOx) for Tier 2 standards.

[e] Useful life is expressed in hours or years, whichever comes first. For Tiers 3 and 4, a longer useful life in hours for an engine family must be specified if either:1) the engine is designed, advertised, or marketed to operate longer than the minimum useful life; or 2) the basic mechanical warranty is longer than the minimum useful life.

[f] Warranty period is expressed in years and hours, whichever comes first.

[g] For Tiers 3 and 4, there are no evaporative emission standards for diesel-fueled engines, or engines using other nonvolatile or nonliquid fuels (e.g., natural gas). If an engine uses a volatile liquid fuel, such as methanol, the engine's fuel system and the vessel in which the engine is installed must meet the evaporative emission requirements of 40 Code of Federal Regulations (CFR) Part 1045 that apply with respect to spark-ignition engines. Manufacturers subject to evaporative emission standards must meet the requirements of 40 CFR 1045.112 as described in 40 CFR 1060.1(a)(2).

[h] Indicates the model years for which the specified standards start.

[i] N is the maximum test speed of the engine in revolutions per minute (rpm).

[j] Manufacturers of Tier 3 engines greater than or equal to 19 kW and less than 75 kW with displacement below 0.9 L/cylinder may alternatively certify some or all of their engine families to a particulate matter (PM) emission standard of 0.20 grams per kilowatt-hour (g/kW-hr) and a NOx+HC emission standard fo 5.8 g/kW-hr for 2014 and later model years.

[k] The applicable Tier 2 NOx+HC standards continue to apply instead of the Tier 3 values for engines at or above 2000 kW.

[l] These Tier 3 standards apply to Category 1 engines below 3700 kW except for recreational marine engines at or above 3700 kW (with any displacement), which must meet the Tier 3 standards specified for recreational marine engines with a displacement of 3.5 to 7.0 L/cylinder.

[m] The following provisions are optional: 1) Manufacturers may use NOx credits to certify Tier 4 engines to a NOX+HC emission standard of 1.9 g/kW-hr instead of the NOX and HC standards. See 40 CFR 1042.101(a)(8)(i) for more details. 2) For engines below 1000 kW, manufacturers may delay complying with the Tier 4 standards until October 1, 2017. 3) For engines at or above 3700 kW, manufacturers may delay complying with the Tier 4 standards until December 31, 2016.

[n] The Tier 4 standard is for HC (not HC+NOx) in g/kW-hr.

[o] These Tier 3 standards apply to Category 2 engines below 3700 kW; no Tier 3 standards apply for Category 2 engines at or above 3700 kW, although there are Tier 4 standards that apply.

Table 13.26 (continued)
Marine Compression-Ignition (CI) Engines – Exhaust Emission Standards

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[p] An alternative set of Tier 3 and Tier 4 standards for PM, NOx, and HC are available for Category 2 engines at or above 1400 kW, but must be applied to all of a manufacturer's engines in a given displacement category in model years 2012 through 2015.

Tier	Maximum engine power	Model year	PM (g/kW-hr)	NOx (g/kW-hr)	HC (g/kW-hr)
3	kW ≥ 1400	2012-2014	0.14	7.8 NOx+HC	
4	1400 ≤ kW < 3700	2015	0.04	1.8	0.19
	kW ≥ 3700	2015	0.06	1.8	0.19

[q] Interim Tier 4 PM standards apply for 2014 and 2015 model year Category 2 engines with per-cylinder displacement at or above 15.0 liters: 0.34 g/kW-hr for engines 2000 = kW < 3000, and 0.27 g/kW-hr for engines 3300 = kW < 3700.

These standards apply to gasoline boats and personal watercraft, such as pleasure boats, jet-skis, outboard engines and sterndrive/inboard engines.

Table 13.27
Marine Spark-Ignition Engines and Vessels – Exhaust Emission Standards

	Engine type		Model year	HC + NOx[a] (g/KW-hr)		CO[c] (g/KW-hr)		Useful life (hours/years)[d]
				$P \leq 4.3$ kW[b]	$P > 4.3$ kW[b]	$P \leq 4.3$ kW[b]	$P > 4.3$ kW[b]	
Federal[e]	Personal watercraft & outboard marine engines		1998	278 ABT	(0.917 x (151 + $557/P^{0.9}$ + 2.44) [ABT]	--	--	350 / 5
			1999	253 ABT	(0.833 x (151 + $557/P^{0.9}$ + 2.89) [ABT]	--	--	
			2000	228 ABT	(0.750 x (151 + $557/P^{0.9}$) + 3.33 [ABT]	--	--	
			2001	204 ABT	(0.667 x (151 + $557/P^{0.9}$) + 3.78 [ABT]	--	--	
			2002	179 ABT	(0.583 x (151 + $557/P^{0.9}$) + 4.22 [ABT]	--	--	
			2003	155 ABT	(0.500 x (151 + $557/P^{0.9}$) + 4.67 [ABT]	--	--	
			2004	130 ABT	(0.417 x (151 + $557/P^{0.9}$) + 5.11 [ABT]	--	--	
			2005	105 ABT	(0.333 x (151 + $557/P^{0.9}$) + 5.56 [ABT]	--	--	
			2006-2009	81 ABT	(0.250 x (151 + $557/P^{0.9}$) + 6.00 [ABT]	--	--	
			2010 +[g]	30 ABT	2.1 + 0.09 x (151 + $557/P^{0.9}$) [ABT]	500 - 5.0 x P	300	Personal Watercraft: 350 / 5[h] Outboard: 350 / 10[h]
	Sterndrive/ inboard engines	Conventional engines[g]	2010 +	5.0 [ABT]		75 [ABT]		480 / 10[i]
		High-performance engines		$P \leq$ kW[b]	$P > 485$ kW[b]	350		$P \leq 485$ kW: 150 / 3
			2010	20.0	25.0			$P > 485$ kW: 50 / 1
			2011+	16.0	22.0			

Sources:
40 CFR 91.104 = Outboard and personal watercraft (PWC) exhaust emission standards (1998-2009)
40 CFR 91.105 = Outboard and PWC useful life (1998-2009)
40 CFR 1045.103 = Outboard and PWC exhaust emission standards (2010+)
40 CFR 1045.105 = Sterndrive/Inboard exhaust emission standards
40 CFR 1045.107 = Not-to-exceed exhaust emission standards (Additional resources: www.epa.gov/emission-standards-reference-guide/nonroad-engines-and-vehicles-emission-standards)

[a] The numerical emission standards for hydrocarbons (HC) must be met based on the following types of HC emissions for engines powered by the following fuels: (1) total hydrocarbon equivalent for alcohol; (2) non-methane hydrocarbon for natural gas; and (3) total hydrocarbons for other fuels.

Table 13.27 (continued)
Marine Spark-Ignition Engines and Vessels – Exhaust Emission Standards

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[b] P stands for the maximum engine power in kilowatts.

[c] Manufacturers may generate or use emission credits for averaging, but not for banking or trading.

[d] Useful life and warranty period are expressed hours or years of operation (unless otherwise indicated), whichever comes first.

[e] The test procedure for federal standards uses the International Organization for Standardization (ISO) 8178 E4 5-Mode Steady-State Test Cycle.

[f] Also applies to model year (MY) 1997 engine families certified pursuant to 40 Code of Federal Regulations (CFR) 91.205.

[g] Not-to-exceed emission standards specified in 40 CFR 1045.107 also apply.

[h] A longer useful life in terms of hours must be specified for the engine family if the average service life is longer than the minimum value as described in 40 CFR 1045.103(e)(3).

[i] The useful life may not be shorter than: (1) 150 hours of operation; (2) the recommended overhaul interval; or (3) the engine's mechanical warranty. A longer useful life must be specified in terms of hours if the average service life is longer than the minimum value as described in 40 CFR 1045.105(e)(3).

These standards apply to land-based recreational vehicles, such as snowmobiles, dirt bikes, all-terrain vehicles and go-karts.

Table 13.28
Nonroad Recreational Engines and Vehicles – Exhaust Emission Standards

	Vehicle	Phase	Year	HC[a] g/kW-hr	HC + NOx g/km	CO g/kW-hr	CO g/km	Minimum useful life (hours/years/km)[b]
Federal	Snowmobiles[c]	1[d]	2006+	100 [ABT]	-	275 [ABT]	-	400 / 5 / 8,000
		2	2010-2011	75 [ABT]	-	275 [ABT]	-	
		3[e]	2012+	150[f] [ABT]	-	400[f] [ABT]	-	
	Off-highway motorcycles[g]	1[d]	2006+	-	2.0[h, i] [ABT]	-	25[h, i] [ABT]	> 70 cc Displacement: - / 5 / 10,000 ≤ 70 cc Displacement: - / 5 / 5,000
	ATVs[g]	1[d]	2006+	-	1.5[j, k] [ABT]	-	35[k] [ABT]	≥ 100 cc Displacement: 1000 / 5 / 10,000 < 100 cc Displacement: 500 / 5 / 5,000

Source:
40 CFR 1051.101-115 = Emission standards (Additional resources: www.epa.gov/emission-standards-reference-guide/nonroad-engines-and-vehicles-emission-standards)

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[a] The numerical emission standards for hydrocarbons (HC) must be met based on the following types of hydrocarbon emissions for recreational engines and vehicles powered by the following fuels: (1) non-methane hydrocarbons for natural gas; (2) total hydrocarbon equivalent for alcohol; and (3) total hydrocarbons for other fuels.

[b] Useful life is expressed in hours, years, or kilometers, whichever comes first; warranty period is expressed in hours, months, or kilometers (km), whichever comes first. Nonroad recreational engines and vehicles must meet emission standards over their full useful life. A longer useful life in terms of km and hours must be specified for the engine family if the average service life is longer than the minimum value as described in 40 Code of Federal Regulations (CFR) 1051 Subpart B.

[c] Test procedures for snowmobiles use the equipment and procedures for spark-ignition engines in 40 CFR Part 1065.

[d] Phase 1 standards will be phased in: 50 percent by 2006, 100 percent by 2007.

[e] Litigation on the November 2002 final rule resulted in a court decision that requires EPA to clarify the evidence and analysis upon which the Phase 3 carbon monoxide (CO) and HC standards were based. EPA will address this in a future rulemaking.

[f] These are the maximum allowable family emission limits (FEL). The HC and CO standards are defined by a functional relationship as described in 40 CFR 1051.103(a)(2).

[g] For off-highway motorcycles and ATVs, chassis dynamometer emissions test procedures are specified in 40 CFR Part 86, Subpart F and engine dynamometer emissions test procedures are specified in 40 CFR Part 1065.

[h] Maximum allowable FEL: 20.0 grams per kilometer (g/km) for HC plus nitrogen oxides (NOx) and 50 g/km for CO.

Table 13.28 (continued)
Nonroad Recreational Engines and Vehicles – Exhaust Emission Standards

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[i] Manufacturers may certify off-highway motorcycles with engines that have total displacement of 70 cubic centimeters (cc) or less to an HC+NOx standard of 16.1 grams per kilowatt-hour (g/kW-hr) (with an FEL cap of 32.2 g/kW-hr) and a CO standard of 519 g/kW-hr.

[j] Maximum allowable FEL for HC+NOx is 20.0 g/km.

[k] Manufacturers may certify all-terrain vehicles with engines that have total displacement of less than 100 cc to an HC+NOx standard of 25.0 g/kW-hr (with an FEL cap of 40.0 g/kW-hr) and a CO standard of 500 g/kW-hr.

The latest standards were established by the Environmental Protection Agency in conjunction with the Tier 3 emission standards.

Table 13.29
Gasoline Sulfur Standards

	Regulated entity	Refinery average and per-gallon cap by year (ppm)						
		2004	2005	2006	2007	2008-2016	2017-2019	2020
Federal	Large refiners / importers[a]	120[b] / 300[c]	30 / 90[b] / 300	30 / 80	30 / 80	30 / 80	10 / 80	10 / 80
	GPA refiners [d, e]	150 / 300[c]	150 / 300	150 / 300	30 / 80	30 / 80	30 / 80	10 / 80
	Small refiners [f, g, h]	[k]	[k]	[k]	[k]	30 / 80	30 / 80	10 / 80
	Downstream standards [i, j]	378	326	95	95	95	95	95

Source:
40 CFR 80 Subpart H (Additional resources: www.epa.gov/emission-standards-reference-guide/fuel-sulfur-standards)

[a] Standards effective January 1 at the refinery gate.
[b] No Refinery Average Standard applies in 2004; Corporate Average Standard applies in 2004 (120 ppm) and 2005 (90 ppm).
[c] Cap exceedances up to 50 ppm in 2004 must be made up in 2005.
[d] Geographic Phase-in Area (GPA) refiners must also comply with the corporate average standards in 2004 and 2005 if less than 50% of the refiner's gasoline is designated as GPA gasoline in a given compliance period.
[e] GPA refiners may receive an additional two years (i.e., through 2008) to comply with the 30 / 80 ppm gasoline sulfur standards in exchange for producing 95% of their highway diesel fuel at the 15 ppm sulfur standard by June 1, 2006.
[f] Small refiners may receive an additional two years (i.e., through 2009) to comply with the 30 / 80 ppm gasoline sulfur standards via a hardship demonstration.
[g] Small refiners may receive an additional three years (i.e., through 2010) to comply with the 30 / 80 ppm gasoline sulfur standards in exchange for producing 95% of their highway diesel fuel at the 15 ppm sulfur standard by June 1, 2006.
[h] Small refiners may receive a 20% increase in their annual average and per-gallon cap standards in exchange for producing 95% of their highway, nonroad, locomotive, and marine diesel fuel at the 15 ppm sulfur standard by June 1, 2006.
[i] Downstream standards are effective February 1 at any downstream location other than at a retail outlet or wholesale purchaser-consumer (e.g., pipelines and terminals) and March 1 at any downstream location.
[j] Downstream standards for gasoline that is not blended with small refiner gasoline are shown. Refer to the Code of Federal Regulations (CFR) for the downstream standards that apply when a gasoline blend includes small refiner gasoline.
[k]

1997-98 Refinery baseline sulfur level (ppm)	Small refiner interim gasoline sulfur standards (ppm) 2004 - 2007	
	Average	Cap
0 to 30	30	300
31 to 200	baseline level	300
201 to 400	200	300
401 to 600	50% of baseline	1.5 x avg. standard
601 and above	300	450

Ultra-low sulfur diesel (ULSD) fuel is necessary for new advanced emission control technologies. It also reduces particulate matter in the existing fleet of nonroad engines and equipment.

Table 13.30
Highway, Nonroad, Locomotive, and Marine (NRLM) Diesel Fuel Sulfur Standards

<table>
<tr><th rowspan="2"></th><th rowspan="2">Regulated entity</th><th rowspan="2">Covered fuel</th><th colspan="9">Per-gallon maximum sulfur level by year (ppm)</th></tr>
<tr><th>2006[a]</th><th>2007[b]</th><th>2008</th><th>2009</th><th>2010[c,d]</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td rowspan="9">Federal</td><td rowspan="2">Large refiners & importers</td><td rowspan="2">Highway</td><td colspan="4">80% 15</td><td colspan="5" rowspan="3">15</td></tr>
<tr><td colspan="4">20% 500</td></tr>
<tr><td>Small refiners</td><td>Highway</td><td colspan="4">500</td></tr>
<tr><td rowspan="3">Large refiners & importers</td><td>NR</td><td>-</td><td>500</td><td>500</td><td>500</td><td>15</td><td>15</td><td>15</td><td>15</td><td>15</td></tr>
<tr><td>LM</td><td>-</td><td>500</td><td>500</td><td>500</td><td>500</td><td>500</td><td>15</td><td>15</td><td>15</td></tr>
<tr><td>NRLM with credits[e]</td><td>-</td><td>HS</td><td>HS</td><td>HS</td><td>500</td><td>500</td><td>500</td><td>500</td><td>15</td></tr>
<tr><td>Small refiners</td><td>NRLM[f]</td><td>-</td><td>HS</td><td>HS</td><td>HS</td><td>500</td><td>500</td><td>500</td><td>500</td><td>15</td></tr>
<tr><td rowspan="2">Transmix processor & in-use</td><td>NR[e]</td><td>-</td><td>HS</td><td>HS</td><td>HS</td><td>500</td><td>500</td><td>500</td><td>500</td><td>15</td></tr>
<tr><td>LM[e]</td><td>-</td><td>HS</td><td>HS</td><td>HS</td><td>500</td><td>500</td><td>500</td><td>500</td><td>500</td></tr>
</table>

Source:
40 CFR 80 Subpart I (Additional resources: www.epa.gov/emission-standards-reference-guide/fuel-sulfur-standards)

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[a] For highway diesel fuel, standards are effective June 1 for refiners/importers, September 1 for pipelines and terminals, and October 15 for retailers and wholesale purchaser-consumers. Anti-downgrading provisions effective October 16, 2006.

[b] For Nonroad, Locomotive, and Marine (NRLM) diesel fuel, standards are effective June 1 for refiners; downstream requirements apply for Northeast/Mid-Atlantic area only (August 1 for terminals, October 1 for retailers and wholesale purchaser-consumers, and December 1 for in-use).

[c] For highway diesel fuel, standards are effective June 1 for refiners/importers, October 1 for pipelines and terminals, and December 1 for retailers and wholesale purchaser-consumers.

[d] For NRLM diesel fuel, standards are effective June 1 for refiners, August 1 for terminals, October 1 for retailers and wholesale purchaser-consumers, and December 1 for in-use.

[e] Excluding the Northeast and Alaska.

[f] Excluding the Northeast, with approval in Alaska.

APPENDIX A

SOURCES & METHODOLOGIES

SOURCES & METHODOLOGIES

This appendix contains documentation of the estimation procedures used by ORNL. The reader can examine the methodology behind the estimates and form an opinion as to their utility. The appendix is arranged by subject heading. Only tables which contain ORNL estimations are documented in Appendix A; all other tables have sources listed at the bottom of the table. Since abbreviations are used throughout the appendix, a list of abbreviations is also included.

Contents of Appendix A

1. LIST OF ABBREVIATIONS USED IN APPENDIX A

AAR	Association of American Railroads
APTA	American Public Transportation Association
Amtrak	National Railroad Passenger Corporation
BTS	Bureau of Transportation Statistics
Btu	British thermal unit
CD	Compact Disc
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CPI	Consumer Price Index
CY	Calendar Year
DOE	Department of Energy
DOT	Department of Transportation
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
IRS	Internal Revenue Service
gal	Gallons
kWh	Kilowatt hour
L	Liter
lb	Pound
lng	Liquefied Natural Gas
lpg	Liquefied Petroleum Gas
mpg	Miles per Gallon
NHTS	National Household Travel Survey
NPTS	Nationwide Personal Transportation Survey
NVPP	National Vehicle Population Profile
ORNL	Oak Ridge National Laboratory
RTECS	Residential Transportation Energy Consumption Survey
SCF	Standard Cubic Feet
TIUS	Truck Inventory and Use Survey
VIUS	Vehicle Inventory and Use Survey
vmt	vehicle-miles traveled

2. ENERGY USE SOURCES

2.1 HIGHWAY ENERGY USE

2.1.1 Cars

Fuel use in gallons (1970-2008) – DOT, FHWA, *Highway Statistics 2008*, Table VM-1 and annual editions back to 1996; DOT, FHWA, *Highway Statistics Summary* to 1995.

Fuel use in gallons (2009–2017) – See Section 7. Appendix A Car and Light Truck Shares.

Fuel type distribution for gallons – Fuel use was distributed among fuel types using the percentages shown in Table A.1. The FHWA discontinued gasohol data in 2005. Therefore, data from EIA, *Alternatives to Traditional Transportation Fuels*, 2006-2011, Table C1 were used through 2013. From 2014-on, author estimates were used, with knowledge of how the Renewable Fuels Standard affects the gasoline/gasohol mix.

Electricity use (2010-2017) – Estimates derived using cumulative electric vehicle (EV) and plug-in hybrid vehicle (PHEV) sales as a proxy for vehicle population; sales-weighted vehicle efficiencies from the U.S. Department of Energy and U.S. Environmental Protection Agency's vehicle database on www.fueleconomy.gov; and annual miles traveled from varying PHEV utility factors and EV usage assumptions. Methodology documented in an Argonne National Laboratory report *Impacts of Electrification of Light-Duty Vehicles in the United States, 2010-2017*, January 2018, www.ipd.anl.gov/anlpubs/2018/01/141595.pdf. For tables in the main body of the report, electricity was converted from kWh to Btu using 3,412 Btu/kWh. For tables in Appendix C, electricity generation and distribution were considered. Table C.1 contains the conversion factors used for tables in Appendix C.

Table A.1
Car Fuel Use and Fuel Type Shares for Calculation of Energy Use

Year	Fuel use (million gallons)	Source for gasohol shares	Source for gasoline/diesel shares	Shares by fuel type[b] Gasoline	Gasohol	Diesel
1970	67,820		1984 NVPP	99.8%	0.0%	0.2%
1971	71,346		interpolated	99.2%	0.0%	0.8%
1972	75,937		interpolated	98.7%	0.0%	1.3%
1973	78,233		interpolated	98.1%	0.0%	1.9%
1974	74,229		interpolated	97.5%	0.0%	2.5%
1975	74,140		interpolated	97.0%	0.0%	3.0%
1976	78,297		interpolated	96.4%	0.0%	3.6%
1977	79,060		interpolated	95.8%	0.0%	4.2%
1978	80,652		interpolated	95.3%	0.0%	4.7%
1979	76,588		1979 RTECS	94.7%	0.0%	5.3%
1980	69,981	FHWA, MF-33e	interpolated	93.9%	0.5%	5.6%
1981	69,112	FHWA, MF-33e	1981 RTECS	93.4%	0.7%	5.9%
1982	69,116	FHWA, MF-33e	interpolated	93.5%	2.3%	4.2%
1983	70,322	FHWA, MF-33e	1983 RTECS	93.2%	4.3%	2.5%
1984	70,663	FHWA, MF-33e	interpolated	92.7%	5.3%	2.0%
1985	71,518	FHWA, MF-33e	1985 RTECS	90.8%	7.7%	1.5%
1986	73,174	FHWA, MF-33e	interpolated	91.0%	7.6%	1.4%
1987	73,308	FHWA, MF-33e	interpolated	92.4%	6.3%	1.3%
1988	73,345	FHWA, MF-33e	1988 RTECS	91.4%	7.4%	1.2%
1989	73,913	FHWA, MF-33e	interpolated	92.6%	6.2%	1.2%
1990	69,568	FHWA, MF-33e	interpolated	92.0%	6.8%	1.2%
1991	64,318	FHWA, MF-33e	1991 RTECS	90.8%	8.0%	1.2%
1992	65,436	FHWA, MF-33e	interpolated	90.8%	7.9%	1.2%
1993	67,047	FHWA, MF-33e	interpolated	89.7%	9.1%	1.3%
1994	67,874	FHWA, MF-33e	1994 RTECS	89.1%	9.6%	1.3%
1995	68,072	FHWA, MF-33e	interpolated	87.6%	11.2%	1.2%
1996	69,221	FHWA, MF-33e	interpolated	88.8%	10.1%	1.0%
1997	69,892	FHWA, MF-33e	interpolated	86.9%	12.2%	0.9%
1998	71,695	FHWA, MF-33e	interpolated	88.0%	11.2%	0.8%
1999	73,283	FHWA, MF-33e	interpolated	88.3%	11.0%	0.6%
2000	73,065	FHWA, MF-33e	2000 NVPP	86.9%	12.6%	0.5%
2001	73,559	FHWA, MF-33e	2001 NVPP	86.5%	13.0%	0.5%
2002	75,471	FHWA, MF-33e	2001 NVPP	83.9%	15.6%	0.5%
2003	74,590	FHWA, MF-33e	2001 NVPP	75.3%	24.2%	0.5%
2004	75,402	FHWA, MF-33e	2001 NVPP	67.2%	32.3%	0.5%
2005	77,418	FHWA, MF-33e	2001 NVPP	66.9%	32.6%	0.5%
2006	75,009	EIA, C1	2001 NVPP	78.2%	21.3%	0.5%
2007	74,377	EIA, C1	2001 NVPP	72.9%	26.6%	0.5%
2008	71,497 [a]	EIA, C1	2001 NVPP	61.8%	37.7%	0.5%
2009	66,587	EIA, C1	2001 NVPP	55.8%	43.7%	0.5%
2010	62,245	EIA, C1	2001 NVPP	49.5%	50.0%	0.5%
2011	59,646	EIA, C1	2001 NVPP	48.7%	50.8%	0.5%
2012	57,899	EIA, C1	2001 NVPP	48.7%	50.8%	0.5%
2013	57,290	EIA, C1	2001 NVPP	49.0%	50.5%	0.5%
2014	56,420	Author estimates	2001 NVPP	24.5%	75.0%	0.5%
2015	55,212	Author estimates	2001 NVPP	14.5%	85.0%	0.5%
2016	54,248	Author estimates	2001 NVPP	4.5%	95.0%	0.5%
2017	52,268	Author estimates	2001 NVPP	4.5%	95.0%	0.5%
Heat content used for conversion to btu:				125,000 btu/gallon	120,900 btu/gallon	138,700 btu/gallon

[a] Data are not continuous between 2008 and 2009 due to changes in source.
[b] Percentages may not sum due to rounding.

2.1.2 Motorcycles

DOT, FHWA, *Highway Statistics 2017*, Table VM-1, and annual editions. The FHWA made methodology changes for *Highway Statistics 2009-10*. At that time, they published historical data back to 2007 which do not match the previous data.

Table A.2
Motorcycle Fuel Use

Year	Fuel use (thousand gallons)	Year	Fuel use (thousand gallons)	
1970	59,580	1994	204,800	
1971	72,140	1995	198,262	
1972	86,620	1996	195,940	
1973	103,880	1997	201,620	
1974	108,900	1998	205,660	
1975	112,580	1999	211,680	
1976	120,060	2000	209,380	
1977	126,980	2001	192,780	
1978	143,160	2002	191,040	
1979	172,740	2003	190,780	
1980	204,280	2004	202,447	
1981	213,800	2005	189,495	
1982	198,200	2006	221,030	[a]
1983	175,200	2007	474,923	
1984	175,680	2008	489,417	
1985	181,720	2009	482,290	
1986	187,940	2010	426,732	
1987	190,120	2011	426,378	
1988	200,480	2012	491,130	
1989	207,420	2013	467,716	
1990	191,140	2014	458,628	
1991	183,560	2015	447,879	
1992	191,140	2016	465,802	
1993	198,120	2017	458,429	
Heat content used for conversion to btu:			125,000 btu/gallon	

[a] Data are not continuous between 2006 and 2007 due to changes in estimation methodology. See source document for details.

2.1.3 Buses

Transit

APTA, *2019 Public Transportation Fact Book*, Washington, DC, 2019. Includes motorbus and trolley bus data.

Table A.3
Transit Bus Fuel Use

Year	LNG (million gallons)	LPG (million gallons)	CNG (million gallons)	Gasoline (million gallons)	Diesel fuel (million gallons)	Electricity (thousand kilowatt hours)	Biodiesel (million gallons)	Methanol (million gallons)
1994	1.1	0.2	3.1	2.1	565.1	102.9	[a]	12.5
1995	1.7	0.3	10.0	2.3	563.8	100.0	[a]	12.0
1996	2.3	0.6	11.5	1.8	577.7	69.0	[a]	11.6
1997	3.3	1.0	20.0	2.7	597.6	78.0	[a]	8.7
1998	3.1	0.9	32.6	2.0	606.6	74.0	[a]	5.0
1999	5.3	0.8	39.9	1.4	618.0	75.0	[a]	2.7
2000	10.5	0.7	50.4	1.3	635.2	77.0	[a]	0.8
2001	11.7	1.2	60.9	1.5	587.2	74.0	[a]	0.8
2002	16.8	1.8	77.8	1.3	559.0	73.0	[a]	1.8
2003	14.2	1.8	94.9	1.1	536.0	69.0	[a]	1.9
2004	16.5	1.7	106.7	1.8	550.5	68.0	[a]	4.7
2005	18.3	2.0	117.2	1.0	533.8	67.0	[a]	8.1
2006	19.6	1.6	138.8	2.3	536.7	62.0	20.5	0.9
2007	18.3	[a]	129.1	2.5	494.1	61.0	25.8	1.3
2008	17.9	[a]	135.5	3.8	493.3	62.2	41.8	0.9
2009	25.5	[a]	141.6	6.7	455.5	69.5	40.6	0.0
2010	23.0	[a]	126.2	8.1	435.4	66.0	43.5	0.0
2011	21.6	[a]	131.1	8.9	455.1	61.0	51.1	0.0
2012	19.6	[a]	127.3	12.5	439.0	61.0	56.6	0.0
2013	17.6	6.3	134.9	12.9	427.5	63.0	66.2	0.0
2014	15.4	6.2	146.0	11.7	413.6	64.0	38.1	1.2
2015	11.3	8.2	158.9	11.1	415.0	62.0	43.9	0.9
2016	10.7	6.9	170.3	11.6	428.9	64.0	43.2	0.0
2017	4.9	6.7	173.8	12.9	432.0	62.0	37.2	0.6
Heat content used for conversion to btu:	84,800 btu/gallon	91,300 btu/gallon	138,700 btu/gallon	125,000 btu/gallon	138,700 btu/gallon	3,412 btu/kWh	126,200 btu/gallon	64,600 btu/gallon

Note: CNG is reported in diesel-gallon equivalents.

[a] Data are not available.

Intercity and School

Eno Transportation Foundation, *Transportation in America, 2001, Nineteenth Edition*, 2003, Washington, DC, pp. 20–23. School bus fuel was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services. Intercity bus fuel was assumed to be 100% diesel.

Table A.4
Intercity and School Bus Fuel Use

Year	Intercity (million gallons)	School (million gallons)
1970	305.34	299.88
1975	181.02	341.88
1980	213.78	379.68
1981	205.38	386.82
1982	227.22	398.58
1983	237.30	400.68
1984	169.26	375.06
1985	165.48	425.04
1986	148.68	462.42
1987	155.82	487.20
1988	160.44	511.14
1989	166.74	498.12
1990	159.60	472.08
1991	160.44	533.40
1992	157.08	546.00
1993	171.36	533.40
1994	195.30	546.00
1995	195.30	545.16
1996	199.92	545.16
1997	212.52	544.74
1998	220.08	550.20
1999	241.08	555.66
2000	233.10	577.08
2001	217.35[a]	538.08[a]
2002	210.22[a]	520.44[a]
2003	208.32[a]	515.72[a]
2004	208.87[a]	517.09[a]
2005	214.37[a]	530.70[a]
2006	208.32[a]	515.72[a]
2007	214.37[a]	530.70[a]
2008	218.48[a]	540.89[a]
2009	224.58[a]	556.00[a]
2010	214.95[a]	532.15[a]
2011	215.53[a]	533.58[a]
2012	230.42[a]	570.45[a]
2013	236.76[a]	586.14[a]
2014	249.75[a]	618.29[a]
2015	253.35[a]	627.22[a]
2016	255.22[a]	631.84[a]
2017	268.92[a]	665.76[a]
Fuel type shares	100% diesel	90% diesel 10% gasoline
Heat content used for conversion to btu:	138,700 btu/gallon	138,700 btu/gallon 125,000 btu/gallon

[a] Estimated using the rate of change of bus vehicle-miles traveled from FHWA *Highway Statistics*, Table VM-1.

2.1.4 Trucks

Light Trucks

Fuel use in gallons (1970-2007) – DOT, FHWA, *Highway Statistics 2008*, Table VM-1 and annual editions back to 1996 and DOT, FHWA, *Highway Statistics Summary to 1995.*

Fuel use in gallons (2008–2017) – See Section 7. Appendix A Car and Light Truck Shares.

Fuel type distribution for gallons – Fuel use was distributed among fuel types using the percentages shown in Table A.1. The FHWA discontinued gasohol data in 2005. Therefore, data from EIA, *Alternatives to Traditional Transportation Fuels*, 2006-2011, Table C1 were used through 2013. From 2014-on, author estimates were used, with knowledge of how the Renewable Fuels Standard affects the gasoline/gasohol mix.

Electricity use (2010-2017) – Estimates derived using cumulative electric vehicle (EV) and plug-in hybrid vehicle (PHEV) sales as a proxy for vehicle population; sales-weighted vehicle efficiencies from the U.S. Department of Energy and U.S. Environmental Protection Agency's vehicle database on www.fueleconomy.gov; and annual miles traveled from varying PHEV utility factors and EV usage assumptions. Methodology documented in an Argonne National Laboratory report *Impacts of Electrification of Light-Duty Vehicles in the United States, 2010-2017*, January 2018, www.ipd.anl.gov/anlpubs/2018/01/141595.pdf. For tables in the main body of the report, electricity was converted from kWh to Btu using 3,412 Btu/kWh. For tables in Appendix C, electricity generation and distribution were considered. Table C.1 contains the conversion factors used for tables in Appendix C.

Table A.5
Light Truck Fuel Use and Fuel Type Shares for Calculation of Energy Use

Year	Fuel use (million gallons)	Source for gasohol shares	Source for gasoline/diesel /lpg shares	Shares by fuel type: Gasoline	Gasohol	Diesel	Lpg
1970	12,313		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1975	19,081		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1976	20,828		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1977	22,383		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1978	24,162		Interpolated	97.1%	0.0%	2.0%	0.9%
1979	24,445		Interpolated	96.7%	0.0%	2.4%	1.0%
1980	23,796	FHWA, MF-33e	Interpolated	95.7%	0.5%	2.7%	1.0%
1981	23,697	FHWA, MF-33e	Interpolated	95.1%	0.7%	3.1%	1.1%
1982	22,702	FHWA, MF-33e	1982 TIUS	93.0%	2.3%	3.5%	1.2%
1983	23,945	FHWA, MF-33e	Interpolated	91.0%	4.3%	3.5%	1.2%
1984	25,604	FHWA, MF-33e	Interpolated	90.0%	5.3%	3.5%	1.2%
1985	27,363	FHWA, MF-33e	Interpolated	87.6%	7.7%	3.5%	1.2%
1986	29,074	FHWA, MF-33e	Interpolated	87.7%	7.6%	3.5%	1.2%
1987	30,598	FHWA, MF-33e	1987 TIUS	89.0%	6.3%	3.5%	1.2%
1988	32,653	FHWA, MF-33e	Interpolated	88.2%	7.4%	3.5%	1.0%
1989	33,271	FHWA, MF-33e	Interpolated	89.5%	6.2%	3.4%	0.8%
1990	35,611	FHWA, MF-33e	Interpolated	89.2%	6.8%	3.4%	0.7%
1991	38,217	FHWA, MF-33e	Interpolated	88.1%	8.0%	3.3%	0.5%
1992	40,929	FHWA, MF-33e	1992 TIUS	88.5%	7.9%	3.3%	0.3%
1993	42,851	FHWA, MF-33e	Interpolated	87.3%	9.1%	3.3%	0.3%
1994	44,112	FHWA, MF-33e	Interpolated	86.8%	9.6%	3.3%	0.3%
1995	45,605	FHWA, MF-33e	Interpolated	85.1%	11.2%	3.4%	0.3%
1996	47,354	FHWA, MF-33e	Interpolated	86.2%	10.1%	3.4%	0.3%
1997	49,388	FHWA, MF-33e	1997 VIUS	84.2%	12.2%	3.4%	0.2%
1998	50,462	FHWA, MF-33e	Interpolated	85.0%	11.2%	3.5%	0.3%
1999	52,859	FHWA, MF-33e	Interpolated	84.9%	11.0%	3.6%	0.4%
2000	52,939	FHWA, MF-33e	Interpolated	83.1%	12.6%	3.8%	0.6%
2001	53,522	FHWA, MF-33e	Interpolated	82.4%	13.0%	3.9%	0.7%
2002	55,220	FHWA, MF-33e	2002 VIUS	79.6%	15.6%	4.0%	0.8%
2003	60,758	FHWA, MF-33e	2002 VIUS	71.0%	24.2%	4.0%	0.8%
2004	63,417	FHWA, MF-33e	2002 VIUS	62.9%	32.3%	4.0%	0.8%
2005	58,869	FHWA, MF-33e	2002 VIUS	62.6%	32.6%	4.0%	0.8%
2006	60,685	EIA, C1	2002 VIUS	73.9%	21.3%	4.0%	0.8%
2007	61,836	EIA, C1	2002 VIUS	68.6%	26.6%	4.0%	0.8%
2008	61,199 [a]	EIA, C1	2002 VIUS	57.5%	37.7%	4.0%	0.8%
2009	61,824	EIA, C1	2002 VIUS	51.5%	43.7%	4.0%	0.8%
2010	64,687	EIA, C1	2002 VIUS	45.2%	50.0%	4.0%	0.8%
2011	65,786	EIA, C1	2002 VIUS	44.4%	50.8%	4.0%	0.8%
2012	66,395	EIA, C1	2002 VIUS	44.4%	50.8%	4.0%	0.8%
2013	65,555	EIA, C1	2002 VIUS	44.7%	50.5%	4.0%	0.8%
2014	69,012	Author estimates	2002 VIUS	25.2%	70.0%	4.0%	0.8%
2015	70,933	Author estimates	2002 VIUS	15.2%	80.0%	4.0%	0.8%
2016	73,107	Author estimates	2002 VIUS	5.2%	90.0%	4.0%	0.8%
2017	73,835	Author estimates	2002 VIUS	0.2%	95.0%	4.0%	0.8%
		Heat content used for conversion to btu:		125,000 btu/gallon	120,900 btu/gallon	138,700 btu/gallon	90,800 btu/gallon

[a] Data are not continuous between 2008 and 2009 due to changes in source.

Medium/Heavy Trucks

DOT, FHWA, *Highway Statistics 2017*, Table VM-1 and annual editions back to 1996 and DOT, FHWA, *Highway Statistics Summary to 1995*. The FHWA made methodology changes for *Highway Statistics 2009*. At that time, they published historical data back to 2007 which do not match the previous data. Total gallons for medium/heavy trucks are the sum of single-unit trucks and combination trucks.

Table A.6
Medium/Heavy Truck Fuel Use and Fuel Type Shares for Calculation of Energy Use

Year	Fuel use (million gallons)	Source for fuel type shares	Shares by fuel type		
			Gasoline	Diesel	Lpg
1970	11,316	1977 TIUS	10.4%	89.5%	0.1%
1975	14,598	1977 TIUS	10.4%	89.5%	0.1%
1980	19,960	Interpolated	27.9%	71.4%	0.6%
1981	20,376	Interpolated	33.8%	65.4%	0.8%
1982	20,386	1982 TIUS	39.6%	59.4%	1.0%
1983	20,761	Interpolated	35.6%	63.6%	0.8%
1984	21,428	Interpolated	31.5%	67.8%	0.7%
1985	21,405	Interpolated	27.5%	72.0%	0.5%
1986	21,861	Interpolated	23.4%	76.2%	0.4%
1987	22,513	1987 TIUS	19.4%	80.4%	0.2%
1988	22,925	Interpolated	18.8%	81.0%	0.3%
1989	23,512	Interpolated	18.1%	81.6%	0.3%
1990	24,490	Interpolated	17.5%	82.1%	0.4%
1991	24,981	Interpolated	16.8%	82.7%	0.4%
1992	25,453	1992 TIUS	16.2%	83.3%	0.5%
1993	26,236	Interpolated	15.4%	84.1%	0.5%
1994	27,685	Interpolated	14.7%	84.8%	0.5%
1995	28,828	Interpolated	13.9%	85.6%	0.5%
1996	29,601	Interpolated	13.2%	86.3%	0.5%
1997	29,878	1997 VIUS	12.4%	87.1%	0.5%
1998	30,841	Interpolated	12.1%	87.4%	0.5%
1999	33,909	Interpolated	11.8%	87.6%	0.5%
2000	35,229	Interpolated	11.6%	87.9%	0.5%
2001	35,179	Interpolated	11.3%	88.1%	0.5%
2002	36,800	2002 VIUS	11.0%	88.4%	0.5%
2003	35,775	2002 VIUS	11.0%	88.4%	0.5%
2004	33,150	2002 VIUS	11.0%	88.4%	0.5%
2005	37,190	2002 VIUS	11.0%	88.4%	0.5%
2006	37,959 [a]	2002 VIUS	11.0%	88.4%	0.5%
2007	47,218	2002 VIUS	11.0%	88.4%	0.5%
2008	47,705	2002 VIUS	11.0%	88.4%	0.5%
2009	44,303	2002 VIUS	11.0%	88.4%	0.5%
2010	45,024	2002 VIUS	11.0%	88.4%	0.5%
2011	42,396	2002 VIUS	11.0%	88.4%	0.5%
2012	42,351	2002 VIUS	11.0%	88.4%	0.5%
2013	43,297	2002 VIUS	11.0%	88.4%	0.5%
2014	44,012	2002 VIUS	11.0%	88.4%	0.5%
2015	43,734	2002 VIUS	11.0%	88.4%	0.5%
2016	44,893	2002 VIUS	11.0%	88.4%	0.5%
2017	45,963	2002 VIUS	11.0%	88.4%	0.5%
Heat content used for conversion to btu:			125,000 btu/gallon	138,700 btu/gallon	90,800 btu/gallon

[a] Data are not continuous between 2006 and 2007 due to changes in methodology. See source for details.

Shares of Class 3-6 and 7-8 energy use by fuel type were calculated from the 2002 Vehicle Inventory and Use Survey (VIUS) and applied to all years 1970-2017.

Table A.7
Share of Medium and Heavy Truck Energy Use

	Share of energy use		
Fuel type	Class 3-6	Class 7-8	Total
Gasoline	92%	8%	100%
Diesel	14%	86%	100%
LPG	99%	1%	100%

2.2 OFF-HIGHWAY ENERGY USE

U.S. Environmental Protection Agency, MOVES2014a model, results generated September 2018. Gallons of fuel by fuel type were produced for agricultural equipment, airport equipment, construction and mining equipment, industrial equipment, lawn and garden equipment, logging equipment, railroad maintenance equipment, and recreational equipment. Some non-transportation-related equipment, such as generators, chain saws, compressors, and pumps, were excluded from the data.

2.3 NONHIGHWAY ENERGY USE

2.3.1 Air

General Aviation

DOT, FAA, *General Aviation and Part 135 Activity Surveys - CY 2017*, Table 5.1, and annual. 2011 Data: *Aviation Forecasts*, Tables 28 and 29, May 2013.

Table A.8
General Aviation Fuel Use

Year	Jet fuel (million gallons)	Aviation gasoline (million gallons)	Year	Jet fuel (million gallons)	Aviation gasoline (million gallons)
1970	208.0	551.0	1994	470.8	264.1
1971	226.0	508.0	1995	544.0	276.0
1972	245.0	584.0	1996	567.5	286.5
1973	304.0	411.0	1997	639.4	289.7
1974	357.0	443.0	1998	814.6	311.4
1975	453.0	412.0	1999	967.2	345.4
1976	495.0	432.0	2000	998.1	336.3
1977	536.0	456.0	2001	938.7	319.3
1978	763.0	518.0	2002	815.5	261.4
1979	736.0	570.0	2003	820.0	255.5
1980	766.0	520.0	2004	1,075.2	256.1
1981	759.0	489.0	2005	1,507.4	323.6
1982	887.0	448.0	2006	1,636.3	294.7
1983	613.0	428.0	2007	1,516.3	314.8
1984	738.9	462.4	2008	1,688.6	306.3
1985	691.0	421.0	2009	1,350.6	226.6
1986	732.1	408.6	2010	1,451.5	210.3
1987	672.7	401.8	2011	1,490.7	215.5
1988	746.0	398.0	2012	1,492.1	227.7
1989	688.0	342.8	2013	1,353.6	173.3
1990	662.0	353.0	2014	1,454.1	205.8
1991	579.0	348.0	2015	1,384.4	183.2
1992	496.0	306.0	2016	1,445.7	187.8
1993	454.1	268.4	2017	1,548.7	192.4
Heat content used for conversion to btu:	135,000 btu/gallon	120,200 btu/gallon		135,000 btu/gallon	120,200 btu/gallon

Domestic and International Air Carrier

DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables," www.transtats.bts.gov/fuel. The table below shows all international fuel use. Because the data for international include fuel purchased abroad, for the tables in Chapter 2, the international total was divided in half to estimate domestic fuel use for international flights.

Table A.9
Air Carrier Fuel Use

Year	Domestic (thousand gallons)	International (thousand gallons)	Total (thousand gallons)
1970	Separate estimates for domestic and international are not available from 1970-1976.		10,085,000
1975			10,412,640
1976			10,400,040
1977	8,202,051	1,708,376	9,910,427
1978	8,446,117	1,741,918	10,188,035
1979	8,865,885	1,828,435	10,694,320
1980	8,519,233	1,747,306	10,266,539
1981	8,555,249	2,032,520	10,587,769
1982	8,432,465	1,967,733	10,400,198
1983	8,672,574	1,998,289	10,670,863
1984	9,625,958	2,286,407	11,912,365
1985	10,115,007	2,487,929	12,602,936
1986	11,137,331	2,544,996	13,682,327
1987	11,586,838	2,893,617	14,480,455
1988	11,917,904	3,262,824	15,180,728
1989	11,905,144	3,557,294	15,462,438
1990	12,429,305	3,963,081	16,392,386
1991	11,506,477	3,939,666	15,446,144
1992	11,762,852	4,120,132	15,882,983
1993	11,958,663	4,113,321	16,071,984
1994	12,475,549	4,310,879	16,786,428
1995	12,811,717	4,511,418	17,323,135
1996	13,187,305	4,658,093	17,845,398
1997	13,659,581	4,964,181	18,623,762
1998	13,876,971	5,185,562	19,062,533
1999	14,402,127	5,250,492	19,652,619
2000	14,844,592	5,474,685	20,319,277
2001	14,017,461	5,237,487	19,254,948
2002	12,848,329	4,990,798	17,839,127
2003	12,958,581	4,836,356	17,794,936
2004	13,622,603	4,931,546	18,554,149
2005	13,778,869	5,520,889	19,309,758
2006	13,694,437	6,017,638	19,712,075
2007	13,681,664	6,204,502	19,886,165
2008	12,666,911	6,186,747	18,853,658
2009	11,339,220	5,721,298	17,060,517
2010	11,256,900	6,041,500	17,288,400
2011	11,035,400	6,522,600	17,558,000
2012	10,439,700	6,506,300	16,946,000
2013	10,337,000	6,487,300	16,824,300
2014	10,458,600	6,321,400	16,780,000
2015	10,928,600	6,420,600	17,349,200
2016	11,373,600	6,294,800	17,668,400
2017	11,587,600	6,441,300	18,028,900
Heat content used for conversion to btu:	135,000 btu/gallon	135,000 btu/gallon	135,000 btu/gallon

2.3.2 Water

Freight

Total – DOE, EIA, *Petroleum and Other Liquids Database*, September 2019. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

Table A.10
Diesel and Residual Fuel Oil for Vessel Bunkering

Year	Distillate fuel oil (thousand gallons)	Residual fuel oil (thousand gallons)
1970	819,000	3,774,120
1975	1,097,880	4,060,140
1980	717,376	7,454,242
1981	1,723,143	7,922,512
1982	1,423,216	6,408,818
1983	1,418,890	5,724,115
1984	1,692,045	5,688,931
1985	1,894,265	5,269,733
1986	2,034,215	5,690,250
1987	2,223,258	5,869,154
1988	2,310,367	6,025,511
1989	2,356,444	6,621,100
1990	2,197,004	6,248,095
1991	2,167,640	6,786,055
1992	2,240,170	7,199,078
1993	2,043,745	6,269,882
1994	2,026,899	5,944,383
1995	1,978,105	6,431,238
1996	2,177,608	5,804,977
1997	2,107,561	4,789,861
1998	2,125,568	4,640,153
1999	2,064,590	5,598,630
2000	2,041,433	6,192,294
2001	2,099,011	4,345,284
2002	2,056,465	4,783,956
2003	1,863,150	3,801,425
2004	2,313,448	4,886,978
2005	2,115,381	5,533,552
2006	2,206,690	6,000,434
2007	2,158,930	6,773,950
2008	1,980,729	6,274,047
2009	2,138,690	5,331,657
2010	2,427,051	6,032,367
2011	2,651,859	5,207,886
2012	1,842,107	4,560,546
2013	1,655,258	3,876,795
2014	1,626,527	2,987,363
2015	2,415,253	3,103,402
2016	2,020,587	4,192,719
2017	1,807,230	4,472,233
Heat content used for conversion to btu:	138,700 btu/gallon	149,700 btu/gallon
Domestic share of total fuel use	77.5%	9.3%

Recreational Boating

Fuel use by recreational boating for years 1970-1998 comes from the EPA's MOVES2014a model. Data from 1999-on come from the updated MOVES2014b model.

Table A.11
Recreational Boating Fuel Use

Year	Diesel use (gallons)	Gasoline use (gallons)
1970	39,589,953	1,213,397,311
1975	77,294,680	1,251,387,972
1976	84,835,632	1,258,986,070
1977	92,376,573	1,266,584,111
1978	99,917,523	1,274,182,341
1979	107,458,470	1,281,780,460
1980	114,999,421	1,289,378,532
1981	122,540,357	1,296,976,672
1982	130,081,302	1,304,574,832
1983	137,622,248	1,312,172,890
1984	145,163,202	1,319,771,007
1985	152,704,140	1,327,369,146
1986	160,245,074	1,334,967,322
1987	167,786,030	1,342,565,455
1988	175,326,970	1,362,856,034
1989	182,867,916	1,383,146,636
1990	190,408,869	1,403,437,194
1991	197,949,808	1,429,688,292
1992	205,490,749	1,455,939,504
1993	213,031,707	1,482,190,597
1994	220,572,649	1,539,794,180
1995	228,113,596	1,597,269,921
1996	235,654,521	1,654,446,069
1997	243,195,481	1,657,737,628
1998	250,736,414	1,659,056,085
1999	273,614,890	1,660,897,656
2000	273,885,726	1,658,797,382
2001	274,699,518	1,656,581,817
2002	275,242,097	1,648,949,353
2003	276,055,034	1,639,089,564
2004	275,783,985	1,621,105,112
2005	279,309,693	1,621,729,779
2006	277,411,274	1,593,043,638
2007	279,037,889	1,580,468,954
2008	274,156,923	1,535,255,008
2009	274,970,396	1,519,694,458
2010	268,462,593	1,466,964,903
2011	263,581,279	1,421,359,003
2012	261,140,658	1,391,588,940
2013	259,784,908	1,367,836,644
2014	257,886,775	1,341,947,672
2015	270,902,771	1,344,235,659
2016	281,478,856	1,354,416,848
2017	287,444,461	1,363,320,915
Heat content used for conversion to btu:	138,700 btu/gallon	125,000 btu/gallon

2.3.3 Pipeline

The sum of natural gas, crude petroleum and petroleum product, and coal slurry and water.

Natural Gas

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, *Natural Gas Annual 2017*, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft3. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., End Use Energy Consumption DataBase: Transportation Sector. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horsepower was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015.

Crude Petroleum and Petroleum Product

J. N. Hooker, *Oil Pipeline Energy Consumption and Efficiency*, ORNL-5697, ORNL, Oak Ridge, TN, 1981. (Data held constant; Latest available data.)

Coal Slurry and Water

W. F. Banks, Systems, Science and Software, *Energy Consumption in the Pipeline Industry*, LaJolla, CA, October 1977. (Data held constant; Latest available data.)

Table A.12
Pipeline Fuel Use

Year	Natural gas (million cubic feet)	Estimated natural gas pipeline electricity use (million kWh)	Electricity constant (trillion btu)
1970	722,166	3,272.9	70.0
1975	582,963	2,642.0	70.0
1976	548,323	2,485.0	70.0
1977	532,669	2,414.1	70.0
1978	530,451	2,404.0	70.0
1979	600,964	2,723.6	70.0
1980	634,622	2,876.1	70.0
1981	642,325	2,911.0	70.0
1982	596,411	2,703.0	70.0
1983	490,042	2,220.9	70.0
1984	528,754	2,396.3	70.0
1985	503,766	2,283.1	70.0
1986	485,041	2,198.2	70.0
1987	519,170	2,352.9	70.0
1988	613,912	2,782.3	70.0
1989	629,308	2,852.0	70.0
1990	659,816	2,990.3	70.0
1991	601,305	2,725.1	70.0
1992	587,710	2,663.5	70.0
1993	624,308	2,829.4	70.0
1994	685,362	3,106.1	70.0
1995	700,335	3,173.9	70.0
1996	711,446	3,224.3	70.0
1997	751,470	3,405.7	70.0
1998	635,477	2,880.0	70.0
1999	645,319	2,924.6	70.0
2000	642,210	2,910.5	70.0
2001	624,964	2,832.3	70.0
2002	666,920	3,022.5	70.0
2003	591,492	2,680.7	70.0
2004	566,187	2,566.0	70.0
2005	584,026	2,646.8	70.0
2006	584,213	2,647.7	70.0
2007	621,364	2,816.0	70.0
2008	647,956	2,936.6	70.0
2009	670,174	3,037.2	70.0
2010	674,124	3,055.1	70.0
2011	687,784	3,117.0	70.0
2012	730,790	3,312.0	70.0
2013	833,061	3,775.4	70.0
2014	700,150	3,173.1	70.0
2015	678,183	3,073.5	70.0
2016	686,732	3,112.3	70.0
2017	721,518	3,269.9	70.0
Heat content used for conversion to btu:	1,031 btu/cubic foot	3,412 Btu/kWh[a]	

[a] For tables in the main body of the report, electricity was converted from kWh to Btu using 3,412 Btu/kWh. For tables in Appendix C, electricity generation and distribution were considered. Table C.1 contains the conversion factors used for tables in Appendix C.

Note: Formula for estimating electricity use for natural gas pipelines is:
Natural gas use (in million cubic ft) × 1,031 btu/cubic ft × 0.015 × 29.305 ×10-5 kWh/btu.

2.3.4 Rail

Freight

AAR, *Railroad Facts*, 2018 Edition, Washington, DC, 2018.

Table A.13
Class I Freight Railroad Fuel Use

Year	Diesel fuel (thousand gallons)
1970	3,807,663
1971	3,822,907
1972	3,996,985
1973	4,160,730
1974	4,175,375
1975	3,736,484
1976	3,895,542
1977	3,985,069
1978	3,968,007
1979	4,072,187
1980	3,955,996
1981	3,756,439
1982	3,178,116
1983	3,137,295
1984	3,388,173
1985	3,144,190
1986	3,039,069
1987	3,102,227
1988	3,182,267
1989	3,190,815
1990	3,134,446
1991	2,925,970
1992	3,022,108
1993	3,111,981
1994	3,355,802
1995	3,503,096
1996	3,600,649
1997	3,602,793
1998	3,619,341
1999	3,749,428
2000	3,720,107
2001	3,729,985
2002	3,751,413
2003	3,849,229
2004	4,082,236
2005	4,119,879
2006	4,214,459
2007	4,087,405
2008	3,911,178
2009	3,220,059
2010	3,519,021
2011	3,710,485
2012	3,634,025
2013	3,712,582
2014	3,897,113
2015	3,723,491
2016	3,418,577
2017	3,536,618
Heat content used for conversion to btu:	138,700 Btu/gallon

Passenger

Commuter - APTA, *2019 Public Transportation Fact Book*, Washington, DC, 2019.

Table A.14
Commuter Rail Fuel Use

Year	Diesel (thousand gallons)	Electricity (million kWh)
1984	58,320	901
1985	55,372	1,043
1986	54,608	1,170
1987	51,594	1,155
1988	53,054	1,195
1989	52,516	1,293
1990	52,681	1,226
1991	54,315	1,239
1992	54,951	1,124
1993	59,766	1,196
1994	61,900	1,244
1995	63,064	1,253
1996	61,888	1,255
1997	63,195	1,270
1998	69,200	1,299
1999	73,005	1,322
2000	70,818	1,370
2001	72,204	1,354
2002	72,847	1,334
2003	72,264	1,383
2004	71,999	1,449
2005	76,714	1,484
2006	78,600	1,478
2007	80,700	1,763
2008	83,500	1,718
2009	95,000	1,780
2010	93,200	1,797
2011	93,900	1,813
2012	92,800	1,808
2013	98,700	1,816
2014	93,900	1,809
2015	97,400	1,792
2016	102,878	1,764
2017	104,245	1,776
Heat content used for conversion to btu:	138,700 Btu/gallon	3,412 Btu/kWh[a]

[a] For tables in the main body of the report, electricity was converted from kWh to Btu using 3,412 Btu/kWh. For tables in Appendix C, electricity generation and distribution were considered. Table C.1 contains the conversion factors used for tables in Appendix C.

Transit – APTA, *2019 Public Transportation Fact Book*, Washington, DC, 2019. Includes light rail and heavy rail.

Table A.15
Transit Rail Fuel Use

	Electricity (million kWh)		
Year	Light rail	Heavy rail	Total
1970			2,561
1975	Light rail and heavy rail data are not available separately from 1970 to 1985.		2,646
1976			2,576
1977			2,303
1978			2,223
1979			2,473
1980			2,446
1981			2,655
1982			2,722
1983			2,930
1984			3,092
1985			2,928
1986	173	3,066	3,239
1987	191	3,219	3,410
1988	243	3,256	3,499
1989	242	3,286	3,528
1990	239	3,284	3,523
1991	274	3,248	3,522
1992	297	3,193	3,490
1993	281	3,287	3,568
1994	282	3,431	3,713
1995	288	3,401	3,689
1996	321	3,322	3,643
1997	363	3,253	3,616
1998	382	3,280	3,662
1999	416	3,385	3,801
2000	563	3,549	4,112
2001	587	3,646	4,233
2002	510	3,683	4,193
2003	507	3,632	4,138
2004	553	3,684	4,237
2005	571	3,769	4,339
2006	634	3,709	4,343
2007	687	3,817	4,505
2008	721	3,898	4,619
2009	738	3,866	4,624
2010	749	3,780	4,529
2011	789	3,854	4,643
2012	806	3,795	4,601
2013	882	3,856	4,738
2014	985	3,812	4,797
2015	898	3,816	4,713
2016	907	3,760	4,667
2017	930	3,728	4,658
Heat content used for conversion to btu:	3,412 Btu/kWh[a]	3,412 Btu/kWh[a]	3,412 Btu/kWh[a]

[a] For tables in the main body of the report, electricity was converted from kWh to Btu using 3,412 Btu/kWh. For tables in Appendix C, electricity generation and distribution were considered. Table C.1 contains the conversion factors used for tables in Appendix C.

Intercity – Personal communication with Amtrak, Washington, DC, 2018.

Table A.16
Intercity Rail Fuel Use

Year	Diesel fuel (thousand gallons)	Electricity (thousand kWh)
1994	73,516	308,948
1995	72,371	335,818
1996	71,226	362,689
1997	75,656	389,559
1998	75,999	416,429
1999	79,173	443,300
2000	94,968	470,170
2001	96,846	455,703
2002	84,432	518,306
2003	74,621	536,950
2004	68,605	550,695
2005	65,477	531,377
2006	62,463	548,856
2007	61,824	577,864
2008	63,428	582,022
2009	61,704	564,968
2010	63,474	558,662
2011	63,450	555,425
2012	63,058	549,201
2013	66,036	525,127
2014	65,711	515,332
2015	62,468	504,017
2016	60,212	515,711
2017	60,076	489,949
Heat content used for conversion to Btu	138,700 Btu/gallon	3,412 Btu/kWh[a]

[a] For tables in the main body of the report, electricity was converted from kWh to Btu using 3,412 Btu/kWh. For tables in Appendix C, electricity generation and distribution were considered. Table C.1 contains the conversion factors used for tables in Appendix C.

2.4 CALCULATION OF MILLION BARRELS PER DAY CRUDE OIL EQUIVALENT

One gallon of gasoline, diesel fuel, or lpg is estimated to be the equivalent of one gallon of crude oil. Petroleum used for electricity was calculated using the following formula:

$(\{[(BTU \times S)/G\,]/P\,\}/365)/1000$

BTU = Btus of electricity
S = Share of petroleum used in making primary electricity (Calculated from Table 2.6 from the EIA, Monthly Energy Review)
G = Electricity generation and distribution (assumed 29%)
P = Btus per barrel of petroleum product (Table A3 from the EIA, Monthly Energy Review).

3. PASSENGER TRAVEL AND ENERGY USE

3.1 CARS

Number of vehicles – DOT, FHWA, *Highway Statistics 2017*, Table MV-1 and annual editions back to 2009. From 1970-2008, Table VM-1 was used.
Vehicle-miles – See Appendix A, Section 7. Car and Light Truck Shares.
Passenger-miles – Vehicle-miles multiplied by an average load factor.
Load factor – 2017 NHTS shows car load factor as 1.54 persons per vehicle.
Energy intensities –

***Btu per vehicle-mile* –** Car energy use divided by vehicle-miles.
***Btu per passenger-mile* –** Car energy use divided by passenger-miles.

Energy use – See Section 2. Energy Use Sources. Data series shown in Table 2.9.

3.2 LIGHT TRUCKS

Number of vehicles – DOT, FHWA, *Highway Statistics 2017*, Table MV-9 and annual editions back to 2009. From 1970-2008, Table VM-1 was used. Columns for pickups, vans, sport utility vehicles, and other light trucks. Data were multiplied by the shares of light trucks which are for personal use (Table A.17) which were derived by ORNL from the 2002 VIUS Micro Data File on CD.
Vehicle-miles – See Appendix A, Section 7. Car and Light Truck Shares. Data were multiplied by the shares of vehicle miles which are for personal use (Table A.17) which were derived by ORNL from the 2002 VIUS Micro Data File on CD.
Passenger-miles – Vehicle-miles multiplied by an average load factor.
Load factor – 2017 NHTS shows personal light truck load factor as 1.82 persons per vehicle.
Energy intensities -

***Btu per vehicle-mile* –** Personal light truck energy use divided by personal light truck vehicle-miles.
***Btu per passenger-mile* –** Personal light truck energy use divided by personal light truck passenger-miles.

Energy use – See Section 2. Energy Use Sources (light trucks, medium/heavy trucks). Data by truck type were multiplied by the shares of truck fuel use which are for personal use (Table A.17) which were derived by ORNL from the 2002 VIUS Micro Data File on CD.

Table A.17
Share of Trucks, Truck Travel,
and Fuel Use for Personal Travel

Personal trucks	
85.6%	2-axle, 4-tire trucks
26.9%	Other single-unit and combination trucks
Personal truck travel	
80.9%	2-axle, 4-tire trucks
13.1%	Other single-unit and combination trucks
Personal truck fuel use	
78.0%	2-axle, 4-tire trucks
6.0%	Other single-unit and combination trucks

Note: Since these shares come from the 2002 VIUS, they may underestimate the amount of personal trucks, truck travel, and energy use for 2017.

3.3 MOTORCYCLES

Number of vehicles, vehicle-miles – DOT, FHWA, *Highway Statistics 2017*, Table VM-1.
Passenger-miles – Vehicle-miles multiplied by an average load factor.
Load factor – 2017 NHTS shows motorcycle load factor as 1.20 persons per vehicle.
Energy intensities –
***Btu per vehicle-mile* –** Motorcycle energy use divided by vehicle-miles.
***Btu per passenger-mile* –** Motorcycle energy use divided by passenger-miles.
Energy use – See Section 2. Energy Use Sources. Data series shown in Table 2.9.

3.4 DEMAND RESPONSE

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2019 Public Transportation Fact Book*, Washington, DC, 2019.
Load factor – Passenger-miles divided by vehicle-miles.
Energy intensities –
***Btu per vehicle-mile* –** Energy use divided by vehicle-miles.
***Btu per passenger-mile* –** Energy use divided by passenger-miles.
Energy use – APTA, *2019 Public Transportation Fact Book*, Washington, DC, 2019.

3.5 BUSES

3.5.1 Transit

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2017 Public Transportation Fact Book*, Washington, DC, 2016. Data series shown on Table 7.9. Data for 2016 are directly from the U.S. Department of Transportation, Federal Transit Administration, National Transit Database.
Load factor – Passenger-miles divided by vehicle-miles.
Energy intensities –
***Btu per vehicle-mile* –** Transit bus energy use divided by transit bus vehicle-miles.
***Btu per passenger-mile* –** Transit bus energy use divided by transit bus passenger-miles.
Energy use – See Section 2. Energy Use Sources. Data series shown in Table 7.9.

3.5.2 Intercity

Energy use – See Section 2. Energy Use Sources. Because the data past 2000 are not available, the rate of change in bus VMT from FHWA, *Highway Statistics 2016*, was used to estimate the change in energy use.

3.5.3 School

Number of vehicles – DOT, FHWA, *Highway Statistics 2016*, Table MV-10.
Energy use – See Section 2. Energy Use Sources. Because the data past 2000 are not available, the rate of change in bus VMT from FHWA, *Highway Statistics 2016*, was used to estimate the change in energy use.

3.6 AIR

3.6.1 Certificated Air Carriers

Aircraft-miles, passenger-miles – DOT, BTS, U.S. Air Traffic Statistics Through December 2017, www.transtats.bts.gov, Washington, DC.
Load factor – Passenger-miles divided by aircraft-miles.
Energy intensities –
***Btu per passenger-mile* –** Certificated air carrier energy use divided by passenger-miles.
Energy use – See Section 2. Energy Use Sources. All of domestic fuel use and half of international fuel use was considered to be domestic use.
Note: These data differ from the data in Table 9.2 because that table contains data on ALL domestic AND international air carrier energy use and passenger-miles.

3.6.2 General Aviation

Number of vehicles – DOT, FAA, *General Aviation and Air Taxi Activity Surveys - CY 2016.* 2011 Data: *Aviation Forecasts*, Tables 28 and 29, May 2013. Data series shown in Table 9.3.

Energy intensities –

Btu per passenger-mile – General aviation energy use divided by passenger-miles.

Energy use – See Section 2. Energy Use Sources. Data series shown in Table 9.3.

3.7 RECREATIONAL BOATING

Number of vehicles and energy use – U.S. EPA's MOVES2014a model.

3.8 RAIL

3.8.1 Intercity

Number of vehicles, vehicle-miles, passenger-miles – AAR, *Railroad Facts, 2017 Edition*, Washington, DC, 2017.

Load factor – Passenger-miles divided by vehicle-miles.

Energy Intensities –

Btu per vehicle-mile – Intercity rail energy use divided by vehicle-miles.

Btu per passenger-mile – Intercity rail energy use divided by passenger-miles.

Energy use – See Section 2. Energy Use Sources. Data series shown in Table 9.10.

3.8.2 Transit

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2017 Public Transportation Fact Book*, Washington, DC, 2017. Sum of light and heavy rail transit. Data series shown on Table 9.12. Data for 2016 are directly from the U.S. Department of Transportation, Federal Transit Administration, National Transit Database.

Load factor – Passenger-miles divided by vehicle-miles.

Energy intensities –

Btu per vehicle-mile – Light and heavy transit rail energy use divided by vehicle-miles.

Btu per passenger-mile – Light and heavy transit rail energy use divided by passenger-miles.

Energy use – See Section 2. Energy Use Sources. Data series shown in Table 9.12.

3.8.3 Commuter

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2017 Public Transportation Fact Book*, Washington, DC, 2017. Data series shown on Table 9.11. Data for 2016 are directly from the U.S. Department of Transportation, Federal Transit Administration, National Transit Database.

Load factor – Passenger-miles divided by vehicle-miles.

Energy intensities –

Btu per vehicle-mile – Commuter rail energy use divided by vehicle-miles.

Btu per passenger-mile – Commuter rail energy use divided by passenger-miles.

Energy use – See Section 2. Energy Use Sources. Data series shown in Table 9.11.

4. HIGHWAY PASSENGER MODE ENERGY INTENSITIES

4.1 CARS

Btu per vehicle-mile – Car energy use divided by car vehicle miles of travel.

Energy use – See Section 2. Energy Use Sources. Data series shown in Table 2.9.

Vehicle-miles – 1970-2008: DOT, FHWA, *Highway Statistics 2009*, Table VM-1 and annual editions back to 1996 and DOT, FHWA, *Highway Statistics Summary to 1995*. Data series shown in Table 4.1.

2009-2016: See Appendix A, Section 7. Car and Light Truck Shares.

Btu per passenger-mile – Car energy use divided by car passenger-miles.

Energy use – See Section 2. Energy Use Sources. Data series shown in Table 2.9.

Passenger miles – Vehicle miles multiplied by an average load factor.

Vehicle-miles – 1970-2008: DOT, FHWA, *Highway Statistics 2009*, Table VM-1 and annual editions back to 1996 and DOT, FHWA, *Highway Statistics Summary to 1995*. Data series shown in Table 4.1.

2009-2015: See Appendix A, Section 7. Car and Light Truck Shares.

Load factor – NPTS 1969, 1977, 1983/84, 1990, and 1995; NHTS 2001, 2009, and 2017. Data series shown in Table A.18.

Table A.18
Car Load Factor used to Calculate Passenger-Miles

Year	Source	Load Factor
1970	1969 NPTS	1.90
1971	Interpolated	1.90
1972	Interpolated	1.90
1973	Interpolated	1.90
1974	Interpolated	1.90
1975	Interpolated	1.90
1976	Interpolated	1.90
1977	1977 NPTS	1.90
1978	Interpolated	1.88
1979	Interpolated	1.87
1980	Interpolated	1.85
1981	Interpolated	1.83
1982	Interpolated	1.82
1983	1983/84 NPTS	1.80
1984	Interpolated	1.77
1985	Interpolated	1.74
1986	Interpolated	1.71
1987	Interpolated	1.69
1988	Interpolated	1.66
1989	Interpolated	1.63
1990	1990 NPTS	1.60
1991	Interpolated	1.60
1992	Interpolated	1.60
1993	Interpolated	1.60
1994	Interpolated	1.60
1995	1995 NPTS	1.60
1996	Interpolated	1.60
1997	Interpolated	1.59
1998	Interpolated	1.59
1999	Interpolated	1.58
2000	Interpolated	1.58
2001	2001 NHTS	1.57
2002	2001 NHTS	1.57
2003	2001 NHTS	1.57
2004	2001 NHTS	1.57
2005	2001 NHTS	1.57
2006	2001 NHTS	1.57
2007	2001 NHTS	1.57
2008	2009 NHTS	1.55
2009	2009 NHTS	1.55
2010	2009 NHTS	1.55
2011	2009 NHTS	1.55
2012	2009 NHTS	1.55
2013	2009 NHTS	1.55
2014	2009 NHTS	1.55
2015	2009 NHTS	1.55
2016	2017 NHTS	1.54
2017	2017 NHTS	1.54

4.2 LIGHT TRUCKS

Btu per vehicle-mile – Light truck energy use divided by light truck vehicle miles of travel.

***Energy use* –** See Section 2. Energy Use Sources. Data series shown in Table 2.9.

***Vehicle-miles* –** 1970-2008: DOT, FHWA, *Highway Statistics 2008*, Table VM-1 and annual editions back to 1996 and DOT, FHWA, *Highway Statistics Summary to 1995*. Data series shown in Table 4.2. 2009-2016: See Appendix A, Section 7. Car and Light Truck Shares.

Table A.19
Light Truck Load Factor used to Calculate Passenger-Miles

Year	Source	Load Factor
1970	1969 NPTS	1.90
1971	Interpolated	1.89
1972	Interpolated	1.87
1973	Interpolated	1.86
1974	Interpolated	1.84
1975	Interpolated	1.83
1976	Interpolated	1.81
1977	1977 NPTS	1.80
1978	Interpolated	1.81
1979	Interpolated	1.83
1980	Interpolated	1.84
1981	Interpolated	1.86
1982	Interpolated	1.87
1983	1983/84 NPTS	1.90
1984	Interpolated	1.87
1985	Interpolated	1.84
1986	Interpolated	1.81
1987	Interpolated	1.79
1988	Interpolated	1.76
1989	Interpolated	1.73
1990	1990 NPTS	1.70
1991	Interpolated	1.68
1992	Interpolated	1.66
1993	Interpolated	1.64
1994	Interpolated	1.62
1995	1995 NPTS	1.60
1996	Interpolated	1.62
1997	Interpolated	1.64
1998	Interpolated	1.66
1999	Interpolated	1.68
2000	Interpolated	1.70
2001	2001 NHTS	1.72
2002	2001 NHTS	1.72
2003	2001 NHTS	1.72
2004	2001 NHTS	1.72
2005	2001 NHTS	1.72
2006	2001 NHTS	1.72
2007	2001 NHTS	1.72
2008	2009 NHTS	1.84
2009	2009 NHTS	1.84
2010	2009 NHTS	1.84
2011	2009 NHTS	1.84
2012	2009 NHTS	1.84
2013	2009 NHTS	1.84
2014	2009 NHTS	1.84
2015	2009 NHTS	1.84
2016	2017 NHTS	1.82
2017	2017 NHTS	1.82

Btu per passenger-mile – Light truck energy use divided by light trucks passenger-miles.
Energy use – See Section 2. Energy Use Sources. Data series shown in Table 2.9.
Passenger miles – Vehicle miles multiplied by an average load factor.
Vehicle-miles – 1970-2008: DOT, FHWA, *Highway Statistics 2009*, Table VM-1 and annual editions back to 1996 and DOT, FHWA, *Highway Statistics Summary to 1995*. Data series shown in Table 4.2.
2009-2015: See Appendix A, Section 7. Car and Light Truck Shares.
Load factor – NPTS 1969, 1977, 1983/84, 1990, and 1995; NHTS 2001, 2009, and 2017. Data series shown in Table A.19.

4.3 Buses

4.3.1 Transit

Btu per vehicle-mile – Transit bus energy use divided by transit bus vehicle-miles.
Energy use – See Section 2. Energy Use Sources. Data series shown in Table 7.9.
Vehicle-miles – APTA, *2017 Public Transportation Fact Book*, Washington, DC, 2018. Data series shown on Table 7.9. Data for 2016 are directly from the U.S. Department of Transportation, Federal Transit Administration, National Transit Database.

Btu per passenger-mile – Transit bus energy use divided by transit bus passenger-miles.
Energy use – See Section 2. Energy Use Sources. Data series shown in Table 7.9.
Passenger-miles – APTA, *2017 Public Transportation Fact Book*, Washington, DC, 2016. Data series shown on Table 7.9. Data for 2016 are directly from the U.S. Department of Transportation, Federal Transit Administration, National Transit Database.

4.3.2 Intercity

Btu per passenger-mile – Data are not available.
Energy use – See Section 2. Energy Use Sources. Because the data past 2000 are not available, the rate of change in bus VMT from FHWA, *Highway Statistics 2016*, was used to estimate the change in energy use.
Passenger-miles – Data are not available.

5. NONHIGHWAY MODE ENERGY INTENSITIES

5.1 AIR

5.1.1 Certificated Air Carriers

Btu per passenger-mile – Certificated air carrier energy use divided by passenger-miles.

***Energy use* –** See Section 2. Energy Use Sources. All of domestic fuel use and half of international fuel use was considered to be domestic use.

***Passenger-miles* –** DOT, BTS, *Air Carrier Traffic Statistics*, Washington, DC, www.transtats.bts.gov. Pre-1994 data are from various editions of the *FAA Statistical Handbook of Aviation* (no longer published). Scheduled service passenger-miles of domestic air carriers and half of international air carriers were used to coincide with fuel use.

Note: These data differ from the data in Table 9.2 because that table contains data on ALL domestic AND international air carrier energy use and passenger-miles.

5.1.2 General Aviation

Btu per passenger-mile – Data are not available.

***Energy use* –** See Section 2. Energy Use Sources. Data series shown in Table 9.3.

***Passenger-miles* –** Data are not available.

5.2 RAIL

5.2.1 Intercity

Btu per passenger-mile – Intercity rail energy use divided by passenger-miles.

***Energy use* –** See Section 2. Energy Use Sources. Data series shown in Table 9.10.

***Passenger-miles* –** AAR, *Railroad Facts, 2017 Edition*, and previous annual editions.

5.2.2 Transit

Btu per passenger-mile – Transit rail energy use divided by passenger-miles.

***Energy use* –** See Section 2. Energy Use Sources. Data series shown in Table 9.12.

***Passenger-miles* –** APTA, *2017 Public Transportation Fact Book*, Washington, DC, 2017. Data series shown on Table 9.12. Data for 2016 are directly from the U.S. Department of Transportation, Federal Transit Administration, National Transit Database.

5.2.3 Commuter

Btu per passenger-mile – Commuter rail energy use divided by passenger-miles.

***Energy use* –** See Section 2. Energy Use Sources. Data series shown in Table 9.11.

***Passenger-miles* –** APTA, *2017 Public Transportation Fact Book*, Washington, DC, 2018. Data series shown on Table 9.11. Data for 2016 are directly from the U.S. Department of Transportation, Federal Transit Administration, National Transit Database.

6. FREIGHT MODE ENERGY INTENSITIES

6.1 TRUCK

Btu per vehicle-mile – Heavy single-unit and combination truck energy use divided by vehicle miles

Energy use – See Section 2. Energy Use Sources (medium/heavy trucks).

Vehicle-miles – DOT, FHWA, *Highway Statistics 2016*, Table VM-1 and annual editions back to 1996 and DOT, FHWA, *Highway Statistics Summary to 1995*. Data series is the total of vehicle travel data on Tables 5.1 and 5.2.

6.2 RAIL

Btu per freight car-mile – Class I rail energy use divided by freight car-miles.

Energy use – See Section 2. Energy Use Sources. Data series shown in Table 9.8.

Freight car miles – AAR, *Railroad Facts, 2017 Edition*, Washington, DC, 2017. Data series shown in Table 9.8.

Btu per ton-mile – Class I rail energy use divided by ton-miles.

Energy use – See Section 2. Energy Use Sources. Data series shown in Table 9.8.

Ton-miles – AAR, *Railroad Facts, 2017 Edition*, Washington, DC, 2017. Data series shown in Table 9.8.

6.3 WATER

Btu per ton-mile – Domestic waterborne commerce energy use on taxable waterways divided by ton-miles on taxable waterways.

Energy use – Modeled by Chrisman A. Dager, University of Tennessee, Knoxville, using Waterborne Commerce Statistics Center detail records and annual IRS reports on the Inland Waterway Trust Fund tax on diesel fuel used on the inland waterway.

Note: These data are not available for 2015 or 2016.

Ton-miles – Based on detailed records from the U.S. Department of the Army, Army Corps of Engineers, Waterborne Commerce Statistics Center. Includes only ton-miles on taxable waterways.

7. CAR AND LIGHT TRUCK SHARES

In 2011, the Federal Highway Administration (FHWA) changed the methodology for producing the data on the VM-1 Table in the annual *Highway Statistics* publication. Historically, VM-1 included individual categories for passenger cars and 2-axle, 4-tire trucks. VM-1 included the vehicle miles of travel (VMT), registrations, fuel use, and fuel economy of passenger cars and 2-axle, 4-tire trucks. After the methodology change, the categories of light vehicles on VM-1 changed to Light-Duty Vehicles with Short wheelbase (less than or equal to 121 inches) and Light-Duty Vehicles with Long Wheelbase (over 121 inches). As some passenger cars have long wheelbases and some 2-axle, 4-tire trucks have short wheelbases, the categories of cars and 2-axle, 4-tire trucks are no longer available. Despite these changes, there are many transportation analysts who require information on cars and 2-axle, 4-tire trucks. Thus, a new methodology to estimate the data in these categories was developed for years 2009 through 2016.

7.1 CARS

Registrations – DOT, FHWA, *Highway Statistics 2017*, Table MV-1 and annual editions back to 2009.

Vehicle travel –

***Total for all light vehicles* –** DOT, FHWA, *Highway Statistics 2017,* Table VM-1 and annual editions back to 2009; sum of light-duty short wheelbase and light-duty long wheelbase VMT.

Cars – Using historical shares of passenger cars/2-axle, 4-tire trucks from the *Highway Statistics*, the percent of light vehicle travel attributable to cars was estimated for 2009-2017, keeping in mind the economic conditions present in those years and the general trend in total light vehicle VMT. The estimated share was applied to total VMT as shown in Table A.20.

Table A.20
Estimated Car VMT

Year	Total Light Vehicle VMT (billions)	Share Attributable to Cars	Total Car VMT (billions)
2009	2,633.3	59.5%	1,566.8
2010	2,648.5	56.5%	1,496.4
2011	2,650.5	55.0%	1,457.8
2012	2,664.1	54.0%	1,438.6
2013	2,677.8	54.0%	1,446.0
2014	2,710.6	53.0%	1,436.6
2015	2,779.7	52.0%	1,445.4
2016	2,849.7	51.0%	1,453.4
2017	2,877.4	49.5%	1,424.3

Miles per Vehicle – Vehicle travel divided by registrations.

Fuel Use – Vehicle travel divided by fuel economy.

Fuel Economy – DOE, EIA, *Annual Energy Outlook 2019,* January 2019 and annual editions back to 2012.

7.2 2-AXLE, 4-TIRE TRUCKS

Registrations – DOT, FHWA, *Highway Statistics 2017*, Table MV-1 and annual editions back to 2009.

Vehicle travel –

Total for all light vehicles – DOT, FHWA, *Highway Statistics 2017*, Table VM-1 and annual editions back to 2009; sum of light-duty short wheelbase and light-duty long wheelbase VMT.

2-axle, 4-tire truck VMT – Using historical shares of passenger cars/2-axle, 4-tire trucks from the *Highway Statistics*, the percent of light vehicle travel attributable to cars was estimated for 2009-2017, keeping in mind the economic conditions present in those years and the general trend in total light vehicle VMT. The estimated share was applied to total VMT as shown in Table A.21.

Table A.21
Estimated 2-axle, 4-tire Truck VMT

Year	Total Light Vehicle VMT (billions)	Share Attributable to 2-axle, 4-tire Trucks	Total 2-axle, 4-tire Truck VMT (billions)
2009	2,633.2	40.5%	1,066.5
2010	2,648.5	43.5%	1,152.1
2011	2,650.5	45.0%	1,192.7
2012	2,664.1	46.0%	1,225.5
2013	2,677.8	46.0%	1,231.8
2014	2,710.6	47.0%	1,274.0
2015	2,779.7	48.0%	1,334.3
2016	2,849.7	49.0%	1,396.4
2017	2,877.4	50.5%	1,453.1

Miles per Vehicle – Vehicle travel divided by registrations.

Fuel Use – Vehicle travel divided by fuel economy.

Fuel Economy – DOE, EIA, *Annual Energy Outlook 2019,* January 2019 and annual editions back to 2012.

APPENDIX B

CONVERSIONS

CONVERSIONS

A Note about Heating Values

The heat content of a fuel is the quantity of energy released by burning a unit amount of that fuel. However, this value is not absolute and can vary according to several factors. For example, empirical formulae for determining the heating value of liquid fuels depend on the fuels' American Petroleum Institute (API) gravity. The API gravity varies depending on the percent by weight of the chemical constituents and impurities in the fuel, both of which are affected by the combination of raw materials used to produce the fuel and by the type of manufacturing process. Temperature and climatic conditions are also factors.

Because of these variations, the heating values in Table B.4 may differ from values in other publications. The figures in this report are representative or average values, not absolute ones. The gross (higher) heating values used here agree with those used by the Energy Information Administration (EIA).

Heating values fall into two categories, usually referred to as "higher" (or gross) and "lower" (or net). If the products of fuel combustion are cooled back to the initial fuel-air or fuel-oxidizer mixture temperature and the water formed during combustion is condensed, the energy released by the process is the higher (gross) heating value. If the products of combustion are cooled to the initial fuel-air temperature, but the water is considered to remain as a vapor, the energy released by the process is the lower (net) heating value. Usually the difference between the gross and net heating values for fuels used in transportation is around 5 to 8 percent; however, it is important to be consistent in their use.

The Transportation Energy Data Book has always used gross heating values for fuel conversion.

Table B.1
Hydrogen Heat Content

1 kilogram hydrogen =	
Higher heating value	Lower heating value
134,200 Btu	113,400 Btu
39.3 kWhr	33.2 kWhr
141,600 kJ	119,600 kJ
33,800 kCal	28,560 kCal

Table B.2
Hydrogen Conversions

	Weight		Gas		Liquid	
	Pounds (lb)	Kilograms (kg)	Standard cubic feet (SCF)	Normal cubic meter (Nm^3)	Gallons (gal)	Liters (L)
1 lb	1.0	0.4536	192.00	5.047	1.6928	6.408
1 kg	2.205	1.0	423.3	11.126	3.733	14.128
1 SCF gas	0.005209	0.002363	1.0	0.02628	0.00882	0.0339
1 Nm^3 gas	0.19815	0.08988	38.04	1.0	0.3355	1.2699
1 gal liquid	0.5906	0.2679	113.41	2.981	1.0	3.785
1 L liquid	0.15604	0.07078	29.99	0.77881	0.2642	1.0

Table B.3
Pressure Conversions

	Bar	Atmosphere	lb/in^2 (or psi)
Bar	1.0	0.987	14.5
Atmosphere	1.013	1.0	14.696
lb/in^2 (or psi)	0.0689	0.0680	1.0

Table B.4
Heat Content for Various Fuels

Conventional gasoline	125,000 Btu/gal (gross) = 115,400 Btu/gal (net)
E10	120,900 Btu/gal (gross) = 112,400 Btu/gal (net)
E15	119,000 Btu/gal (gross) = 109,400 Btu/gal (net)
Hydrogen	134,200 Btu/kg (gross) = 113,400 Btu/kg (net)
Low-sulfur diesel	138,700 Btu/gal (gross) = 128,700 Btu/gal (net)
Biodiesel	126,200 Btu/gal (gross) = 117,100 Btu/gal (net)
Methanol	64,600 Btu/gal (gross) = 56,600 Btu/gal (net)
Ethanol	84,600 Btu/gal (gross) = 75,700 Btu/gal (net)
E85	90,700 Btu/gal (gross) = 81,600 Btu/gal (net)
Aviation gasoline	120,200 Btu/gal (gross) = 112,000 Btu/gal (net)
Liquefied petroleum gas (LPG)	91,300 Btu/gal (gross) = 83,500 Btu/gal (net)
Butane	103,000 Btu/gal (gross) = 93,000 Btu/gal (net)
Jet fuel (naphtha)	127,500 Btu/gal (gross) = 118,700 Btu/gal (net)
Jet fuel (kerosene)	135,000 Btu/gal (gross) = 128,100 Btu/gal (net)
Lubricants	144,400 Btu/gal (gross) = 130,900 Btu/gal (net)
Waxes	131,800 Btu/gal (gross) = 120,200 Btu/gal (net)
Asphalt and road oil	158,000 Btu/gal (gross) = 157,700 Btu/gal (net)
Liquefied natural gas (LNG)	23,700 Btu/lb (gross) = 20,900 Btu/lb (net)
Compressed natural gas (CNG)	22,500 Btu/lb (gross) = 20,200 Btu/lb (net)
Crude petroleum	138,100 Btu/gal (gross) = 131,800 Btu/gal (net)
Fuel Oils	
Residual	149,700 Btu/gal (gross) = 138,400 Btu/gal (net)
Distillate	138,700 Btu/gal (gross) = 131,800 Btu/gal (net)
Coal	
Production average	19.880 x 10^6 Btu/short ton
Consumption average	19.499 x 10^6 Btu/short ton

Note: Heat content values are approximate. Data are rounded to the nearest hundred.

Table B.5
Fuel Equivalents

1 million bbl crude oil/day	= 0.365 billion bbl crude oil/year = 2.089 quadrillion Btu/year = 107.110 million short tons coal/year = 97.170 million metric tons coal/year = 2.016 trillion ft^3 natural gas/year = 2,203 petajoules/year
1 billion bbl crude oil/year	= 2.740 million bbl crude oil/day = 5.722 quadrillion Btu/year = 293.451 million short tons coal/year = 266.219 million metric tons coal/year = 5.523 trillion ft^3 natural gas/year = 6,037 petajoules/year
1 quadrillion Btu/year	= 8.000 billion gasoline gallon equivalents/year = 0.479 million bbl crude oil/day = 174.764 million bbl crude oil/year = 51.285 million short tons coal/year = 46.525 million metric tons coal/year = 965.251 billion ft^3 natural gas/year = 1,055 petajoules/year
1 billion short tons coal/year	= 0.907 billion metric tons coal/year = 9.336 million bbl crude oil/day = 3.408 billion bbl crude oil/year = 19.499 quadrillion Btu/year = 18.821 trillion ft^3 natural gas/year = 20,572 petajoules/year
1 billion metric tons coal/year	= 1.102 billion short tons coal/year = 8.470 million bbl crude oil/day = 3.091 billion bbl crude oil/year = 17.689 quadrillion btu/year = 17.075 trillion ft^3 natural gas/year = 18,662 petajoules/year
1 trillion ft^3 natural gas/year	= 0.496 million bbl crude oil/day = 0.181 billion bbl crude oil/year = 1.036 quadrillion Btu/year = 53.131 million short tons coal/year = 48.200 million metric tons coal/year = 1,093 petajoules/year
1 petajoule/year	= 453.844 bbl crude oil/day = 165.653 thousand bbl crude oil/year = 0.948 trillion Btu/year = 48.661 thousand short tons coal/year = 44.100 thousand metric tons coal/year = 0.915 billion ft^3 natural gas/year

Table B.6
Energy Unit Conversions

1 Btu	= 778.2 ft-lb	1 kWhr	= 3412 Btu[a]
	= 107.6 kg-m		= 2.655 x 10^{6} ft-lb
	= 1055 J		= 3.671 x 10^{5} kg-m
	= 39.30 x 10^{-5} hp-h		= 3.600 x 10^{6} J
	= 39.85 x 10^{-5} metric hp-h		= 1.341 hp-h
	= 29.31 x 10^{-5} kWhr		= 1.360 metric hp-h
1 kg-m	= 92.95 x 10^{-4} Btu	1 Joule	= 94.78 x 10^{-5} Btu
	= 7.233 ft-lb		= 0.7376 ft-lb
	= 9.806 J		= 0.1020 kg-m
	= 36.53 x 10^{-7} hp-h		= 37.25 x 10^{-8} hp-h
	= 37.04 x 10^{-7} metric hp-h		= 37.77 x 10^{-8} metric hp-h
	= 27.24 x 10^{-7} kWhr		= 27.78 x 10^{-8} kWhr
1 hp-h	= 2544 Btu	1 metric hp-h	= 2510 Btu
	= 1.98 x 10^{6} ft-lb		= 1.953 x 10^{6} ft-lb
	= 2.738 x 10^{6} kgm		= 27.00 x 10^{4} kg-m
	= 2.685 x 10^{6} J		= 2.648 x 10^{6} J
	= 1.014 metric hp-h		= 0.9863 hp-h
	= 0.7475 kWhr		= 0.7355 kWhr

[a]This figure does not take into account the fact that electricity generation and distribution efficiency is approximately 33%. If generation and distribution efficiency are taken into account, 1 kWhr = 10,339 Btu.

Table B.7
International Energy Conversions

To:	**Petajoules**	**Giga-calories**	**Million metric tons of oil equivalent**	**Million Btu**	**Gigawatt-hours**
From:	*multiply by:*				
Petajoules	1	238.8 x 10^{3}	2.388 x 10^{-2}	947.8 x 10^{3}	277.8
Gigacalories	4.1868 x 10^{-6}	1	10^{-7}	3.968	1.163 x 10^{-3}
Million metric tons of oil equivalent	41.868	10^{7}	1	3.968 x 10^{7}	11,630
Million Btu	1.0551 x 10^{-6}	0.252	2.52 X 10^{-8}	1	2.931 x 10^{-4}
Gigawatthours	3.6 x 10^{-3}	860	8.6 x 10^{-5}	3412	1

Table B.8
Distance and Velocity Conversions

1 in	= 83.33×10^{-3} ft	1 ft	= 12.0 in
	= 27.78×10^{-3} yd		= 0.33 yd
	= 15.78×10^{-6} mile		= 189.4×10^{-3} mile
	= 25.40×10^{-3} m		= 0.3048 m
	= 0.2540×10^{-6} km		= 0.3048×10^{-3} km
1 mile	= 63360 in	1 km	= 39370 in
	= 5280 ft		= 3281 ft
	= 1760 yd		= 1093.6 yd
	= 1609 m		= 0.6214 mile
	= 1.609 km		= 1000 m

1 ft/sec = 0.3048 m/s = 0.6818 mph = 1.0972 km/h

1 m/sec = 3.281 ft/s = 2.237 mph = 3.600 km/h

1 km/h = 0.9114 ft/s = 0.2778 m/s = 0.6214 mph

1 mph = 1.467 ft/s = 0.4469 m/s = 1.609 km/h

Table B.9
Alternative Measures of Greenhouse Gases

1 pound methane, measured in carbon units (CH_4)	=	1.333 pounds methane, measured at full molecular weight (CH_4)
1 pound carbon dioxide, measured in carbon units (CO_2-C)	=	3.6667 pounds carbon dioxide, measured at full molecular weight (CO_2)
1 pound carbon monoxide, measured in carbon units (CO-C)	=	2.333 pounds carbon monoxide, measured at full molecular weight (CO)
1 pound nitrous oxide, measured in nitrogen units (N_2O-N)	=	1.571 pounds nitrous oxide, measured at full molecular weight (N_2O)

Table B.10
Volume and Flow Rate Conversions[a]

A U.S. gallon of gasoline weighs 6.2 pounds

1 U.S. gal	= 231 in^3	1 liter	= 61.02 in^3
	= 0.1337 ft^3		= 3.531 x 10^{-2} ft^3
	= 3.785 liters		= 0.2642 U.S. gal
	= 0.8327 imperial gal		= 0.2200 imperial gal
	= 0.0238 bbl		= 6.29 x 10^{-3} bbl
	= 0.003785 m^3		= 0.001 m^3
1 imperial gal	= 277.4 in^3	1 bbl	= 9702 in^3
	= 0.1605 ft^3		= 5.615 ft^3
	= 4.546 liters		= 158.97 liters
	= 1.201 U.S. gal		= 42 U.S. gal
	= 0.0286 bbl		= 34.97 imperial gal
	= 0.004546 m^3		= 0.15898 m^3
1 U.S. gal/hr	= 3.208 ft^3/day		= 1171 ft^3/year
	= 90.85 liter/day		= 33160 liter/year
	= 19.78 imperial gal/day		= 7220 imperial gal/year
	= 0.5714 bbl/day		= 208.57 bbl/year
1 liter/hr	= 0.8476 ft^3/day		= 309.3 ft^3/year
	= 6.340 U.S. gal/day		= 2308 U.S. gal/year
	= 5.28 imperial gal/day		= 1927 imperial gal/year
	= 0.1510 bbl/day		= 55.10 bbl/year
1 bbl/hr	= 134.7 ft^3/day		= 49184 ft^3/year
	= 1008 U.S. gal/day		= 3.679 x 10^5 U.S. gal/year
	= 839.3 imperial gal/day		= 3.063 x 10^5 imperial gal/year
	= 3816 liter/day		= 1.393 x 10^6 liter/day

[a] The conversions for flow rates are identical to those for volume measures, if the time units are identical. Conversions to/from barrels (bbl) are based on barrels of petroleum.

Table B.11
Power Conversions

FROM	TO					
	Horsepower	Kilowatts	Metric horsepower	Ft-lb per sec	Kilocalories per sec	Btu per sec
Horsepower	1	0.7457	1.014	550	0.1781	0.7068
Kilowatts	1.341	1	1.360	737.6	0.239	0.9478
Metric horsepower	0.9863	0.7355	1	542.5	0.1757	0.6971
Ft-lb per sec	1.36×10^{-3}	1.356×10^{-3}	1.84×10^{-3}	1	0.3238×10^{-3}	1.285×10^{-3}
Kilocalories per sec	5.615	4.184	5.692	3088	1	3.968
Btu per sec	1.415	1.055	1.434	778.2	0.2520	1

Table B.12
Mass Conversions

FROM	TO				
	Pound	Kilogram	Short ton	Long ton	Metric ton
Pound	1	0.4536	5.0×10^{-4}	4.4643×10^{-4}	4.5362×10^{-4}
Kilogram	2.205	1	1.1023×10^{-3}	9.8425×10^{-4}	1.0×10^{-3}
Short ton	2,000	907.2	1	0.8929	0.9072
Long ton	2,240	1,106	1.12	1	1.016
Metric ton	2,205	1,000	1.102	0.9842	1

Table B.13
Fuel Efficiency Conversions

MPG	Miles/liter	Kilometers/L	L/100 kilometers	Grams of CO_2 per mile[a]	Pounds of CO_2 per mile[a]
10	2.64	4.25	23.52	877.80	1.94
15	3.96	6.38	15.68	585.20	1.29
20	5.28	8.50	11.76	438.90	0.97
25	6.60	10.63	9.41	351.12	0.78
30	7.92	12.75	7.84	292.60	0.65
35	9.25	14.88	6.72	250.80	0.55
40	10.57	17.00	5.88	219.45	0.49
45	11.89	19.13	5.23	195.07	0.43
50	13.21	21.25	4.70	175.56	0.39
55	14.53	23.38	4.28	159.60	0.35
60	15.85	25.51	3.92	146.30	0.32
65	17.17	27.63	3.62	135.05	0.30
70	18.49	29.76	3.36	125.40	0.28
75	19.81	31.88	3.14	117.04	0.26
80	21.13	34.01	2.94	109.73	0.24
85	22.45	36.13	2.77	103.27	0.23
90	23.77	38.26	2.61	97.53	0.22
95	25.09	40.38	2.48	92.40	0.20
100	26.42	42.51	2.35	87.78	0.19
105	27.74	44.64	2.24	83.60	0.18
110	29.06	46.76	2.14	79.80	0.18
115	30.38	48.89	2.05	76.33	0.17
120	31.70	51.01	1.96	73.15	0.16
125	33.02	53.14	1.88	70.22	0.16
130	34.34	55.26	1.81	67.52	0.15
135	35.66	57.39	1.74	65.02	0.14
140	36.98	59.51	1.68	62.70	0.14
145	38.30	61.64	1.62	60.54	0.13
150	39.62	63.76	1.57	58.52	0.13
Formula	MPG/3.785	MPG/[3.785/1.609]	235.24/MPG	8,778/MPG	19.4/MPG

[a] For gasoline-fueled vehicles.

Table B.14
SI Prefixes and Their Values

	Value	Prefix	Symbol
One million million millionth	10^{-18}	atto	a
One thousand million millionth	10^{-15}	femto	f
One million millionth	10^{-12}	pico	p
One thousand millionth	10^{-9}	nano	n
One millionth	10^{-6}	micro	µ
One thousandth	10^{-3}	milli	m
One hundredth	10^{-2}	centi	c
One tenth	10^{-1}	deci	
One	10^{0}		
Ten	10^{1}	deca	
One hundred	10^{2}	hecto	
One thousand	10^{3}	kilo	k
One million	10^{6}	mega	M
One billion[a]	10^{9}	giga	G
One trillion[a]	10^{12}	tera	T
One quadrillion[a]	10^{15}	peta	P
One quintillion[a]	10^{18}	exa	E

[a] Care should be exercised in the use of this nomenclature, especially in foreign correspondence, as it is either unknown or carries a different value in other countries. A "billion," for example, signifies a value of 10^{12} in most other countries.

Table B.15
Metric Units and Abbreviations

Quantity	Unit name	Symbol
Energy	Joule	J
Specific energy	Joule/kilogram	J/kg
Specific energy consumption	Joule/kilogram•kilometer	J/(kg•km)
Energy consumption	Joule/kilometer	J/km
Energy economy	kilometer/kilojoule	km/kJ
Power	kilowatt	kW
Specific power	Watt/kilogram	W/kg
Power density	Watt/meter^3	W/m^3
Speed	kilometer/hour	km/h
Acceleration	meter/second^2	m/s^2
Range (distance)	kilometer	km
Weight	kilogram	kg
Torque	Newton•meter	N•m
Volume	meter^3	m^3
Mass; payload	kilogram	kg
Length; width	meter	m
Brake specific fuel consumption	kilogram/Joule	kg/J
Fuel economy (heat engine)	Liters/100 km	L/100 km

Table B.16
Carbon Coefficients
(Million metric tons carbon per quadrillion Btu)

Energy Source	Fuel Type	Carbon Coefficients
Coal		
	Anthracite	28.28
	Bituminous	25.45
	Subbituminous	26.51
	Lignite	26.65
	Coke	31.12
	Coal (All types)	26.00
Natural gas		
	Natural Gas	14.47
	Flared natural gas	14.92
	Propane	17.20
	Butane	17.71
	Butane/Propane Mix	17.46
Petroleum		
	Gasoline	19.45
	Diesel fuel	19.95
	Jet Fuel	19.34
	Aviation Gas	18.87
	Kerosene	19.72
	Residual Heating Fuel	21.49
	Petroleum coke	27.85
	Asphalt and Road Oil	20.62
	Lubricants	20.24
	Petrochemical Feedstocks	19.37
	Special Naphthas (solvents)	19.85
	Waxes	19.81
	Other petroleum & miscellaneous	19.81

Note: Additional information:
www.eia.gov/environment/emissions/co2_vol_mass.cfm

Conversion of Constant Dollar Values

Many types of information in this data book are expressed in dollars. Generally, constant dollars are used–that is, dollars of a fixed value for a specific year, such as 2010 dollars. Converting current dollars to constant dollars, or converting constant dollars for one year to constant dollars for another year, requires conversion factors (Table B.17 and Table B.18). Table B.17 shows conversion factors for the Consumer Price Index inflation factors. Table B.18 shows conversion factors using the Gross National Product Implicit Price Deflator.

Table B.17
Consumer Price Inflation (CPI) Index

	To:									
From:	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
1970	1.000	1.044	1.077	1.144	1.271	1.387	1.466	1.562	1.680	1.871
1971	0.958	1.000	1.032	1.096	1.217	1.328	1.405	1.496	1.610	1.793
1972	0.928	0.969	1.000	1.062	1.179	1.287	1.361	1.450	1.560	1.737
1973	0.874	0.912	0.941	1.000	1.110	1.212	1.282	1.365	1.468	1.635
1974	0.787	0.822	0.848	0.901	1.000	1.091	1.154	1.229	1.323	1.473
1975	0.721	0.753	0.777	0.825	0.916	1.000	1.058	1.126	1.212	1.349
1976	0.682	0.712	0.735	0.780	0.866	0.946	1.000	1.065	1.146	1.276
1977	0.640	0.668	0.690	0.733	0.814	0.888	0.939	1.000	1.076	1.198
1978	0.595	0.621	0.641	0.681	0.756	0.825	0.873	0.929	1.000	1.113
1979	0.534	0.558	0.576	0.612	0.679	0.741	0.784	0.835	0.898	1.000
1980	0.471	0.492	0.507	0.539	0.598	0.653	0.691	0.735	0.791	0.881
1981	0.427	0.446	0.460	0.488	0.542	0.592	0.626	0.667	0.717	0.799
1982	0.402	0.420	0.433	0.460	0.511	0.558	0.590	0.628	0.676	0.752
1983	0.390	0.407	0.420	0.446	0.495	0.540	0.571	0.608	0.655	0.729
1984	0.373	0.390	0.402	0.427	0.474	0.518	0.548	0.583	0.628	0.699
1985	0.361	0.376	0.388	0.413	0.458	0.500	0.529	0.563	0.606	0.675
1986	0.354	0.370	0.381	0.405	0.450	0.491	0.519	0.553	0.595	0.662
1987	0.342	0.357	0.368	0.391	0.434	0.474	0.501	0.533	0.574	0.639
1988	0.328	0.342	0.353	0.375	0.417	0.455	0.481	0.512	0.551	0.614
1989	0.313	0.327	0.337	0.358	0.398	0.434	0.459	0.489	0.526	0.585
1990	0.297	0.310	0.320	0.340	0.377	0.412	0.435	0.464	0.499	0.555
1991	0.285	0.297	0.307	0.326	0.362	0.395	0.418	0.445	0.479	0.533
1992	0.277	0.289	0.298	0.316	0.351	0.383	0.406	0.432	0.465	0.517
1993	0.269	0.280	0.289	0.307	0.341	0.372	0.394	0.419	0.451	0.502
1994	0.262	0.273	0.282	0.300	0.333	0.363	0.384	0.409	0.440	0.490
1995	0.255	0.266	0.274	0.291	0.323	0.353	0.373	0.398	0.428	0.476
1996	0.247	0.258	0.266	0.283	0.314	0.343	0.363	0.386	0.416	0.463
1997	0.242	0.252	0.260	0.277	0.307	0.335	0.355	0.378	0.406	0.452
1998	0.238	0.248	0.256	0.272	0.302	0.330	0.349	0.372	0.400	0.445
1999	0.233	0.243	0.251	0.267	0.296	0.323	0.342	0.364	0.391	0.436
2000	0.225	0.235	0.243	0.258	0.286	0.312	0.330	0.352	0.379	0.422
2001	0.219	0.229	0.236	0.251	0.278	0.304	0.321	0.342	0.368	0.410
2002	0.216	0.225	0.232	0.247	0.274	0.299	0.316	0.337	0.362	0.404
2003	0.211	0.220	0.227	0.241	0.268	0.292	0.309	0.329	0.354	0.395
2004	0.205	0.214	0.221	0.235	0.261	0.285	0.301	0.321	0.345	0.384
2005	0.199	0.207	0.214	0.227	0.252	0.275	0.291	0.310	0.334	0.372
2006	0.192	0.201	0.207	0.220	0.245	0.267	0.282	0.301	0.323	0.360
2007	0.187	0.195	0.202	0.214	0.238	0.259	0.274	0.292	0.314	0.350
2008	0.180	0.188	0.194	0.206	0.229	0.250	0.264	0.281	0.303	0.337
2009	0.181	0.189	0.195	0.207	0.230	0.251	0.265	0.282	0.304	0.338
2010	0.178	0.186	0.192	0.204	0.226	0.247	0.261	0.278	0.299	0.333
2011	0.172	0.180	0.186	0.197	0.219	0.239	0.253	0.269	0.290	0.323
2012	0.169	0.176	0.182	0.193	0.215	0.234	0.248	0.264	0.284	0.316
2013	0.167	0.174	0.179	0.191	0.212	0.231	0.244	0.260	0.280	0.312
2014	0.164	0.171	0.177	0.188	0.208	0.227	0.240	0.256	0.275	0.307
2015	0.164	0.171	0.176	0.187	0.208	0.227	0.240	0.256	0.275	0.306
2016	0.162	0.169	0.174	0.185	0.205	0.224	0.237	0.252	0.272	0.302
2017	0.158	0.165	0.171	0.181	0.201	0.219	0.232	0.247	0.266	0.296
2018	0.155	0.161	0.166	0.177	0.196	0.214	0.227	0.241	0.260	0.289

Table B.17
Consumer Price Inflation (CPI) Index (Continued)

	To:									
From:	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**
1970	2.124	2.343	2.487	2.567	2.678	2.773	2.825	2.928	3.049	3.196
1971	2.035	2.244	2.383	2.459	2.565	2.657	2.706	2.805	2.921	3.062
1972	1.971	2.175	2.309	2.383	2.486	2.574	2.622	2.718	2.830	2.967
1973	1.856	2.047	2.173	2.243	2.340	2.423	2.468	2.559	2.664	2.793
1974	1.671	1.844	1.957	2.020	2.108	2.183	2.223	2.304	2.400	2.515
1975	1.532	1.690	1.794	1.851	1.931	2.000	2.037	2.112	2.199	2.305
1976	1.448	1.598	1.696	1.750	1.826	1.891	1.926	1.996	2.079	2.179
1977	1.360	1.500	1.592	1.644	1.715	1.776	1.809	1.875	1.952	2.046
1978	1.264	1.394	1.480	1.528	1.594	1.650	1.681	1.742	1.814	1.902
1979	1.135	1.252	1.329	1.372	1.431	1.482	1.510	1.565	1.629	1.708
1980	1.000	1.103	1.171	1.209	1.261	1.306	1.330	1.379	1.436	1.505
1981	0.906	1.000	1.062	1.096	1.143	1.184	1.206	1.250	1.301	1.364
1982	0.854	0.942	1.000	1.032	1.077	1.115	1.136	1.177	1.226	1.285
1983	0.827	0.913	0.969	1.000	1.043	1.080	1.100	1.141	1.188	1.245
1984	0.793	0.875	0.929	0.959	1.000	1.036	1.055	1.093	1.139	1.193
1985	0.766	0.845	0.897	0.926	0.966	1.000	1.019	1.056	1.099	1.152
1986	0.752	0.829	0.880	0.909	0.948	0.982	1.000	1.036	1.079	1.131
1987	0.725	0.800	0.849	0.877	0.915	0.947	0.965	1.000	1.041	1.092
1988	0.697	0.768	0.816	0.842	0.878	0.910	0.926	0.960	1.000	1.048
1989	0.665	0.733	0.778	0.803	0.838	0.868	0.884	0.916	0.954	1.000
1990	0.630	0.695	0.738	0.762	0.795	0.823	0.839	0.869	0.905	0.949
1991	0.605	0.667	0.709	0.731	0.763	0.790	0.805	0.834	0.869	0.910
1992	0.587	0.648	0.688	0.710	0.741	0.767	0.781	0.810	0.843	0.884
1993	0.570	0.629	0.668	0.689	0.719	0.745	0.758	0.786	0.819	0.858
1994	0.556	0.613	0.651	0.672	0.701	0.726	0.740	0.767	0.798	0.837
1995	0.541	0.596	0.633	0.654	0.682	0.706	0.719	0.745	0.776	0.814
1996	0.525	0.579	0.615	0.635	0.662	0.686	0.699	0.724	0.754	0.790
1997	0.513	0.566	0.601	0.621	0.647	0.670	0.683	0.708	0.737	0.773
1998	0.506	0.558	0.592	0.611	0.637	0.660	0.672	0.697	0.726	0.761
1999	0.495	0.546	0.579	0.598	0.624	0.646	0.658	0.682	0.710	0.744
2000	0.479	0.528	0.560	0.578	0.603	0.625	0.636	0.660	0.687	0.720
2001	0.465	0.513	0.545	0.562	0.587	0.608	0.619	0.641	0.668	0.700
2002	0.458	0.505	0.536	0.554	0.578	0.598	0.609	0.631	0.658	0.689
2003	0.448	0.494	0.524	0.541	0.565	0.585	0.596	0.617	0.643	0.674
2004	0.436	0.481	0.511	0.527	0.550	0.570	0.580	0.601	0.626	0.656
2005	0.422	0.465	0.494	0.510	0.532	0.551	0.561	0.582	0.606	0.635
2006	0.409	0.451	0.479	0.494	0.515	0.534	0.544	0.563	0.587	0.615
2007	0.397	0.438	0.465	0.480	0.501	0.519	0.529	0.548	0.571	0.598
2008	0.383	0.422	0.448	0.463	0.483	0.500	0.509	0.528	0.549	0.576
2009	0.384	0.424	0.450	0.464	0.484	0.502	0.511	0.530	0.551	0.578
2010	0.378	0.417	0.443	0.457	0.476	0.493	0.503	0.521	0.543	0.569
2011	0.366	0.404	0.429	0.443	0.462	0.478	0.487	0.505	0.526	0.551
2012	0.359	0.396	0.420	0.434	0.453	0.469	0.477	0.495	0.515	0.540
2013	0.354	0.390	0.414	0.428	0.446	0.462	0.470	0.488	0.508	0.532
2014	0.348	0.384	0.408	0.421	0.439	0.455	0.463	0.480	0.500	0.524
2015	0.348	0.384	0.407	0.420	0.438	0.454	0.462	0.479	0.499	0.523
2016	0.343	0.379	0.402	0.415	0.433	0.448	0.457	0.473	0.493	0.517
2017	0.336	0.371	0.394	0.406	0.424	0.439	0.447	0.463	0.483	0.506
2018	0.328	0.362	0.384	0.397	0.414	0.429	0.436	0.452	0.471	0.494

Table B.17
Consumer Price Inflation (CPI) Index (Continued)

	To:									
From:	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
1970	3.369	3.510	3.616	3.724	3.820	3.928	4.044	4.137	4.201	4.294
1971	3.227	3.363	3.464	3.568	3.659	3.763	3.874	3.963	4.025	4.114
1972	3.127	3.258	3.356	3.457	3.545	3.646	3.754	3.840	3.900	3.986
1973	2.944	3.068	3.160	3.255	3.338	3.432	3.534	3.615	3.671	3.752
1974	2.651	2.763	2.846	2.931	3.006	3.091	3.183	3.256	3.306	3.379
1975	2.429	2.532	2.608	2.686	2.755	2.833	2.916	2.983	3.030	3.097
1976	2.297	2.394	2.466	2.540	2.605	2.678	2.757	2.821	2.865	2.928
1977	2.157	2.248	2.315	2.384	2.446	2.515	2.589	2.649	2.690	2.749
1978	2.005	2.089	2.152	2.216	2.273	2.337	2.406	2.462	2.500	2.555
1979	1.800	1.876	1.933	1.990	2.041	2.099	2.161	2.211	2.245	2.295
1980	1.586	1.653	1.703	1.754	1.799	1.850	1.904	1.948	1.978	2.022
1981	1.438	1.498	1.543	1.590	1.630	1.677	1.726	1.766	1.793	1.833
1982	1.354	1.411	1.454	1.497	1.536	1.579	1.626	1.663	1.689	1.726
1983	1.312	1.367	1.409	1.451	1.488	1.530	1.575	1.611	1.637	1.673
1984	1.258	1.311	1.350	1.391	1.426	1.467	1.510	1.545	1.569	1.603
1985	1.215	1.266	1.304	1.343	1.377	1.416	1.458	1.492	1.515	1.548
1986	1.193	1.243	1.280	1.318	1.352	1.391	1.432	1.464	1.487	1.520
1987	1.151	1.199	1.235	1.272	1.305	1.342	1.381	1.413	1.435	1.467
1988	1.105	1.151	1.186	1.221	1.253	1.288	1.326	1.357	1.378	1.408
1989	1.054	1.098	1.131	1.165	1.195	1.229	1.265	1.294	1.315	1.344
1990	1.000	1.042	1.073	1.106	1.134	1.166	1.200	1.228	1.247	1.275
1991	0.960	1.000	1.030	1.061	1.088	1.119	1.152	1.178	1.197	1.223
1992	0.932	0.971	1.000	1.030	1.056	1.086	1.118	1.144	1.162	1.187
1993	0.904	0.943	0.971	1.000	1.026	1.055	1.086	1.111	1.128	1.153
1994	0.882	0.919	0.947	0.975	1.000	1.028	1.059	1.083	1.100	1.124
1995	0.858	0.894	0.921	0.948	0.972	1.000	1.030	1.053	1.070	1.093
1996	0.833	0.868	0.894	0.921	0.945	0.971	1.000	1.023	1.039	1.062
1997	0.814	0.849	0.874	0.900	0.923	0.950	0.978	1.000	1.016	1.038
1998	0.802	0.836	0.861	0.887	0.909	0.935	0.963	0.985	1.000	1.022
1999	0.785	0.818	0.842	0.867	0.890	0.915	0.942	0.963	0.978	1.000
2000	0.759	0.791	0.815	0.839	0.861	0.885	0.911	0.932	0.947	0.967
2001	0.738	0.769	0.792	0.816	0.837	0.861	0.886	0.906	0.920	0.941
2002	0.727	0.757	0.780	0.803	0.824	0.847	0.872	0.892	0.906	0.926
2003	0.710	0.740	0.763	0.785	0.805	0.828	0.853	0.872	0.886	0.905
2004	0.692	0.721	0.743	0.765	0.785	0.807	0.831	0.850	0.863	0.882
2005	0.669	0.697	0.718	0.740	0.759	0.780	0.803	0.822	0.835	0.853
2006	0.648	0.676	0.696	0.717	0.735	0.756	0.778	0.796	0.809	0.826
2007	0.630	0.657	0.677	0.697	0.715	0.735	0.757	0.774	0.786	0.804
2008	0.607	0.633	0.652	0.671	0.688	0.708	0.729	0.745	0.757	0.774
2009	0.609	0.635	0.654	0.674	0.691	0.710	0.731	0.748	0.760	0.777
2010	0.599	0.625	0.643	0.663	0.680	0.699	0.720	0.736	0.748	0.764
2011	0.581	0.605	0.624	0.642	0.659	0.678	0.698	0.714	0.725	0.741
2012	0.569	0.593	0.611	0.629	0.645	0.664	0.683	0.699	0.710	0.726
2013	0.561	0.585	0.602	0.620	0.636	0.654	0.674	0.689	0.700	0.715
2014	0.552	0.575	0.593	0.610	0.626	0.644	0.663	0.678	0.689	0.704
2015	0.551	0.575	0.592	0.610	0.625	0.643	0.662	0.677	0.688	0.703
2016	0.545	0.567	0.585	0.602	0.617	0.635	0.654	0.669	0.679	0.694
2017	0.533	0.556	0.572	0.590	0.605	0.622	0.640	0.655	0.665	0.680
2018	0.520	0.542	0.559	0.575	0.590	0.607	0.625	0.639	0.649	0.663

Table B.17
Consumer Price Inflation (CPI) Index (Continued)

	To:									
From:	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
1970	4.438	4.564	4.637	4.742	4.869	5.034	5.196	5.344	5.549	5.529
1971	4.252	4.373	4.442	4.543	4.664	4.822	4.978	5.120	5.316	5.297
1972	4.120	4.237	4.304	4.402	4.519	4.672	4.823	4.960	5.151	5.132
1973	3.878	3.989	4.052	4.144	4.255	4.399	4.541	4.670	4.849	4.832
1974	3.493	3.592	3.649	3.732	3.832	3.961	4.089	4.206	4.367	4.352
1975	3.201	3.292	3.344	3.420	3.511	3.630	3.747	3.854	4.002	3.988
1976	3.026	3.112	3.162	3.234	3.320	3.432	3.543	3.644	3.784	3.770
1977	2.842	2.922	2.969	3.036	3.117	3.223	3.327	3.421	3.553	3.540
1978	2.641	2.716	2.759	2.822	2.897	2.995	3.092	3.180	3.302	3.290
1979	2.372	2.439	2.478	2.534	2.602	2.690	2.777	2.856	2.966	2.955
1980	2.090	2.149	2.183	2.233	2.292	2.370	2.447	2.516	2.613	2.604
1981	1.894	1.948	1.979	2.024	2.078	2.149	2.218	2.281	2.369	2.360
1982	1.784	1.835	1.864	1.907	1.958	2.024	2.089	2.149	2.231	2.223
1983	1.729	1.778	1.806	1.847	1.897	1.961	2.024	2.082	2.162	2.154
1984	1.657	1.705	1.731	1.771	1.818	1.880	1.940	1.996	2.072	2.065
1985	1.600	1.646	1.672	1.710	1.756	1.815	1.874	1.927	2.001	1.994
1986	1.571	1.616	1.641	1.679	1.724	1.782	1.839	1.892	1.964	1.957
1987	1.516	1.559	1.584	1.620	1.663	1.719	1.775	1.825	1.895	1.889
1988	1.456	1.497	1.521	1.555	1.597	1.651	1.704	1.753	1.820	1.813
1989	1.389	1.428	1.451	1.484	1.523	1.575	1.626	1.672	1.736	1.730
1990	1.318	1.355	1.376	1.408	1.445	1.494	1.542	1.586	1.647	1.641
1991	1.264	1.300	1.321	1.351	1.387	1.434	1.480	1.522	1.581	1.575
1992	1.227	1.262	1.282	1.311	1.346	1.392	1.437	1.478	1.535	1.529
1993	1.192	1.226	1.245	1.273	1.307	1.352	1.395	1.435	1.490	1.485
1994	1.162	1.195	1.214	1.242	1.275	1.318	1.360	1.399	1.453	1.448
1995	1.130	1.162	1.180	1.207	1.240	1.281	1.323	1.360	1.413	1.408
1996	1.098	1.129	1.147	1.173	1.204	1.245	1.285	1.321	1.372	1.367
1997	1.073	1.103	1.121	1.146	1.177	1.217	1.256	1.292	1.341	1.337
1998	1.056	1.087	1.104	1.129	1.159	1.198	1.237	1.272	1.321	1.316
1999	1.034	1.063	1.080	1.104	1.134	1.172	1.210	1.245	1.292	1.288
2000	1.000	1.028	1.045	1.069	1.097	1.134	1.171	1.204	1.250	1.246
2001	0.972	1.000	1.016	1.039	1.067	1.103	1.138	1.171	1.216	1.211
2002	0.957	0.984	1.000	1.023	1.050	1.086	1.121	1.153	1.197	1.193
2003	0.936	0.963	0.978	1.000	1.027	1.061	1.096	1.127	1.170	1.166
2004	0.912	0.938	0.952	0.974	1.000	1.034	1.067	1.098	1.140	1.136
2005	0.882	0.907	0.921	0.942	0.967	1.000	1.032	1.062	1.102	1.098
2006	0.854	0.878	0.892	0.913	0.937	0.969	1.000	1.028	1.068	1.064
2007	0.831	0.854	0.868	0.887	0.911	0.942	0.972	1.000	1.038	1.035
2008	0.800	0.823	0.836	0.855	0.877	0.907	0.936	0.963	1.000	0.996
2009	0.803	0.825	0.839	0.858	0.881	0.910	0.940	0.966	1.004	1.000
2010	0.790	0.812	0.825	0.844	0.866	0.896	0.925	0.951	0.987	0.984
2011	0.766	0.787	0.800	0.818	0.840	0.868	0.896	0.922	0.957	0.954
2012	0.750	0.771	0.784	0.801	0.823	0.851	0.878	0.903	0.938	0.934
2013	0.739	0.760	0.772	0.790	0.811	0.838	0.865	0.890	0.924	0.921
2014	0.727	0.748	0.760	0.777	0.798	0.825	0.852	0.876	0.909	0.906
2015	0.727	0.747	0.759	0.776	0.797	0.824	0.851	0.875	0.908	0.905
2016	0.717	0.738	0.750	0.767	0.787	0.814	0.840	0.864	0.897	0.894
2017	0.703	0.723	0.734	0.751	0.771	0.797	0.822	0.846	0.878	0.875
2018	0.686	0.705	0.716	0.733	0.752	0.778	0.803	0.826	0.857	0.854

Table B.17
Consumer Price Inflation (CPI) Index (Continued)

	To:								
From:	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
1970	5.620	5.797	5.917	6.004	6.101	6.109	6.186	6.318	6.472
1971	5.384	5.554	5.669	5.752	5.845	5.852	5.926	6.052	6.200
1972	5.217	5.381	5.493	5.573	5.664	5.670	5.742	5.864	6.007
1973	4.911	5.066	5.171	5.247	5.332	5.338	5.406	5.521	5.656
1974	4.423	4.563	4.657	4.725	4.802	4.808	4.868	4.972	5.093
1975	4.053	4.181	4.268	4.330	4.400	4.406	4.461	4.556	4.667
1976	3.832	3.953	4.035	4.094	4.161	4.166	4.218	4.308	4.413
1977	3.598	3.712	3.789	3.844	3.907	3.911	3.961	4.045	4.144
1978	3.344	3.450	3.521	3.573	3.631	3.635	3.681	3.760	3.851
1979	3.004	3.098	3.162	3.209	3.261	3.265	3.306	3.376	3.459
1980	2.646	2.730	2.786	2.827	2.873	2.876	2.913	2.975	3.047
1981	2.399	2.475	2.526	2.563	2.604	2.607	2.640	2.697	2.762
1982	2.260	2.331	2.379	2.414	2.453	2.456	2.487	2.540	2.602
1983	2.189	2.258	2.305	2.339	2.377	2.380	2.410	2.461	2.521
1984	2.099	2.165	2.210	2.242	2.278	2.281	2.310	2.359	2.417
1985	2.027	2.091	2.134	2.165	2.200	2.203	2.231	2.278	2.334
1986	1.990	2.052	2.095	2.126	2.160	2.163	2.190	2.236	2.291
1987	1.920	1.980	2.021	2.051	2.084	2.086	2.113	2.158	2.210
1988	1.843	1.901	1.941	1.969	2.001	2.004	2.029	2.072	2.123
1989	1.759	1.814	1.852	1.879	1.909	1.911	1.936	1.977	2.025
1990	1.668	1.721	1.757	1.782	1.811	1.813	1.836	1.875	1.921
1991	1.601	1.652	1.686	1.710	1.738	1.740	1.762	1.800	1.844
1992	1.554	1.603	1.636	1.660	1.687	1.689	1.711	1.747	1.790
1993	1.509	1.557	1.589	1.612	1.638	1.640	1.661	1.696	1.738
1994	1.471	1.518	1.549	1.572	1.597	1.599	1.619	1.654	1.694
1995	1.431	1.476	1.507	1.529	1.553	1.555	1.575	1.608	1.648
1996	1.390	1.434	1.463	1.485	1.509	1.511	1.530	1.562	1.600
1997	1.359	1.401	1.430	1.451	1.475	1.477	1.495	1.527	1.565
1998	1.338	1.380	1.409	1.429	1.452	1.454	1.472	1.504	1.541
1999	1.309	1.350	1.378	1.398	1.421	1.423	1.441	1.471	1.507
2000	1.266	1.306	1.333	1.353	1.375	1.376	1.394	1.423	1.458
2001	1.231	1.270	1.296	1.315	1.337	1.338	1.355	1.384	1.418
2002	1.212	1.250	1.276	1.295	1.316	1.317	1.334	1.363	1.396
2003	1.185	1.222	1.248	1.266	1.287	1.288	1.304	1.332	1.365
2004	1.154	1.191	1.215	1.233	1.253	1.255	1.271	1.298	1.329
2005	1.117	1.152	1.176	1.193	1.212	1.214	1.229	1.255	1.286
2006	1.082	1.116	1.139	1.156	1.174	1.176	1.191	1.216	1.246
2007	1.052	1.085	1.107	1.124	1.142	1.143	1.158	1.182	1.211
2008	1.013	1.045	1.066	1.082	1.100	1.101	1.115	1.138	1.166
2009	1.016	1.048	1.070	1.086	1.103	1.105	1.119	1.143	1.170
2010	1.000	1.032	1.053	1.068	1.086	1.087	1.101	1.124	1.152
2011	0.969	1.000	1.021	1.036	1.052	1.054	1.067	1.090	1.116
2012	0.950	0.980	1.000	1.015	1.031	1.032	1.045	1.068	1.094
2013	0.936	0.966	0.986	1.000	1.016	1.017	1.030	1.052	1.078
2014	0.921	0.950	0.970	0.984	1.000	1.001	1.014	1.035	1.061
2015	0.920	0.949	0.969	0.983	0.999	1.000	1.013	1.034	1.059
2016	0.909	0.937	0.957	0.971	0.986	0.988	1.000	1.021	1.046
2017	0.890	0.918	0.937	0.950	0.966	0.967	0.979	1.000	1.024
2018	0.868	0.896	0.914	0.928	0.943	0.944	0.956	0.976	1.000

Source:
U.S. Bureau of Labor Statistics.

Table B.18
Gross National Product Implicit Price Deflator

	To:									
From:	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
1970	1.000	1.051	1.097	1.156	1.260	1.377	1.453	1.543	1.651	1.788
1971	0.952	1.000	1.043	1.100	1.199	1.310	1.382	1.468	1.571	1.701
1972	0.912	0.958	1.000	1.055	1.149	1.256	1.325	1.407	1.506	1.630
1973	0.865	0.909	0.948	1.000	1.090	1.191	1.256	1.334	1.428	1.546
1974	0.794	0.834	0.870	0.918	1.000	1.093	1.153	1.224	1.311	1.419
1975	0.726	0.763	0.796	0.840	0.915	1.000	1.055	1.121	1.199	1.298
1976	0.688	0.723	0.755	0.796	0.867	0.948	1.000	1.062	1.137	1.231
1977	0.648	0.681	0.711	0.749	0.817	0.892	0.942	1.000	1.070	1.159
1978	0.606	0.636	0.664	0.700	0.763	0.834	0.880	0.934	1.000	1.083
1979	0.559	0.588	0.613	0.647	0.705	0.770	0.813	0.863	0.924	1.000
1980	0.513	0.539	0.563	0.593	0.647	0.707	0.745	0.792	0.847	0.917
1981	0.469	0.493	0.515	0.543	0.591	0.646	0.682	0.724	0.775	0.839
1982	0.442	0.464	0.485	0.511	0.557	0.608	0.642	0.682	0.730	0.790
1983	0.425	0.447	0.466	0.492	0.536	0.585	0.617	0.656	0.702	0.760
1984	0.411	0.431	0.450	0.475	0.517	0.565	0.596	0.633	0.678	0.734
1985	0.398	0.418	0.436	0.460	0.501	0.548	0.578	0.614	0.657	0.711
1986	0.390	0.410	0.428	0.451	0.491	0.537	0.566	0.602	0.644	0.697
1987	0.380	0.399	0.417	0.440	0.479	0.523	0.552	0.586	0.628	0.679
1988	0.367	0.386	0.403	0.425	0.463	0.506	0.533	0.567	0.606	0.656
1989	0.353	0.371	0.388	0.409	0.445	0.487	0.513	0.545	0.584	0.632
1990	0.341	0.358	0.374	0.394	0.429	0.469	0.495	0.526	0.563	0.609
1991	0.330	0.346	0.362	0.381	0.415	0.454	0.479	0.509	0.544	0.589
1992	0.322	0.339	0.353	0.373	0.406	0.444	0.468	0.497	0.532	0.576
1993	0.315	0.331	0.345	0.364	0.397	0.434	0.457	0.486	0.520	0.563
1994	0.308	0.324	0.338	0.357	0.389	0.425	0.448	0.476	0.509	0.551
1995	0.302	0.317	0.331	0.349	0.381	0.416	0.439	0.466	0.499	0.540
1996	0.297	0.312	0.325	0.343	0.374	0.408	0.431	0.458	0.490	0.530
1997	0.292	0.306	0.320	0.337	0.367	0.401	0.424	0.450	0.481	0.521
1998	0.288	0.303	0.316	0.334	0.363	0.397	0.419	0.445	0.476	0.516
1999	0.284	0.299	0.312	0.329	0.358	0.392	0.413	0.439	0.470	0.508
2000	0.278	0.292	0.305	0.322	0.350	0.383	0.404	0.429	0.459	0.497
2001	0.272	0.286	0.298	0.314	0.343	0.374	0.395	0.419	0.449	0.486
2002	0.268	0.281	0.294	0.310	0.337	0.369	0.389	0.413	0.442	0.479
2003	0.262	0.276	0.288	0.303	0.331	0.361	0.381	0.405	0.433	0.469
2004	0.255	0.268	0.280	0.295	0.322	0.352	0.371	0.394	0.422	0.457
2005	0.248	0.260	0.271	0.286	0.312	0.341	0.360	0.382	0.409	0.442
2006	0.240	0.252	0.263	0.278	0.303	0.331	0.349	0.370	0.397	0.429
2007	0.234	0.246	0.256	0.270	0.295	0.322	0.340	0.361	0.386	0.418
2008	0.229	0.241	0.252	0.265	0.289	0.316	0.333	0.354	0.379	0.410
2009	0.228	0.239	0.250	0.263	0.287	0.313	0.331	0.351	0.376	0.407
2010	0.225	0.236	0.246	0.260	0.283	0.309	0.326	0.347	0.371	0.402
2011	0.220	0.232	0.242	0.255	0.278	0.303	0.320	0.340	0.364	0.394
2012	0.217	0.228	0.237	0.250	0.273	0.298	0.315	0.334	0.358	0.387
2013	0.213	0.224	0.234	0.247	0.269	0.294	0.310	0.329	0.352	0.381
2014	0.210	0.220	0.230	0.243	0.264	0.289	0.305	0.324	0.346	0.375
2015	0.207	0.217	0.226	0.239	0.260	0.284	0.300	0.319	0.341	0.369
2016	0.204	0.214	0.224	0.236	0.257	0.281	0.296	0.315	0.337	0.365
2017	0.200	0.211	0.220	0.232	0.252	0.276	0.291	0.309	0.331	0.358
2018	0.196	0.206	0.215	0.227	0.247	0.270	0.285	0.303	0.324	0.351

Table B.18
Gross National Product Implicit Price Deflator (Continued)

	To:									
From:	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**
1970	1.949	2.131	2.263	2.353	2.436	2.514	2.565	2.631	2.723	2.830
1971	1.854	2.028	2.153	2.239	2.318	2.392	2.441	2.504	2.591	2.693
1972	1.777	1.943	2.064	2.145	2.222	2.293	2.339	2.399	2.484	2.580
1973	1.685	1.843	1.957	2.034	2.107	2.174	2.218	2.275	2.355	2.447
1974	1.547	1.691	1.796	1.867	1.933	1.995	2.036	2.088	2.161	2.246
1975	1.415	1.548	1.644	1.709	1.769	1.826	1.863	1.911	1.978	2.055
1976	1.341	1.467	1.558	1.619	1.677	1.731	1.766	1.811	1.875	1.948
1977	1.263	1.381	1.467	1.525	1.579	1.629	1.662	1.705	1.765	1.834
1978	1.180	1.290	1.370	1.425	1.475	1.522	1.553	1.593	1.649	1.714
1979	1.090	1.192	1.266	1.316	1.363	1.406	1.435	1.472	1.523	1.583
1980	1.000	1.093	1.161	1.207	1.250	1.290	1.316	1.350	1.398	1.452
1981	0.915	1.000	1.062	1.104	1.143	1.180	1.204	1.235	1.278	1.328
1982	0.861	0.942	1.000	1.040	1.076	1.111	1.133	1.163	1.203	1.250
1983	0.828	0.906	0.962	1.000	1.035	1.069	1.090	1.118	1.158	1.203
1984	0.800	0.875	0.929	0.966	1.000	1.032	1.053	1.080	1.118	1.162
1985	0.775	0.848	0.900	0.936	0.969	1.000	1.020	1.047	1.083	1.126
1986	0.760	0.831	0.882	0.917	0.950	0.980	1.000	1.026	1.062	1.103
1987	0.741	0.810	0.860	0.894	0.926	0.956	0.975	1.000	1.035	1.075
1988	0.716	0.782	0.831	0.864	0.895	0.923	0.942	0.966	1.000	1.039
1989	0.689	0.753	0.800	0.831	0.861	0.888	0.906	0.930	0.962	1.000
1990	0.664	0.726	0.771	0.802	0.830	0.857	0.874	0.897	0.928	0.964
1991	0.643	0.703	0.746	0.776	0.803	0.829	0.846	0.867	0.898	0.933
1992	0.628	0.687	0.730	0.758	0.785	0.810	0.827	0.848	0.878	0.912
1993	0.614	0.671	0.713	0.741	0.767	0.792	0.808	0.828	0.858	0.891
1994	0.601	0.657	0.698	0.725	0.751	0.775	0.791	0.811	0.840	0.872
1995	0.588	0.644	0.683	0.710	0.736	0.759	0.775	0.795	0.822	0.855
1996	0.578	0.632	0.671	0.698	0.722	0.746	0.761	0.780	0.808	0.839
1997	0.568	0.621	0.660	0.686	0.710	0.733	0.748	0.767	0.794	0.825
1998	0.562	0.615	0.653	0.679	0.703	0.725	0.740	0.759	0.786	0.816
1999	0.554	0.606	0.644	0.669	0.693	0.715	0.729	0.748	0.774	0.805
2000	0.542	0.592	0.629	0.654	0.677	0.699	0.713	0.732	0.757	0.787
2001	0.530	0.579	0.615	0.639	0.662	0.683	0.697	0.715	0.740	0.769
2002	0.522	0.570	0.606	0.630	0.652	0.673	0.687	0.704	0.729	0.757
2003	0.511	0.559	0.594	0.617	0.639	0.660	0.673	0.691	0.715	0.743
2004	0.498	0.544	0.578	0.601	0.622	0.642	0.655	0.672	0.696	0.723
2005	0.482	0.527	0.560	0.582	0.603	0.622	0.635	0.651	0.674	0.700
2006	0.468	0.512	0.543	0.565	0.585	0.604	0.616	0.632	0.654	0.679
2007	0.456	0.498	0.529	0.550	0.570	0.588	0.600	0.615	0.637	0.662
2008	0.447	0.489	0.519	0.540	0.559	0.577	0.588	0.604	0.625	0.649
2009	0.444	0.485	0.515	0.536	0.555	0.572	0.584	0.599	0.620	0.644
2010	0.438	0.479	0.508	0.529	0.547	0.565	0.576	0.591	0.612	0.636
2011	0.429	0.469	0.499	0.518	0.537	0.554	0.565	0.580	0.600	0.623
2012	0.422	0.461	0.490	0.509	0.527	0.544	0.555	0.570	0.590	0.613
2013	0.416	0.455	0.483	0.502	0.520	0.536	0.547	0.561	0.581	0.604
2014	0.409	0.447	0.475	0.493	0.511	0.527	0.538	0.552	0.571	0.593
2015	0.402	0.440	0.467	0.486	0.503	0.519	0.530	0.543	0.562	0.584
2016	0.397	0.435	0.461	0.480	0.497	0.513	0.523	0.537	0.555	0.577
2017	0.390	0.427	0.453	0.471	0.488	0.504	0.514	0.527	0.546	0.567
2018	0.383	0.419	0.445	0.462	0.479	0.494	0.504	0.517	0.535	0.556

Table B.18
Gross National Product Implicit Price Deflator (Continued)

	To:									
From:	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
1970	2.935	3.033	3.102	3.176	3.243	3.311	3.372	3.429	3.467	3.517
1971	2.793	2.886	2.952	3.022	3.086	3.151	3.209	3.263	3.299	3.346
1972	2.676	2.766	2.829	2.896	2.958	3.020	3.075	3.128	3.162	3.207
1973	2.538	2.623	2.683	2.746	2.805	2.863	2.916	2.966	2.998	3.041
1974	2.329	2.407	2.462	2.520	2.574	2.628	2.676	2.722	2.751	2.791
1975	2.131	2.203	2.253	2.307	2.356	2.405	2.449	2.491	2.518	2.554
1976	2.020	2.088	2.135	2.186	2.233	2.279	2.321	2.361	2.387	2.421
1977	1.902	1.966	2.011	2.058	2.102	2.146	2.185	2.223	2.247	2.279
1978	1.777	1.837	1.879	1.923	1.964	2.005	2.042	2.077	2.099	2.130
1979	1.642	1.697	1.735	1.776	1.814	1.852	1.886	1.918	1.939	1.967
1980	1.506	1.556	1.592	1.630	1.664	1.699	1.730	1.760	1.779	1.805
1981	1.377	1.423	1.456	1.490	1.522	1.554	1.582	1.609	1.627	1.650
1982	1.297	1.340	1.371	1.403	1.433	1.463	1.490	1.516	1.532	1.554
1983	1.247	1.289	1.319	1.350	1.379	1.408	1.433	1.458	1.474	1.495
1984	1.205	1.245	1.273	1.304	1.331	1.359	1.384	1.408	1.423	1.444
1985	1.167	1.206	1.234	1.263	1.290	1.317	1.341	1.364	1.379	1.399
1986	1.144	1.182	1.209	1.238	1.264	1.291	1.315	1.337	1.352	1.371
1987	1.115	1.153	1.179	1.207	1.233	1.259	1.282	1.303	1.318	1.337
1988	1.078	1.114	1.139	1.166	1.191	1.216	1.238	1.259	1.273	1.291
1989	1.037	1.072	1.096	1.122	1.146	1.170	1.192	1.212	1.225	1.243
1990	1.000	1.033	1.057	1.082	1.105	1.128	1.149	1.169	1.181	1.198
1991	0.968	1.000	1.023	1.047	1.069	1.092	1.112	1.131	1.143	1.159
1992	0.946	0.978	1.000	1.024	1.046	1.067	1.087	1.106	1.118	1.134
1993	0.924	0.955	0.977	1.000	1.021	1.043	1.062	1.080	1.092	1.107
1994	0.905	0.935	0.956	0.979	1.000	1.021	1.040	1.057	1.069	1.084
1995	0.886	0.916	0.937	0.959	0.979	1.000	1.018	1.036	1.047	1.062
1996	0.870	0.899	0.920	0.942	0.962	0.982	1.000	1.017	1.028	1.043
1997	0.856	0.884	0.905	0.926	0.946	0.966	0.983	1.000	1.011	1.025
1998	0.847	0.875	0.895	0.916	0.936	0.955	0.973	0.989	1.000	1.014
1999	0.835	0.862	0.882	0.903	0.922	0.942	0.959	0.975	0.986	1.000
2000	0.816	0.843	0.863	0.883	0.902	0.921	0.938	0.954	0.964	0.978
2001	0.798	0.824	0.843	0.863	0.882	0.900	0.917	0.932	0.942	0.956
2002	0.786	0.812	0.830	0.850	0.868	0.886	0.903	0.918	0.928	0.941
2003	0.770	0.796	0.814	0.834	0.851	0.869	0.885	0.900	0.910	0.923
2004	0.750	0.775	0.792	0.811	0.829	0.846	0.861	0.876	0.886	0.898
2005	0.726	0.751	0.768	0.786	0.803	0.820	0.835	0.849	0.858	0.870
2006	0.705	0.728	0.745	0.763	0.779	0.795	0.810	0.824	0.832	0.844
2007	0.686	0.709	0.726	0.743	0.759	0.775	0.789	0.802	0.811	0.823
2008	0.673	0.696	0.712	0.729	0.744	0.760	0.773	0.787	0.795	0.807
2009	0.668	0.690	0.706	0.723	0.738	0.754	0.768	0.781	0.789	0.800
2010	0.659	0.681	0.697	0.713	0.729	0.744	0.758	0.770	0.779	0.790
2011	0.647	0.668	0.683	0.700	0.715	0.729	0.743	0.756	0.764	0.775
2012	0.635	0.657	0.672	0.688	0.702	0.717	0.730	0.743	0.751	0.761
2013	0.626	0.647	0.662	0.677	0.692	0.706	0.719	0.732	0.740	0.750
2014	0.616	0.636	0.651	0.666	0.680	0.695	0.707	0.719	0.727	0.738
2015	0.606	0.626	0.641	0.656	0.670	0.684	0.696	0.708	0.716	0.727
2016	0.598	0.618	0.633	0.648	0.661	0.675	0.688	0.699	0.707	0.718
2017	0.588	0.608	0.621	0.636	0.650	0.663	0.675	0.687	0.695	0.705
2018	0.577	0.597	0.610	0.625	0.638	0.651	0.663	0.675	0.682	0.692

Table B.18
Gross National Product Implicit Price Deflator (Continued)

	To:									
From:	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
1970	3.596	3.679	3.735	3.810	3.915	4.040	4.164	4.275	4.359	4.393
1971	3.422	3.501	3.555	3.626	3.725	3.845	3.963	4.068	4.148	4.180
1972	3.280	3.355	3.407	3.475	3.570	3.685	3.798	3.899	3.976	4.006
1973	3.110	3.181	3.230	3.295	3.385	3.494	3.601	3.697	3.770	3.799
1974	2.854	2.920	2.965	3.024	3.107	3.206	3.305	3.393	3.460	3.487
1975	2.612	2.672	2.713	2.767	2.843	2.934	3.025	3.105	3.166	3.191
1976	2.476	2.532	2.571	2.623	2.695	2.781	2.867	2.943	3.001	3.024
1977	2.331	2.384	2.421	2.470	2.537	2.619	2.699	2.771	2.825	2.847
1978	2.178	2.228	2.262	2.307	2.371	2.447	2.522	2.589	2.640	2.660
1979	2.012	2.058	2.090	2.131	2.190	2.260	2.330	2.392	2.439	2.457
1980	1.846	1.888	1.917	1.955	2.009	2.073	2.137	2.194	2.237	2.254
1981	1.688	1.726	1.753	1.788	1.837	1.896	1.954	2.006	2.046	2.062
1982	1.589	1.626	1.651	1.684	1.730	1.785	1.840	1.889	1.926	1.941
1983	1.529	1.564	1.588	1.620	1.664	1.717	1.770	1.817	1.853	1.867
1984	1.476	1.510	1.533	1.564	1.607	1.659	1.710	1.755	1.789	1.803
1985	1.431	1.463	1.486	1.516	1.557	1.607	1.657	1.701	1.734	1.747
1986	1.402	1.434	1.456	1.485	1.526	1.575	1.624	1.667	1.700	1.713
1987	1.367	1.398	1.420	1.448	1.488	1.536	1.583	1.625	1.657	1.670
1988	1.321	1.351	1.372	1.399	1.437	1.484	1.529	1.570	1.601	1.613
1989	1.271	1.300	1.320	1.347	1.383	1.428	1.472	1.511	1.541	1.553
1990	1.225	1.254	1.273	1.298	1.334	1.377	1.419	1.457	1.485	1.497
1991	1.186	1.213	1.232	1.256	1.291	1.332	1.373	1.410	1.437	1.448
1992	1.159	1.186	1.204	1.228	1.262	1.302	1.343	1.378	1.405	1.416
1993	1.132	1.158	1.176	1.200	1.233	1.272	1.311	1.346	1.373	1.383
1994	1.109	1.134	1.152	1.175	1.207	1.246	1.284	1.318	1.344	1.355
1995	1.086	1.111	1.128	1.151	1.182	1.220	1.258	1.291	1.317	1.327
1996	1.067	1.091	1.108	1.130	1.161	1.198	1.235	1.268	1.293	1.303
1997	1.049	1.073	1.089	1.111	1.141	1.178	1.214	1.247	1.271	1.281
1998	1.037	1.061	1.077	1.099	1.129	1.165	1.201	1.233	1.257	1.267
1999	1.023	1.046	1.062	1.083	1.113	1.149	1.184	1.216	1.240	1.249
2000	1.000	1.023	1.039	1.059	1.088	1.123	1.158	1.189	1.212	1.222
2001	0.978	1.000	1.015	1.036	1.064	1.098	1.132	1.162	1.185	1.194
2002	0.963	0.985	1.000	1.020	1.048	1.082	1.115	1.145	1.167	1.176
2003	0.944	0.966	0.980	1.000	1.027	1.060	1.093	1.122	1.144	1.153
2004	0.919	0.940	0.954	0.973	1.000	1.032	1.064	1.092	1.114	1.122
2005	0.890	0.911	0.925	0.943	0.969	1.000	1.031	1.058	1.079	1.087
2006	0.864	0.883	0.897	0.915	0.940	0.970	1.000	1.027	1.047	1.055
2007	0.841	0.861	0.874	0.891	0.916	0.945	0.974	1.000	1.020	1.028
2008	0.825	0.844	0.857	0.874	0.898	0.927	0.955	0.981	1.000	1.008
2009	0.819	0.837	0.850	0.867	0.891	0.920	0.948	0.973	0.992	1.000
2010	0.808	0.826	0.839	0.856	0.879	0.908	0.936	0.960	0.979	0.987
2011	0.792	0.810	0.823	0.839	0.862	0.890	0.917	0.942	0.960	0.968
2012	0.779	0.797	0.809	0.825	0.848	0.875	0.902	0.926	0.944	0.951
2013	0.767	0.785	0.797	0.813	0.835	0.862	0.888	0.912	0.930	0.937
2014	0.755	0.772	0.784	0.800	0.822	0.848	0.874	0.898	0.915	0.922
2015	0.744	0.761	0.772	0.788	0.809	0.835	0.861	0.884	0.901	0.908
2016	0.734	0.751	0.762	0.778	0.799	0.825	0.850	0.873	0.890	0.897
2017	0.721	0.738	0.749	0.764	0.785	0.810	0.835	0.857	0.874	0.881
2018	0.708	0.723	0.735	0.748	0.768	0.792	0.816	0.838	0.855	0.861

Table B.18
Gross National Product Implicit Price Deflator (Continued)

	To:								
From:	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
1970	4.451	4.539	4.618	4.688	4.767	4.841	4.903	4.991	5.098
1971	4.236	4.319	4.395	4.461	4.536	4.607	4.666	4.749	4.851
1972	4.059	4.140	4.212	4.275	4.348	4.415	4.472	4.552	4.650
1973	3.849	3.925	3.994	4.054	4.123	4.187	4.241	4.317	4.408
1974	3.533	3.602	3.665	3.720	3.784	3.842	3.892	3.961	4.045
1975	3.233	3.297	3.354	3.405	3.463	3.516	3.562	3.625	3.702
1976	3.064	3.125	3.179	3.227	3.282	3.333	3.376	3.436	3.508
1977	2.885	2.942	2.993	3.038	3.090	3.138	3.179	3.235	3.303
1978	2.696	2.749	2.797	2.839	2.887	2.932	2.970	3.023	3.085
1979	2.490	2.539	2.583	2.622	2.667	2.708	2.743	2.792	2.849
1980	2.284	2.329	2.370	2.406	2.447	2.485	2.517	2.561	2.613
1981	2.089	2.130	2.167	2.200	2.237	2.272	2.301	2.343	2.387
1982	1.967	2.006	2.041	2.072	2.107	2.139	2.167	2.206	2.248
1983	1.892	1.929	1.963	1.993	2.027	2.058	2.085	2.122	2.163
1984	1.827	1.863	1.896	1.924	1.957	1.987	2.013	2.049	2.088
1985	1.771	1.806	1.837	1.865	1.896	1.926	1.951	1.986	2.024
1986	1.735	1.770	1.801	1.828	1.859	1.888	1.912	1.946	1.984
1987	1.692	1.725	1.755	1.782	1.812	1.840	1.864	1.897	1.935
1988	1.634	1.667	1.696	1.721	1.751	1.778	1.801	1.833	1.869
1989	1.573	1.604	1.632	1.657	1.685	1.711	1.733	1.764	1.799
1990	1.517	1.547	1.574	1.597	1.625	1.650	1.671	1.701	1.733
1991	1.468	1.497	1.523	1.546	1.572	1.596	1.617	1.646	1.676
1992	1.435	1.463	1.489	1.511	1.537	1.561	1.581	1.609	1.639
1993	1.402	1.429	1.454	1.476	1.501	1.525	1.544	1.572	1.601
1994	1.372	1.400	1.424	1.445	1.470	1.493	1.512	1.539	1.568
1995	1.344	1.371	1.395	1.416	1.440	1.462	1.481	1.507	1.535
1996	1.320	1.346	1.370	1.390	1.414	1.436	1.454	1.480	1.508
1997	1.298	1.324	1.347	1.367	1.390	1.412	1.430	1.455	1.482
1998	1.284	1.309	1.332	1.352	1.375	1.397	1.415	1.440	1.466
1999	1.266	1.291	1.313	1.333	1.354	1.375	1.393	1.418	1.445
2000	1.238	1.262	1.284	1.303	1.324	1.345	1.362	1.386	1.413
2001	1.210	1.234	1.255	1.274	1.295	1.315	1.332	1.356	1.383
2002	1.192	1.215	1.236	1.255	1.275	1.295	1.312	1.335	1.361
2003	1.168	1.191	1.212	1.230	1.250	1.270	1.286	1.309	1.337
2004	1.137	1.160	1.180	1.198	1.217	1.236	1.252	1.274	1.302
2005	1.102	1.123	1.143	1.160	1.179	1.197	1.213	1.234	1.262
2006	1.069	1.090	1.109	1.126	1.144	1.161	1.176	1.197	1.225
2007	1.041	1.062	1.080	1.097	1.114	1.131	1.146	1.166	1.193
2008	1.021	1.041	1.059	1.075	1.092	1.109	1.124	1.144	1.170
2009	1.013	1.033	1.051	1.067	1.084	1.101	1.115	1.135	1.161
2010	1.000	1.020	1.038	1.053	1.070	1.086	1.100	1.120	1.148
2011	0.981	1.000	1.017	1.033	1.048	1.064	1.078	1.097	1.124
2012	0.964	0.983	1.000	1.015	1.030	1.045	1.059	1.077	1.103
2013	0.949	0.968	0.985	1.000	1.015	1.029	1.042	1.060	1.084
2014	0.935	0.954	0.971	0.986	1.000	1.010	1.024	1.042	1.064
2015	0.920	0.940	0.957	0.972	0.990	1.000	1.013	1.031	1.053
2016	0.909	0.928	0.945	0.960	0.977	0.987	1.000	1.018	1.042
2017	0.893	0.911	0.928	0.943	0.960	0.970	0.982	1.000	1.022
2018	0.871	0.889	0.907	0.922	0.940	0.950	0.960	0.978	1.000

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Washington, DC, monthly.

APPENDIX C

ENERGY TABLES INCLUDING ELECTRICITY GENERATION AND DISTRIBUTION

ENERGY TABLES INCLUDING ELECTRICITY GENERATION AND DISTRIBUTION

The heat content of electricity is "the amount of heat energy available to be released by the transformation or use of a specified physical unit of an energy form (e.g., a ton of coal, a barrel of oil, a kilowatt-hour of electricity, a cubic foot of natural gas, or a pound of steam).[a]" The heat content does not change whether the electricity is created from coal, natural gas, oil, biomass, etc. Table C.1 shows the heat content of electricity.

The heat rate for electricity is "a measure of generating station thermal efficiency commonly stated as Btu per kilowatt-hour. [a]" The heat rate for electricity can change depending on power plant efficiency and the source from which electricity is created. Table C.1 shows the heat rate for electricity for fossil-fuels, noncombustible renewable energy[b], and nuclear.

The tables in the body of the *Transportation Energy Data Book* show only end-use energy for transportation modes using electricity, thus, were converted from kilowatt-hours to Btu using 3,412 Btu per kilowatt-hour. In Appendix C, those same tables and graphics are displayed taking electricity generation and distribution into account by using the conversion rates in Table C.1 for fossil-fuels and noncombustible renewable energy. Only tables/figures with electricity use are displayed in Appendix C.

[a] U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, Washington, DC, March 2019, Glossary.
[b] Noncombustible renewable energy includes hydro, geothermal, solar, thermal, photovoltaic, and wind.

Table C.1
Approximate Heat Rates and Heat Content of Electricity, 1970-2018
(Btu per kilowatt-hour)

Year	Electricity Net Generation Heat Rate for Fossil-Fuels	Electricity Net Generation Heat Rate for Nuclear	Electricity Net Generation Heat Rate for Noncombustible Renewable Energy[a]	Heat Content of Electricity
1970	10,494	10,977	10,494	3,412
1975	10,406	11,013	10,406	3,412
1976	10,373	11,047	10,373	3,412
1977	10,435	10,769	10,435	3,412
1978	10,361	10,941	10,361	3,412
1979	10,353	10,879	10,353	3,412
1980	10,388	10,908	10,388	3,412
1981	10,453	11,030	10,453	3,412
1982	10,454	11,073	10,454	3,412
1983	10,520	10,905	10,520	3,412
1984	10,440	10,843	10,440	3,412
1985	10,447	10,622	10,447	3,412
1986	10,446	10,579	10,446	3,412
1987	10,419	10,442	10,419	3,412
1988	10,324	10,602	10,324	3,412
1989	10,432	10,583	10,432	3,412
1990	10,402	10,582	10,402	3,412
1991	10,436	10,484	10,436	3,412
1992	10,342	10,471	10,342	3,412
1993	10,309	10,504	10,309	3,412
1994	10,316	10,452	10,316	3,412
1995	10,312	10,507	10,312	3,412
1996	10,340	10,503	10,340	3,412
1997	10,213	10,494	10,213	3,412
1998	10,197	10,491	10,197	3,412
1999	10,226	10,450	10,226	3,412
2000	10,201	10,429	10,201	3,412
2001	10,333	10,443	10,333	3,412
2002	10,173	10,442	10,173	3,412
2003	10,125	10,422	10,125	3,412
2004	10,016	10,428	10,016	3,412
2005	9,999	10,436	9,999	3,412
2006	9,919	10,435	9,919	3,412
2007	9,884	10,489	9,884	3,412
2008	9,854	10,452	9,854	3,412
2009	9,760	10,459	9,760	3,412
2010	9,756	10,452	9,756	3,412
2011	9,716	10,464	9,716	3,412
2012	9,516	10,479	9,516	3,412
2013	9,541	10,449	9,541	3,412
2014	9,510	10,459	9,510	3,412
2015	9,319	10,458	9,319	3,412
2016	9,232	10,459	9,232	3,412
2017	9,213	10,459	9,213	3,412
2018	9,213	10,459	9,213	3,412

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, Washington, DC, March 2019, Table A6.

[a] The fossil-fuels heat rate is used as the thermal conversion factor for electricity net generation from noncombustible renewable energy to approximate the quantity of fossil fuels replaced by these sources. Noncombustible renewable energy includes hydro, geothermal, solar, thermal, photovoltaic, and wind.

This table is the same as Table 2.7 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. Please see Appendix A for a description of the methodology used to develop these data.

Table C.2
Domestic Consumption of Transportation Energy by Mode and Fuel Type with Electricity Generation and Distribution, 2017[a]
(trillion Btu)

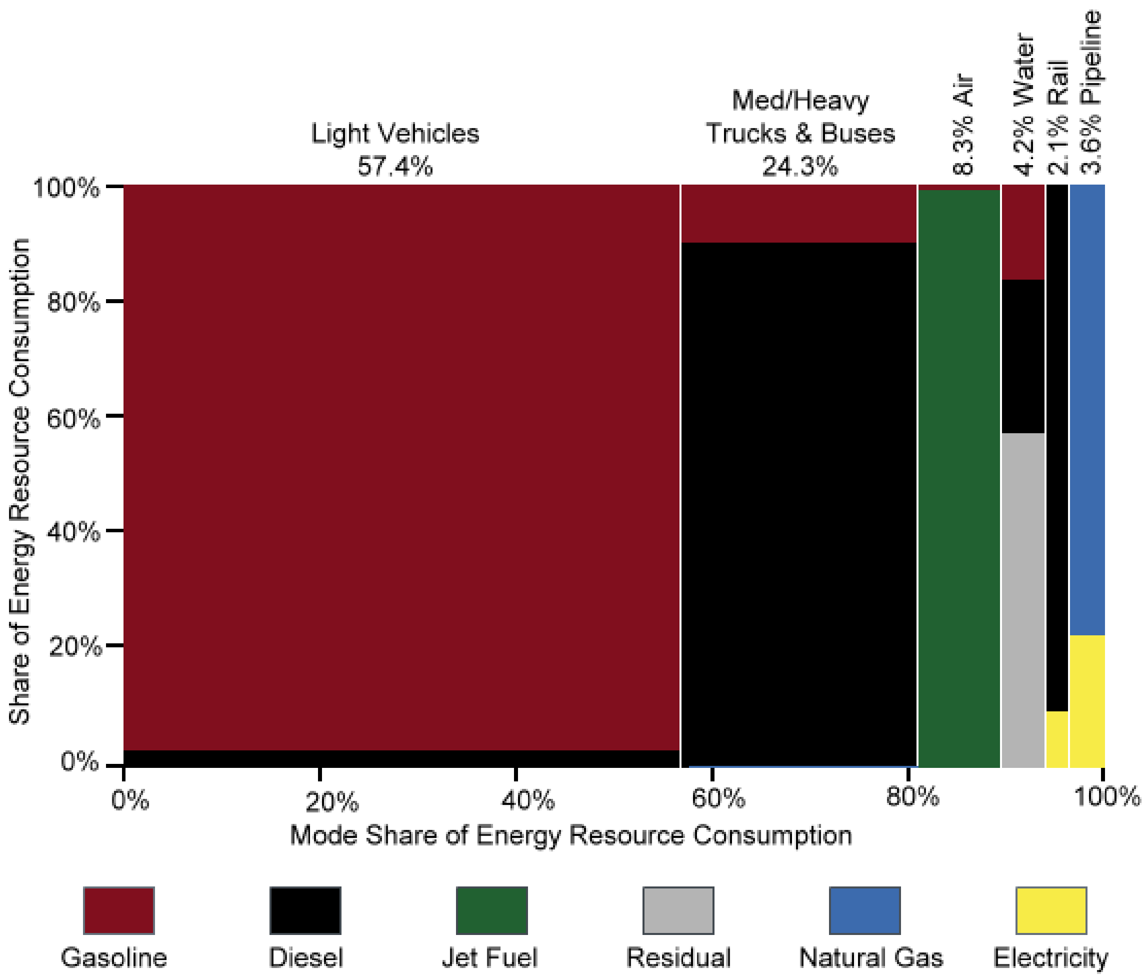
	Gasoline	Diesel fuel	Liquefied petroleum gas	Jet fuel	Residual fuel oil	Natural gas	Electricity[b]	Total[c]
HIGHWAY	**15,495.3**	**6,266.5**	**75.5**	**-**	**-**	**24.6**	**18.4**	**21,880.3**
Light vehicles	**14,853.3**	**445.9**	**53.9**	**-**	**-**	**-**	**17.9**	**15,371.0**
Cars	6,297.2	36.2					15.6	6,349.1
Light trucks[d]	8,498.8	409.6	53.9				2.3	8,964.6
Motorcycles	57.3							57.3
Buses	**9.9**	**185.0**	**0.6**	**-**	**-**	**24.6**	**0.6**	**220.7**
Transit	1.6	64.6	0.6			24.6	0.6	92.0
Intercity		37.3						37.3
School	8.3	83.1						91.4
Medium/heavy trucks	**632.0**	**5,635.6**	**21.0**	**-**	**-**	**-**	**-**	**6,288.6**
Class 3-6 trucks	581.4	789.0	20.8					1,391.2
Class 7-8 trucks	50.6	4,846.6	0.2					4,897.4
NONHIGHWAY	**193.0**	**803.9**	**-**	**2,208.2**	**669.5**	**743.9**	**274.3**	**4,892.7**
Air	**22.6**	**-**	**-**	**2,208.2**	**-**	**-**	**-**	**2,230.8**
General aviation	22.6			209.1				231.7
Domestic air carriers				1,564.3				1,564.3
International air carriers[e]				434.8				434.8
Water	**170.4**	**290.5**	**-**	**-**	**669.5**	**-**	**-**	**1,130.4**
Freight		250.7			669.5			920.2
Recreational	170.4	39.9						210.3
Pipeline	**-**	**-**	**-**	**-**	**-**	**743.9**	**219.0**	**962.9**
Rail	**-**	**513.3**	**-**	**-**	**-**	**-**	**55.2**	**568.5**
Freight (Class I)		490.5						490.5
Passenger		22.8					55.2	78.0
Transit							34.3	34.3
Commuter		14.5					16.4	30.8
Intercity		8.3					4.5	12.8
TOTAL HWY & NONHWY[c]	**15,710.1**	**7,085.0**	**75.5**	**2,208.2**	**669.5**	**768.4**	**292.7**	**26,773.0**

Source:
See Appendix A, Section 2. Energy Use Sources.

[a] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).
[b] Primary energy use for electricity including electricity generation and distribution losses.
[c] Totals may not sum due to rounding.
[d] Two-axle, four-tire trucks.
[e] One half of fuel used by domestic carriers in international operation.

This figure is the same as Figure 2.6 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu.The gasoline and diesel used in highway modes accounted for the majority of transportation energy use (81.7%) and nearly all highway use in 2017.

Figure C.1. Domestic Consumption of Transportation Energy Use by Mode and Fuel Type, 2017[a]



Note: Residual fuel oil is heavier oil which can be used in vessel bunkering.

Source:
See Table C.2 or Appendix A, Section 2. Energy Use Sources.

[a] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles). Primary energy use for electricity including electricity generation and distribution losses.

This table is the same as Table 2.8 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. Please see Appendix A for a description of the methodology used to develop these data.

Table C.3
Transportation Energy Use by Mode, 2016–2017[a]

	Trillion Btu		Percentage of total based on Btus	
	2016	2017	2016	2017
HIGHWAY	**21,889.8**	**21,880.3**	**82.1%**	**81.7%**
Light vehicles	**15,533.3**	**15,371.0**	**58.3%**	**57.4%**
Cars	6,583.7	6,349.1	24.7%	23.7%
Light trucks[b]	8,891.4	8,964.6	33.3%	33.5%
Motorcycles	58.2	57.3	0.2%	0.2%
Buses	**214.4**	**220.7**	**0.8%**	**0.8%**
Transit	92.2	92.0	0.3%	0.3%
Intercity	35.4	37.3	0.1%	0.1%
School	86.8	91.4	0.3%	0.3%
Medium/heavy trucks	**6,142.1**	**6,288.6**	**23.0%**	**23.5%**
Class 3-6 trucks	1,358.8	1,391.2	5.1%	5.2%
Class 7-8 trucks	4,783.3	4,897.4	17.9%	18.3%
NONHIGHWAY	**4,772.9**	**4,892.7**	**17.9%**	**18.3%**
Air	**2,178.1**	**2,230.8**	**8.2%**	**8.3%**
General aviation	217.8	231.7	0.8%	0.9%
Domestic air carriers	1,535.4	1,564.3	5.8%	5.8%
International air	424.9	434.8	1.6%	1.6%
Water	**1,116.2**	**1,130.4**	**4.2%**	**4.2%**
Freight	907.9	920.2	3.4%	3.4%
Recreational	208.3	210.3	0.8%	0.8%
Pipeline	**926.1**	**962.9**	**3.5%**	**3.6%**
Rail	**552.5**	**568.5**	**2.1%**	**2.1%**
Freight (Class I)	474.2	490.5	1.8%	1.8%
Passenger	78.4	78.0	0.3%	0.3%
Transit	34.7	34.3	0.1%	0.1%
Commuter	30.6	30.8	0.1%	0.1%
Intercity	13.1	12.8	0.0%	0.0%
HWY & NONHWY TOTAL	**26,662.7**	**26,773.0**	**100.0%**	**100.0%**
Off-highway[c]	**1,895.5**	**1,980.8**		

Source:
See Appendix A, Section 2. Energy Use Sources.

[a] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles). Includes primary energy use for electricity including electricity generation and distribution losses.

[b] Two-axle, four-tire trucks.

[c] Includes equipment that does not travel on roads, such as equipment from agriculture, construction, and airports.

This table is the same as Table 2.9 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. Light trucks include pick-ups, minivans, sport-utility vehicles, and vans.

Table C.4
Highway Transportation Energy Consumption by Mode, 1970–2017
(trillion Btu)

Year	Cars	Light trucks	Light vehicles subtotal	Motor-cycles	Buses	Class 3-6 trucks	Class 7-8 trucks	Heavy trucks subtotal	Highway subtotal	Total transportation[a]
1970	8,479	1,539	10,018	7	129	333	1,220	1,553	11,707	15,379
1975	9,298	2,384	11,682	14	124	430	1,574	2,003	13,823	17,384
1980	8,800	2,975	11,775	26	143	929	1,757	2,686	14,630	18,941
1981	8,693	2,963	11,656	27	145	1,065	1,659	2,724	14,552	18,743
1982	8,673	2,837	11,510	25	151	1,182	1,525	2,707	14,393	18,240
1983	8,802	2,990	11,792	22	152	1,121	1,649	2,770	14,736	18,373
1984	8,837	3,197	12,034	22	146	1,072	1,801	2,873	15,075	18,965
1985	8,932	3,413	12,345	23	153	986	1,897	2,883	15,404	19,208
1986	9,138	3,629	12,767	23	161	920	2,038	2,958	15,909	20,279
1987	9,157	3,819	12,976	24	165	858	2,203	3,061	16,226	20,772
1988	9,158	4,078	13,236	25	170	860	2,257	3,118	16,549	21,325
1989	9,232	4,156	13,388	26	170	869	2,330	3,199	16,783	21,686
1990	8,688	4,451	13,139	24	167	891	2,442	3,334	16,664	21,581
1991	8,029	4,774	12,803	23	178	895	2,507	3,402	16,406	21,183
1992	8,169	5,117	13,286	24	184	897	2,570	3,468	16,962	21,838
1993	8,368	5,356	13,724	25	183	906	2,671	3,577	17,509	22,318
1994	8,470	5,515	13,985	26	183	936	2,842	3,778	17,972	22,926
1995	8,489	5,695	14,184	25	184	954	2,983	3,937	18,330	23,461
1996	8,634	5,917	14,551	24	186	958	3,088	4,045	18,806	23,970
1997	8,710	6,169	14,879	25	192	945	3,141	4,086	19,182	24,320
1998	8,936	6,303	15,239	26	196	967	3,251	4,218	19,679	24,653
1999	9,134	6,602	15,736	26	203	1,054	3,584	4,638	20,603	25,955
2000	9,100	6,607	15,707	26	209	1,085	3,734	4,819	20,761	26,265
2001	9,161	6,678	15,839	24	196	1,074	3,738	4,813	20,872	25,939
2002	9,391	6,883	16,274	24	192	1,114	3,921	5,035	21,525	26,525
2003	9,255	7,551	16,806	24	190	1,083	3,812	4,895	21,915	26,700
2004	9,331	7,861	17,192	25	194	1,003	3,532	4,535	21,946	27,153
2005	9,579	7,296	16,875	24	196	1,126	3,963	5,088	22,183	27,561
2006	9,316	7,550	16,866	28	199	1,149	4,045	5,193 [b]	22,286	27,733
2007	9,221	7,679	16,900	59	195	1,429	5,031	6,460	23,615	29,193
2008	8,831	7,572	16,404	61	200	1,444	5,083	6,527	23,192	28,554
2009	8,209	7,635	15,843	60	200	1,341	4,720	6,061	22,164	27,065
2010	7,657	7,971	15,628	53	190	1,363	4,797	6,160	22,032	27,136
2011	7,336	8,104	15,440	53	195	1,283	4,517	5,801	21,489	26,543
2012	7,122	8,180	15,301	61	200	1,282	4,512	5,794	21,358	26,148
2013	7,050	8,077	15,127	58	204	1,310	4,613	5,924	21,313	26,054
2014	6,895	8,448	15,343	57	206	1,332	4,689	6,022	21,628	26,132
2015	6,720	8,656	15,376	56	210	1,324	4,660	5,984	21,625	26,263
2016	6,584	8,891	15,475	58	214	1,359	4,783	6,142	21,890	26,663
2017	6,349	8,965	15,314	57	221	1,391	4,897	6,289	21,880	26,774
					Average annual percentage change					
1970-2017	-0.6%	3.8%	0.9%	4.6%	1.1%	3.1%	3.0%	3.0%	1.3%	1.2%
2007-2017	-3.7%	1.6%	-1.0%	-0.4%	1.2%	-0.3%	-0.3%	-0.3%	-0.8%	-0.9%

Note: Totals may not add due to rounding.

Source:
See Appendix A, Section 2.1 Highway Energy Use.

[a] Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g., snowmobiles). Includes primary energy use for electricity including electricity generation and distribution losses.

[b] Due to changes in the FHWA fuel use methodology, motorcycle, bus, and heavy truck data are not comparable with data before the year 2007. Car and light truck data changed after 2008; see Appendix A for car/light truck shares.

This table is the same as Table 2.10 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. About 18% of transportation energy use is for nonhighway modes. Air travel accounts for 46% of nonhighway energy use.

Table C.5
Nonhighway Transportation Energy Consumption by Mode, 1970–2017
(trillion Btu)

Year	Air	Water	Pipeline	Rail	Nonhighway subtotal	Total transportation[a]
1970	1,287	836	994	555	3,672	15,379
1975	1,234	927	842	558	3,561	17,384
1980	1,434	1,393	897	587	4,311	18,941
1985	1,677	871	757	498	3,804	19,208
1986	1,823	1,323	737	486	4,369	20,279
1987	1,899	1,378	773	496	4,546	20,772
1988	1,978	1,417	873	508	4,776	21,325
1989	1,981	1,516	892	513	4,903	21,686
1990	2,046	1,442	925	504	4,917	21,581
1991	1,916	1,523	862	475	4,776	21,183
1992	1,945	1,599	846	487	4,876	21,838
1993	1,986	1,437	884	502	4,809	22,318
1994	2,075	1,394	950	536	4,955	22,926
1995	2,141	1,468	966	556	5,131	23,461
1996	2,206	1,411	979	569	5,164	23,970
1997	2,300	1,250	1,019	569	5,138	24,320
1998	2,275	1,232	894	573	4,973	24,653
1999	2,483	1,370	905	594	5,351	25,955
2000	2,554	1,455	901	594	5,504	26,265
2001	2,397	1,187	885	597	5,067	25,939
2002	2,229	1,246	927	598	5,000	26,525
2003	2,260	1,071	845	610	4,785	26,700
2004	2,456	1,293	815	643	5,206	27,153
2005	2,532	1,363	834	649	5,378	27,561
2006	2,511	1,442	832	661	5,446	27,733
2007	2,509	1,550	871	648	5,578	29,193
2008	2,396	1,444	899	624	5,363	28,554
2009	2,127	1,323	921	529	4,900	27,065
2010	2,149	1,460	925	570	5,104	27,136
2011	2,157	1,362	939	597	5,054	26,543
2012	2,077	1,148	980	584	4,790	26,148
2013	2,037	1,017	1,091	597	4,741	26,054
2014	2,060	876	947	621	4,504	26,132
2015	2,118	1,005	919	596	4,637	26,263
2016	2,178	1,116	926	553	4,773	26,663
2017	2,231	1,130	963	569	4,893	26,774
			Average annual percentage change			
1970-2017	1.2%	0.6%	-0.1%	0.1%	0.6%	1.2%
2007-2017	-1.2%	-3.1%	1.0%	-1.3%	-1.3%	-0.9%

Note: Totals may not add due to rounding.

Source:
See Appendix A, Section 2.3 Nonhighway Energy Use.

[a] Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g., snowmobiles). Includes primary energy use for electricity including electricity generation and distribution losses.

This table is the same as Table 2.13 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences among the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes. These values are averages, and there is a great deal of variability even within a mode.

Table C.6
Passenger Travel and Energy Use, 2017[a]

	Number of vehicles (thousands)	Vehicle-miles (millions)	Passenger-miles (millions)	Load factor (persons/ vehicle)	Energy intensities (Btu per vehicle-mile)	Energy intensities (Btu per passenger-mile)	Energy use (trillion Btu)
Cars	111,177.0	1,424,302	2,195,206	1.5	4,458	2,892	6,349.1
Personal trucks	121,202.8	1,214,523	2,210,432	1.8	6,067	3,334	7,368.6
Motorcycles	8,715.2	20,149	23,978	1.2	2,844	2,390	57.3
Demand response[b]	69.3	1,705	2,031	1.2	15,619	13,109	26.6
Buses	[c]	[c]	[c]	[c]	[c]	[c]	214.2
Transit	72.9	2,513	20,209	8.0	36,611	4,552	92.0
Intercity[d]	[c]	[c]	[c]	[c]	[c]	[c]	35.4
School[d]	702.3	[c]	[c]	[c]	[c]	[c]	86.8
Air	[c]	[c]	[c]	[c]	[c]	[c]	1,872.2
Certificated route[e]	[c]	5,848	685,977	117.3	280,416	2,391	1,640.0
General aviation	211.8	[c]	[c]	[c]	[c]	[c]	232.2
Recreational boats	12,396.7	[c]	[c]	[c]	[c]	[c]	210.3
Rail	20.6	1,518	39,116	25.8	44,607	1,731	67.7
Intercity (Amtrak)	0.4	316	6,563	20.8	40,634	1,957	12.8
Transit	12.8	823.6	20,169	24.5	41,703	1,703	34.3
Commuter	7.3	378	12,384	32.7	54,251	1,657	20.5

Source:
See Appendix A, Section 3. Passenger Travel and Energy Use.

[a] Includes primary energy use for electricity including electricity generation and distribution losses.
[b] Demand response data are for 2015. Includes passenger cars, vans, and small buses operating in response to calls from passengers to the transit operator who dispatches the vehicles.
[c] Data are not available.
[d] Energy use is estimated.
[e] Only domestic service and domestic energy use are shown on this table. (Previous editions included half of international energy.) These energy intensities may be inflated because all energy use is attributed to passengers–cargo energy use is not taken into account.

This table is the same as Table 2.14 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences among the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes. These values are averages, and there is a great deal of variability even within a mode.

Table C.7
Energy Intensities of Highway Passenger Modes, 1970–2017

	Cars		Light truck[b]		Transit Buses[c]	
Year	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per vehicle-mile)	(Btu per passenger-mile)
1970	9,250	4,868	12,479	6,568	31,796	2,472
1975	8,993	4,733	11,879	6,496	33,748	2,814
1980	7,916	4,279	10,224	5,548	36,553	2,813
1985	7,164	4,110	8,730	4,737	38,876	3,423
1990	6,169	3,856	7,746	4,557	37,374	3,794
1991	5,912	3,695	7,351	4,376	37,732	3,877
1992	5,956	3,723	7,239	4,361	40,243	4,310
1993	6,087	3,804	7,182	4,379	39,043	4,262
1994	6,024	3,765	7,212	4,452	37,258	4,262
1995	5,902	3,689	7,208	4,505	37,250	4,307
1996	5,874	3,683	7,247	4,473	37,452	4,340
1997	5,797	3,646	7,251	4,421	38,857	4,434
1998	5,767	3,638	7,260	4,373	41,292	4,399
1999	5,821	3,684	7,327	4,361	40,574	4,344
2000	5,687	3,611	7,158	4,211	41,690	4,531
2001	5,626	3,583	7,080	4,116	38,535	4,146
2002	5,662	3,612	7,125	4,142	37,543	4,133
2003	5,535	3,537	7,673	4,461	37,090	4,212
2004	5,489	3,513	7,653	4,449	37,846	4,363
2005	5,607	3,594	7,009	4,075	37,421	4,249
2006	5,511	3,538	6,974	4,055	39,558	4,315
2007	5,513	3,546	6,904	4,014	39,919	4,371
2008	5,466	3,520	6,830	3,712	39,894	4,347
2009	5,239	3,380	7,159	3,891	39,261	4,253
2010	5,117	3,304	6,919	3,760	36,030	4,126
2011	5,032	3,252	6,795	3,693	37,806	4,250
2012	4,951	3,202	6,675	3,628	37,191	4,039
2013	4,875	3,156	6,557	3,564	37,432	4,070
2014	4,799	3,109	6,631	3,604	35,397	3,827
2015	4,649	3,014	6,487	3,526	36,472	4,076
2016	4,530	2,939	6,368	3,499	36,975	4,300
2017	4,458	2,895	6,169	3,390	36,611	4,552
			Average annual percentage change			
1970-2017	-1.5%	-1.1%	-1.5%	-1.4%	0.3%	1.3%
2007-2017	-2.1%	-2.0%	-1.1%	-1.7%	-0.9%	0.4%

Source:
See Appendix A, Section 4. Highway Passenger Mode Energy Intensities.

[a] Includes primary energy use for electricity including electricity generation and distribution losses.
[b] All two-axle, four-tire trucks.
[c] Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transportation Association (APTA).

This table is the same as Table 2.15 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences between the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes.

Table C.8
Energy Intensities of Nonhighway Passenger Modes, 1970–2017[a]

	Air	Rail		
Year	Certificated air carriers[b] (Btu per passenger-mile)	Intercity Amtrak (Btu per passenger-mile)	Rail transit (Btu per passenger-mile)	Commuter rail (Btu per passenger-mile)
1970	10,115	c	2,190	c
1975	7,625	3,311	2,642	c
1980	5,561	2,859	2,323	c
1985	5,053	2,710	2,838	2,843
1986	5,011	2,487	2,909	2,945
1987	4,827	2,456	2,891	2,815
1988	4,861	2,378	2,854	2,869
1989	4,844	2,621	2,734	2,881
1990	4,797	2,509	2,836	2,832
1991	4,602	2,422	3,029	2,786
1992	4,455	2,534	2,887	2,629
1993	4,490	2,564	3,099	2,971
1994	4,407	2,280	3,077	2,679
1995	4,349	2,500	3,071	2,628
1996	4,199	2,690	2,751	2,582
1997	4,173	2,801	2,538	2,704
1998	3,987	2,777	2,494	2,625
1999	4,108	2,933	2,454	2,697
2000	3,960	3,224	2,382	2,531
2001	3,943	3,256	2,413	2,514
2002	3,718	3,196	2,482	2,491
2003	3,614	2,779	2,438	2,514
2004	3,505	2,728	2,316	2,521
2005	3,346	2,675	2,338	2,690
2006	3,250	2,608	2,218	2,467
2007	3,153	2,470	2,088	2,566
2008	3,055	2,352	2,028	2,580
2009	2,901	2,380	1,996	2,720
2010	2,825	2,220	1,985	2,801
2011	2,772	2,162	1,918	2,681
2012	2,633	2,054	1,821	2,690
2013	2,568	2,081	1,805	2,615
2014	2,506	2,100	1,740	2,580
2015	2,477	2,044	1,717	2,557
2016	2,449	2,011	1,659	2,568
2017	2,415	1,957	1,703	2,489
		Average annual percentage change[d]		
1970-2017	-3.0%	-1.4%	-0.5%	-0.4%
2007-2017	-2.6%	-2.3%	-2.0%	-0.3%

Source:
See Appendix A, Section 5. Nonhighway Passenger Mode Energy Intensities.

[a] Includes primary energy use for electricity including electricity generation and distribution losses.

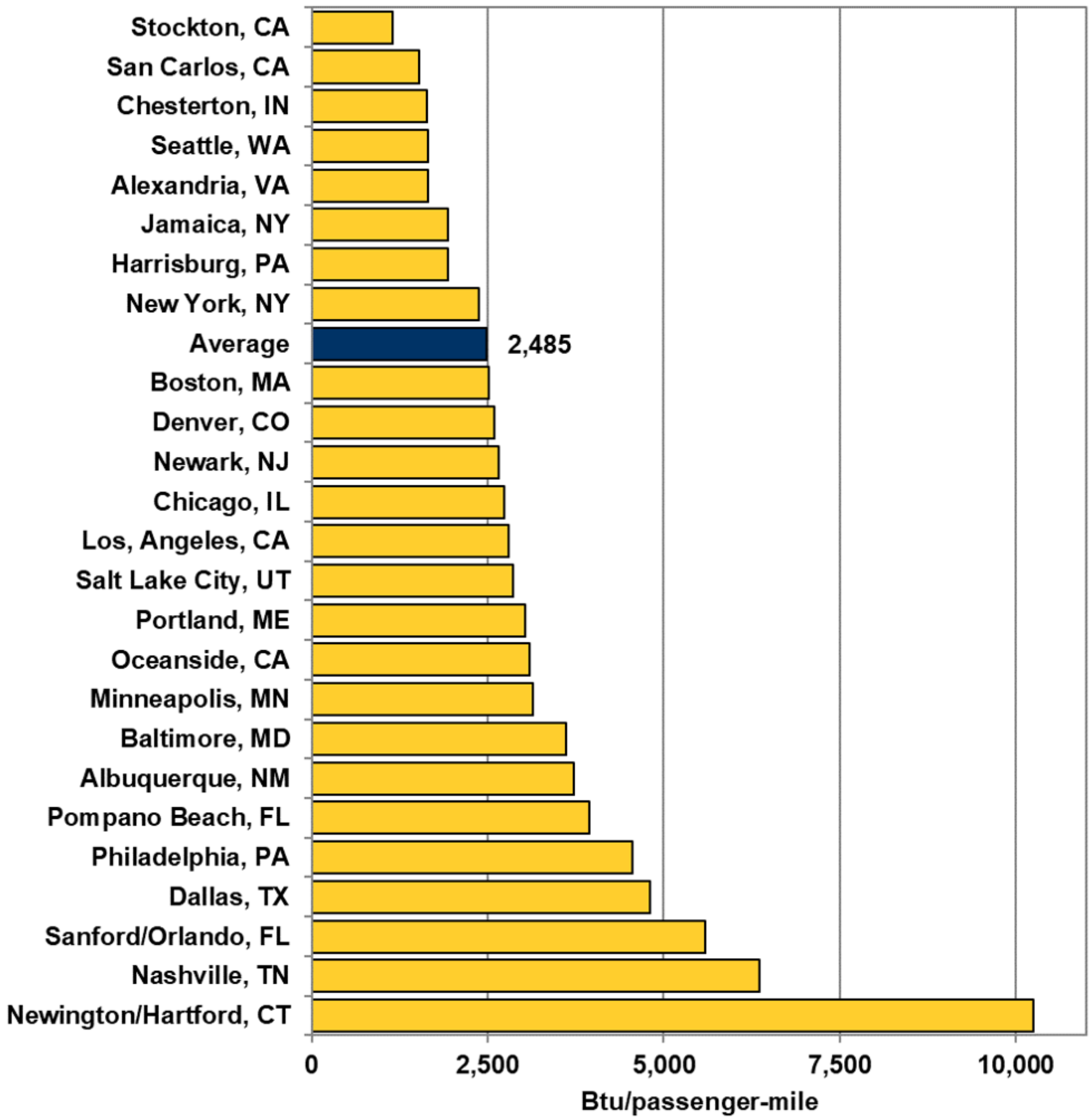
[b] These data differ from the data on Table C.6 because they include half of international services. These energy intensities may be inflated because all energy use is attributed to passengers–cargo energy use is not taken into account.

[c] Data are not available.

[d] Average annual percentage calculated to earliest year possible.

This table is the same as Figure 7.1 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. The energy intensity of commuter rail systems, measured in Btu per passenger-mile, varies greatly. The average of all commuter rail systems in 2017 is 2,485 Btu/passenger-mile. Most of these 25 systems used diesel power, but nine systems used both diesel and electricity: Chesterton, IN; Harrisburg, PA; Jamaica, NY; Denver, CO; New York, NY; Newark, NJ; Philadelphia, PA; Chicago, IL; and Baltimore, MD.

Figure C.2. Energy Intensity of Commuter Rail Transit Systems[a], 2017



Note: Does not include systems classified as hybrid rail.

Source:
U.S. Department of Transportation, *2017 National Transit Database*, October 2018. (Additional resources: www.transit.dot.gov/ntd)

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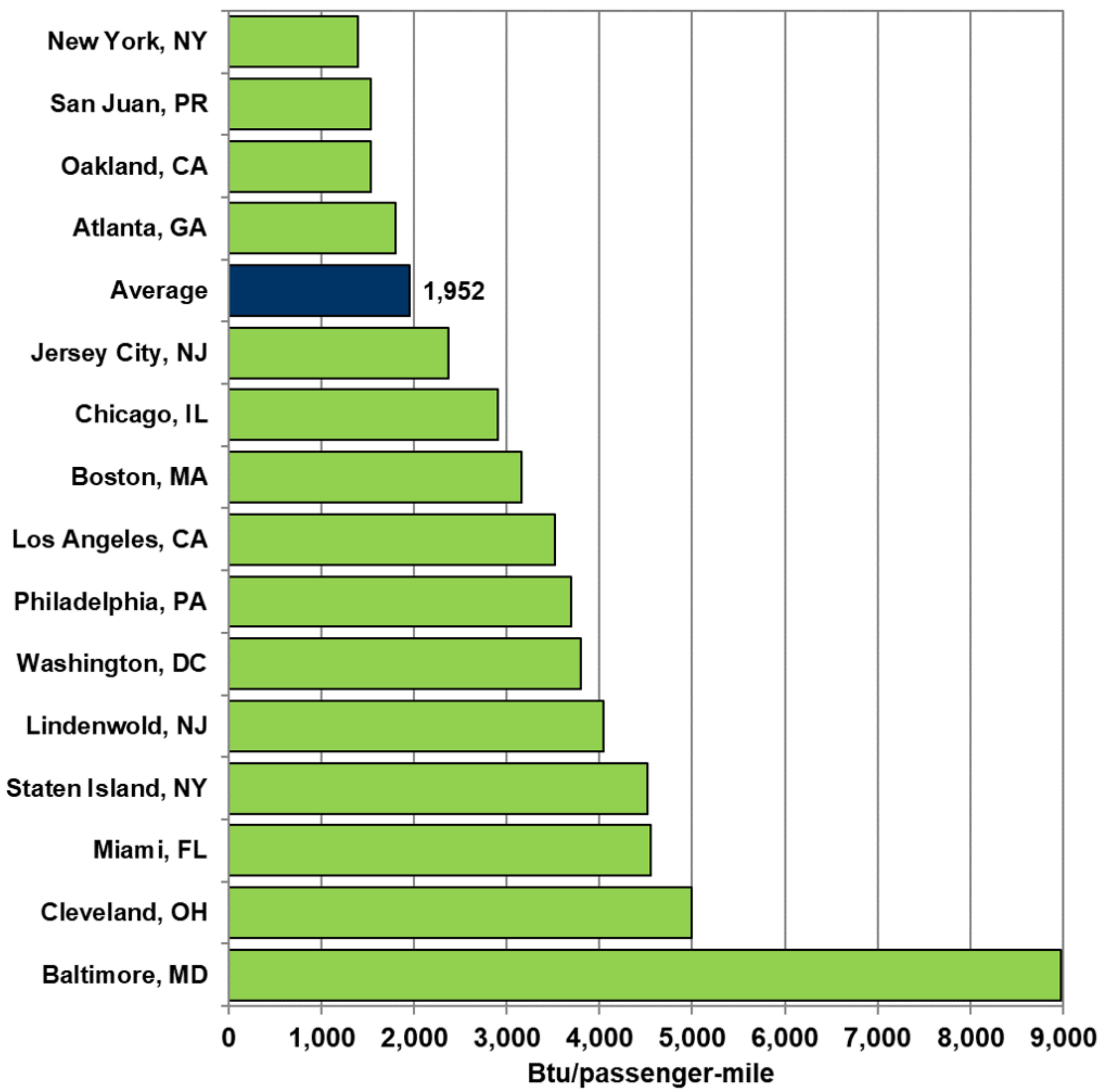
[a] Electric railcar or diesel-propelled railway for urban passenger train service between a central city and adjacent suburbs. Includes primary energy use for electricity including electricity generation and distribution losses.

This table is the same as Figure 7.2 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. The energy intensity of heavy rail systems, measured in Btu per passenger-mile, varies greatly. The average of all heavy rail systems in 2017 is 1,952 Btu/passenger-mile.

Figure C.3. Energy Intensity of Heavy Rail Systems[a], 2017



Source:
U.S. Department of Transportation, *2017 National Transit Database*, October 2018. (Additional resources: www.transit.dot.gov/ntd)

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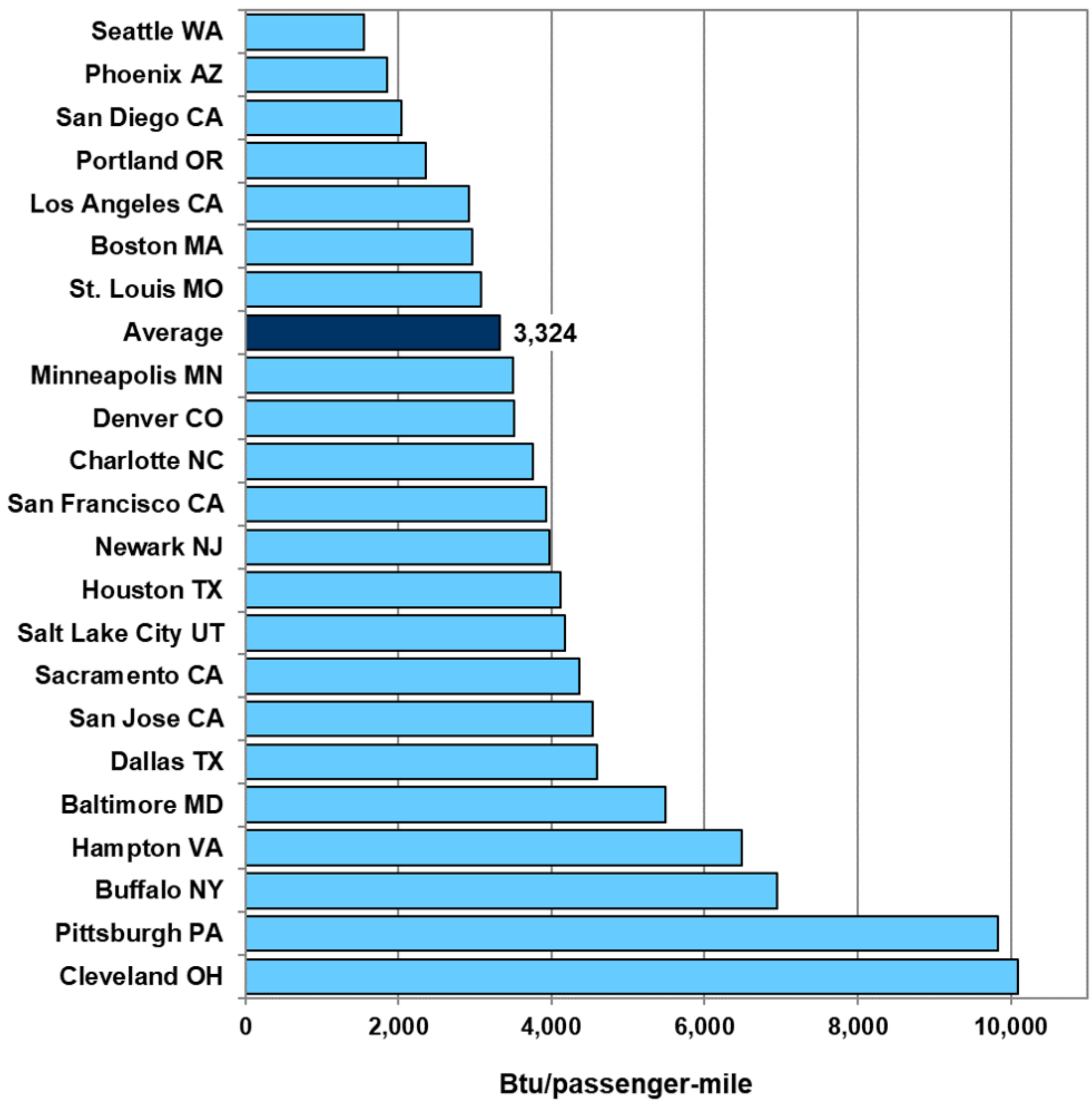
[a] An electric railway with the capacity for a heavy volume of traffic. Includes primary energy use for electricity including electricity generation and distribution losses.

This table is the same as Figure 7.3 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. The energy intensity of light rail systems, measured in Btu per passenger-mile, varies greatly. The average of all light rail systems in 2017 is 3,324 Btu/passenger-mile.

Figure C.4. Energy Intensity of Light Rail Transit Systems[a], 2017



Source:
U.S. Department of Transportation, *2017 National Transit Database*, October 2018. (Additional resources: www.transit.dot.gov/ntd)

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[a] An electric railway with a light volume traffic capacity with power drawn from an overhead electric line. Includes primary energy use for electricity including electricity generation and distribution losses.

This table is the same as Table 10.10 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. The National Railroad Passenger Corporation, known as Amtrak, began operation in 1971.

Table C.9
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971–2017

Year	Number of locomotives in service	Number of passenger cars	Train-miles (thousands)	Car-miles (thousands)	Revenue passenger-miles (millions)	Average trip length (miles)	Energy intensity (Btu per revenue passenger-mile)	Energy use (trillion Btu) [a]
1971	[a]	1,165	16,537	140,147	1,993	188	[a]	[a]
1975	355	1,913	30,166	253,898	3,753	224	3,311	12.4
1980	448	2,128	29,487	235,235	4,503	217	2,859	12.9
1985	382	1,818	30,038	250,642	4,785	238	2,710	13.0
1990	318	1,863	33,000	300,996	6,057	273	2,509	15.2
1991	316	1,786	34,000	312,484	6,273	285	2,422	15.2
1992	336	1,796	34,000	307,282	6,091	286	2,534	15.4
1993	360	1,853	34,936	302,739	6,199	280	2,564	15.9
1994	411	1,874	34,940	305,600	5,869	276	2,280	13.4
1995	422	1,907	31,579	282,579	5,401	266	2,500	13.5
1996	348	1,501	30,542	277,750	5,066	257	2,690	13.6
1997	292	1,572	32,000	287,760	5,166	255	2,801	14.5
1998	362	1,347	32,926	315,823	5,325	251	2,777	14.8
1999	385	1,285	34,080	349,337	5,289	245	2,933	15.5
2000	385	1,891	35,404	371,215	5,574	243	3,224	18.0
2001	401	2,084	36,512	377,705	5,571	238	3,256	18.1
2002	372	2,896	37,624	378,542	5,314	228	3,196	17.0
2003	442	1,623	37,459	331,864	5,680	231	2,779	15.8
2004	276	1,211	37,159	308,437	5,511	219	2,728	15.0
2005	258	1,186	36,199	264,796	5,381	215	2,675	14.4
2006	319	1,191	36,083	263,908	5,410	220	2,608	14.1
2007	270	1,164	37,484	266,545	5,784	218	2,470	14.3
2008	278	1,177	37,736	271,762	6,179	215	2,352	14.5
2009	274	1,214	38,300	282,764	5,914	217	2,380	14.1
2010	282	1,274	37,453	294,820	6,420	220	2,220	14.3
2011	287	1,301	37,090	296,315	6,670	213	2,162	14.2
2012	485	2,090	37,640	319,088	6,804	218	2,054	14.0
2013	418	1,447	38,410	324,949	6,810	218	2,081	14.2
2014	428	1,419	38,013	324,683	6,675	218	2,100	14.0
2015	423	1,428	37,798	319,464	6,536	218	2,044	13.4
2016	434	1,402	37,808	316,384	6,520	208	2,011	13.1
2017	419	1,405	37,859	316,148	6,563	205	1,957	12.8
			Average annual percentage change					
1971–2017	[b]	0.4%	1.8%	1.8%	2.6%	0.2%	[b]	[a]
2007–2017	4.5%	1.9%	0.1%	1.7%	1.3%	-0.6%	-2.3%	-1.1%

Sources:

1971–83 – Association of American Railroads, Economics and Finance Department, *Statistics of Class I Railroads*, Washington, DC, and annual.

1984–88 – Association of American Railroads, *Railroad Facts*, 1988 Edition, Washington, DC, December 1989, p. 61, and annual.

1989–93 – Personal communication with the Corporate Accounting Office of Amtrak, Washington, DC.

1994–2017 – Number of locomotives in service, number of passenger cars, train-miles, car-miles, revenue passenger-miles, and average trip length - Association of American Railroads, *Railroad Facts*, *2018 Edition*, Washington, DC, 2019, p. 73.

Energy use – Personal communication with the Amtrak, Washington, DC. (Additional resources: www.amtrak.com, www.aar.org)

[a] Includes primary energy use for electricity including electricity generation and distribution losses.
[b] Data are not available.
[c] Energy use for 1994 on is not directly comparable to earlier years. Some commuter rail energy use may have been inadvertently included in earlier years.

This table is the same as Table 7.3 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. Commuter rail, which is also known as regional rail or suburban rail, is long-haul rail passenger service operating between metropolitan and suburban areas, whether within or across state lines. Commuter rail lines usually have reduced fares for multiple rides and commutation tickets for regular, recurring riders.

Table C.10
Summary Statistics for Commuter Rail Operations, 1984–2017

Year	Number of passenger vehicles	Vehicle-miles (millions)	Passenger trips (millions)	Passenger-miles (millions)	Average trip length (miles)	Energy intensity (Btu/passenger-mile) [a]	Energy use (trillion Btu) [a]
1984	1984	4,075	167.9	267	6,207	23.2	2,819
1985	1985	4,035	182.7	275	6,534	23.8	2,843
1990	4,982	212.7	328	7,082	21.6	2,832	20.1
1991	5,126	214.9	318	7,344	23.1	2,786	20.5
1992	5,164	218.8	314	7,320	23.3	2,629	19.2
1993	4,982	223.9	322	6,940	21.6	2,971	20.6
1994	5,126	230.8	339	7,996	23.6	2,679	21.4
1995	5,164	237.7	344	8,244	24.0	2,628	21.7
1996	5,240	241.9	352	8,351	23.7	2,582	21.6
1997	5,426	250.7	357	8,038	22.5	2,704	21.7
1998	5,536	259.5	381	8,704	22.8	2,625	22.8
1999	5,550	265.9	396	8,766	22.1	2,697	23.6
2000	5,498	270.9	413	9,402	22.8	2,531	23.8
2001	5,572	277.3	419	9,548	22.8	2,514	24.0
2002	5,724	283.7	414	9,504	22.9	2,491	23.7
2003	5,959	286.0	410	9,559	23.3	2,514	24.0
2004	6,228	294.7	414	9,719	23.5	2,521	24.5
2005	6,392	303.4	423	9,473	22.4	2,690	25.5
2006	6,403	314.7	441	10,361	23.5	2,467	25.6
2007	6,391	325.7	459	11,153	24.3	2,566	28.6
2008	6,617	310.2	472	11,049	23.4	2,580	28.5
2009	6,941	343.5	468	11,232	24.0	2,720	30.5
2010	6,927	345.3	464	10,874	23.4	2,801	30.5
2011	7,193	345.2	466	11,427	24.5	2,681	30.6
2012	7,059	346.4	471	11,181	23.7	2,690	30.1
2013	7,310	359.1	480	11,862	24.7	2,615	31.0
2014	7,337	370.8	490	11,718	23.9	2,580	30.2
2015	7,216	373.7	495	11,813	23.9	2,557	30.2
2016	7,350	376.0	504	11,899	23.6	2,568	30.6
2017	7,290	378.2	503	12,384	24.6	2,489	30.8
				Average annual percentage change			
1984–2017	1.8%	2.5%	1.9%	2.1%	0.2%	-0.4%	1.7%
2007–2017	1.3%	1.5%	0.9%	1.1%	0.1%	-0.3%	0.7%

Source:
American Public Transportation Association, *2019 Public Transportation Fact Book*, Washington, DC, April 2019, Appendix A. (Additional resources: www.apta.com)

[a] Includes primary energy use for electricity including electricity generation and distribution losses.

This table is the same as Table 7.4 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. This table includes data on light rail and heavy rail systems. Light rail vehicles are usually single vehicles driven electrically with power drawn from overhead wires. Heavy rail is characterized by high speed and rapid acceleration of rail cars operating on a separate right-of-way.

Table C.11
Summary Statistics for Rail Transit Operations, 1970–2017[a]

Year	Number of passenger vehicles	Vehicle-miles (millions)	Passenger trips (millions)[b]	Passenger-miles (millions)[c]	Average trip length (miles)[d]	Energy intensity (Btu/passenger-mile)[e]	Energy use (trillion Btu)[e]
1970	10,548	440.8	2,116	12,273	f	2,190	26.9
1975	10,617	446.9	1,797	10,423	f	2,642	27.5
1980	10,654	402.2	2,241	10,939	4.9	2,323	25.4
1985	11,109	467.8	2,422	10,777	4.4	2,838	30.6
1990	11,332	560.9	2,521	12,046	4.8	2,836	34.2
1995	11,156	571.8	2,284	11,419	5.0	3,071	35.1
1996	11,341	580.7	2,418	12,487	5.2	2,751	34.4
1997	11,471	598.9	2,692	13,091	4.9	2,538	33.2
1998	11,521	609.5	2,669	13,412	5.0	2,494	33.4
1999	11,603	626.4	2,813	14,108	5.0	2,454	34.6
2000	12,168	648.0	2,952	15,200	5.1	2,382	36.2
2001	12,084	662.4	3,064	15,615	5.1	2,413	37.7
2002	12,479	681.9	3,025	15,095	5.0	2,482	37.5
2003	12,236	694.2	3,005	15,082	5.0	2,438	36.8
2004	12,480	709.7	3,098	15,930	5.1	2,316	36.9
2005	12,755	715.4	3,189	16,118	5.1	2,338	37.7
2006	12,853	726.4	3,334	16,587	5.0	2,218	36.8
2007	13,032	741.2	3,879	18,070	4.7	2,088	37.7
2008	13,346	762.8	4,001	18,941	4.7	2,028	38.4
2009	13,529	775.3	3,955	19,004	4.8	1,996	37.9
2010	13,614	759.6	4,007	18,580	4.6	1,985	36.9
2011	13,328	744.1	4,083	19,520	4.8	1,918	37.4
2012	12,455	749.5	4,192	19,835	4.7	1,821	36.1
2013	12,434	774.3	4,275	20,381	4.8	1,805	36.8
2014	12,608	780.9	4,411	20,829	4.7	1,740	36.3
2015	12,820	803.2	4,339	20,710	4.8	1,717	35.6
2016	12,912	810.2	4,346	20,922	4.8	1,659	34.7
2017	12,848	823.6	4,314	20,169	4.7	1,703	34.3
			Average annual percentage change				
1970–2017	0.4%	1.3%	1.5%	1.1%	-0.6%	-0.5%	0.5%
2007–2017	-0.1%	1.1%	1.1%	1.1%	0.0%	-2.0%	-0.9%

Sources:
American Public Transportation Association, *2019 Public Transportation Fact Book*, Washington, DC, April 2019, Appendix A. (Additional resources: www.apta.com)
Energy use – See Appendix A for Rail Transit Energy Use.

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[a] Heavy rail and light rail. Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.

[b] 1970–79 data represents total passenger rides; after 1979, data represents unlinked passenger trips.

[c] Estimated for years 1970–76 based on an average trip length of 5.8 miles.

[d] Calculated as the ratio of passenger-miles to passenger trips.

[e] Includes primary energy use for electricity including electricity generation and distribution losses.

[f] Data are not available.

[g] Average annual percentage change is calculated for years 1977–2017.

This table is the same as Table 10.1 but with electricity generation and distribution considered when converting kilowatt-hours of electricity to Btu. Nonhighway transportation modes accounted for 18.4% of total transportation energy use in 2017.

Table C.12
Nonhighway Energy Use Shares, 1970–2017

	Share of transportation energy use					
Year	Air	Water	Pipeline	Rail	Nonhighway total	Transportation total (trillion Btu) [a]
1970	8.4%	5.4%	6.5%	3.6%	23.9%	15,379
1975	7.1%	5.3%	4.8%	3.2%	20.5%	17,384
1980	7.6%	7.4%	4.7%	3.1%	22.8%	18,941
1981	7.8%	6.8%	4.8%	3.0%	22.4%	18,743
1982	7.9%	5.8%	4.7%	2.6%	21.1%	18,240
1983	7.8%	5.3%	4.1%	2.6%	19.8%	18,373
1984	8.5%	5.1%	4.1%	2.8%	20.5%	18,965
1985	8.7%	4.5%	3.9%	2.6%	19.8%	19,208
1986	9.0%	6.5%	3.6%	2.4%	21.5%	20,279
1987	9.1%	6.6%	3.7%	2.4%	21.9%	20,772
1988	9.3%	6.6%	4.1%	2.4%	22.4%	21,325
1989	9.1%	7.0%	4.1%	2.4%	22.6%	21,686
1990	9.5%	6.7%	4.3%	2.3%	22.8%	21,581
1991	9.0%	7.2%	4.1%	2.2%	22.5%	21,183
1992	8.9%	7.3%	3.9%	2.2%	22.3%	21,838
1993	8.9%	6.4%	4.0%	2.2%	21.5%	22,318
1994	9.1%	6.1%	4.1%	2.3%	21.6%	22,926
1995	9.1%	6.3%	4.1%	2.4%	21.9%	23,461
1996	9.2%	5.9%	4.1%	2.4%	21.5%	23,970
1997	9.5%	5.1%	4.2%	2.3%	21.1%	24,320
1998	9.2%	5.0%	3.6%	2.3%	20.2%	24,653
1999	9.6%	5.3%	3.5%	2.3%	20.6%	25,955
2000	9.7%	5.5%	3.4%	2.3%	21.0%	26,265
2001	9.2%	4.6%	3.4%	2.3%	19.5%	25,939
2002	8.4%	4.7%	3.5%	2.3%	18.8%	26,525
2003	8.5%	4.0%	3.2%	2.3%	17.9%	26,700
2004	9.0%	4.8%	3.0%	2.4%	19.2%	27,153
2005	9.2%	4.9%	3.0%	2.4%	19.5%	27,561
2006	9.1%	5.2%	3.0%	2.4%	19.6%	27,733
2007	8.6%	5.3%	3.0%	2.2%	19.1%	29,193
2008	8.4%	5.1%	3.1%	2.2%	18.8%	28,554
2009	7.9%	4.9%	3.4%	2.0%	18.1%	27,065
2010	7.9%	5.4%	3.4%	2.1%	18.8%	27,136
2011	8.1%	5.1%	3.5%	2.2%	19.0%	26,543
2012	7.9%	4.4%	3.7%	2.2%	18.3%	26,148
2013	7.8%	3.9%	4.2%	2.3%	18.2%	26,054
2014	7.9%	3.4%	3.6%	2.4%	17.2%	26,132
2015	8.1%	3.8%	3.5%	2.3%	17.7%	26,263
2016	8.2%	4.2%	3.5%	2.1%	17.9%	26,663
2017	8.3%	4.2%	3.6%	2.1%	18.3%	26,774

Source:
See Appendix A, Section 2.3. Nonhighway Energy Use.

[a] Includes primary energy use for electricity including electricity generation and distribution losses.

GLOSSARY

Acceleration power – Often measured in kilowatts. Pulse power obtainable from a battery used to accelerate a vehicle. This is based on a constant current pulse for 30 seconds at no less than 2/3 of the maximum open-circuit-voltage, at 80% depth-of-discharge relative to the battery's rated capacity and at 20° C ambient temperature.

Age – The amount of time a person or thing has existed.

Air Carrier – The commercial system of air transportation consisting of certificated air carriers, air taxis (including commuters), supplemental air carriers, commercial operators of large aircraft, and air travel clubs.

Certificated route air carrier: An air carrier holding a Certificate of Public Convenience and Necessity issued by the Department of Transportation to conduct scheduled interstate services. Nonscheduled or charter operations may also be conducted by these carriers. These carriers operate large aircraft (30 seats or more, or a maximum payload capacity of 7,500 pounds or more) in accordance with Federal Aviation Regulation part 121.

Domestic air operator: Commercial air transportation within and between the 50 States and the District of Columbia. Includes operations of certificated route air carriers, Pan American, local service, helicopter, intra-Alaska, intra-Hawaii, all-cargo carriers and other carriers. Also included are transborder operations conducted on the domestic route segments of U.S. air carriers. Domestic operators are classified based on their operating revenue as follows:

Majors - over $1 billion
Nationals - $100 million to $1 billion
Large Regionals - $20 million to $99 million
Medium Regionals – Less than $20 million

International air operator: Commercial air transportation outside the territory of the United States, including operations between the U.S. and foreign countries and between the U.S. and its territories and possessions.

Supplemental air carrier: A class of air carriers which hold certificates authorizing them to perform passenger and cargo charter services supplementing the scheduled service of the certificated route air carriers. Supplemental air carriers are often referred to as nonscheduled air carriers or "nonskeds."

Alcohol – The family name of a group of organic chemical compounds composed of carbon, hydrogen, and oxygen. The molecules in the series vary in chain length and are composed of a hydrocarbon plus a hydroxyl group. Alcohol includes methanol and ethanol.

Alternative fuel – For transportation applications, includes the following: methanol; denatured ethanol, and other alcohols; fuel mixtures containing 85 percent or more by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas (propane); hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials (biofuels such as soy diesel fuel); and electricity (including electricity from solar energy). The term "alternative fuel" does not include alcohol or other blended portions of primarily petroleum-based fuels used as oxygenates or extenders, i.e. MTBE, ETBE, other ethers, and the 10-percent ethanol portion of gasohol.

Amtrak – See Rail.

Anthropogenic – Human made. Usually used in the context of emissions that are produced as the result of human activities.

Aviation – See *General aviation*.

Aviation gasoline – All special grades of gasoline for use in aviation reciprocating engines, as given in the American Society for Testing and Materials (ASTM) Specification D 910. Includes all refinery products within the gasoline range that are to be marketed straight or in blends as aviation gasoline without further processing (any refinery operation except mechanical blending). Also included are finished components in the gasoline range which will be used for blending or compounding into aviation gasoline.

Barges – Shallow, non-self-propelled vessels used to carry bulk commodities on the rivers and the Great Lakes.

Battery efficiency – Measured in percentage. Net DC energy delivered on discharge, as a percentage of the total DC energy required to restore the initial state-of-charge. The efficiency value must include energy losses resulting from self-discharge, cell equalization, thermal loss compensation, and all battery-specific auxiliary equipment.

Bike sharing – Allows users access to bicycles on an as-needed basis for a pre-determined fee. Station-based bike sharing typically involves an unattended kiosk and bikes can be returned to any kiosk. Some bike share users have annual/monthly memberships and others are casual users paying higher usage rates than members. Some bike share programs offer electric-assist bikes, often called e-bikes.

Btu – British thermal unit. The amount of energy required to raise the temperature of 1 pound of water 1 degree Fahrenheit at or near 39.2 degrees Fahrenheit. An average Btu content of fuel is the heat value per quantity of fuel as determined from tests of fuel samples.

Bunker – A storage tank.

Bunker fuels – Fuel supplied to ships and aircraft, both domestic and foreign, consisting primarily of residual and distillate fuel oil for ships and kerosene-based jet fuel for aircraft.

Bus –A mode of transit service characterized by roadway vehicles powered by diesel, gasoline, battery, or alternative fuel engines contained within the vehicle.

Intercity bus: A standard size bus equipped with front doors only, high backed seats, luggage compartments separate from the passenger compartment and usually with restroom facilities, for high-speed long-distance service.

Motor bus: Rubber-tired, self-propelled, manually-steered bus with fuel supply on board the vehicle. Motor bus types include intercity, school, and transit.

School and other nonrevenue bus: Bus services for which passengers are not directly charged for transportation, either on a per passenger or per vehicle basis.

Transit bus: A bus designed for frequent stop service with front and center doors, normally with a rear-mounted diesel engine, low-back seating, and without luggage storage compartments or restroom facilities.

Trolley coach: Rubber-tired electric transit vehicle, manually-steered, propelled by a motor drawing current, normally through overhead wires, from a central power source not on board the vehicle.

Calendar year – The period of time between January 1 and December 31 of any given year.

Captive imports – Products produced overseas specifically for domestic manufacturers.

Carsharing – Users have access to a light vehicle on a temporary basis, typically paying a fee for each use in addition to membership fees. The carshare operator maintains a fleet of vehicles that are parked in various locations across a city or urban area. The operator typically provides the insurance, gasoline, parking, and maintenance.

Car size classifications – Size classifications of cars are established by the Environmental Protection Agency (EPA) as follows:

Minicompact – less than 85 cubic feet of passenger and luggage volume.
Subcompact – between 85 to 99 cubic feet of passenger and luggage volume.
Compact – between 100 to 109 cubic feet of passenger and luggage volume.
Midsize – between 110 to 119 cubic feet of passenger and luggage volume.
Large – 120 cubic feet or more of passenger and luggage volume.
Two seater – cars designed primarily to seat only two adults.
Small station wagon – less than 130 cubic feet of passenger and luggage volume.
Mid-size station wagon – between 130 to 159 cubic feet of passenger and luggage volume.
Large station wagon – 160 or more cubic feet of passenger and luggage volume.

Carbon dioxide (CO_2) – A colorless, odorless, non-poisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion.

Carbon monoxide (CO) – A colorless, odorless, highly toxic gas that is a by-product of incomplete fossil fuel combustion. Carbon monoxide, one of the major air pollutants, can be harmful in small amounts if breathed over a certain period of time.

Car-mile (railroad) – A single railroad car moved a distance of one mile.

Cargo ton-mile – See *Ton-mile*.

Certificated route air carriers – See *Air carriers*.

Class I freight railroad – See *Rail*.

Coal slurry – Finely crushed coal mixed with sufficient water to form a fluid.

Combination trucks – Consist of a power unit (a truck tractor) and one or more trailing units (a semi-trailer or trailer). The most frequently used combination is popularly referred to as a "tractor-semitrailer" or "tractor trailer."

Commercial sector – An energy-consuming sector that consists of service-providing facilities of: businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social or fraternal groups. Includes institutional living quarters.

Commuter rail – A mode of transit service (also called metropolitan rail, regional rail, or suburban rail) characterized by an electric or diesel propelled railway for urban passenger train service consisting of local short distance travel operating between a central city and adjacent suburbs.

Compact car – See *car size classifications*.

Compression ignition – The form of ignition that initiates combustion in a diesel engine. The rapid compression of air within the cylinders generates the heat required to ignite the fuel as it is injected.

Constant dollars – A time series of monetary figures is expressed in constant dollars when the effect of change over time in the purchasing power of the dollar has been removed. Usually the data are expressed in terms of dollars of a selected year or the average of a set of years.

Consumer Price Index (CPI) – A measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services.

Continuous discharge capacity – Measured as percent of rated energy capacity. Energy delivered in a constant power discharge required by an electric vehicle for hill climbing and/or high-speed cruise, specified as the percent of its rated energy capacity delivered in a one hour constant-power discharge.

Conventional Refueling Station – An establishment for refueling motor vehicles with traditional transportation fuels, such as gasoline and diesel fuel.

Corporate Average Fuel Economy (CAFE) Standards – CAFE standards were originally established by Congress for new cars, and later for light-duty trucks, in Title V of the Motor Vehicle Information and Cost Savings Act (15 U.S.C.1901, et seq.) with subsequent amendments. Under CAFE, car manufacturers are required by law to produce vehicle fleets with a composite sales-weighted fuel economy which cannot be lower than the CAFE standards in a given year, or for every vehicle which does not meet the standard, a fine of $5.00 is paid for every one-tenth of a mpg below the standard.

Criteria pollutant – A pollutant determined to be hazardous to human health and regulated under EPA's National Ambient Air Quality Standards. The 1970 amendments to the Clean Air Act require EPA to describe the health and welfare impacts of a pollutant as the "criteria" for inclusion in the regulatory regime.

Crude oil – A mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Crude oil production is measured at the wellhead and includes lease condensate.

Crude oil imports – The volume of crude oil imported into the 50 States and the District of Columbia, including imports from U.S. territories, but excluding imports of crude oil into the Hawaiian Foreign Trade Zone.

Curb weight – The weight of a vehicle including all standard equipment, spare tire and wheel, all fluids and lubricants to capacity, full tank of fuel, and the weight of major optional accessories normally found on the vehicle.

Current dollars – Represents dollars current at the time designated or at the time of the transaction. In most contexts, the same meaning would be conveyed by the use of the term "dollars." See also constant dollars.

Demand Response – A transit mode that includes passenger cars, vans, and small buses operating in response to calls from passengers to the transit operator who dispatches the vehicles. The vehicles do not operate over a fixed route on a fixed schedule. Can also be known as paratransit or dial-a-ride.

Diesel fuel – See *Distillate fuel oil*.

Disposable personal income – See *Income*.

Distillate fuel oil – The lighter fuel oils distilled off during the refining process. Included are products known as ASTM grades numbers 1 and 2 heating oils, diesel fuels, and number 4 fuel oil. The major uses of distillate fuel oils include heating, fuel for on-and off-highway diesel engines, and railroad diesel fuel.

Domestic air operator – See *Air carrier*.

Domestic water transportation – See *Internal water transportation*.

E85 – 85% ethanol and 15% gasoline.

E95 – 95% ethanol and 5% gasoline.

Electric utilities sector – Consists of privately and publicly owned establishments which generate electricity primarily for resale.

Emission standards – Limits or ranges established for pollution levels emitted by vehicles as well as stationary sources. The first standards were established under the 1963 Clean Air Act.

End-use sector – See *Sector*.

Energy capacity – Often measured in kilowatt hours. The energy delivered by the battery up to termination of discharge specified by the battery manufacturer.

Energy efficiency – In reference to transportation, the inverse of energy intensiveness: the ratio of outputs from a process to the energy inputs; for example, miles traveled per gallon of fuel (mpg).

Energy intensity – In reference to transportation, the ratio of energy inputs to a process to the useful outputs from that process; for example, gallons of fuel per passenger-mile or Btu per ton-mile.

Ethanol (C_2H_5OH) – Otherwise known as ethyl alcohol, alcohol, or grain-spirit. A clear, colorless, flammable oxygenated hydrocarbon with a boiling point of 78.5 degrees Celsius in the anhydrous state. In transportation, ethanol is used as a vehicle fuel by itself (E100 – 100% ethanol by volume), blended with gasoline (E85 – 85% ethanol by volume), or as a gasoline octane enhancer and oxygenate (10% by volume).

Excise tax – Paid when purchases are made on a specific good, such as gasoline. Excise taxes are often included in the price of the product. There are also excise taxes on activities, such as highway usage by trucks.

Ferry boat – A transit mode comprising vessels carrying passengers and in some cases vehicles over a body of water, and that are generally steam or diesel-powered.

Fixed operating cost – See *Operating cost*.

Fleet vehicles –

Private fleet vehicles: Ideally, a vehicle could be classified as a member of a fleet if it is:

a) operated in mass by a corporation or institution,
b) operated under unified control, or
c) used for non-personal activities.

However, the definition of a fleet is not consistent throughout the fleet industry. Some companies make a distinction between cars that were bought in bulk rather than singularly, or whether they are operated in bulk, as well as the minimum number of vehicles that constitute a fleet (i.e. 4 or 10).

Government fleet vehicles: Includes vehicles owned by all Federal, state, county, city, and metro units of government, including toll road operations.

Foreign freight – Movements between the United States and foreign countries and between Puerto Rico, the Virgin Islands, and foreign countries. Trade between U.S. territories and possessions (e.g. American Samoa, Guam, North Mariana Islands and U.S. Outlying Islands) and foreign countries is excluded. Traffic to or from the Panama Canal Zone is included, but traffic with U.S. origin and U.S. destination traveling through the Panama Canal is not.

Gas Guzzler Tax – Originates from the 1978 Energy Tax Act (Public Law 95-618). A new car purchaser is required to pay the tax if the car purchased has a combined city/highway fuel economy rating that is below the standard for that year. For model years 1986 and later, the standard is 22.5 mpg.

Gasohol – A mixture of 10% anhydrous ethanol and 90% gasoline by volume; 7.5% anhydrous ethanol and 92.5% gasoline by volume; or 5.5% anhydrous ethanol and 94.5% gasoline by volume. There are other fuels that contain methanol and gasoline, but these fuels are not referred to as gasohol.

Gasoline – See *Motor gasoline*.

General aviation – That portion of civil aviation which encompasses all facets of aviation except air carriers. It includes any air taxis, commuter air carriers, and air travel clubs which do not hold Certificates of Public Convenience and Necessity.

Global warming potential (GWP) – An index used to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result from the emission of one kilogram of a greenhouse gas to that from the emission of one kilogram of carbon dioxide over a fixed period of time, such as 100 years.

Greenhouse gases – Those gases, such as water vapor, carbon dioxide, nitrous oxide, methane, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride, that are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation, thus preventing long-wave radiant energy from leaving Earth's atmosphere. The net effect is a trapping of absorbed radiation and a tendency to warm the planet's surface.

Gross Domestic Product (GDP) – The market value of goods and services produced by labor and property in the United States, regardless of nationality; gross domestic product replaced gross national product as the primary measure of U.S. production in 1991.

Gross National Product (GNP) – A measure of monetary value of the goods and services becoming available to the nation from economic activity. The market value of goods and services produced by labor and property supplied by U.S. residents, regardless of where they are located. Calculated quarterly by the Department of Commerce, the gross national product is the broadest available measure of the level of economic activity.

Gross vehicle weight (gvw) – The weight of the empty truck plus the maximum anticipated load weight, including passengers, fluids, and cargo.

Gross vehicle weight rating (gvwr) – The gross vehicle weight which is assigned to each new truck by the manufacturer. This rating may be different for trucks of the same model because of certain features, such as heavy-duty suspension. Passenger cars are not assigned gross vehicle weight ratings.

Heavy-heavy truck – See *Truck size classifications*.

Heavy rail – A mode of transit service (also called metro, subway, rapid transit, or rapid rail) operating on an electric railway with the capacity for a heavy volume of traffic. Characterized by high speed and rapid acceleration of passenger rail cars.

Household – Consists of all persons who occupy a housing unit, including the related family members and all unrelated persons, if any, who share the housing unit.

Housing unit – A house, apartment, a group of rooms, or a single room occupied or intended for occupancy as separate living quarters. Separate living quarters are those in which the occupants do not live and eat with any other persons in the structure and which have either (1) direct access from the outside of the building or through a common hallway intended to be used by the occupants of another unit or by the general public, or (2) complete kitchen facilities for the exclusive use of the occupants. The occupants may be a single family, one person living alone, two or more families living together, or any other group of related or unrelated persons who share living arrangements.

Hybrid-electric vehicles – Combines the benefits of gasoline engines and electric motors and can be configured to obtain different objectives, such as improved fuel economy, increased power, or additional auxiliary power for electronic devices and power tools.

Hydrocarbon (HC) – A compound that contains only hydrogen and carbon. The simplest and lightest forms of hydrocarbon are gaseous. With greater molecular weights they are liquid, while the heaviest are solids.

Income –

Disposable personal income: Personal income less personal tax and non-tax payments.

National income: The aggregate earnings of labor and property which arise in the current production of goods and services by the nation's economy.

Personal income: The current income received by persons from all sources, net of contributions for social insurance.

Industrial sector – Construction, manufacturing, agricultural and mining establishments.

Inertia weight – The curb weight of a vehicle plus 300 pounds.

Intercity bus – See *Bus*.

Intermodal – Transportation activities involving more than one mode of transportation, including transportation connections and coordination of various modes.

Internal water transportation – Includes all local (intraport) traffic and traffic between ports or landings wherein the entire movement takes place on inland waterways. Also termed internal are movements involving carriage on both inland waterways and the water of the Great Lakes, and inland movements that cross short stretches of open water that link inland systems.

International air operator – See *Air carrier*.

International freight – See *Foreign freight*.

Jet fuel – Includes both naphtha-type and kerosene-type fuels meeting standards for use in aircraft turbine engines. Although most jet fuel is used in aircraft, some is used for other purposes such as generating electricity in gas turbines.

Kerosene-type jet fuel: A quality kerosene product with an average gravity of 40.7 degrees API and 10% to 90% distillation temperatures of 217 to 261 degrees Celsius. Used primarily as fuel for commercial turbojet and turboprop aircraft engines. It is a relatively low freezing point distillate of the kerosene type.

Naphtha-type jet fuel: A fuel in the heavy naphtha boiling range with an average gravity of 52.8 degrees API and 10% to 90% distillation temperatures of 117 to 233 degrees Celsius used for turbojet and turboprop aircraft engines, primarily by the military. Excludes ramjet and petroleum.

Kerosene – A petroleum distillate in the 300 to 500 degrees Fahrenheit boiling range and generally having a flash point higher than 100 degrees Fahrenheit by the American Society of Testing and Material (ASTM) Method D56, a gravity range from 40 to 46 degrees API, and a burning point in the range of 150 to 175 degrees Fahrenheit. It is a clean-burning product suitable for use as an illuminant when burned in wick lamps. Includes grades of kerosene called range oil having properties similar to Number 1 fuel oil, but with a gravity of about 43 degrees API and an end point of 625 degrees Fahrenheit. Used in space heaters, cooking stoves, and water heaters.

Kerosene-type jet fuel – See Jet fuel.

Large car – See *Car size classifications*.

Lease Condensate – A liquid recovered from natural gas at the well or at small gas/oil separators in the field. Consists primarily of pentanes and heavier hydrocarbons (also called field condensate).

Light-duty vehicles – Cars and light-duty trucks combined.

Light-duty truck – Light-duty trucks are defined differently by different agencies/companies. Therefore, this document does not have one single definition of light-duty trucks. The Environmental Protection Agency defines light-duty trucks size classes as follows:

Class	Gross Vehicle Weight Rating (GVWR)	
Pickup Trucks	**Through 2007**	**As of 2008**
Small	< 4,500 lbs	< 6,000 lbs
Standard	4,500 to 8,500 lbs	6,000 to 8,500 lbs
Vans	**Through 2010**	**As of 2011**
Passenger	< 8,500 lbs	< 10,000 lbs
Cargo	< 8,500 lbs	
Minivans	< 8,500 lbs	
SUVs	**Through 2010**	**2011–12**
All	< 8,500 lbs	< 10,000 lbs
	As of 2013	
Small	< 6,000 lbs	
Standard	6,000 to 9,999 lbs	
	Through 2010	**As of 2011**
Special Purpose Vehicles	< 8,500 lbs	< 8,500 lbs or < 10,000 lbs depending on configuration

Light-heavy truck – See *Truck size classifications*.

Light rail – Mode of transit service (also called streetcar, tramway or trolley) operating passenger rail cars singly (or in short, usually two-car or three-car trains) on fixed rails in right-of-way that is often separated from other traffic for part or much of the way.

Liquefied petroleum gas (lpg) – Consists of propane and butane and is usually derived from natural gas. In locations where there is no natural gas and the gasoline consumption is low, naphtha is converted to lpg by catalytic reforming.

Load factor – Total passenger miles divided by total vehicle miles.

Low emission vehicle – Any vehicle certified to the low emission standards which are set by the Federal government and/or the state of California.

M85 – 85% methanol and 15% gasoline.

M100 – 100% methanol.

Medium truck – See *Truck size classifications*.

Methanol (CH_3OH) – A colorless highly toxic liquid with essentially no odor and very little taste. It is the simplest alcohol and boils at 64.7 degrees Celsius. In transportation, methanol is used as a vehicle fuel by itself (M100), or blended with gasoline (M85).

Midsize car – See *Car size classifications*.

Minicompact car – See *Car size classifications*.

Model year – In this publication, model year is referring to the "sales" model year, the period from October 1 to the next September 31.

Motor bus – See *Bus*.

Motor gasoline – A mixture of volatile hydrocarbons suitable for operation of an internal combustion engine whose major components are hydrocarbons with boiling points ranging from 78 to 217 degrees Celsius and whose source is distillation of petroleum and cracking, polymerization, and other chemical reactions by which the naturally occurring petroleum hydrocarbons are converted into those that have superior fuel properties.

Regular gasoline: Gasoline having an antiknock index, i.e., octane rating, greater than or equal to 85 and less than 88. Note: Octane requirements may vary by altitude.

Midgrade gasoline: Gasoline having an antiknock index, i.e., octane rating, greater than or equal to 88 and less than or equal to 90. Note: Octane requirements may vary by altitude.

Premium gasoline: Gasoline having an antiknock index, i.e., octane rating, greater than 90. Note: Octane requirements may vary by altitude.

Reformulated gasoline: Finished motor gasoline formulated for use in motor vehicles, the composition and properties of which meet the requirements of the reformulated gasoline regulations promulgated by the U.S. Environmental Protection Agency under Section 211(k) of the Clean Air Act. For more details on this clean fuel program see http://www.epa.gov/otaq/fuels/gasolinefuels/rfg/index.htm. Note: This category includes oxygenated fuels program reformulated gasoline (OPRG) but excludes reformulated gasoline blendstock for oxygenate blending (RBOB).

MTBE – Methyl Tertiary Butyl Ether–a colorless, flammable, liquid oxygenated hydrocarbon containing 18.15 percent oxygen.

Naphtha-type jet fuel – See *Jet fuel*.

National income – See *Income*.

Nationwide Household Travel Survey (NHTS) – A nationwide survey of households that provides information on the characteristics and personal travel patterns of the U.S. population. Surveys were conducted in 2001, 2009, and 2017 by the U.S. Bureau of Census for the U.S. Department of Transportation. This is a follow-on to the NPTS.

Nationwide Personal Transportation Survey (NPTS) – A nationwide survey of households that provides information on the characteristics and personal travel patterns of the U.S. population. Surveys were conducted in 1969, 1977, 1983, 1990, and 1995 by the U.S. Bureau of Census for the U.S. Department of Transportation.

Natural gas – A mixture of hydrocarbon compounds and small quantities of various non-hydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions.

Natural gas, dry: Natural gas which remains after: 1) the liquefiable hydrocarbon portion has been removed from the gas stream; and 2) any volumes of nonhydrocarbon gases have been removed where they occur in sufficient quantity to render the gas unmarketable. Dry natural gas is also known as consumer-grade natural gas. The parameters for measurement are cubic feet at 60 degrees Fahrenheit and 14.73 pounds per square inch absolute.

Natural gas, wet: The volume of natural gas remaining after removal of lease condensate in lease and/or field separation facilities, if any, and after exclusion of nonhydrocarbon gases where they occur in sufficient quantity to render the gas unmarketable. Natural gas liquids may be recovered from volumes of natural gas, wet after lease separation, at natural gas processing plants.

Natural gas plant liquids: Natural gas liquids recovered from natural gas in processing plants and from natural gas field facilities and fractionators. Products obtained include ethane, propane, normal butane, isobutane, pentanes plus, and other products from natural gas processing plants.

Nitrogen oxides (NO_x) – A product of combustion of fossil fuels whose production increases with the temperature of the process. It can become an air pollutant if concentrations are excessive.

Nonattainment area – Any area that does not meet the national primary or secondary ambient air quality standard established by the Environmental Protection Agency for designated pollutants, such as carbon monoxide and ozone.

Oil Stocks – Oil stocks include crude oil (including strategic reserves), unfinished oils, natural gas plant liquids, and refined petroleum products.

Operating cost –

Fixed operating cost: In reference to passenger car operating cost, refers to those expenditures that are independent of the amount of use of the car, such as insurance costs, fees for license and registration, depreciation and finance charges.

Variable operating cost: In reference to passenger car operating cost, expenditures which are dependent on the amount of use of the car, such as the cost of gas and oil, tires, and other maintenance.

Organization for Economic Cooperation and Development (OECD) – Consists of Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States. Total OECD includes the United States Territories (Guam, Puerto Rico, and the U.S. Virgin Islands).

OECD Europe: Consists of Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, and United Kingdom.

OECD Pacific: Consists of Australia, Japan, South Korea, and New Zealand.

Organization for Petroleum Exporting Countries (OPEC) – Includes Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela.

Arab OPEC – Consists of Algeria, Bahrain, Egypt, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, Syria, Tunisia, and the United Arab Emirates.

Other single-unit truck – See *Single-unit truck*.

Oxygenate – A substance which, when added to gasoline, increases the amount of oxygen in that gasoline blend. Includes fuel ethanol, methanol, and methyl tertiary butyl ether (MTBE).

Paratransit – Mode of transit service (also called demand response or dial-a-ride) characterized by the use of passenger cars, vans or small buses operating in response to calls from passengers or their agents to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations.

Particulates – Carbon particles formed by partial oxidation and reduction of the hydrocarbon fuel. Also included are trace quantities of metal oxides and nitrides, originating from engine wear, component degradation, and inorganic fuel additives. In the transportation sector, particulates are emitted mainly from diesel engines.

Passenger-miles traveled (PMT) – One person traveling the distance of one mile. Total passenger-miles traveled, thus, give the total mileage traveled by all persons.

Passenger rail – See *Rail*, "*Amtrak*" and "*Transit Railroad*".

Persian Gulf countries – Consists of Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates.

Personal Consumption Expenditures (PCE) – As used in the national accounts, the market value of purchases of goods and services by individuals and nonprofit institutions and the value of food, clothing, housing, and financial services received by them as income in kind. It includes the rental value of owner-occupied houses but excludes purchases of dwellings, which are classified as capital goods (investment).

Personal income – See *Income.*

Petroleum – A generic term applied to oil and oil products in all forms, such as crude oil, lease condensate, unfinished oil, refined petroleum products, natural gas plant liquids, and non-hydrocarbon compounds blended into finished petroleum products.

Petroleum consumption: A calculated demand for petroleum products obtained by summing domestic production, imports of crude petroleum and natural gas liquids, imports of petroleum products, and the primary stocks at the beginning of the period and then subtracting the exports and the primary stocks at the end of the period.

Petroleum exports: Shipments of petroleum products from the 50 States and the District of Columbia to foreign countries, Puerto Rico, the Virgin Islands, and other U.S. possessions and territories.

Petroleum imports: All imports of crude petroleum, natural gas liquids, and petroleum products from foreign countries and receipts from Guam, Puerto Rico, the Virgin Islands, and the Hawaiian Trade Zone. The commodities included are crude oil, unfinished oils, plant condensate, and refined petroleum products.

Petroleum inventories: The amounts of crude oil, unfinished oil, petroleum products, and natural gas liquids held at refineries, at natural gas processing plants, in pipelines, at bulk terminals operated by refining and pipeline companies, and at independent bulk terminals. Crude oil held in storage on leases is also included; these stocks are known as primary stocks. Secondary stocks–those held by jobbers dealers, service station operators, and consumers–are excluded. Prior to 1975, stock held at independent bulk terminals were classified as secondary stocks.

Petroleum products supplied: For each petroleum product, the amount supplied is calculated by summing production, crude oil burned directly, imports, and net withdrawals from primary stocks and subtracting exports.

Plug-in hybrid-electric vehicles (PHEVs) — Hybrid-electric vehicles with high capacity batteries that can be charged by plugging them into an electrical outlet or charging station. There are two basic PHEV configurations:

Parallel or Blended PHEV: Both the engine and electric motor are mechanically connected to the wheels, and both propel the vehicle under most driving conditions. Electric-only operation usually occurs only at low speeds.

Series PHEVs, also called Extended Range Electric Vehicles (EREVs): Only the electric motor turns the wheels; the gasoline engine is only used to generate electricity. Series PHEVs can run solely on electricity until the battery needs to be recharged. The gasoline engine will then generate the electricity needed to power the electric motor. For shorter trips, these vehicles might use no gasoline at all.

Processing Gain – The amount by which the total volume of refinery output is greater than the volume of input for given period of time. The processing gain arises when crude oil and other hydrocarbons are processed into products that are, on average, less dense than the input.

Processing Loss – The amount by which the total volume of refinery output is less than the volume of input for given period of time. The processing loss arises when crude oil and other hydrocarbons are processed into products that are, on average, denser than the input.

Proved Reserves of Crude Oil – The estimated quantities of all liquids defined as crude oil, which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions.

Quad – Quadrillion, 10^{15}. In this publication, a Quad refers to Quadrillion Btu.

Rail –

Amtrak (American Railroad Tracks): Operated by the National Railroad Passenger Corporation of Washington, DC. This rail system was created by President Nixon in 1970, and was given the responsibility for the operation of intercity, as distinct from suburban, passenger trains between points designated by the Secretary of Transportation.

Class I freight railroad: Defined by the Interstate Commerce Commission each year based on annual operating revenue. A railroad is dropped from the Class I list if it fails to meet the annual earnings threshold for three consecutive years.

Commuter railroad: Those portions of mainline railroad (not electric railway) transportation operations which encompass urban passenger train service for local travel between a central city and adjacent suburbs. Commuter railroad service–using both locomotive-hauled and self-propelled railroad passenger cars–is characterized by multi-trip tickets, specific station-to-station fares, and usually only one or two stations in the central business district. Also known as suburban railroad.

Transit railroad: Includes "heavy" and "light" transit rail. **Heavy transit rail** is characterized by exclusive rights-of-way, multi-car trains, high speed rapid acceleration, sophisticated signaling, and high platform loading. Also known as subway, elevated railway, or metropolitan railway (metro). **Light transit rail** may be on exclusive or shared rights-of-way, high or low platform loading, multi-car trains or single cars, automated or manually operated. In generic usage, light rail includes streetcars, trolley cars, and tramways.

Refiner sales price – Sales from the refinery made directly to ultimate consumers, including bulk consumers (such as agriculture, industry, and electric utilities) and residential and commercial consumers.

Reformulated gasoline (RFG) – See *Motor gasoline*.

RFG area – An ozone nonattainment area designated by the Environmental Protection Agency which requires the use of reformulated gasoline.

Residential sector – An energy consuming sector that consists of living quarters for private households. Excludes institutional living quarters.

Residential Transportation Energy Consumption Survey (RTECS) – This survey was designed by the Energy Information Administration of the Department of Energy to provide information on how energy is used by households for personal vehicles. It has been conducted five times since 1979, the most recent being 1991.

Residual fuel oil – The heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are boiled off in refinery operations. Included are products know as ASTM grade numbers 5 and 6 oil, heavy diesel oil, Navy Special Fuel Oil, Bunker C oil, and acid sludge and pitch used as refinery fuels. Residual fuel oil is used for the production of electric power, for heating, and for various industrial purposes.

Ride hailing – Ride hailing services (also called transportation network companies) provide on-demand transportation for a fee, typically via a mobile phone application that matches drivers and riders. The most popular ride hailing companies in the U.S. are Uber and Lyft.

Rural – Usually refers to areas with population less than 5,000.

Sales period – October 1 of the previous year to September 30 of the given year. Approximately the same as a model year.

Sales-weighted miles per gallon (mpg) – Calculation of a composite vehicle fuel economy based on the distribution of vehicle sales.

Scrappage rate – As applied to motor vehicles, it is usually expressed as the percentage of vehicles of a certain type in a given age class that are retired from use (lacking registration) in a given year.

School and other nonrevenue bus – See *Bus*.

Sector – A group of major energy-consuming components of U.S. society developed to measure and analyze energy use. The sectors most commonly referred to are: residential, commercial, industrial, transportation, and electric power.

Shared micromobility –Refers to small fleets of fully or partially human-powered vehicles including bikes, e-bikes and e-scooters.

Shared mobility – Any mode of shared transportation, such as public transit, bike and scooter sharing, carsharing, carpooling, and ride hailing.

Single-unit truck – Includes two-axle, four-tire trucks and other single-unit trucks.

Two-axle, four-tire truck: A motor vehicle consisting primarily of a single motorized device with two axles and four tires.

Other single-unit truck: A motor vehicle consisting primarily of a single motorized device with more than two axles or more than four tires.

Spark ignition engine – An internal combustion engine in which the charge is ignited electrically (e.g., with a spark plug).

Special fuels – Consist primarily of diesel fuel with small amount of liquefied petroleum gas, as defined by the Federal Highway Administration.

Specific acceleration power – Measured in watts per kilogram. Acceleration power divided by the battery system weight. Weight must include the total battery system.

Specific energy – Measured in watt hours per kilogram. The rated energy capacity of the battery divided by the total battery system weight.

Subcompact car – See *Car size classifications*.

Supplemental air carrier – See *Air carrier*.

Survival rate – As applied to motor vehicles, it is usually expressed as the percentage of vehicles of a certain type in a given age class that will be in use at the end of a given year.

Tax incentives – In general, a means of employing the tax code to stimulate investment in or development of a socially desirable economic objective without direct expenditure from the budget of a given unit of government. Such incentives can take the form of tax exemptions or credits.

Test weight – The weight setting at which a vehicle is tested on a dynamometer by the U.S. Environmental Protection Agency (EPA). This weight is determined by the EPA using the inertia weight of the vehicle.

Ton-mile – The movement of one ton of freight the distance of one mile. Ton-miles are computed by multiplying the weight in tons of each shipment transported by the distance hauled.

Transmission types –

A3 – Automatic three speed
A4 – Automatic four speed
A5 – Automatic five speed
L4 – Automatic lockup four speed
M5 – Manual five speed

Transit bus – See *Bus*.

Transit railroad – See *Rail*.

Transportation network company (TNC) – provides on-demand transportation for a fee, typically via a mobile phone application that matches drivers and riders. The most popular TNCs in the U.S. are Uber and Lyft.

Transportation sector – Consists of both private and public passenger and freight transportation, as well as government transportation, including military operations.

Truck Inventory and Use Survey (TIUS) – Survey designed to collect data on the characteristics and operational use of the nation's truck population. It is conducted every five years by the U.S. Bureau of the Census. Surveys were conducted in 1963, 1967, 1972, 1977, 1982, 1987, and 1992. For the 1997 survey, it was renamed the Vehicle Inventory and Use Survey in anticipation of including additional vehicle types. However, no additional vehicle types were added to the 1997 survey.

Trolleybus – Mode of transit service (also called transit coach) using vehicles propelled by a motor drawing current from overhead wires via connecting poles called a trolley pole, from a central power source not onboard the vehicle.

Truck size classifications – U.S. Bureau of the Census has categorized trucks by gross vehicle weight (gvw) as follows:

Light – Less than 10,000 pounds gvw (Also see *Light-duty truck*.)
Medium – 10,001 to 20,000 pounds gvw
Light-heavy – 20,001 to 26,000 pounds gvw
Heavy-heavy – 26,001 pounds gvw or more.

Two-axle, four-tire truck – See *Single-unit truck*.

Two-seater car – See *Car size classifications*.

Ultra-low emission vehicle – Any vehicle certified to the ultra-low emission standards which are set by the Federal government and/or the state of California.

Urban – Usually refers to areas with population of 5,000 or greater.

Vanpool: A ridesharing prearrangement using vans or small buses providing round-trip transportation between the participant’s prearranged boarding points and a common and regular destination.

Variable operating cost – See *Operating cost*.

Vehicle Inventory and Use Survey – Last conducted in 2002. See *Truck Inventory and Use Survey*.

Vehicle-miles traveled (vmt) – One vehicle traveling the distance of one mile. Total vehicle miles, thus, is the total mileage traveled by all vehicles.

Volatile organic compounds (VOCs) – Organic compounds that participate in atmospheric photochemical reactions.

Waterborne Commerce –

Coastwise: Domestic traffic receiving a carriage over the ocean, or the Gulf of Mexico. Traffic between Great Lakes ports and seacoast ports, when having a carriage over the ocean, is also termed Coastwise.

Domestic: Includes coastwise, lakewise, and internal waterborne movements.

Foreign: Waterborne import, export, and in-transit traffic between the United States, Puerto Rico and the Virgin Islands and any foreign country.

Internal: Vessel movements (origin and destination) which take place solely on inland waterways. An inland waterway is one geographically located within the boundaries of the contiguous 48 states or within the boundaries of the State of Alaska.

Lakewise: Waterborne traffic between the United States ports on the Great Lakes System. The Great Lakes System is treated as a separate waterway system rather than as a part of the inland waterway system. In comparing historical data for the Great Lakes System, one should note that prior to calendar year 1990, marine products, sand and gravel being moved from the Great Lakes to Great Lake destinations were classified as local traffic. From 1990-on, these activities are classified as lakewise traffic.

Well-to-wheel – A life cycle analysis used in transportation to consider the entire energy cycle for a given mode, rather than just tailpipe emissions. The analysis starts at the primary energy source and ends with the turning wheels of the vehicle.

Zero-emission vehicle – Any vehicle certified to the zero emission standards which are set by the Federal government and/or the state of California. These standards apply to the vehicle emissions only.