Chapter 11
Greenhouse Gas Emissions

Summary Statistics from Tables/Figures in this Chapter

Source			
Table 11.1	Carbon dioxide emissions (million metric tonnes)	1990	2008
	United States	*4,989*	*5,838*
	OECD Europe	*4,149*	*4,345*
	China	*2,293*	*6,801*
	Russia	*2,393*	*1,663*
	Japan	*1,054*	*1,215*
	Non-OECD Europe	*1,853*	*1,169*
	India	*573*	*1,462*
Table 11.5	Transportation share of U.S. carbon dioxide emissions from fossil fuel consumption		
	1990		*31.6%*
	2005		*33.4%*
	2010		*32.7%*
Table 11.6	Motor gasoline share of transportation carbon dioxide emissions		63.8%
Table 11.10	Average annual carbon footprint (short tons of CO_2)		
	Cars		*5.7*
	Light trucks		*7.9*

The U.S. accounted for 23.2% of the World's carbon dioxide emissions in 1990 and 19.34% in 2008. Nearly half (42%) of the U.S. carbon emissions are from oil use.

Table 11.1
World Carbon Dioxide Emissions, 1990 and 2008

	1990		2008	
	Million metric tons	Percent of emissions from oil use	Million metric tons	Percent of emissions from oil use
United States	4,989	44%	5,838	42%
Canada	471	48%	595	48%
Mexico	302	77%	493	66%
OECD[a] Europe	4,149	45%	4,345	48%
OECD Asia	243	59%	522	39%
Japan	1,054	65%	1,215	47%
Australia/New Zealand	298	38%	464	33%
Russia	2,393	33%	1,663	20%
Non-OECD Europe	1,853	32%	1,169	25%
China	2,293	15%	6,801	15%
India	573	28%	1,462	25%
Non-OECD Asia	811	57%	1,838	48%
Middle East	704	70%	1,581	57%
Africa	659	46%	1,078	41%
Central & South America	695	76%	1,128	71%
Total World	21,488	42%	30,190	37%

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Outlook 2011*, Washington, DC, September 2011, Tables A10 and A11. (Additional resources: www.eia.doe.gov)

[a] OECD is the Organization for Economic Cooperation and Development. See Glossary for included countries.

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 11.2
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	500 years
Carbon dioxide (CO_2)	5-200[a]	1	1	1
Methane (CH_4)	12	72	25	8
Nitrous oxide (N_2O)	114	289	298	153
HFCs[b], PFCs[c], and sulfur hexafluoride				
HFC-23	270	12,000	14,800	12,200
HFC-125	29	6,350	3,500	1,100
HFC-134a	14	3,830	1,430	435
HFC-152a	1	437	124	38
HFC-227ea	34	5,310	3,220	1,040
Perfluoromethane (CF_4)	50,000	5,210	7,390	11,200
Perfluoroethane (C_2F_6)	10,000	8,630	12,200	18,200
Sulfur hexafluoride (SF_6)	3,200	16,300	22,800	32,600

Source:
Solomon, S. et al., "Technical Summary," in *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007. (Additional resources: www.ipcc.ch)

Note: The typical uncertainty for global warming potentials is estimated by the Intergovernmental Panel on Climate Change ± 35 percent.

[a] No single lifetime can be defined for carbon dioxide due to different rates of uptake by different removal processes.
[b] Hydrofluorocarbons
[c] Perfluorocarbons

Carbon dioxide emissions in 2010 were 12% higher than in 1990. Carbon dioxide accounts for the majority of greenhouse gases.

Table 11.3
U.S. Emissions of Greenhouse Gases, based on Global Warming Potential, 1990–2010
(million metric tonnes carbon dioxide equivalent[a])

	Carbon dioxide	Methane	Nitrous oxide	High GWP gases[b]	Total
1990	5,067.0	668.2	316.1	90.1	6,141.4
2005	5,067.0	625.7	331.6	139.0	6,163.3
2006	5,960.0	664.7	336.8	138.6	7,100.1
2007	6,065.2	656.1	334.7	143.1	7,199.1
2008	5,876.1	667.9	316.9	139.0	6,999.9
2009	5,455.2	672.2	303.9	131.4	6,562.7
2010	5,660.9	666.6	305.9	142.5	6,775.9

Source:
U.S. Environmental Protection Agency, *Inventory of U. S. Greenhouse Gas Emissions and Sinks: 1990-2010*, EPA 430-R-12-001, April 2012, http://www.epa.gov/climatechange/emissions/downloads12/US-GHG-Inventory-2012-Main-Text.pdf

Note: This greenhouse gas emissions inventory includes two "adjustments to energy consumption" which make the data different from Table 11.5. The adjustments are as follows:
(1) Emissions from U.S. Territories are included.
(2) International bunker fuels and military bunker fuels are excluded from the U.S. total.

[a] Carbon dioxide equivalents are computed by multiplying the weight of the gas being measured by its estimated Global Warming Potential (See Table 11.2).
[b] GWP = Global warming potential. Includes HFC-hydrofluorocarbons; PFC-perfluorocarbons; and SF_6-sulfur hexaflouride.

Though the transportation sector accounts for the largest share of carbon dioxide emissions, the industrial sector accounts for the largest share of total greenhouse gas emissions.

Table 11.4
Total U.S. Greenhouse Gas Emissions by End-Use Sector, 2010
(million metric tonnes carbon dioxide equivalent[a])

	Carbon dioxide	Methane	Nitrous oxide	Hydroflurocarbons, perflurocarbons, sulfur hexafluoride	Total greenhouse gas emissions
Residential	1,190.0	3.7	9.3	23.5	1,226.5
Commercial	1,002.9	126.9	13.5	27.6	1,170.9
Agricultural	82.6	207.2	231.1	0.1	521.0
Industrial	1,625.9	327.2	33.0	32.9	2,019.0
Transportation	1,759.5	1.6	19.0	58.4	1,838.5
Transportation share of total	31.1%	0.2%	6.2%	41.0%	27.1%
Total greenhouse gas emissions	5,660.9	666.6	305.9	142.5	6,775.9

Source:
U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2010*. EPA 430-R-12-001, April 2012. (Additional resources: http://www.epa.gov/climatechange/emissions/usinventoryreport.html)

Note: Totals may not sum due to rounding.

[a] Carbon dioxide equivalents are computed by multiplying the weight of the gas being measured by its estimated Global Warming Potential (See Table 11.2).

Gases which contain carbon can be measured in terms of the full molecular weight of the gas or just in terms of their carbon content. This table presents carbon dioxide gas. The ratio of the weight of carbon to carbon dioxide is 0.2727. The transportation sector accounts for approximately one-third of carbon emissions.

Table 11.5
U.S. Carbon Emissions from Fossil Fuel Consumption
by End-Use Sector, 1990–2010[a]
(million metric tonnes of carbon dioxide)

	End use sector				Transportation	CO_2 from
	Residential	Commercial	Industrial	Transportation	percentage	all sectors
1990	931.4	757.0	1,533.1	1,489.0	31.6%	4,710.5
2005	1,214.7	1,027.2	1,553.3	1,901.3	33.4%	5,696.5
2006	1,152.4	1,007.6	1,560.2	1,882.6	33.6%	5,602.8
2007	1,205.2	1,047.7	1,559.8	1,899.0	33.2%	5,711.7
2008	1,192.2	1,041.1	1,503.8	1,794.5	32.4%	5,531.6
2009	1,125.5	978.0	1,328.6	1,732.4	33.5%	5,164.5
2010	1,183.7	997.1	1,415.4	1,750.0	32.7%	5,346.2
	Average annual percentage change					
1990–2010	1.2%	1.4%	-0.4%	0.8%		0.6%
2005–2010	-0.5%	-0.6%	-1.8%	-1.6%		-1.3%

Source:
U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2010*. EPA 430-R-12-001, April 2012. (Additional resources: http://www.epa.gov/climatechange/emissions/usinventoryreport.html)

[a] Includes energy from petroleum, coal, and natural gas. Electric utility emissions are distributed across consumption sectors.

Most U.S. transportation sector carbon dioxide emissions come from petroleum fuels (97.5%). Motor gasoline has been responsible for about two-thirds of U.S. carbon dioxide emissions over the last twenty years.

Table 11.6
U.S. Carbon Emissions from Fossil Fuel Combustion in the Transportation End-Use Sector

	1990		2005		2010	
Fuel	Emissions	Percentage	Emissions	Percentage	Emissions	Percentage
			Petroleum			
Motor gasoline	983.7	66.1%	1,187.8	62.5%	1,117.0	63.8%
LPG[a]	1.4	0.1%	1.7	0.1%	1.8	0.1%
Jet fuel	176.2	11.8%	194.2	10.2%	140.5	8.0%
Distillate fuel	262.9	17.7%	458.1	24.1%	418.9	23.9%
Residual fuel	22.6	1.5%	19.3	1.0%	25.3	1.4%
Lubricants	3.1	0.2%	2.4	0.1%	1.9	0.1%
Aviation gas	1,449.9	97.4%	1,863.5	98.0%	1,705.4	97.5%
Subtotal	**983.7**	**66.1%**	**1,187.8**	**62.5%**	**1,117.0**	**63.8%**
			Other energy			
Natural gas	36.0	2.4%	33.1	1.7%	40.1	2.3%
Electricity[b]	3.0	0.2%	4.7	0.2%	4.5	0.3%
Total[c]	**1,488.9**	**100.0%**	**1,901.3**	**100.0%**	**1,750.0**	**100.0%**

Source:
U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2010*. EPA 430-R-12-001, April 2012. (Additional resources: http://www.epa.gov/climatechange/emissions/usinventoryreport.html)

[a] Liquified petroleum gas.
[b] Share of total electric utility carbon dioxide emissions weighted by sales to the transportation sector.
[c] Totals may not equal sum of components due to independent rounding.

Highway vehicles are responsible for the majority of greenhouse gas emissions in the transportation sector.

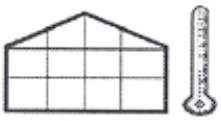
Table 11.7
Transportation Greenhouse Gas Emissions by Mode, 1990 and 2010
(Million metric tonnes of carbon dioxide equivalent)

	Carbon dioxide	Methane	Nitrous oxide
1990			
Highway total	1,190.5	4.2	40.4
Cars, light trucks, motorcycles	952.2	4.0	39.6
Medium & heavy trucks and buses	238.3	0.2	0.8
Water	44.5	0.0	0.6
Air	179.3	0.2	1.7
Rail	38.5	0.1	0.3
Pipeline	36.0	0.0	0.0
Other	0.0	0.2	0.9
Total[a]	1,489.0	4.7	43.9
2010			
Highway total	1,482.5	1.4	16.6
Cars, light trucks, motorcycles	1,077.2	1.3	15.6
Medium & heavy trucks and buses	405.3	0.1	1.0
Water	42.6	0.0	0.6
Air	142.4	0.1	1.3
Rail	43.5	0.1	0.3
Pipeline	38.8	0.0	0.0
Other	0.0	0.3	1.6
Total[a]	1,750.0	1.9	20.4
Percent change 1990–2010			
Highway total	24.5%	-66.7%	-58.9%
Cars, light trucks, motorcycles	13.1%	-67.5%	-60.6%
Medium & heavy trucks and buses	70.1%	-50.0%	25.0%
Water	-4.3%	0.0%	0.0%
Air	-20.6%	-50.0%	-23.5%
Rail	13.0%	0.0%	0.0%
Pipeline	7.8%	0.0%	0.0%
Other	0.0%	0.0%	77.8%
Total[a]	17.5%	-59.6%	-53.5%

Source:
U.S. Environmental Protection Agency, *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2010*, Tables 3-12, 3-13, 3-14, April 2012. (Additional resources: www.epa.gov/climatechange/emissions)

Note: Emissions from U.S. Territories, International bunker fuels, and military bunker fuels are not included.

[a] The sums of subcategories may not equal due to rounding.

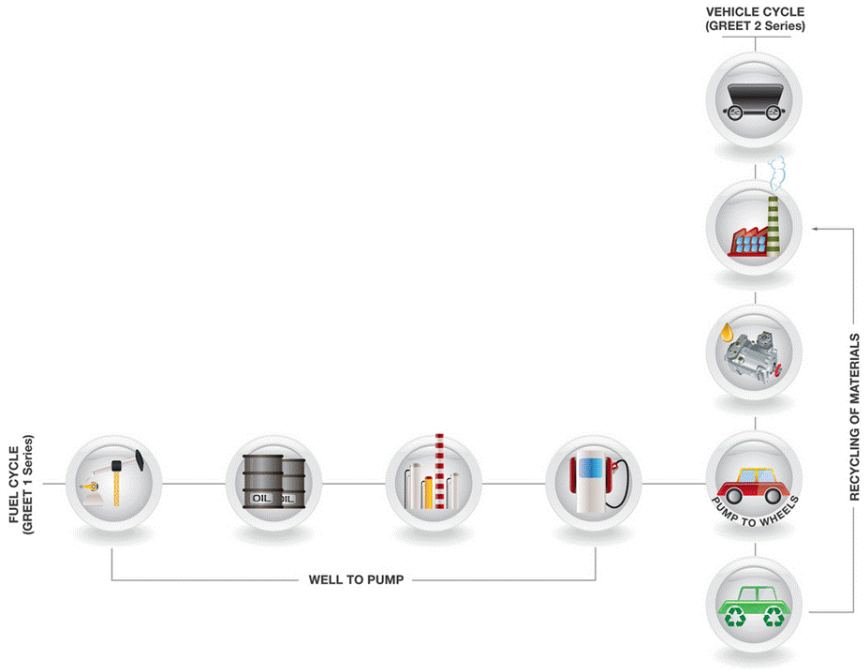


The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model

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 emission impacts of various vehicle and fuel combinations on a full fuel-cycle/vehicle-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 2012 version for fuel-cycle analysis and GREET 2.7 version for vehicle-cycle analysis.

Figure 11.1. GREET Model



For a given vehicle and fuel system, GREET separately calculates the following:

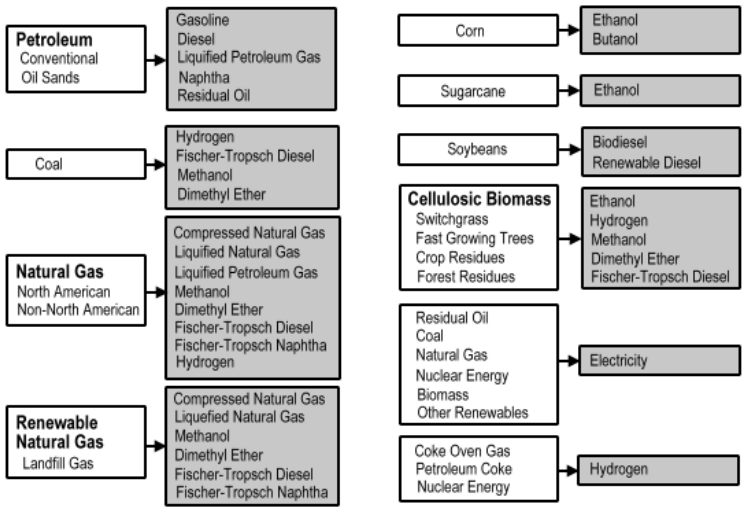
- Consumption of total energy (energy in non-renewable and renewable sources), fossil fuels (petroleum, natural gas, and coal together), petroleum, coal and natural gas.
- Emissions of CO_2-equivalent greenhouse gases - primarily carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

- Emissions of six 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 ($PM_{2.5}$),and sulfur oxides (SOx).

GREET includes more than 100 fuel production pathways and more than 80 vehicle/fuel systems. These vehicle/fuel systems cover all major vehicle technologies in the market and R&D arena:

- Conventional spark-ignition (SI) engines
- Direct-injection, SI engines
- Direct injection, compression-ignition (CI) engines
- Grid-independent hybrid electric vehicles (both SI and CI)
- Grid-connected (or plug-in) hybrid electric vehicles (both SI and CI)
- Battery-powered electric vehicles
- Fuel-cell vehicles

Figure 11.2. GREET Model Feedstocks and Fuels



To address technology improvements over time, GREET simulates vehicle/fuel systems over the period from 1990 to 2035, in five-year intervals.

For additional information about the GREET model, see the GREET Web site, or contact:

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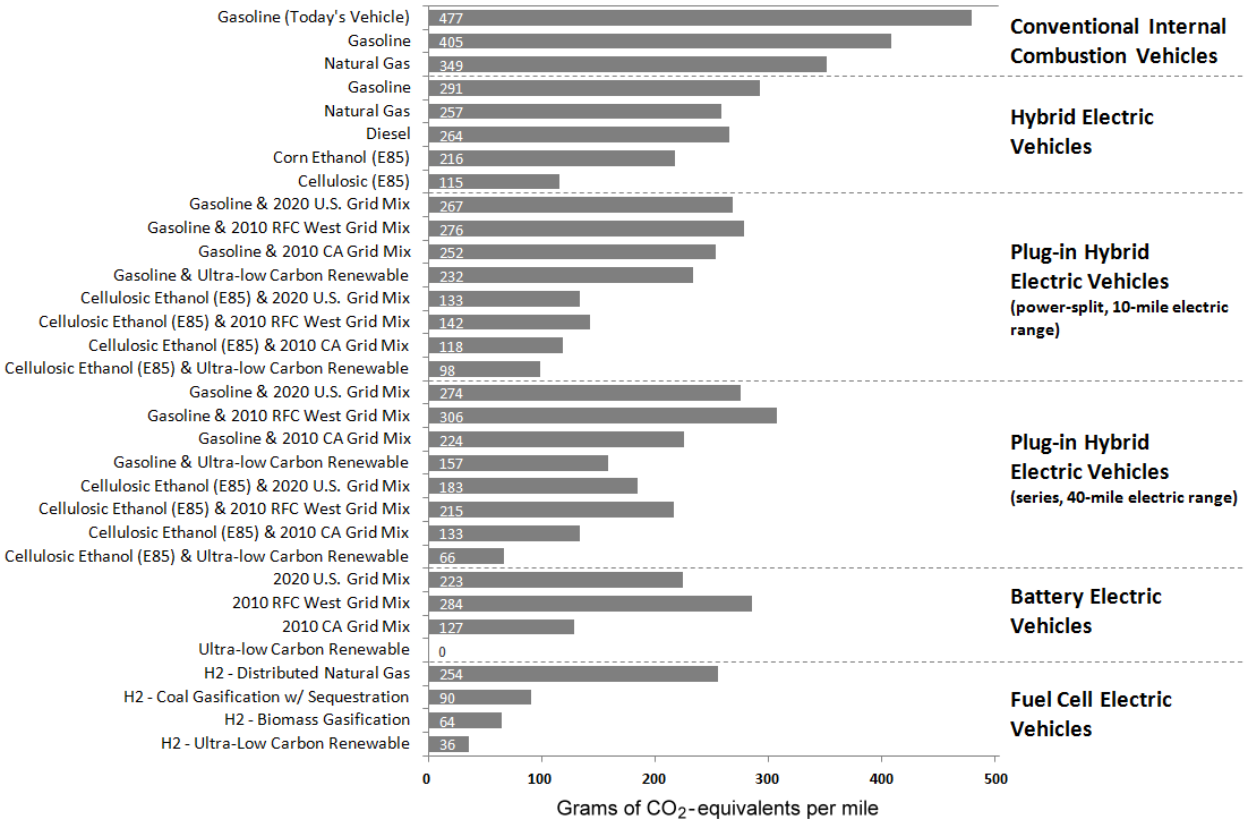
These are results from the GREET model (see preceding pages for description). California's (CA) grid mix was chosen due to the high renewable energy mix in that state. While in contrast, West Virginia's (WV) grid mix is primarily coal. Both of these are compared against the average U.S. grid mix for various vehicle technologies.

Figure 11.3. Well-to-Wheel Emissions for Various Fuels and Vehicle Technologies



Source: Argonne National Laboratory, GREET 1 2012 Model.

Note: H2 = hydrogen; High-T = high-temperature.

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. The equation to calculate carbon footprint uses results of the GREET model version 1.8.

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

where:

CO_2 = (Tailpipe CO_2 + Upstream Greenhouse Gases) in grams per million Btu

LHV = Lower (or net) Heating Value in million Btu per gallon

CH_4 = Tailpipe CO_2 equivalent methane in grams per mile

N_2O = Tailpipe CO_2 equivalent nitrous oxide in grams per mile

Note: The Environmental Protection Agency publishes tailpipe emissions in the *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 through 2010*, www.epa.gov/otaq/fetrends.htm.

The carbon footprint for all classifications of cars declined between 1975 and 2011. Midsize cars have experienced the greatest reduction in carbon footprint with a decrease of 60%.

Table 11.8
Sales-Weighted Annual Carbon Footprint of New Domestic and Import Cars by Size Class, Model Years 1975–2011[a]
(short tons of CO_2)

	Cars			Wagons			Non-truck SUVs		
Sales period	Small	Midsize	Large	Small	Midsize	Large	Small	Midsize	Large
1975	10.2	13.7	14.2	8.4	14.1	15.6	15.5	12.6	14.2
1980	7.2	8.6	9.8	6.5	8.8	9.8	b	11.4	9.6
1981	6.6	8.1	9.1	6.2	8.1	9.4	b	11.1	b
1982	6.4	7.8	9.0	6.1	7.9	9.7	7.9	9.9	b
1983	6.4	7.8	9.2	5.8	7.7	9.5	8.1	7.7	b
1984	6.4	7.8	9.1	5.9	7.5	9.4	8.3	8.6	b
1985	6.3	7.5	8.4	5.8	7.4	8.9	b	8.7	b
1986	6.2	7.2	7.8	6.0	7.2	8.5	8.0	8.8	b
1987	6.2	7.2	7.8	6.1	7.3	8.4	8.0	8.6	b
1988	6.2	7.0	7.7	6.0	7.1	8.2	8.1	8.5	b
1989	6.2	7.0	7.8	5.9	7.3	8.3	8.1	8.7	b
1990	6.3	7.1	7.9	6.3	7.4	8.2	8.0	8.9	b
1991	6.2	7.2	7.9	6.1	7.2	8.2	8.2	8.7	b
1992	6.2	7.3	7.9	6.2	7.1	8.2	8.0	8.9	b
1993	6.1	7.2	7.7	5.8	7.1	8.3	8.1	9.2	b
1994	6.2	7.2	7.8	5.7	7.2	8.2	7.5	8.8	b
1995	6.1	7.2	7.6	5.6	7.0	8.2	6.4	9.1	b
1996	6.1	7.1	7.7	5.9	7.1	8.1	6.4	9.0	9.8
1997	6.1	7.0	7.6	5.8	7.1	b	6.7	9.0	10.1
1998	6.1	6.9	7.6	5.8	7.1	b	7.3	8.7	9.0
1999	6.2	6.9	7.5	5.9	7.1	b	6.9	8.5	10.4
2000	6.2	6.9	7.3	6.4	6.9	b	8.0	8.6	10.5
2001	6.1	6.9	7.3	6.9	7.0	b	7.0	8.3	8.9
2002	6.1	6.8	7.2	7.2	6.8	b	7.0	8.2	9.0
2003	6.1	6.6	7.2	6.2	6.9	b	6.5	7.9	8.8
2004	6.1	6.5	7.2	6.0	7.1	8.5	6.4	7.9	8.4
2005	6.0	6.3	7.1	5.8	7.2	8.4	6.3	7.6	8.0
2006	6.0	6.3	7.2	6.0	7.1	8.5	b	7.4	7.9
2007	5.9	6.0	7.2	5.9	6.8	8.5	8.6	7.1	8.1
2008	5.9	6.0	6.9	5.8	7.0	8.6	8.6	6.9	7.9
2009	5.6	5.8	6.6	5.6	6.7	8.7	8.5	6.7	7.6
2010	5.5	5.5	6.6	5.5	6.5	b	8.5	6.5	6.9
2011	5.4	5.4	6.1	5.4	7.5	b	b	6.4	6.8
				Average annual percentage change					
1975–2011	-1.8%	-2.6%	-2.3%	-1.2%	-1.7%	[c]	[c]	-1.9%	-2.0%
2001–2011	-1.2%	-2.4%	-1.8%	-2.4%	0.7%	[c]	[c]	-2.6%	-2.7%

Source:
Calculated using fuel economy from the U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2011*, March 2012. See page 11-12 for details. (Additional resources: www.epa.gov/otaq/fetrends.htm)

[a] Annual carbon footprint is based on 15,000 miles of annual driving. Includes tailpipe plus upstream emissions.
[b] No vehicles in this category were sold in this model year.
[c] Data are not available.

The annual carbon footprint of light trucks decreased for all classes of light trucks between 1975 and 2011. In the last ten years, midsize truck SUVs experienced the greatest decline with about 23% while small truck SUVs experienced a 10% gain in carbon emissions.

Table 11.9
Sales-Weighted Annual Carbon Footprint of New Domestic and Import Light Trucks by Size Class, Model Years 1975–2011[a]
(short tons of CO_2)

	Pickups			Vans			Truck SUVs		
Sales period	Small	Midsize	Large	Small	Midsize	Large	Small	Midsize	Large
1975	8.3	8.9	14.2	9.1	14.0	14.8	11.1	15.8	17.9
1980	7.7	7.2	10.8	9.8	11.1	11.7	9.9	13.1	13.0
1981	6.6	7.1	10.0	10.1	10.4	11.1	9.2	12.0	12.2
1982	6.8	7.0	10.0	8.6	10.4	11.6	9.5	11.5	9.9
1983	6.9	7.1	10.3	9.5	10.0	11.5	8.9	10.2	10.6
1984	7.2	7.3	10.5	7.3	9.7	11.4	8.7	10.1	11.0
1985	7.0	7.3	10.6	7.3	9.4	11.6	8.5	9.6	11.0
1986	7.2	7.2	10.2	7.3	9.0	10.6	7.9	9.6	11.1
1987	7.2	7.4	10.5	7.7	8.8	11.0	7.7	9.6	11.0
1988	7.5	7.4	10.3	7.6	8.6	11.0	7.7	9.7	11.2
1989	7.8	7.5	10.3	7.5	8.6	11.1	8.2	9.7	11.2
1990	7.5	7.6	10.3	7.8	8.6	11.3	8.0	9.8	11.2
1991	7.5	7.6	10.2	7.8	8.5	11.2	7.8	9.4	11.5
1992	7.6	7.9	10.2	6.9	8.6	11.0	7.9	9.6	11.9
1993	7.1	7.9	10.0	6.6	8.4	11.0	8.0	9.4	11.4
1994	7.5	7.8	10.2	6.9	8.5	11.0	7.9	9.6	11.4
1995	7.7	7.6	10.4	7.1	8.4	10.9	7.9	9.6	11.2
1996	7.6	7.5	10.2	7.1	8.2	10.9	6.7	9.4	10.8
1997	7.5	7.7	9.9	[b]	8.3	10.0	8.6	9.2	10.7
1998	7.6	7.8	10.0	[b]	8.0	10.2	8.0	9.1	10.9
1999	8.0	8.3	10.1	[b]	8.1	10.4	8.0	9.0	10.9
2000	7.1	8.2	9.7	[b]	8.0	10.4	8.4	9.0	10.6
2001	7.1	8.6	9.9	[b]	7.8	10.5	7.8	8.9	10.3
2002	8.1	8.9	10.0	[b]	7.9	10.4	7.8	8.8	9.9
2003	8.0	8.2	9.9	[b]	7.8	10.0	7.7	8.6	10.1
2004	8.3	8.6	9.8	[b]	7.8	9.6	7.9	8.5	10.1
2005	7.2	7.9	9.6	[b]	7.7	9.6	8.1	8.4	9.6
2006	7.0	7.8	9.5	[b]	7.6	9.6	8.7	8.2	9.4
2007	[b]	8.0	9.5	[b]	7.7	9.4	8.3	7.9	9.1
2008	[b]	7.8	9.4	6.1	7.6	9.3	8.2	7.6	9.0
2009	[b]	7.6	9.2	6.2	7.5	9.3	9.1	7.2	8.4
2010	[b]	7.5	9.1	6.1	7.5	9.3	8.6	7.0	8.3
2011	[b]	6.8	8.8	[b]	7.0	10.2	8.6	6.8	8.0
				Average annual percentage change					
1975-2011	[c]	-0.7%	-1.3%	[c]	-1.9%	-1.0%	-0.7%	-2.3%	-2.2%
2001-2011	[c]	-2.3%	-1.2%	[c]	-1.1%	-0.3%	1.0%	-2.7%	-2.5%

Source:
Calculated using fuel economy from the U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2011*, March 2012. See page 11-12 for details. (Additional resources: www.epa.gov/otaq/fetrends.htm)

Note: Includes light trucks of 8,500 lbs. or less.

[a] Annual carbon footprint is based on 15,000 miles of annual driving. Includes tailpipe plus upstream emissions.
[b] No vehicles in this category were sold in this model year.
[c] Data are not available.

Between 1975 and 2011, the carbon footprint for light vehicles sold in the United States dropped dramatically. Cars experienced the greatest decrease at 51.5% while the carbon footprint for light trucks decreased by 41.7%.

Table 11.10
Average Annual Carbon Footprint by Vehicle Classification, 1975 and 2011[a]
(short tons of CO_2)

	Market share		Carbon footprint		Percent change
Fuel	1975	2011	1975	2011	1975 - 2011
Cars					
Small	40.0%	17.7%	10.2	5.4	-46.5%
Midsize	16.0%	21.4%	13.7	5.4	-60.4%
Large	15.2%	9.9%	14.2	6.1	-56.7%
Small wagon	4.7%	3.9%	8.4	5.4	-35.2%
Midsize wagon	2.8%	0.0%	14.1	7.5	-46.8%
Large wagon	1.9%	b	15.6	b	c
Small non-truck SUV	0.1%	b	15.5	b	c
Midsize non-truck SUV	0.1%	6.3%	12.6	6.4	-49.4%
Large non-truck SUV	0.1%	3.1%	14.2	6.8	-52.0%
Total cars	**80.8%**	**62.4%**	**11.8**	**5.7**	**-51.5%**
Light trucks					
Small van	0.0%	b	9.1	b	c
Midsize van	3.0%	4.3%	14.0	7.0	-49.6%
Large van	1.5%	0.1%	14.8	10.2	-31.3%
Small truck SUV	0.5%	0.8%	11.1	8.6	-22.5%
Midsize truck SUV	1.1%	8.7%	15.8	6.8	-56.7%
Large truck SUV	0.0%	9.6%	17.9	8.0	-55.1%
Small pickup	1.6%	b	8.3	b	c
Midsize pickup	0.5%	0.6%	8.9	6.8	-23.3%
Large pickup	11.0%	13.5%	14.2	8.8	-38.3%
Total cars	19.2%	37.6%	13.6	7.9	-41.7%

Source:
Calculated using fuel economy from the U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2011*, March 2012. See page 11-10 for details. (Additional resources: www.epa.gov/otaq/fetrends.htm)

[a] Annual carbon footprint is based on 15,000 miles of annual driving. Includes tailpipe and upstream emissions.
[b] Data are not available.
[c] Not applicable.

The amount of carbon dioxide released into the atmosphere by a vehicle is primarily determined by the carbon content of the fuel. However, there is a small portion of the fuel that is not oxidized into carbon dioxide when the fuel is burned. The Environmental Protection Agency (EPA) has published information on carbon dioxide emissions from gasoline and diesel which takes the oxidation factor into account and is based on the carbon content used in EPA's fuel economy analyses. The other fuels listed come from the Energy Information Administration.

Table 11.11
Carbon Dioxide Emissions from a Gallon of Fuel

	Grams per gallon	Kilograms per gallon	Pounds per gallon
Gasoline	8,788	8.8	19.4
Diesel	10,084	10.1	22.2
LPG	5,805	5.8	12.8
Propane	5,760	5.8	12.7
Aviation gasoline	8,345	8.3	18.4
Jet fuel	9,569	9.6	21.1
Kerosene	9,751	9.8	21.5
Residual fuel	11,791	11.8	26.0

Sources:
Gasoline and Diesel: U.S. Environmental Protection Agency, "Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel," February 2009. (Additional resources: www.epa.gov/OMS)
All others: Energy Information Administration, Voluntary Reporting of Greenhouse Gases Program, Fuel and Energy Source Codes and Emission Coefficients.