

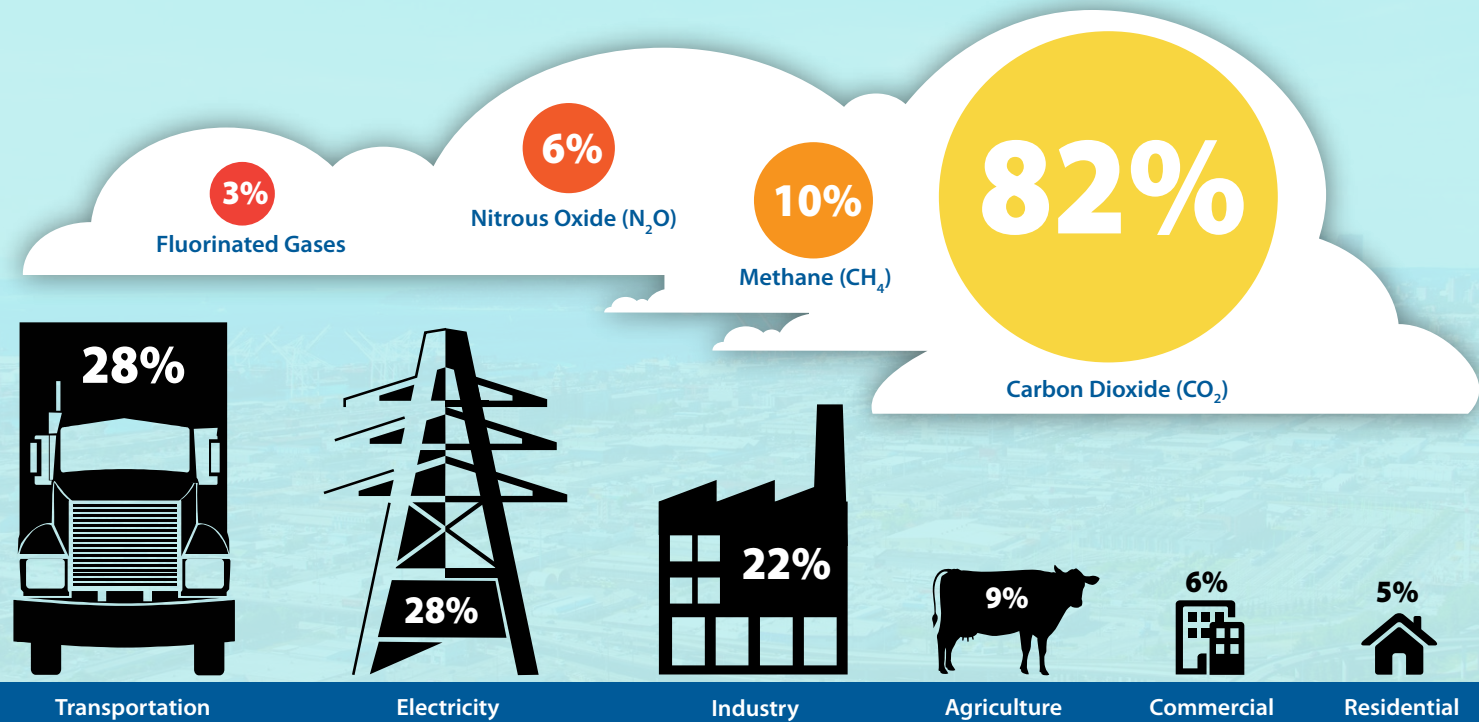
Fast Facts

1990-2016

National-Level U.S. Greenhouse Gas Inventory

U.S. Greenhouse Gas Emissions in 2016

Total U.S. Greenhouse Gas Emissions by Economic Sector in 2016



U.S. Greenhouse Gas Emissions

2016 Total Emissions	2015-2016 Change	1990-2016 Change
6,511 million metric tons of CO ₂ equivalent	↓ 1.9% total emissions	↑ 2.4% total emissions
CO ₂ emissions from fossil fuel combustion: 76.3% of total emissions	↓ 2.0% CO ₂ emissions	↑ 3.7% CO ₂ emissions
CO ₂ removals by forests and other lands: 11.6% of total emissions	↓ 1.6% CO ₂ emissions from fossil fuel combustion	↑ 4.8% CO ₂ emissions from fossil fuel combustion

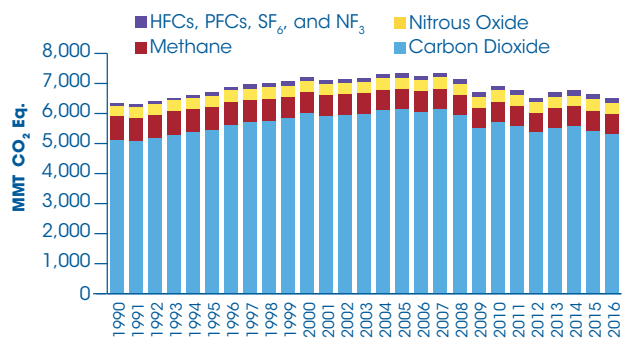
To learn more about the inventory, visit www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks, or explore the data at www3.epa.gov/climatechange/ghgemissions/inventoryexplorer.



April 2018
EPA 430-F-18-002

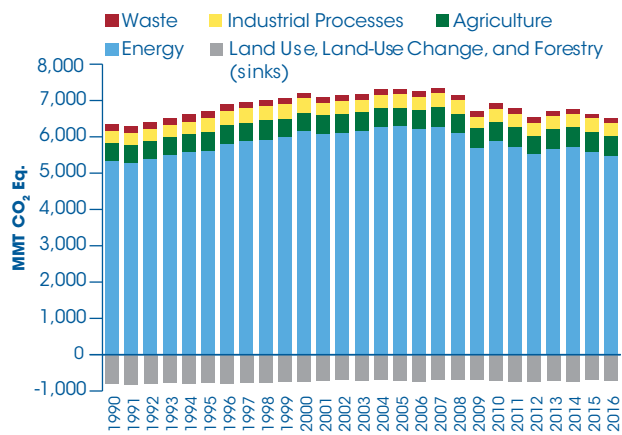
U.S. Greenhouse Gas Emissions

by Gas



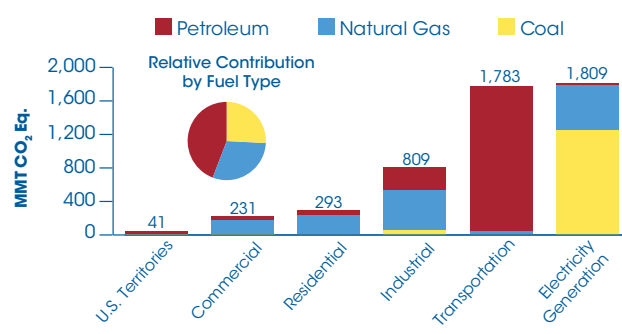
U.S. Greenhouse Gas Emissions/Sinks

by Chapter/IPCC Sector



2016 U.S. CO₂ Emissions

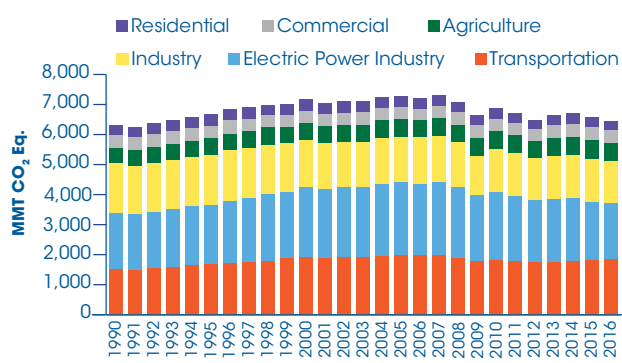
from Fossil Fuel Combustion by Fuel Type and End-Use Sector



Note: Electricity generation also includes emissions of less than 0.5 MMT CO₂ Eq. from geothermal-based electricity generation.

U.S. Greenhouse Gas Emissions

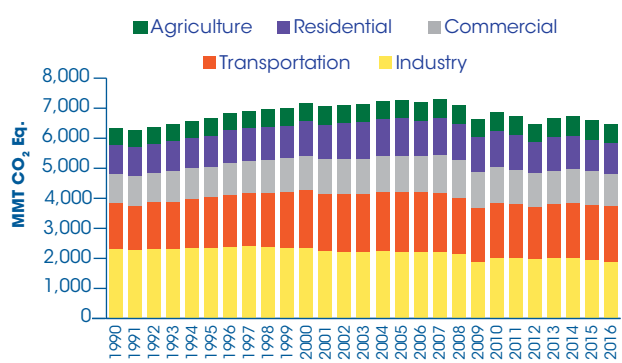
Allocated to Economic Sectors



Note: Does not include U.S. territories.

U.S. Greenhouse Gas Emissions

with Electricity Distributed to Economic Sectors



Note: Does not include U.S. territories.

* Additional sources that do not exceed 0.05 MMT CO₂ Eq. in all listed years:

CO₂: Abandoned Oil and Gas Wells, Magnesium Production and Processing.

CH₄: Ferroalloy Production, Silicon Carbide Production and Consumption, Iron and Steel Production and Metallurgical Coke Production, Incineration of Waste.

PFCs: Substitution of Ozone Depleting Substances.

+ Does not exceed 0.05 MMT CO₂ Eq.

° Emissions from wood biomass, ethanol, and biodiesel consumption are not included specifically in summing energy sector totals. Net carbon fluxes from changes in biogenic carbon reservoirs are accounted for in the estimates for land use, land-use change, and forestry.

° Emissions from international bunker fuels are not included in totals.

° LULUCF emissions of CH₄ and N₂O are reported separately from gross emissions totals.

° Total gross emissions exclude land use, land-use change, and forestry. Net emissions include this category.

Note: Totals may not sum due to independent rounding.

U.S. Greenhouse Gas Emissions and Sinks (MMT CO₂ Equivalents)

Gas/Source*	1990	2005	2012	2013	2014	2015	2016
CO₂	5,121.3	6,132.0	5,366.7	5,519.6	5,568.8	5,420.8	5,310.9
Fossil Fuel Combustion	4,740.3	5,746.9	5,024.4	5,156.9	5,200.3	5,049.3	4,966.0
Electric Power Sector	1,820.8	2,400.9	2,022.2	2,038.1	2,038.0	1,900.7	1,809.3
Transportation	1,467.6	1,855.8	1,661.9	1,677.6	1,717.1	1,735.5	1,782.6
Industrial	858.8	855.7	812.9	843.3	824.9	809.5	809.1
Residential	338.3	357.8	282.5	329.7	345.3	316.8	292.5
Commercial	227.2	227.0	201.3	225.7	233.6	245.4	231.3
U.S. Territories	27.6	49.7	43.5	42.5	41.4	41.4	41.4
Non-Energy Use of Fuels	119.5	138.9	108.0	123.5	118.9	125.6	112.2
Iron and Steel Production and Metallurgical Coke Production	101.6	68.2	55.6	53.5	58.4	47.8	42.3
Cement Production	33.5	46.2	35.3	36.4	39.4	39.9	39.4
Petrochemical Production	21.2	26.8	26.5	26.4	26.5	28.1	28.1
Natural Gas Systems	29.8	22.5	23.3	24.8	25.3	24.9	25.5
Petroleum Systems	7.7	11.7	19.3	22.6	26.3	28.8	22.8
Lime Production	11.7	14.6	13.8	14.0	14.2	13.3	12.9
Ammonia Production	13.0	9.2	9.4	10.0	9.6	10.9	12.2
Other Process Uses of Carbonates	6.3	7.6	9.1	11.5	13.0	12.3	11.0
Incineration of Waste	8.0	12.5	10.4	10.4	10.6	10.7	10.7
Urea Fertilization	2.4	3.5	4.3	4.4	4.5	4.9	5.1
Carbon Dioxide Consumption	1.5	1.4	4.0	4.2	4.5	4.5	4.5
Urea Consumption for Non-Agricultural Purposes	3.8	3.7	4.4	4.1	1.5	4.2	4.0
Liming	4.7	4.3	6.0	3.9	3.6	3.8	3.9
Ferroalloy Production	2.2	1.4	1.9	1.8	1.9	2.0	1.8
Soda Ash Production	1.4	1.7	1.7	1.7	1.7	1.7	1.7
Titanium Dioxide Production	1.2	1.8	1.5	1.7	1.7	1.6	1.6
Aluminum Production	6.8	4.1	3.4	3.3	2.8	2.8	1.3
Glass Production	1.5	1.9	1.2	1.3	1.3	1.3	1.2
Phosphoric Acid Production	1.5	1.3	1.1	1.1	1.0	1.0	1.0
Zinc Production	0.6	1.0	1.5	1.4	1.0	0.9	0.9
Lead Production	0.5	0.6	0.5	0.5	0.5	0.5	0.5
Silicon Carbide Production and Consumption	0.4	0.2	0.2	0.2	0.2	0.2	0.2
Wood Biomass, Ethanol, and Biodiesel Consumption [°]	219.4	230.7	287.7	316.4	324.3	310.4	309.3
International Bunker Fuels [°]	103.5	113.1	105.8	99.8	103.4	110.9	116.6
CH₄[°]	779.9	688.6	662.5	662.6	664.0	665.4	657.4
Enteric Fermentation	164.2	168.9	166.7	165.5	164.2	166.5	170.1
Natural Gas Systems	195.2	169.1	159.6	163.8	164.3	166.3	163.5
Landfills	179.6	132.7	117.0	113.3	112.7	111.7	107.7
Manure Management	37.2	56.3	65.6	63.3	62.9	66.3	67.7
Coal Mining	96.5	64.1	66.5	64.6	64.6	61.2	53.8
Petroleum Systems	39.8	32.1	32.7	36.6	38.6	38.1	38.6
Wastewater Treatment	15.7	15.8	15.1	14.9	15.0	15.1	14.8
Rice Cultivation	16.0	16.7	11.3	11.5	12.7	12.3	13.7
Stationary Combustion	8.6	7.8	7.4	8.8	8.9	7.9	7.3
Abandoned Oil and Gas Wells	6.5	6.9	7.0	7.0	7.1	7.2	7.1
Abandoned Underground Coal Mines	7.2	6.6	6.2	6.2	6.3	6.4	6.7
Mobile Combustion	12.7	9.4	5.1	4.7	4.2	3.8	3.6
Composting	0.4	1.9	1.9	2.0	2.1	2.1	2.1
Field Burning of Agricultural Residues	0.2	0.2	0.3	0.3	0.3	0.3	0.3
Petrochemical Production	0.2	0.1	0.1	0.1	0.1	0.2	0.2
International Bunker Fuels [°]	0.2	0.1	0.1	0.1	0.1	0.1	0.1
N₂O[°]	354.8	357.8	335.8	363.2	361.2	379.6	369.5
Agricultural Soil Management	250.5	253.5	247.9	276.6	274.0	295.0	283.6
Stationary Combustion	11.1	17.5	16.9	18.7	19.0	18.1	18.6
Mobile Combustion	41.7	38.8	24.3	22.5	20.6	19.3	18.4
Manure Management	14.0	16.5	17.5	17.5	17.5	17.7	18.1
Nitric Acid Production	12.1	11.3	10.5	10.7	10.9	11.6	10.2
Adipic Acid Production	15.2	7.1	5.5	3.9	5.4	4.3	7.0
Wastewater Treatment	3.4	4.4	4.6	4.7	4.8	4.8	5.0
N ₂ O from Product Uses	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Caprolactam, Glyoxal, and Glyoxylic Acid Production	1.7	2.1	2.0	2.0	2.0	2.0	2.0
Composting	0.3	1.7	1.7	1.8	1.9	1.9	1.9
Incineration of Waste	0.5	0.4	0.3	0.3	0.3	0.3	0.3
Semiconductor Manufacture	+	0.1	0.2	0.2	0.2	0.2	0.2
Field Burning of Agricultural Residues	0.1	0.1	0.1	0.1	0.1	0.1	0.1
International Bunker Fuels [°]	0.9	1.0	0.9	0.9	0.9	0.9	1.0
HFCs, PFCs, SF₆, and NF₃	99.7	141.9	163.8	163.7	169.3	172.4	173.5
HFCs	46.6	123.0	150.5	151.1	156.7	160.8	162.3
Substitution of Ozone Depleting Substances	0.3	102.7	144.8	146.8	151.3	156.1	159.1
HCFC-22 Production	46.1	20.0	5.5	4.1	5.0	4.3	2.8
Semiconductor Manufacture	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Magnesium Production and Processing	+	+	+	0.1	0.1	0.1	0.1
PFCs	24.3	6.7	5.9	5.8	5.6	5.1	4.3
Semiconductor Manufacture	2.8	3.3	3.0	2.8	3.1	3.1	3.0
Aluminum Production	21.5	3.4	2.9	3.0	2.5	2.0	1.4
SF₆	28.8	11.8	6.7	6.3	6.4	5.9	6.2
Electrical Transmission and Distribution	23.1	8.3	4.7	4.5	4.7	4.3	4.3
Magnesium Production and Processing	5.2	2.7	1.6	1.5	1.0	0.9	1.0
Semiconductor Manufacture	0.5	0.7	0.3	0.4	0.7	0.7	0.8
NF₃	+	0.5	0.6	0.6	0.5	0.6	0.6
Semiconductor Manufacture	+	0.5	0.6	0.6	0.5	0.6	0.6
Total Emissions^d	6,355.6	7,320.3	6,528.8	6,709.1	6,763.1	6,638.1	6,511.3
LULUCF Emissions	10.6	23.0	26.1	19.2	19.6	38.2	38.1
LULUCF CH ₄ Emissions	6.7	13.3	15.0	10.9	11.2	22.4	22.4
LULUCF N ₂ O Emissions	3.9	9.7	11.1	8.3	8.4	15.8	15.7
LULUCF Carbon Stock Change	(830.2)	(754.2)	(779.5)	(755.0)	(760.0)	(733.4)	(754.9)
LULUCF Sector Net Total	(819.6)	(731.1)	(753.5)	(735.8)	(740.4)	(695.2)	(716.8)
Net Emissions (Sources and Sinks)	5,536.0	6,589.1	5,775.3	5,973.3	6,022.8	5,942.9	5,794.5

Global Warming Potentials (100-Year Time Horizon)

Gas	GWP
CO ₂	1
CH ₄	25
N ₂ O	298
HFC-23	14,800
HFC-32	675
HFC-43-10mee	1,640
HFC-125	3,500
HFC-134a	1,430
HFC-143a	4,470
HFC-152a	124
HFC-227ea	3,220
HFC-236fa	9,810
CF ₄	7,390
C ₂ F ₆	12,200
C ₃ F ₈	8,830
C ₄ F ₁₀	8,860
c-C ₄ F ₈	10,300
C ₅ F ₁₂	9,160
C ₆ F ₁₄	9,300
SF ₆	22,800
NF ₃	17,200

Global warming potential (GWP) is defined as the cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas. The GWP-weighted emissions of direct greenhouse gases in the U.S. inventory are presented in terms of equivalent emissions of carbon dioxide (CO₂), using units of million metric tons of carbon dioxide equivalents (MMT CO₂ Eq.).

Conversion:

1 million metric tons = 10⁹ metric tons = 10⁹ kg. The molecular weight of carbon is 12, and the molecular weight of oxygen is 16; therefore, the molecular weight of CO₂ is 44 (i.e., 12 + [16 × 2]), as compared to 12 for carbon alone. Thus, the weight ratio of carbon to carbon dioxide is 12/44.

Conversion from gigagrams of gas to million metric tons of carbon dioxide equivalents:

$$\text{MMT CO}_2 \text{ Eq.} = \left(\text{Gg of gas} \right) \times (\text{GWP}) \times \left(\frac{\text{MMT}}{1,000 \text{ Gg}} \right)$$

Source:
IPCC Fourth Assessment Report (2007)

Carbon Information

Conversion Factors to Energy Units and Carbon Contents by Fuel Type

The values in this table provide conversion factors from physical units to energy equivalent units and from energy units to carbon contents. These factors can be used as default factors, if local data are not available.

Fuel Type	Heat Content	Carbon (C) Content Coefficients	Carbon Dioxide (CO ₂) per Physical Unit
Solid Fuels	Million Btu/Metric Ton	kg C/Million Btu	kg CO₂/Metric Ton
Anthracite Coal	24.88	28.28	2,579.9
Bituminous Coal	26.33	25.44	2,456.1
Sub-bituminous Coal	18.89	26.50	1,835.5
Lignite	14.18	26.65	1,385.6
Coke	25.76	31.00	2,928.1
Unspecified Coal	27.58	25.34	2,562.3
Gas Fuels	Btu/Cubic Foot	kg C/Million Btu	kg CO₂/Cubic Foot
Natural Gas	1,037	14.46	0.0550
Liquid Fuels	Million Btu/Petroleum Barrel	kg C/Million Btu	kg CO₂/Petroleum Barrel
Motor Gasoline	5.06	19.46	361.0
Distillate Fuel Oil	5.77	20.17	426.7
Residual Fuel Oil	6.29	20.48	472.3
Jet Fuel	5.67	19.70	409.6
Aviation Gasoline	5.05	18.86	349.2
LPG	3.55	16.83	219.1
Kerosene	5.67	19.96	415.0
Still Gas	6.29	18.20	419.8
Petroleum Coke	6.10	27.85	622.9
Pentanes Plus	4.62	19.10	323.6
Unfinished Oils	5.83	20.31	434.2

Note: For fuels with variable heat contents and carbon content coefficients, this table presents 2016 U.S. average values. All factors are presented in gross calorific values (GCV) (i.e., higher heating values). LPG = liquefied petroleum gases.

Energy Units

Btu	British thermal unit	1 Btu
MBtu	Thousand Btu	1 × 10 ³ Btu
MMBtu	Million Btu	1 × 10 ⁶ Btu
BBtu	Billion Btu	1 × 10 ⁹ Btu
TBtu	Trillion Btu	1 × 10 ¹² Btu
QBtu	Quadrillion Btu	1 × 10 ¹⁵ Btu

For more information on calculating CO₂ emissions per kWh, download eGRID data at www.epa.gov/energy/egrid.

For other related information, see www.epa.gov/ghgemissions and <https://unfccc.int>.

Unit Conversions

1 pound	= 0.454 kilograms	= 16 ounces	
1 kilogram	= 2.205 pounds	= 35.27 ounces	
1 short ton	= 0.9072 metric tons	= 2,000 pounds	
1 cubic foot	= 0.02832 cubic meters	= 28.3168 liters	
1 cubic meter	= 35.315 cubic feet	= 1,000 liters	
1 U.S. gallon	= 3.78541 liters	= 0.03175 barrels	= 0.02381 barrels petroleum
1 liter	= 0.2642 U.S. gallons	= 0.0084 barrels	= 0.0063 barrels petroleum
1 barrel	= 31.5 U.S. gallons	= 119 liters	= 0.75 barrels petroleum
1 barrel petroleum	= 42 U.S. gallons	= 159 liters	
1 mile	= 1.609 kilometers	= 5,280 feet	
1 kilometer	= 0.6214 miles	= 3,280.84 feet	
1 square mile	= 2.590 square kilometers	= 640 acres	
1 square kilometer	= 0.386 square miles	= 100 hectares	
1 acre	= 43,560 square feet	= 0.4047 hectares	= 4,047 square meters