A Primer on Carbon Dioxide Emissions

In the United States, most carbon dioxide (98%) is emitted as the result of the combustion of fossil fuels. [1] Energy hungry Americans are responsible for about 25% of global emissions of carbon dioxide (CO2)—more than any other nation—or, on a per capita basis, 6.6 tons of CO2 annually. [2,3] The following collection of statistics examines the sources and magnitudes of carbon emissions, and their relative significance in both a national and global context.

Source	CO2 Emissions [4]
Residential	
Average US kilowatt hour (kWh) of electricity [5]	1.5 pounds
One kWh of electricity from coal [6]	2.1 pounds
One kWh of electricity from natural gas	1.3 pounds
One kWh of electricity from wind/solar [7]	0 pounds
Incandescent bulb (60 watts), used in US home for 1 year [8]	180 pounds
Compact fluorescent (CF) bulb (15 watts), used in US home for 1 year	45 pounds
Typical household's annual electricity consumption (12,000 kWh)	18,000 pounds
Estimated emissions from US residential lighting with incandescents	250 billion pounds
Total annual US residential emissions from electricity consumption	800 million metric tons [9]
Disposal/decomposition of a year's worth of household waste	4,800 pounds
Annual emissions from a year's worth of all US household waste	232 million metric tons
Total annual US residential emissions	**1.2 billion metric tons**
Driving/Transportation	
Combustion of one gallon of gasoline	20 pounds
Driving 10,000 miles a year averaging 22 mpg (Chevy Malibu)	17,000 pounds [10]
Driving 10,000 miles a year averaging 44 mpg (Toyota Prius)	8,500 pounds
Driving 10,000 miles a year averaging 100 mpg (plug-in hybrid)	2,000 pounds [11]
A transcontinental flight (New York to Los Angeles)	1,158 pounds per seat
Total annual US transportation emissions	**2 billion metric tons**

Where Energy is Used in America: CO2 Emissions by Sector [12]

Transportation	33%	1934 million metric tons
Industries	29%	1730 million metric tons
Residences	21%	1212 million metric tons
Businesses	17%	1024 million metric tons
Total USA Emissions	**100%**	**5900 million metric tons**

Transportation: 33% [13]

The transportation sector accounts for about 2 billion metric tons of global warming pollution, or 33% of total US energy-related CO2 emissions. The emissions come from four primary sources:

- Gasoline for cars and light trucks (60%)
- Diesel fuel for heavy trucks, locomotives and ships (22%)
- Jet fuel (12%)
- Heavy fuel oil for maritime uses (2.8%)

Improving gas mileage of cars and trucks has a significant impact on emissions. For example, on a 20-mile commute:

- A gasoline-powered car that gets 20 mpg releases 20 lbs of CO2.
- A hybrid gas-electric car that gets 40 mpg releases 10 lbs of CO2.
- A plug-in hybrid car that gets 100 mpg releases 4 lbs of CO2.

Residences: 21% [14]

Residences account for 21% of US CO2 emissions. More than two-thirds (68%) of residential emissions come from the consumption of electricity, and most of those emissions (80%) come from the burning of coal at coal-fired power plants. Roughly half of all electricity in the US is generated by burning coal in power plants; residences use this energy for lighting, air conditioning and heating, televisions and other household appliances (Fig. 1).

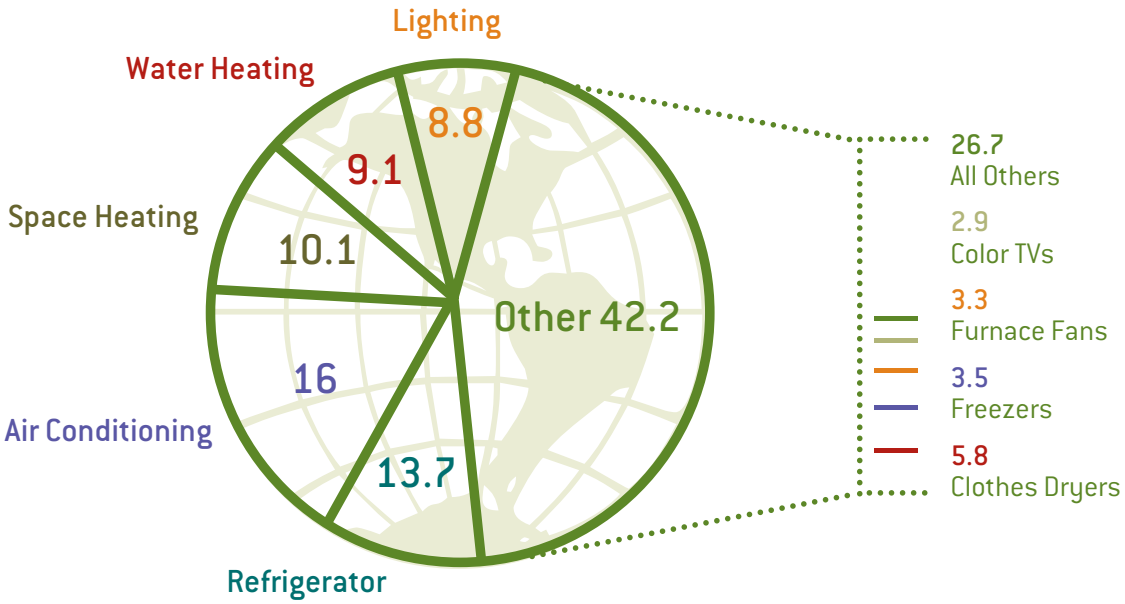

Fig. 1. Residential use of electricity in the US. Source: US EIA. [15]

Electricity is delivered to homes from power plants via the power grid, and is used to run heaters and air conditioners, refrigerators, washer-dryers, entertainment centers, computers and many other appliances and gadgets. Most of the rest of the emissions from homes comes from garbage and the burning of natural gas and oil used for heating.

Reducing energy consumption in the home—through improved insulation and more efficient appliances—would help to reduce emissions. Even more significant would be to reduce the emissions that come from generating electricity by relying more on clean, renewable sources of energy.

Electricity Generation: 39% [16]

CO2 emissions from the generation of electricity account for 39% of total US energy-related CO2 emissions. Of this, coal-fired power plants account for 80%, or 31% of all US CO2 emissions.

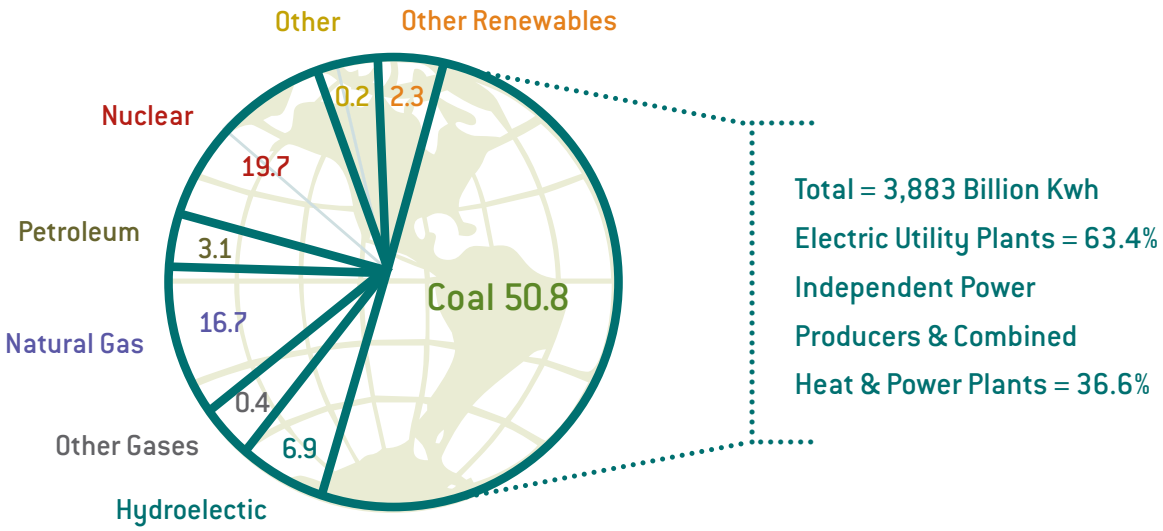

Fig. 2. Electricity generation in the US, by fuel. Source: US EIA [17]

Coal produces 21% more CO2 than oil per unit of energy consumption.

Coal produces 76% more CO2 than natural gas per unit of energy consumption.

Solar, wind, hydroelectric, nuclear and biomass energy sources do not result in significant CO2 emissions. [18]

World Coal Consumption: The Top Five [19]

	Millions of Tons	Global Share
China	800	31%
United States	**574**	**22.3%**
India	185	7.2%
Japan	112	4.4%
Russian Federation	111	4.3%

World Oil Consumption: The Top Five [20]

	Millions of Tons	Global Share
United States	**914.3**	**25.1%**
China	275.2	7.6%
Japan	248.7	6.8%
Germany	125.1	3.4%
Russian Federation	124.7	3.4%

World Natural Gas Consumption: The Top Five [21]

	Millions of Tons	Global Share
United States	**567**	**24.3%**
Russian Federation	365	15.7%
United Kingdom	86	3.7%
Canada	79	3.4%
Germany	77	3.3%

Carbon Calculators [22]

Greenhouse gas emissions calculators are available online from many sources. These interactive calculators vary greatly in complexity, scope, and intent. The most common kinds of calculators include:

- Equivalency Calculators: Translate greenhouse gas reductions into equivalent units (e.g., number of cars taken off the road).
- Individuals: Estimate the greenhouse gas emissions from your daily activities and learn about opportunities to save energy and money.
- Homes and Businesses: Estimate emissions and identify energy savings opportunities in residential and commercial buildings.
- Alternative Energy: Estimate the emission reduction benefits of using photovoltaics, solar water heaters, solar heated swimming pools, or choosing green power.
- Cars and Trucks: Calculate and compare the fuel economy, operating costs, and emissions of cars and trucks by vehicle.

Notes

[1] See http://www.eia.doe.gov/oiaf/1605/ggrpt/summary/carbon.html.
[2] See http://www.eia.doe.gov/oiaf/1605/ggccebro/chapter1.html.
[3] Or carbon dioxide equivalents. These include the other greenhouse gases – methane, nitrous oxide, sulfur hexafluoride, perfluorocarbons and hydrofluorocarbons.
[4] From Environmental Protection Agency's Global Warming Resource Center. See http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterToolsCalculators.html.
[5] National average. In regions that rely more heavily on coal power, emissions are higher per kWh; emissions per kWh are lower in regions that rely more on renewables, natural gas, nuclear and hydropower.
[6] See http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2report.html.
[7] Wind turbines and solar panels emit a negligible amount of greenhouse gases during manufacturing.
[8] Assumes 2,000 hours of use during the course of 1 year/5 hours per day; a 15 watt CF bulb emits as much light as a 60 watt incandescent.

Notes

[9] Residential electricity use accounts for more than two-thirds of all residential GHG emissions. See http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2002.html.
[10] Accounts for both tailpipe emissions and emissions from production and refining of fuels.
[11] Emissions for plug-in hybrids may be lower for vehicle trips less than 50 miles, since no gasoline will be used.
[12] See Energy Information Administration, http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html.
[13] Ibid.
[14] Ibid.
[15] Image source: http://www.eia.doe.gov/neic/brochure/electricity/electricity.html.
[16] See Energy Information Administration, http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html.
[17] Image source: http://www.eia.doe.gov/neic/brochure/electricity/electricity.html.
[18] See http://www.pewclimate.org/global-warming-basics/facts_and_figures/fig10.cfm.
[19] See http://www.pewclimate.org/docUploads/ClimateData%2DSectoral%2Epdf, page 8.
[20] See http://www.pewclimate.org/docUploads/ClimateData%2DSectoral%2Epdf, page 9.
[21] See http://www.pewclimate.org/docUploads/ClimateData%2DSectoral%2Epdf, page 11.
[22] See http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterToolsCalculators.html.