Carbon Footprint

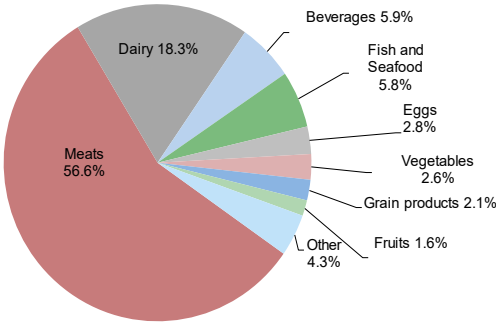
"A carbon footprint is the total greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organization, event or product."[1] It is calculated by summing the emissions resulting from every stage of a product or service's lifetime (material production, manufacturing, use, and end-of-life). Throughout a product's lifetime, or lifecycle, different GHGs may be emitted, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), each with a greater or lesser ability to trap heat in the atmosphere. These differences are accounted for by calculating the global warming potential (GWP) of each gas in units of carbon dioxide equivalents (CO_2e), giving carbon footprints a single unit for easy comparison. See the Center for Sustainable Systems "Greenhouse Gases Factsheet" for more information on GWP. A typical U.S. household has a carbon footprint of 48 metric tons CO_2e/yr.[2]

Sources of Emissions

Food

- Food accounts for 10-30% of a household's carbon footprint, typically a higher portion in lower-income households.[2] Production accounts for 68% of food emissions, while transportation accounts for 5%.[4]
- Food production emissions consist mainly of CO_2, N_2O, and CH_4, which result primarily from agricultural practices.[5]
- Meat products have larger carbon footprints per calorie than grain or vegetable products because of the inefficient transformation of plant energy to animal energy, and due to the methane released from manure management and enteric fermentation in ruminants.[5]
- Ruminants such as cattle, sheep, and goats produced 178 million metric tons (mmt) CO_2e of enteric methane in the U.S. in 2018.[6]
- Eliminating the transport of food for one year could save the GHG equivalent of driving 1,000 miles, while shifting to a vegetarian meal one day a week could save the equivalent of driving 1,160 miles.[5]
- A vegetarian diet greatly reduces an individual's carbon footprint, but switching to less carbon intensive meats can have a major impact as well. For example, beef's GHG emissions per kilogram are 7.2 times greater than those of chicken.[7]

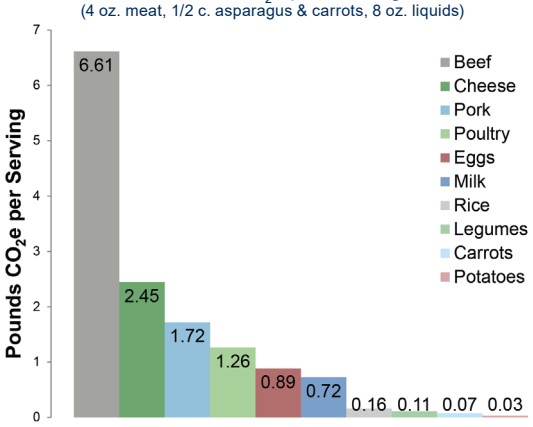
Greenhouse Gases Contribution by Food Type in Average Diet[3]



Household Emissions

- For each kilowatt hour generated in the U.S., an average of 0.953 pounds of CO_2e is released at the power plant.[8] Coal releases 2.2 pounds, petroleum releases 1.9 pounds, and natural gas releases 0.9 pounds. Nuclear, solar, wind, and hydroelectric release no CO_2 when they produce electricity, but emissions are released during upstream production activities (e.g., solar cells, nuclear fuels, cement production).[6,9]
- Residential electricity use in 2018 emitted 666.5 mmt CO_2e, 10% of the U.S. total.[6]
- Residential space heating and cooling are estimated to account for 44% of energy in U.S. homes in 2020.[10]
- Refrigerators are one of the largest users of household appliance energy; in 2015, an average of 720.5 lbs CO_2e per household was due to refrigeration.[11]
- 26 mmt CO_2e are released in the U.S. each year from washing clothes. Switching to a cold water wash once per week, a household can reduce its GHG emissions by over 70 lbs anually.[12]

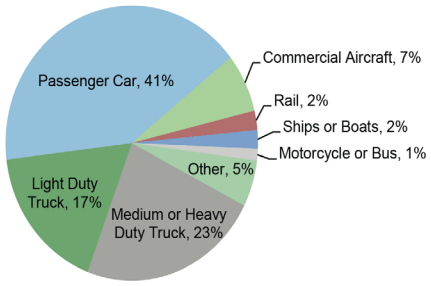
Pounds of CO_2e per Serving[13]
(4 oz. meat, 1/2 c. asparagus & carrots, 8 oz. liquids)



Personal Transportation

- U.S. fuel economy (mpg) declined by 12% from 1987-2004, then improved by 30% from 2004-2018, reaching an average of 25.1 mpg in 2018.[14] Annual per capita miles driven increased 9% since 1995 to 9,919 miles in 2018.[15]
- Cars and light trucks emitted 1.1 billion metric tons CO_2e or 17% of the total U.S. GHG emissions in 2018.[6]
- Of the roughly 66,000 lbs CO_2e emitted over the lifetime of an internal combustion engine car (assuming 93,000 miles driven), 84% come from the use phase.[16]
- Gasoline releases 19.6 pounds of CO_2 per gallon when burned, compared to 22.4 pounds per gallon for diesel.[17] However, diesel has 11% more BTU per gallon, which improves its fuel economy.[18]
- The average passenger car emits 0.78 pounds of CO_2 per mile driven.[14]

Transportation Greenhouse Gases, 2018[6]



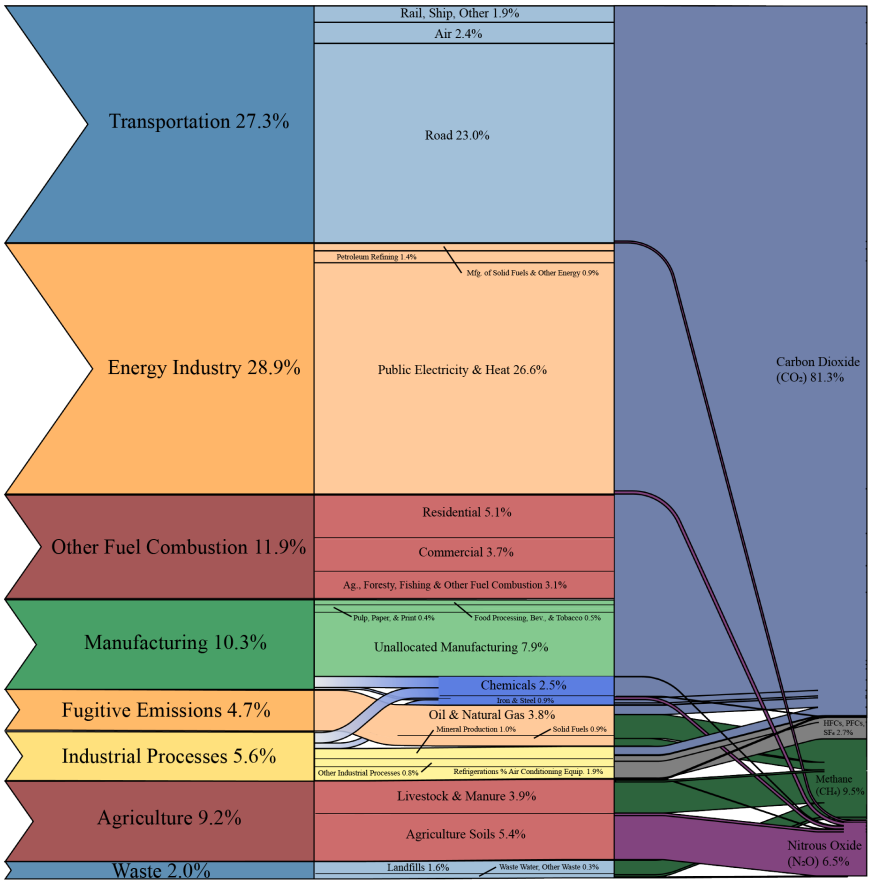
- Automobile fuel economy can improve 7-14% by simply observing the speed limit. Every 5 mph increase in vehicle speed over 50 mph is equivalent to paying an extra $0.13-$0.25 per gallon.[19]
- Commercial aircraft GHG emissions vary according to aircraft type, trip length, occupancy rates, and passenger and cargo weight, and totaled 130.8 mmt CO_2e in 2018.[6] In 2018, the average domestic commercial flight emitted 0.39 pounds of CO_2e per passenger mile.[6]
- Domestic air travel fuel efficiency (passenger miles/gallon) rose by 118% from 1990 to 2018, largely due to increased occupancy.[20] Emissions per domestic passenger-mile decreased 44% from 1990-2018, due to increased occupancy and fuel efficiency.[6,20]
- In 2018, rail transportation emitted 42.9 mmt CO_2e, accounting for 2% of transportation emissions in the U.S.[6]

Solutions and Sustainable Actions

Ways to Reduce Carbon Footprint

- Reduce meat in your diet and avoid wasting food.
- Walk, bike, carpool, use mass transit, or drive a best-in-class vehicle.
- Make sure your car's tires are properly inflated. Fuel efficiency decreases by 0.2% for each 1 PSI decrease.[21]
- Smaller homes use less energy. Average household energy use is highest in houses (82.3 million BTU), followed by mobile homes (59.8 million BTU), apartments with 2-4 units (53.5 million BTU), and apartments with 5+ units in the building (34.2 million BTU).[11]
- Whether you hand wash dishes or use a dishwasher, follow recommended practices to decrease water and energy use and reduce emissions.[22]
- Energy consumed by devices in standby mode accounts for 5-10% of residential energy use, adding up to $100 per year for the average American household. Unplug electronic devices when not in use or plug them into a power strip and turn the power strip off.[23]
- Choose energy-efficient lighting and transition away from incandescent light bulbs.[24]
- Reduce what you send to a landfill by recycling, composting, and buying products with minimal packaging.
- Purchase items with a comparatively low carbon footprint when possible. Some manufacturers have begun assessing and publishing their products' carbon footprints.

U.S. Greenhouse Gas Emissions, 2018[28]



- Covering 80% of roof area on commercial buildings in the U.S. with solar reflective material would offset 125 mmt CO_2 over the structures' lifetime, equivalent to turning off 32 coal power plants for one year.[25,26]
- Replacing the global fleet of shipping containers' roof and wall panels with aluminum would save $28 billion in fuel.[27]

Carbon Footprint Calculator

Use one of these tools to estimate your personal or household greenhouse gas emissions and explore the impact of different techniques to lower those emissions:

- The Nature Conservancy: www.nature.org/greenliving/carboncalculator/
- U.S. Environmental Protection Agency: www3.epa.gov/carbon-footprint-calculator/

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