ClearSky Climate Solutions
for our shared future

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Key steps and assumptions in the ClearSky Carbon Footprint Calculator

General

All figures are converted to metric tons of CO_2 or CO_2 equivalent (CO_2 eq., which accounts for other greenhouse gases in combination with CO_2, such as methane or nitrous oxides). 2205 lbs = 1 metric ton.

Coefficients and calculations are based on the most reliable and current information as of April 2008, and will be updated as new information becomes available.

Using the same sources and calculation as the ClearSky Carbon Footprint Calculator, the US average per capita emissions would be 13.5 metric tons CO_2 eq. per year. This figure results from the following estimates:

- 4.0 metric tons CO_2 from residential energy use (http://www.epa.gov/climatechange/emissions/downloads06/07ES.pdf)
- 3.8 metric tons CO_2 from person vehicle use (http://www.epa.gov/climatechange/emissions/downloads06/07ES.pdf)
- 1.6 metric tons CO_2 equivalent from aviation (http://www.bts.gov/publications/national_transportation_statistics/html/table_04_05.html and http://www.eia.doe.gov/oiaf/1605/coefficients.html)
- 3.6 metric tons CO_2 equivalent from food consumption (http://bie.berkeley.edu/calculator.html and http://bie.berkeley.edu/coolcalc/calculations.html#foodgoodsservices)
- 0.5 metric tons CO_2 equivalent from waste (http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBLPJ/$File/06Waste.pdf)

Using a more inclusive estimate of indirect and direct emissions, the US Energy Information Agency estimates that the US average per capita emissions would be 23.8 metric tons CO_2 eq. per year. This figure results from the estimate that total US emissions were 7,122 million metric tons CO_2 equivalent in 2004, divided by the US population of 299 million.

This calculator does not account for the entire range of personal activities that generate CO_2 emissions but it is based on a few common, standardized activities for the sake of simplicity. Comparing the all-inclusive estimate of 23.8 metric tons CO_2 eq./year and our estimate of 13.5 metric tons CO_2 eq./year for US citizens, it is likely that you would have to increase your calculated emissions from the ClearSky Calculator by 50-70% to account for indirect emissions.

As a comparison, global per capita CO_2 emissions are roughly 4.37 metric tons/person, according to the US Energy Information Administration (http://www.eia.doe.gov/pub/international/iealf/tableh1cco2.xls).

Living Section

The average per capita emissions figure of 8.1 metric tons CO_2 eq. per year results from the following estimates:

- 4.0 metric tons CO_2 from residential energy use (http://www.epa.gov/climatechange/emissions/downloads06/07ES.pdf)
- 3.6 metric tons CO_2 eq. from food consumption (http://bie.berkeley.edu/calculator.html and http://bie.berkeley.edu/coolcalc/calculations.html#foodgoodsservices)

- 0.5 metric tons CO_2 eq. from waste (http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBLPJ/$File/06Waste.pdf)

The US state emission factors for electricity generation are from the EPA's eGRID2006 (version 2.1) database (http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html). US State emissions factors are determined by the eGRID sub-region power pool. In cases where a given state contains multiple sub-regions, the following deciding factors were used to determine which sub-region would represent the entire state:
1) overwhelming population majority in one sub-region over the others (i.e. Nevada),
2) overwhelming geographic majority of one sub-region over the others (i.e. Michigan), and
3) if geography and population of the sub-regions were not clearly biased in one direction, we used the sub-region with the larger emissions factor to remain conservative in our calculations (i.e. Wyoming).

Data for Canadian provinces are derived from 2002 electricity generation figures from Statistics Canada (http://www.statcan.ca/english/freepub/57-001-XIB/0010357-001-XIB.pdf) and from 2002 greenhouse gas (GHG) emissions due to electricity and heat generation from Environment Canada (http://www.ec.gc.ca/pdb/ghg/inventory_report/2005_report/a11_eng.cfm). Province emissions factors were generated by dividing the GHG emissions by electricity generation figures, which is not a perfect solution but does reflect the different methods of electricity production in the various provinces.

Emission factors for propane and heating oil are from the EIA Voluntary Reporting Program (http://www.eia.doe.gov/oiaf/1605/coefficients.html). For natural gas, we assume 1000ft3 = 10 therms and use an emissions factor of 0.0001304 lbs CO_2 per BTU.

Data on total energy use by household type come from the Energy Information Administration's 2001 Residential Energy Consumption Survey (http://www.eia.doe.gov/emeu/recs/contents.html). These figures are scaled according to the number of bedrooms in the household, using information from the same survey.

We multiply input kWh figures by 1.072 to account for electricity transmission losses (http://climatetechnology.gov/library/2003/tech-options/tech-options-1-3-2.pdf).

The method of accounting for the proportion of renewable energy used at home is taken from SafeClimate and the World Resources Institute (http://www.safeclimate.net/calculator/). We reduce the CO_2 emissions due to electricity by the percentage of renewable power used. For example, if 25% of your electricity is supplied by a green power supplier, emissions due to electricity are reduced by 25%.

The estimate of 3.6 metric tons CO_2 eq./ year for US per capita food consumption comes from the Berkeley Institute of the Environment (http://bie.berkeley.edu/calculator.html and http://bie.berkeley.edu/coolcalc/calculations.html#foodgoodsservices). They rely on the Economic Input-Output Life Cycle Assessment model by the Green Design Institute at Carnegie Mellon University, which accounts for the full chain of production for common food groups. This estimate includes emissions related to production, transport, wholesale, and retail activities. For comparison, the US EPA Draft Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2006 report accounts for annual agriculture-related emissions amounting to 724 million metric tons CO_2 eq., or 2.4 metric tons CO_2 eq. per capita (http://www.epa.gov/climatechange/emissions/usinventoryreport.html). This report considers emissions directly from agriculture and attempts to include energy consumption, land-use practices, and fossil fuel combustion (http://www.epa.gov/climatechange/emissions/downloads/08_Agriculture.pdf, http://www.epa.gov/climatechange/emissions/downloads/08_Energy.pdf, http://www.epa.gov/climatechange/emissions/downloads/08_LULUCF.pdf, http://www.eia.doe.gov/oiaf/aeo/supplement/index.html). It is impossible to allocate emissions from some of the overall categories in this report (freight transport or automobile use, for example), so we feel it is best to use the slightly larger, more conservative estimate.

Emissions reductions for diet assume a 24% increase for a heavy meat diet, a 42% decrease for mostly vegetarian diet, and a 72% decrease for a vegan diet. Choosing organic food most of the time reduces calculated GHG emissions by 29%, while "sometimes" results in a 15% reduction. These estimates are based on The Nature Conservancy's Carbon Footprint Calculator, which in turn is based on the following sources: http://geosci.uchicago.edu/~gidon/papers/nutri/nutriEI.pdf (Eshel and Martin 2006) and http://www.news.cornell.edu/stories/July05/organic.farm.vs.other.ssl.html (Pimental et al. 2005).

Data on CO_2 emissions from waste are from the EPA (http://www.news.cornell.edu/stories/July05/organic.farm.vs.other.ssl.html), based on an estimate of 141 million metric tons of waste-related CO_2 eq. Emissions reductions due to recycling and composting are taken from the EPA (http://www.epa.gov/climatechange/emissions/ind_calculator.html and http://www.epa.gov/compost/). Recycling everything locally available results in a 42% reduction in waste-related emissions, while composting everything possible yields a 24% reduction. Values for "sometimes" options in both cases are intermediate values (20% reduction for recycling and 10% for composting).

When calculating an individual's footprint, the Living subtotal is equal to residential energy use divided by the number of people in the household, plus individual emissions for food and waste. When calculating an entire household's footprint, the Living subtotal is equal to residential energy use, plus emissions for food and waste multiplied by the number of people in the household. Food and waste estimates (3.6 metric tons CO_2 eq. for food and 0.5 metric tons CO_2 eq. for waste) are automatically included in the Basic calculation, and they are included with options for reduction in the Advanced calculation.

Driving Section

If the "US Average" option is selected, the calculator multiplies the number of vehicles driven by the US average of 5.5 metric tons CO_2 eq. per vehicle (US EPA, http://www.epa.gov/climatechange/emissions/ind_calculator.html). Otherwise, the Basic calculation assumes the average U.S. vehicle is driven 12,000 miles per year (http://www.epa.gov/climatechange/emissions/ind_calculator.html), and divides this estimate by the EPA's MPG figures for the various vehicle types (http://www.epa.gov/oms/cert/mpg/fetrends/420r06011.pdf). We multiply gallons of fuel consumed by the emissions conversion factor (25.3 lbs CO_2/ gal for gasoline, 27.1 lbs CO_2/gal for diesel) from the Argonne National Laboratory Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model (http://www.transportation.anl.gov/software/GREET/). In the advanced calculation, the same emissions factor is used, but users are allowed to input specific mileage and MPG numbers.

The EIA Voluntary Reporting Program (http://www.eia.doe.gov/oiaf/1605/coefficients.html) lists emissions factors of 19.3 lbs CO_2/ gal for gasoline and 22.4 lbs CO_2/ gal for diesel, which are strictly based on the combustion of the fuel. The GREET model accounts for "upstream" emissions resulting from the production and delivery of the gasoline, and therefore more accurately depicts the full environmental cost.

Flying Section

Our emissions factors for short, medium, long, and extended flights (0.64. 0.45, 0.39, and 0.39 lb CO_2/mile, respectively) are from the World Resources Institute's GHG Protocol for Mobile Sources (http://www.ghgprotocol.org/).

We apply a Radiative Forcing Index (RFI) of 2.7 (Intergovernmental Panel on Climate Change, http://www.grida.no/climate/ipcc/aviation/064.htm) to account for other GHGs emitted during air travel.

The RFI value we use is based on a conservative estimate by the IPCC, which we feel represents the most thorough scientific opinion. Airplane GHG emissions are comprised of only half CO_2, and releasing these gases into the upper atmosphere yields a greater impact than release at ground level. Other carbon footprint calculators may ignore this consideration (basically using an RFI of 1) or use lower values closer to 2. We believe it is our responsibility to fully account for accepted contributions to global climate change, although it may result in a larger carbon footprint value for individuals who fly frequently.

In the Basic calculation, we multiply the resulting emissions (lb CO_2 eq./mile) by the average velocity of 414.65 mph for air travel provided by the Bureau of Transportation Statistics (2005 data for System Revenue Aircraft Miles Flown and total number of scheduled System Revenue Aircraft Hours (Airborne), http://www.bts.gov/xml/air_traffic/src/datadisp.xml). This yields lb CO_2 eq./hr of air travel. We estimate that occasional air travelers fly 10 hrs/year, moderate travelers fly 20 hrs/year, and frequent travelers fly 30 hrs/year. To convert these estimates into metric tons of CO_2 eq., we use WRI's short flight emission factor. These assumptions may result in higher footprint values for individuals who only fly occasionally, so we recommend using the Advanced calculation if you feel the calculator is overshooting your personal impact.

In the Advanced calculation, we multiply the emissions factor (lb CO_2 eq./mile) for by the mileage estimates guides (for a single leg) for short, medium, long, and extended flights. Estimates for individual legs are multiplied by 2 to account for a round-trip flight. Users are asked to input the number of round-trip flights, rather than the number of individual legs, to make counting easier.

Total Footprint

The total carbon footprint in this calculator is the sum of the Living, Driving, and Flying subtotals.

If you still have questions about the ClearSky Carbon Footprint Calculator, send an email to: info@clearskyclimatesolutions.com and we'll be happy to help.