Power Profiler
Terms, Calculations, and Data Sources

Terms

Biomass:
> An organic non-fossil fuel, such as wood and other plant material, that is a renewable energy source.

Carbon dioxide (CO_2):
> A greenhouse gas that is produced during the combustion process. Carbon dioxide is the primary greenhouse gas emitted due to human activities.

eGRID subregion:
> An electricity service area based on NERC regions, balancing authorities, transmission/distribution/utility service territories, and NERC Assessment Areas. The subregions were defined by EPA to establish an aggregated area where the emission rates most accurately matched the generation and emissions from the power plants within that region.

Emission rate (lbs/MWh):
> Average pounds of pollutant (e.g., CO_2, SO_2, NO_X) emitted for each megawatt-hour of electricity generated in a region.

Fossil fuel:
> A hydrocarbon fuel, such as coal, oil, and natural gas, that is formed from dead organic matter by natural processes over millions of years.

Fuel mix:
> The percentage of overall generation attributed to a specific fuel type (i.e., coal, gas, hydro, solar). Also referred to as resource mix.

Line loss:
> Electric energy lost because of the transmission of electricity across power lines. Much of the loss is due to conversion of electricity to heat and electromagnetic energy. Also referred to as grid gross loss (GGL) or T&D losses.

Megawatt-hour (MWh):
> One thousand kilowatt-hours (1,000 kilowatts of electricity being used continuously for one hour) or 1 million watt-hours. One MWh is equivalent to the amount of electricity needed to light 10,000 100-watt light bulbs for one-hour, or the electricity needed to power an average home for about 5 to 6 weeks.

Nitrogen oxide (NO_X):
> An air pollutant that is produced during the combustion process. Nitrogen in the fuel and the atmosphere are oxidized during combustion to form nitric oxide (NO) and nitrogen dioxide (NO_2).

Non-renewables:
> Energy from a finite resource which cannot be replenished once burned. Non-renewables include coal, oil, gas, other fossil, nuclear, and other unknown.

Renewables:
> Energy from a source that is not depleted when used. Renewables include biomass, geothermal, hydro, solar and wind.

Sulfur dioxide (SO_2):
> An air pollutant that is produced during the combustion process. Sulfur in the fuel is oxidized during combustion.

Other fossil fuel:
> A hydrocarbon fuel derived from fossil fuels, such as blast furnace gas, coke oven gas, other gas, process gas, and tire-derived fuels.

Calculations

Estimate Your Emissions

Option 1: Average Monthly Electricity Use

<u>National Average</u>

In these calculations, the national average home electricity consumption of 1,011 kWh/month; national average emission rates of 998.4 lbs CO_2/MWh, 0.8 lbs SO_2/MWh, and 0.7 lbs NO_X/MWh; and the national average percent line loss of 4.48% are used.

$$1,011 \text{ kWh/month} \times 12 \text{ months/year} \times 998.4 \text{ lbs } CO_2/\text{MWh} \times 0.001 \text{ MWh/kWh} \times (1 + .0448)$$
$$= 12,655 \text{ lbs } CO_2$$

$$1,011 \text{ kWh/month} \times 12 \text{ months/year} \times 0.8 \text{ lbs } SO_2/\text{MWh} \times 0.001 \text{ MWh/kWh} \times (1 + .0448)$$
$$= 10 \text{ lbs } SO_2$$

$$1,011 \text{ kWh/month} \times 12 \text{ months/year} \times 0.7 \text{ lbs } NO_X/\text{MWh} \times 0.001 \text{ MWh/kWh} \times (1 + .0448)$$
$$= 9 \text{ lbs } NO_X$$

<u>Subregion Average</u>

In these calculations, the national average home consumption of 1,011 kWh/month, eGRID subregion emission rates, and eGRID subregion percent line loss are used.

The Southwest Power Pool North (SPNO) average emission rates of 1,412.4 lbs CO_2/MWh, 0.5 lbs SO_2/MWh, and 0.8 lbs NO_X/MWh, and the SPNO percent line loss of 4.49% are used in the example calculations below.

$$1{,}011 \text{ kWh/month} \times 12 \text{ months/year} \times 1{,}412.4 \text{ lbs } CO_2\text{/MWh} \times 0.001 \text{ MWh/kWh} \times (1 + .0449)$$
$$= 17{,}905 \text{ lbs } CO_2$$

$$1{,}011 \text{ kWh/month} \times 12 \text{ months/year} \times 0.5 \text{ lbs } SO_2\text{/MWh} \times 0.001 \text{ MWh/kWh} \times (1 + .0449)$$
$$= 6 \text{ lbs } SO_2$$

$$1{,}011 \text{ kWh/month} \times 12 \text{ months/year} \times 0.8 \text{ lbs } NO_X\text{/MWh} \times 0.001 \text{ MWh/kWh} \times (1 + .0449)$$
$$= 10 \text{ lbs } NO_X$$

Your Emissions

In these calculations, a user-supplied average monthly electricity use, eGRID subregion emission rates, and eGRID subregion percent line loss are used.

As an example, average monthly electricity use of 1,000 kWh; the SPNO average emission rates of 1,412.4 lbs CO_2/MWh, 0.5 lbs SO_2/MWh, and 0.8 lbs NO_X/MWh; and the SPNO percent line loss of 4.49% are used in the example calculations below.

$$1{,}000 \text{ kWh/month} \times 12 \text{ months/year} \times 1{,}412.4 \text{ lbs } CO_2\text{/MWh} \times 0.001 \text{ MWh/kWh} \times (1 + .0449)$$
$$= 17{,}710 \text{ lbs } CO_2$$

$$1{,}000 \text{ kWh/month} \times 12 \text{ months/year} \times 0.5 \text{ lbs } SO_2\text{/MWh} \times 0.001 \text{ MWh/kWh} \times (1 + .0449)$$
$$= 6 \text{ lbs } SO_2$$

$$1{,}000 \text{ kWh/month} \times 12 \text{ months/year} \times 0.8 \text{ lbs } NO_X\text{/MWh} \times 0.001 \text{ MWh/kWh} \times (1 + .0449)$$
$$= 10 \text{ lbs } NO_X$$

Option 2: Actual Electricity Use for Each Month

The calculations for national average and subregion average are identical to the Option 1 calculations above. The calculation for "your emissions" uses the actual monthly values entered instead of an average monthly value.

As an example, monthly electricity use of 1,000 kWh for January through March, 1,250 kWh for April through September, and 950 kWh for October through December; the SPNO average emission rates of 1,412.4 lbs CO_2/MWh, 0.5 lbs SO_2/MWh, and 0.8 lbs NO_X/MWh; and the SPNO percent line loss of 4.49% are used.

(1,000 kWh/month × 3 months/year + 1,250 kWh/month × 6 months/year + 950 kWh/month × 3 months/year) × 1,412.4 lbs CO_2/MWh × 0.001 MWh/kWh × (1 +.0449)
= 19,702 lbs CO_2

(1,000 kWh/month × 3 months/year + 1,250 kWh/month × 6 months/year + 950 kWh/month × 3 months/year) × 0.5 lbs SO_2/MWh × 0.001 MWh/kWh × (1 +.0449)
= 7 lbs SO_2

(1,000 kWh/month × 3 months/year + 1,250 kWh/month × 6 months/year + 950 kWh/month × 3 months/year) × 0.8 lbs NO_X/MWh × 0.001 MWh/kWh × (1 +.0449)
= 11 lbs NO_X

Option 3a: National Average Electricity Use for Residential Customers

The calculations for national average are identical to the previous national average calculations and the calculations for "your emissions" are the same as the previous subregion average calculations.

Option 3b: National Average Electricity Use for Commercial Customers

National Average
In these calculations, a user-supplied square footage (example: 500 square feet); national average electricity consumption of 1.22 kWh/sq. ft./month for commercial customers; national average emission rates of 998.4 lbs CO_2/MWh, 0.8 lbs SO_2/MWh, and 0.7 lbs NO_X/MWh; and the national average percent line loss of 4.48% are used.

500 sq. ft. × 1.22 kWh/sq.ft./month x 12 months/year × 998.4 lbs CO_2/MWh × 0.001 MWh/kWh × (1 +.0448)
= 7,636 lbs CO_2

500 sq. ft. × 1.22 kWh/sq.ft./month × 12 months/year × 0.8 lbs SO_2/MWh × 0.001 MWh/kWh × (1 +.0448)
= 6 lbs SO_2

500 sq. ft. × 1.22 kWh/sq.ft./month × 12 months/year × 0.7 lbs NO_X/MWh × 0.001 MWh/kWh × (1 +.0448)
= 5 lbs NO_X

Your Emissions
In these calculations, a user-supplied square footage, eGRID subregion emission rates, and eGRID subregion percent line loss are used. As an example, an area of 500 square feet, national

average electricity consumption of 1.22 kWh/sq. ft./month for commercial customers; the SPNO average emission rates of 1,412.4 lbs CO_2/MWh, 0.5 lbs SO_2/MWh, and 0.8 lbs NO_X/MWh; and the SPNO percent line loss of 4.49% are used in the example calculations below.

$$500 \text{ sq. ft.} \times 1.22 \text{ kWh/sq.ft./month} \times 12 \text{ months/year} \times 1,412.4 \text{ lbs } CO_2/MWh \times 0.001 \text{ MWh/kWh} \times (1 + .0449)$$
$$= 10,803 \text{ lbs } CO_2$$

$$500 \text{ sq. ft.} \times 1.22 \text{ kWh/sq.ft./month} \times 12 \text{ months/year} \times 0.5 \text{ lbs } SO_2/MWh \times 0.001 \text{ MWh/kWh} \times (1 + .0449)$$
$$= 4 \text{ lbs } SO_2$$

$$500 \text{ sq. ft.} \times 1.22 \text{ kWh/sq.ft./month} \times 12 \text{ months/year} \times 0.8 \text{ lbs } NO_X/MWh \times 0.001 \text{ MWh/kWh} \times (1 + .0449)$$
$$= 6 \text{ lbs } NO_X$$

CO_2 Emission Offsets

The calculations to determine the number of tree seedlings grown for 10 years and the number of acres of forests in one year needed to offset your CO_2 emissions are explained in the Greenhouse Gases Equivalencies Calculator – Calculations and References.

Data Sources

Fuel Mix and Emission Rates:

The Emissions & Generation Resource Integrated Database (eGRID) provides the national and subregion fuel mixes, emission rates, and line losses.

Average home consumption:

The 2016 average home consumption is determined from data in the 2018 Annual Energy Outlook, Table A4: Residential Sector Key Indicators and Consumption. According to Table A4, the 2016 residential delivered energy was 4.80 quadrillion Btu (cell D48) and the total number of households was 116.05 million (cell C20).

$$4.80203 \text{ quadrillion Btu} \times 1,000,000,000,000,000 \text{ Btu/quadrillion Btu} \times 0.000293071 \text{ kWh/Btu} / (116.05352 \text{ million homes} \times 1,000,000) / 12 \text{ months/year}$$
$$= 1,011 \text{ kWh/month/household}$$

Commercial customers:

According to the [2012 EIA Commercial Building Energy Consumption Survey (CBECS)](#), Table C14, the annual electricity consumption across all buildings for 2012 was 14.6 kWh per square foot. This converts to 1.22 kWh/sq. ft/month.

CO$_2$ Emission Offsets:

See methodology description and example calculations in the *Number of tree seedlings grown for 10 years* and the *Acres of U.S. forests storing carbon for one year* sections of the [Greenhouse Gases Equivalencies Calculator – Calculations and References](#).