

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 (CO₂):

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 the North American Electric Reliability Corporation (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., CO₂, SO₂, 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 (e.g., coal, gas, hydro, solar). Also referred to as resource mix.

Grid Gross Loss:

Electric energy lost through 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 line loss or transmission & distribution (T&D) losses.

Megawatt-hour (MWh):

One million watt-hours (1 million watts of electricity being used continuously for one hour) or 1,000 kilowatt-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 combustion air are oxidized during combustion to form nitric oxide (NO) and nitrogen dioxide (NO₂).

Non-renewables:

A finite resource used for energy that cannot be replenished once burned. Non-renewable fuels include coal, oil, gas, other fossil fuel, nuclear, and other unknown fuel.

Renewables:

A resource used for energy that is not depleted when used. Renewable fuels include biomass, geothermal, hydro, solar and wind.

Sulfur dioxide (SO₂):

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

Total emissions from electricity use are the result of both direct use (Scope 2) and the result of electricity lost during the transmission and distribution of the electricity (GGL) (Scope 3).

The following general formula is used to estimate emissions attributed to direct electricity use (Scope 2):

$$\text{electricity used (MWh/year)} \times \text{emission rate (lbs/MWh)} = \text{Scope 2 emissions (lbs/year)}$$

The estimated percentage of electricity lost during transmission and distribution is also called line loss or transmission & distribution (T&D) losses. The following general formula is used to estimate emissions attributed to producing the electricity lost during transmission and distribution (Scope 3):

$$\begin{aligned} &(\text{GGL}) \times \text{electricity used (MWh/year)} \times \text{emission rate (lbs/MWh)} / (1 - \text{GGL}) \\ &= \text{Scope 3 emissions (lbs/year)} \end{aligned}$$

Total emissions from electricity use are:

$$\text{Scope 2 emissions} + \text{Scope 3 emissions} = \text{total emissions}$$

Using the general equations above, Power Profiler offers the following five options to determine emissions from electricity use:

1. National Average Electricity Use
2. Subregion Average Electricity Use
3. Average Monthly Electricity Use
4. Actual Monthly Electricity Use
5. National Average Electricity Use for Commercial Customers

Option 1: National Average Electricity Use

Residential

In these calculations, the 2020 national annual average home electricity consumption, national average emission rates, and the national average GGL are used.

$$\text{Annual residential electricity used (MWh/year)} = \mathbf{12.194 \text{ MWh}}$$

$$\text{Annual average U.S. emission rates (lbs/MWh)} = \mathbf{823.1 \text{ lbs CO}_2/\text{MWh}, \mathbf{0.473 \text{ lbs SO}_2/\text{MWh}, \text{ and } \mathbf{0.500 \text{ lbs NOX/MWh}}$$

$$\text{GGL\%} = \mathbf{5.0\%}$$

Commercial

$$\text{Annual commercial electricity used (MWh/year)} = \text{User-supplied square footage} \times \text{national average commercial electricity consumption of } \mathbf{0.01260 \text{ MWh/sq. ft}}$$

$$\text{Annual average U.S. emission rates (lbs/MWh)} = \mathbf{823.1 \text{ lbs CO}_2/\text{MWh}, \mathbf{0.473 \text{ lbs SO}_2/\text{MWh}, \text{ and } \mathbf{0.500 \text{ lbs NOX/MWh}}$$

$$\text{GGL\%} = \mathbf{5.0\%}$$

Option 2: Subregion Average Electricity Use

These calculations use the national average home electricity use, as is used in Option 1 (national average electricity use), but they use the eGRID subregion-specific emission rates and GGL instead of national averages.

Option 2a: Residential

$$\text{Annual residential electricity used (MWh/year)} = \mathbf{12.194 \text{ MWh}}$$

Emission rate (lbs/MWh) = eGRID subregion rates

GGL% = eGRID subregion GGL

Option 2b: Commercial

*Annual commercial electricity used (MWh/year) = User-supplied square footage × national average commercial electricity consumption of **0.01260** MWh/sq. ft*

Emission rate (lbs/MWh) = eGRID subregion rates

GGL% = eGRID subregion GGL

Option 3: Average Monthly Electricity Use

For this option, a user-supplied average monthly electricity use, eGRID subregion emission rates, and eGRID subregion GGL are used.

Electricity used (MWh/year) = User-supplied average monthly value

Emission rate (lbs/MWh) = eGRID subregion rates

GGL% = eGRID subregion GGL

Option 4: Actual Monthly Electricity Use

In lieu of a single user-supplied average monthly electricity use, the actual user-supplied monthly electricity use is used, in addition to the eGRID subregion emission rates and GGL.

Electricity used (MWh/year) = User-supplied actual monthly values

Emission rate (lbs/MWh) = eGRID subregion rates

GGL% = eGRID subregion GGL

CO₂ 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 CO₂ emissions are explained in the [Greenhouse Gases Equivalencies Calculator – Calculations and References](#).

Values used in the Calculations

Fuel mix, emission rates, and grid gross loss (GGL):

The [Emissions & Generation Resource Integrated Database \(eGRID\)](#) provides the national and subregion fuel mixes, emission rates, and GGL.

Average home electricity consumption:

The average home electricity consumption is determined from the reference case in Table 4 Residential Sector Key Indicators and Consumption of the 2023 U.S. Energy Information Administration's (EIA) [Annual Energy Outlook](#).

Average home electricity consumption general equation:

$$\text{residential delivered energy} / \text{number of homes} = \text{average annual home consumption}$$

Using the 2023 values:

$$\begin{aligned} &5.170129 \text{ quadrillion Btu} \times 1,000,000,000,000,000 \text{ Btu/quadrillion Btu} \times 2.93071e-7 \\ &\text{MWh/Btu} / (127.6123 \text{ million homes} \times 1,000,000) \\ &= 11.874 \text{ MWh} \end{aligned}$$

Where:

2022 Residential delivered energy = **5.170129** quadrillion Btu (Table 4, cell D48)

Number of homes = **127.6123** million (Table 4, cell D20)

Commercial customers:

According to the [2018 EIA Commercial Building Energy Consumption Survey \(CBECS\)](#), Table C14, the annual electricity consumption across all buildings for 2018 was 12.6kWh per square foot. This converts to **0.01260** MWh/sq. ft.

CO₂ Emission Offsets:

See methodology description and example calculations in the [Number of urban tree seedlings grown for 10 years](#) and the [Acres of U.S. forests sequestering CO₂ for one year](#) sections of the [Greenhouse Gases Equivalencies Calculator – Calculations and References](#).

Where:

CO₂ sequestered annually per urban tree planted and allowed to grow for 10 years = **0.060** metric tons

CO₂ sequestered annually by one acre of average U.S. forest = **1** metric tons

Conversion Factor for carbon sequestered by one acre of forest preserved from conversion to cropland (in the year of conversion) = **167.36** metric tons