CHSB2025 Guidance on Emission Factors

Cornell Hotel Sustainability Benchmarking Index 2025

This Reference List provides guidance on the application of Emission Factors (EFs) to calculate the hotel carbon emissions for Cornell Hotel Sustainability Benchmarking 2025 (CHSB2025) Index, comprising of 2023 calendar year data.

The calculation of emissions involves multiplying the amount of energy usage by the relevant emission factor for the specific greenhouse gas associated with that energy source.

Emissions = Usage x Emission Factor

For CHSB2025, the amounts of energy usage are harmonized into kilowatt-hours (kWh) as the common unit of measurement.

The set of emission factors applied to each respective energy type was geographically based on available data, with the references for each country and energy type listed in the table below.

Two types of emission factors were applied to calculate carbon emissions.

- **Location-Based EFs (used for the CHSB2025 Public dataset):** Location-based EFs are calculated based on the average carbon emission intensity associated with generating and consuming a specific energy type in a specific geographic location where the facility operates.
- **Market-Based EFs (used for the Benchmark Report):** Market-Based EFs are used to quantify the carbon emission intensity associated electricity consumption, factoring in market dynamics, Renewable Energy Certificates (RECs), carbon offsets, and residual mix. These EFs go beyond conventional emission factors by integrating market mechanisms. They offer a more accurate depiction of emissions linked to electricity use, encompassing both tracked and untracked energy sources.

In the use of Global Warming Potential (GWP) values, Greenview employs distinct methodologies for varying scenarios.

- When the source document provides separate Emission Factor values for CO_2, CH_4 and N_2O, the GWP values from the IPCC Assessment Report version stated in the source document is used to calculate the Emission Factor in CO_2e.

- Otherwise, the GWP values from the latest IPCC Assessment Report at the time of calculation are used to derive the Emission Factor in CO_2e. When a change in GWP value occurs due to an update in a more recent IPCC Assessment Report, the GWP values and Emission Factors are not updated retroactively.
- When the Emission Factor is provided in CO_2e, the source document's GWP values are embedded in the Emission Factor. The Emission Factor provided in CO_2e is used.
- For US properties, Emission Factors for electricity are extracted from eGRID, which uses GWP values from the IPCC Fourth Assessment Report (AR4). Although separate values for CO_2e, CH_4 and N_2O are provided, the summation of these three gases does not align with the CO_2e value provided in the eGRID document. To reduce potential calculation error, align with other US-EPA publications and streamline the whole emission calculation process, CO_2e is used.

TABLE 1: ENERGY EMISSION FACTOR REFERENCES

Country	Purchased Electricity	Natural Gas	Butane, Propane, and Liquefied Petroleum Gas (LPG)	Liquefied Natural Gas (LNG)	Compressed Natural Gas (CNG)	All fuels, unless specified in the "Other Fuels" column	Other Fuels, refer to specific types in brackets	Towngas / City Gas	Purchased Steam and Hot Water	Purchased Chilled Water	Biomass	Charcoal	Ethanol
Australia	National Greenhouse Accounts Factors	National Greenhouse Accounts Factors	National Greenhouse Accounts Factors	National Greenhouse Accounts Factors	National Greenhouse Accounts Factors	WRI Stationary Combustion Tool	National Greenhouse Accounts Factors *[Gasoline (Stationary), Diesel (Stationary), Fuel Oil 1-6, Biogas]*	(Natural Gas as proxy) National Greenhouse Accounts Factors	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	National Greenhouse Accounts Factors (CH4 and N20 Only)	National Greenhouse Accounts Factors (CH4 and N20 Only)

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Canada	National Inventory Report: Greenhouse Gas Sources and Sinks in Canada	National Inventory Report: Greenhouse Gas Sources and Sinks in Canada	National Inventory Report: Greenhouse Gas Sources and Sinks in Canada	National Inventory Report: Greenhouse Gas Sources and Sinks in Canada	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	National Inventory Report: Greenhouse Gas Sources and Sinks in Canada *[Gasoline (Stationary), Diesel (Stationary), Fuel Oil 1-6, Kerosene]*	(Natural Gas as proxy) National Inventory Report: Greenhouse Gas Sources and Sinks in Canada	US Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions	US Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)
European Union (*2021 onwards)	*[Location-based Emissions]* European Environment Agency CO2-emission intensity from electricity generation *[Market-based Emissions]* Association of Issuing Bodies European Residual Mixes	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	(Natural Gas as proxy) WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)

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Hong Kong, China	International Energy Agency	WRI Stationary Combustion Tool	Hong Kong Carbon Accounting guidelines (revised 2010)	WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	Hong Kong Carbon Accounting guidelines (revised 2010) *[Diesel (Stationary), Kerosene]*	Towngas ESG Report & Hong Kong Carbon Accounting guidelines (revised 2010)	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)
Japan (*2021 onwards)	International Energy Agency	National Greenhouse Gas Inventory Report of JAPAN	National Greenhouse Gas Inventory Report of JAPAN	National Greenhouse Gas Inventory Report of JAPAN	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	National Greenhouse Gas Inventory Report of JAPAN *[Gasoline (Stationary), Diesel (Stationary), Biofuel Wood Waste, Kerosene]*	National Greenhouse Gas Inventory Report of JAPAN	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)

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Mexico (*2021 onwards)	México Registro Nacional de Emisiones	Calculadora de emisiones para el Registro Nacional de Emisiones	Calculadora de emisiones para el Registro Nacional de Emisiones	WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	Calculadora de emisiones para el Registro Nacional de Emisiones *[Gasoline (Stationary), Diesel (Stationary)]*	Calculadora de emisiones para el Registro Nacional de Emisiones	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)
New Zealand (*2021 onwards)	Measuring emissions: A guide for organisations - detailed guide	Measuring emissions: A guide for organisations - detailed guide	Measuring emissions: A guide for organisations - detailed guide	WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	Measuring emissions: A guide for organisations - detailed guide *[Diesel (Stationary), Fuel Oil 1-6, Biofuel Wood Waste]*	Measuring emissions: A guide for organisations - detailed guide	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)

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Norway (*2022 onwards)	International Energy Agency	Norwegian Environment Agency Greenhouse Gas Emissions, National Inventory Report	Norwegian Environment Agency Greenhouse Gas Emissions, National Inventory Report	WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	Norwegian Environment Agency Greenhouse Gas Emissions, National Inventory Report	WRI Stationary Combustion Tool *[Diesel (Stationary), Biofuel Used Oil, Biogas]*	Norwegian Environment Agency Greenhouse Gas Emissions, National Inventory Report	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	Norwegian Environment Agency Greenhouse Gas Emissions, National Inventory Report	EPA Emission Factors for GHG Inventories (CH4 and N20 only)
Singapore (*2022 onwards)	Energy Market Authority - Singapore Energy Statistic	Singapore National Environment Agency (NEA) Reckonable Emissions Calculator	Singapore National Environment Agency (NEA) Reckonable Emissions Calculator	Singapore National Environment Agency (NEA) Reckonable Emissions Calculator	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	Singapore National Environment Agency (NEA) Reckonable Emissions Calculator *[Gasoline (Stationary), Diesel (Stationary), Fuel Oil 1-6, Kerosene]*	Singapore National Environment Agency (NEA) Reckonable Emissions Calculator	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	Singapore National Environment Agency (NEA) Reckonable Emissions Calculator (CH4 and N20 Only)	Singapore National Environment Agency (NEA) Reckonable Emissions Calculator (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)

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Sri Lanka (*2023 onwards)	Sri Lanka Energy Balance	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	(Natural Gas as proxy) WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)
Taiwan, China (*2022 onwards)	Energy Administration Taiwan, China - Electricity Carbon Emission Factor	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	(Natural Gas as proxy) WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)

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Thailand (*2022 onwards)	Thailand Ministry of Energy - Energy Policy and Planning Office	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	(Natural Gas as proxy) WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)
United Kingdom	*[Location-based Emissions]* UK Government GHG Conversion Factors for Company Reporting *[Market-based Emissions]* Association of Issuing Bodies European Residual Mixes	UK Government GHG Conversion Factors for Company Reporting	UK Government GHG Conversion Factors for Company Reporting	UK Government GHG Conversion Factors for Company Reporting	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting *[Gasoline (Stationary), Diesel (Stationary), Fuel Oil 1-6]]*	(Natural Gas as proxy) UK Government GHG Conversion Factors for Company Reporting	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)

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United States, Puerto Rico, other US Territories (American Samoa, Guam, Northern Mariana Islands, and US Virgin Islands)	EPA eGRID	EPA Emission Factors for GHG Inventories	EPA Emission Factors for GHG Inventories	EPA Emission Factors for GHG Inventories	EPA Emission Factors for GHG Inventories	WRI Stationary Combustion Tool	EPA Emission Factors for GHG Inventories *[Gasoline (Stationary), Diesel (Stationary), Fuel Oil 1-6]*	EPA Emission Factors for GHG Inventories	US Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions	US Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)
All other countries and Territories	International Energy Agency	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	WRI Stationary Combustion Tool	WRI Stationary Combustion Tool	(Natural Gas as proxy) WRI Stationary Combustion Tool	UK Government GHG Conversion Factors for Company Reporting	US EIA form 1605 (2010). Appendix N	WRI Stationary Combustion Tool (CH4 and N20 Only)	WRI Stationary Combustion Tool (CH4 and N20 Only)	EPA Emission Factors for GHG Inventories (CH4 and N20 only)

EXAMPLE SCENARIO OF CALCULATION

STEP 1: Determining Energy Usage
Suppose a hotel uses 2,500 gallons of propane gas for heating in a particular month.

STEP 2: Converting to Kilowatt-Hours (kWh)
Because the energy usage data is provided in gallon, a unit of mass, an energy conversion factor is included in this step to convert the usage value to kWh as the harmonized energy unit. Suppose for the conversion:

1 gallon of propane = 26.68 kWh[1]

Energy Usage = 2,500 gallons x 26.68 kWh/gallon ≈ 66,700 kWh

STEP 3: Identifying and Applying the Emission Factor to the Calculation
An appropriate location-based or market-based emission factor is selected. Suppose for the calculation:

Emission factor for propane = 1.52 kg CO_2e per kWh[2]

Multiplying the energy consumption in kilowatt-hours by the emission factor to calculate the carbon emissions:

Carbon Emissions = 66,700 kWh x 1.52 kg CO_2e/kWh ≈ 101,284 kg CO_2e

So, the carbon emissions from using 2,500 gallons of propane gas for heating would be approximately 101,284 kilograms of CO2e.

[1] The energy conversion factor presented in this calculation is hypothetical and is used solely for the purpose of this example.
[2] Due to data sharing restrictions and licensing agreements, this figure is hypothetical and is used solely for the purpose of this example.