THE CLIMATE REGISTRY

February 2025

The Climate Registry (TCR) is pleased to present its 2025 default emission factors. Each year, we update the default emission factors associated with our program because:

1. The components of energy (electricity, fuel, etc.) change over time
2. Emission factor quantification methods are frequently refined.

Organizations that rely on these emission factors to measure and report base year inventories should assess whether changes in emissions factors over time materially impact their base year emissions and consider adjusting accordingly. The default emission factors are incorporated into the Climate Registry Information System (CRIS) for use in emissions calculations. We publish these default factors on our website to advance best practices, consistency, and transparency in greenhouse gas (GHG) accounting.

Our default emission factors are compiled from publicly available data sources and cited at the bottom of each table. TCR is not responsible for the underlying data or methodology used to calculate these default emission factors or for communicating any changes to the data sources that occur between our annual updates.

As TCR's General Reporting Protocol (GRP) details, organizations should apply the most up-to-date emission factor available when calculating emissions. To calculate indirect emissions associated with electricity using grid average emission factors, organizations should apply the emission factor that corresponds with the year being reported (or the most recent previous year) and may not apply a factor that post-dates the reporting year.

Changes from the 2024 default emission factor tables are highlighted with blue fill. Example below:

		GJ / megalitre		g CO2 / L
Natural Gas	n/a	39.36	1	1.9

Notable changes from the 2024 default emission factor tables include:

1. **Table 1.3 Canadian Default Factors for Calculating CO2 Emissions from Combustion of Coal:** Coal emission factors were developed for each province based on the rank of the coal and the region of supply. Emission factors were based on data from chemical analysis of coal samples for electric utilities, which account for most of the coal consumption.

2. **Table 2.5 U.S. Default Factors for Calculating CH4 and N2O Emissions from Highway Vehicles by Model Year:** Several light-duty trucks were re-characterized as heavy-duty vehicles based on gross vehicle weight rating (GVWR) in which emission standards for each vehicle type were re-examined. Non-plug-in hybrid vehicles (HEV) were not previously included as they were considered alternative fuel vehicles and therefore were not included in the engine technology breakouts. In this year's update, HEV's are now classified as gasoline vehicles across the entire time series.

3. **Table 2.6 U.S. Default Factors for Calculating CH4 and N2O Emissions from Alternative Fuel Vehicles:** CH_4 and N_2O emission factors for alternative fuel vehicles (AFV) were calculated using Argonne National Laboratory's GREET model (ANL 2022).

4. **Table 3.1 U.S. Default Factors for Calculating Emissions from Grid Electricity by eGRID Subregion:** On January 17, 2025, the U.S. Environmental Protection Agency released its *Emissions and Generation Resource Integrated Database (eGRID)* with 2023 data[1]. This data set includes summary tables of CO_2, CH_4, and N_2O output emission rates for each defined eGRID subregion.

5. **Table 3.8 U.S. Utility-Specific CO2 Emission Factors for Purchased Electricity**: Utility-specific emission factors before 2018 will no longer be included in the publication of default emission factors. TCR members who wish to report an inventory before 2018 may contact us to request these emission factors. These emission factors are still available to TCR members in CRIS.

6. **Table 3.9 U.S. Green-e® Residual Mix Emissions Rates by eGRID Subregion:** On December 20,2024, the Center for Resource Solutions published updated Green-e® Residual Mix Emission Rates using 2022 data[2]. These emission rates are adjusted to remove all Green-e® Energy certified sales for each eGRID subregion. Organizations should use these Green-e® Residual Mix Emissions Rates to calculate Scope 2 - market-based purchased electricity emissions in the absence of contractual instruments

[1] https://www.epa.gov/egrid
[2] https://www.green-e.org/residual-mix

(i.e., certificates or RECs, contracts, utility-specific emission factors), instead of the regional emission factor (e.g., eGRID).

TCR members are encouraged to contact the Help Desk at help@theclimateregistry.org with questions or feedback on these default emission factors or citation information.

Sincerely,

The Climate Registry

Table 1.1 U.S. Default Factors for Calculating CO2 Emissions from Combustion of Fossil Fuel and Biomass

Fuel Type	Heat Content	Carbon Content (Per Unit Energy)	Fraction Oxidized	CO2 Emission Factor (Per Unit Energy)	CO2 Emission Factor (Per Unit Mass or Volume)
Coal and Coke	**MMBtu / short ton**	**kg C / MMBtu**		**kg CO2 / MMBtu**	**kg CO2 / short ton**
Anthracite	25.09	28.28	1	103.69	2602
Bituminous	24.93	25.44	1	93.28	2325
Subbituminous	17.25	26.50	1	97.17	1676
Lignite	14.21	26.65	1	97.72	1389
Coal Coke	24.80	31.00	1	113.67	2819
Mixed Electric Utility/Electric Power	19.73	26.05	1	95.52	1885
Unspecified Residential/Com*	17.38	26.16	1	95.92	1667
Mixed Commercial Sector	21.39	25.71	1	94.27	2016
Mixed Industrial Coking	26.28	25.61	1	93.90	2468
Mixed Industrial Sector	22.35	25.82	1	94.67	2116
Natural Gas	**Btu / scf**	**kg C / MMBtu**		**kg CO2 / MMBtu**	**kg CO2 / scf**
US Weighted Average	1026.00	14.47	1	53.06	0.05444
Greater than 1,000 Btu**	>1000	14.47	1	53.06	varies
975 to 1,000 Btu**	975 – 1,000	14.73	1	54.01	varies
1,000 to 1,025 Btu**	1,000 – 1,025	14.43	1	52.91	varies
1,025 to 1,035 Btu**	1,025 – 1,035	14.45	1	52.98	varies
1,025 to 1,050 Btu**	1,025 – 1,050	14.47	1	53.06	varies
1,050 to 1,075 Btu**	1,050 – 1,075	14.58	1	53.46	varies
1,075 to 1,100 Btu**	1,075 – 1,100	14.65	1	53.72	varies
Greater than 1,100 Btu**	>1,100	14.92	1	54.71	varies
(EPA 2010) Full Sample**		14.48	1	53.09	n/a
(EPA 2010) <1.0% CO2**		14.43	1	52.91	n/a
(EPA 2010) <1.5% CO2**		14.47	1	53.06	n/a
(EPA 2010) <1.0% CO2 and <1,050 Btu/scf**	<1,050	14.42	1	52.87	n/a
(EPA 2010) <1.5% CO2 and <1,050 Btu/scf**	<1,050	14.47	1	53.06	n/a
(EPA 2010) Flare Gas**	>1,100	15.31	1	56.14	n/a

Fuel Type	Heat Content	Carbon Content (Per Unit Energy)	Fraction Oxidized	CO2 Emission Factor (Per Unit Energy)	CO2 Emission Factor (Per Unit Mass or Volume)
Petroleum Products	**MMBtu / gallon**	**kg C / MMBtu**		**kg CO2 / MMBtu**	**kg CO2 / gallon**
Distillate Fuel Oil No. 1	0.139	19.98	1	73.25	10.18
Distillate Fuel Oil No. 2	0.138	20.17	1	73.96	10.21
Distillate Fuel Oil No. 4	0.146	20.47	1	75.04	10.96
Residual Fuel Oil No. 5	0.140	19.89	1	72.93	10.21
Residual Fuel Oil No. 6	0.150	20.48	1	75.10	11.27
Still Gas	0.143	18.20	1	66.73	9.53
Used Oil	0.138	20.18	1	74.00	10.21
Kerosene	0.135	20.51	1	75.20	10.15
LPG	0.092	16.83	1	61.71	5.68
Propane (Liquid)	0.091	17.15	1	62.87	5.72
Propylene	0.091	18.48	1	67.77	6.17
Ethane	0.068	16.25	1	59.60	4.05
Ethylene	0.058	17.99	1	65.96	3.83
Isobutane	0.099	17.71	1	64.94	6.43
Isobutylene	0.103	18.78	1	68.86	7.09
Butane	0.103	17.66	1	64.77	6.67
Butylene	0.105	18.74	1	68.72	7.22
Naphtha (<401 deg F)	0.125	18.55	1	68.02	8.50
Natural Gasoline	0.110	18.24	1	66.88	7.36
Other Oil (>401 deg F)	0.139	20.79	1	76.22	10.59
Pentanes Plus	0.110	19.10	1	70.02	7.70
Petrochemical Feedstocks	0.125	19.37	1	71.02	8.88
Petroleum Coke (Liquid)	0.143	27.93	1	102.41	14.64
Special Naphtha	0.125	19.73	1	72.34	9.04
Unfinished Oils	0.139	20.33	1	74.54	10.36
Heavy Gas Oils	0.148	20.43	1	74.92	11.09
Lubricants	0.144	20.26	1	74.27	10.69

Fuel Type	Heat Content	Carbon Content (Per Unit Energy)	Fraction Oxidized	CO2 Emission Factor (Per Unit Energy)	CO2 Emission Factor (Per Unit Mass or Volume)
Motor Gasoline	0.125	19.15	1	70.22	8.78
Aviation Gasoline	0.120	18.89	1	69.25	8.31
Kerosene-Type Jet Fuel	0.135	19.70	1	72.22	9.75
Asphalt and Road Oil	0.158	20.55	1	75.36	11.91
Crude Oil	0.138	20.33	1	74.54	10.29
Petroleum Waxes**	0.132	19.80	1	72.58	9.57
Fossil Fuel-derived Fuels (gaseous)	**MMBtu / scf**	**kg C / MMBtu**		**kg CO2 / MMBtu**	**kg CO2 / scf**
Acetylene***	0.00147	19.53	1	71.61	0.11
Blast Furnace Gas	0.000092	74.81	1	274.32	0.02524
Coke Oven Gas	0.000599	12.78	1	46.85	0.02806
Propane (Gas)	0.002516	16.76	1	61.46	0.15463
Fuel Gas	0.001388	16.09	1	59.00	0.08189
Fossil Fuel-derived Fuels (solid)	**MMBtu / short ton**	**kg C / MMBtu**		**kg CO2 / MMBtu**	**kg CO2 / short ton**
Municipal Solid Waste	9.95	24.74	1	90.70	902
Tires	28.00	23.45	1	85.97	2407
Plastics	38.00	20.45	1	75.00	2850
Petroleum Coke (Solid)	30.00	27.93	1	102.41	3072
Biomass Fuels-Solid	**MMBtu / short ton**	**kg C / MMBtu**		**kg CO2 / MMBtu**	**kg CO2 / short ton**
Wood and Wood Residuals (12% moisture content)	17.48	25.58	1	93.80	1640
Agricultural Byproducts	8.25	32.23	1	118.17	975
Peat	8.00	30.50	1	111.84	895
Solid Byproducts	10.39	28.78	1	105.51	1096
Kraft Black Liquor (North American Hardwood)		25.55	1	93.70	n/a
Kraft Black Liquor (North American Softwood)		25.75	1	94.40	n/a
Kraft Black Liquor (Bagasse)		26.05	1	95.50	n/a
Kraft Black Liquor (Bamboo)		25.55	1	93.70	n/a
Kraft Black Liquor (Straw)		25.94	1	95.10	n/a
Municipal Solid Waste (Biomass)	9.95	24.74	1	90.70	902

Fuel Type	Heat Content	Carbon Content (Per Unit Energy)	Fraction Oxidized	CO2 Emission Factor (Per Unit Energy)	CO2 Emission Factor (Per Unit Mass or Volume)
Biomass Fuels-Gaseous	**MMBtu / scf**	**kg C / MMBtu**		**kg CO2 / MMBtu**	**kg CO2 / scf**
Biogas (Captured Methane)	0.000655	14.20	1	52.07	0.034106
Landfill Gas (50% CH4/50%CO2)	0.000485	14.20	1	52.07	0.025254
Wastewater Treatment Biogas****	varies	14.20	1	52.07	varies
Biomass Fuels - Liquid	**MMBtu / gallon**	**kg C / MMBtu**		**kg CO2 / MMBtu**	**kg CO2 / gallon**
Ethanol (100%)	0.084	18.67	1	68.44	5.75
Biodiesel (100%)	0.128	20.14	1	73.84	9.45
Rendered Animal Fat	0.125	19.38	1	71.06	8.88
Vegetable Oil	0.120	22.24	1	81.55	9.79

Source:

Heat Content and CO2 emission factors per unit energy are from U.S. Environmental Protection Agency (EPA) Title 40 CFR Part 98—Mandatory Greenhouse Gas Reporting. Subchapter C, Tables C-2 and AA-1.

Carbon Content is derived using the heat content and/or default emission factor. The source marked with * heat content factor for Unspecified Residential/Com is derived from the U.S. Energy Information Administration, Monthly Energy Review (December 2024).

Sources marked with ** are from US Inventory of Greenhouse Gas Emissions and Sinks 1990-2022 (April 2024) Annex 2, Tables A-28, A-30, A-37, A-226.

Sources marked with *** are derived from the API Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry (November 2021), Section 3.6.3, Table 3-8.

Sources marked with **** are derived from the U.S. Environmental Protection Agency (EPA) Climate Leaders Technical Guidance (2008) Table B-2. A fraction oxidized value of 1.00 is from the Intergovernmental Panel on Climate Change (IPCC), Guidelines for National Greenhouse Gas Inventories (2006).

Sources marked as n/a = data not available.

Note: Where not provided from the U.S. Environmental Protection Agency (EPA) Title 40 CFR Part 98—Mandatory Greenhouse Gas Reporting, default CO2 emission factors (per unit energy) are calculated as: Carbon Content × Fraction Oxidized × 44/12. Default CO2 emission factors (per unit mass or volume) are calculated using the equation: Heat Content × Carbon Content × Fraction Oxidized × 44/12 × Conversion Factor (if applicable).

Table 1.2 Canadian Default Factors for Calculating CO2 Emissions from Combustion of Natural Gas, Petroleum Products, and Biomass

Fuel Type	Carbon Content (Per Unit Energy)	Heat Content*	Fraction Oxidized	CO2 Emission Factor** (Per Unit Mass or Volume)
Natural Gas	**kg C / GJ**	**GJ / megalitre**		**g CO2 / m3**
All Provinces				
Still gas (Upgrading Facilities)	n/a	43.24	1	2140
Still gas (Refineries & Others)	n/a	36.08	1	1780
Newfoundland and Labrador				
Marketable	n/a	39.28	1	1919
Non-Marketable	n/a	39.28	1	2340
Nova Scotia				
Marketable	n/a	39.28	1	1919
Non-Marketable	n/a	39.28	1	2494
New Brunswick				
Marketable	n/a	39.28	1	1919
Non-Marketable	n/a	39.28	1	2401
Quebec				
Marketable	n/a	39.28	1	1926
Non-Marketable	n/a	39.28	1	n/o
Ontario				
Marketable	n/a	39.28	1	1921
Non-Marketable	n/a	39.28	1	2401
Manitoba				
Marketable	n/a	39.28	1	1915
Non-Marketable	n/a	39.28	1	2401
Saskatchewan				
Marketable	n/a	39.28	1	1920
Non-Marketable	n/a	39.28	1	2441

Fuel Type	Carbon Content (Per Unit Energy)	Heat Content*	Fraction Oxidized	CO2 Emission Factor** (Per Unit Mass or Volume)
Alberta				
Marketable	n/a	39.28	1	1962
Non-Marketable	n/a	39.28	1	2113
British Columbia				
Marketable	n/a	39.28	1	1966
Non-Marketable	n/a	39.28	1	2162
Yukon				
Marketable	n/a	39.28	1	1966
Non-Marketable	n/a	39.28	1	2401
Northwest Territories				
Marketable	n/a	39.28	1	1966
Non-Marketable	n/a	39.28	1	2466
Nunavut				
Marketable	n/a	39.28	1	1966
Natural Gas Liquids	**kg C / GJ**	**GJ / Kilolitre**		**g CO2 / L**
Propane: Residential Propane	n/a	25.31	1	1515
Propane: Other Uses Propane	n/a	25.31	1	1515
Ethane	n/a	17.22	1	986
Butane	n/a	28.44	1	1747
Refinery LPGs (All Stationary)***	n/a	n/a	1	1613
Petroleum Products	**kg C / GJ**	**GJ / Kilolitre**		**g CO2 / L**
Light Fuel Oil Electric Utilities	n/a	38.80	1	2753
Light Fuel Oil Industrial	n/a	38.80	1	2753
Light Fuel Oil Producer Consumption	n/a	38.80	1	2670
Light Fuel Oil Residential	n/a	38.80	1	2753
Light Fuel Oil Forestry, Construction, Public Administration, Commercial/Institutional	n/a	38.80	1	2753

Fuel Type	Carbon Content (Per Unit Energy)	Heat Content*	Fraction Oxidized	CO2 Emission Factor** (Per Unit Mass or Volume)
Heavy Fuel Oil (Electric Utility, Industrial, Forestry, Construction, Public Administration, Commercial/Institutional)	n/a	42.50	1	3156
Heavy Fuel Oil (Residential)	n/a	42.50	1	3156
Heavy Fuel Oil (Producer Consumption)	n/a	42.50	1	3190
Kerosene (Electric Utility, Industrial, Producer Consumption, Residential, Forestry, Construction, Public Administration, Commercial/Institutional)	n/a	37.68	1	2560
Diesel	n/a	38.30	1	2681
Petroleum Coke from Upgrading Facilities	n/a	40.57	1	3494
Petroleum Coke from Refineries & Others	n/a	46.35	1	3776
Motor Gasoline	n/a	35.00	1	2307
Biomass	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Wood Fuel/Wood Waste	n/a	18.00	1	1715
Spent Pulping Liquor	n/a	14.00	1	1250
Landfill Gas	n/a	n/a	1	2752
Stoves and Fireplaces	n/a	n/a	1	1539
Pellet Stove	n/a	n/a	1	1652
Other Wood-burning Equipment	n/a	n/a	1	1539

Source:

*Default Heat Content: Statistics Canada, Report on Energy Supply and Demand in Canada, 2019-Revision (May 2, 2022), Energy conversion factors, p. 129; Default Carbon Content: Canada-specific carbon content coefficients are not available.

**Default CO2 emission factors: Environment and Climate Change Canada. 2024. National Inventory Report, 1990-2022—Part 2: Greenhouse Gas Sources and Sinks in Canada. Annex 6: Emission Factors, Tables A6.1-1, A6.1-2, A6.1-5, A6.1-6, A6.1-7, A6.6-1 and A6.6-2. Available online at: canada.ca/ghg-inventory.

***The CO2 emission factor for refinery LPGs is from: Environment Canada, National Inventory Report 1990–2012: Greenhouse Gas Sources and Sinks in Canada (2015). Annex 8: Emission Factors, Table A8-5.

If you cannot obtain measured carbon content values specific to your fuels, you should use the default emission factor; Default Fraction Oxidized: Intergovernmental Panel on Climate Change (IPCC), Guidelines for National Greenhouse Gas Inventories (2006).

n/a=data not available. n/o=not occurring.

Table 1.3 Canadian Default Factors for Calculating CO_2 Emissions from Combustion of Coal

Province and Coal Type	Carbon Content	Heat Content	Fraction Oxidized	CO2 Emission Factor
Newfoundland and Labrador	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Canadian Bituminous	n/a	28.96	0.988	2239
Foreign Bituminous	n/a	29.82	0.988	2571
Lignite	n/a	15.00	0.999	1464
Prince Edward Island	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Canadian Bituminous	n/a	28.96	0.988	2239
Foreign Bituminous	n/a	29.82	0.988	2571
Foreign Sub-Bituminous	n/a	19.15	0.998	1743
Lignite	n/a	15.00	0.999	1464
Nova Scotia	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Canadian Bituminous	n/a	28.96	0.988	2239
Foreign Bituminous	n/a	29.82	0.988	2571
Foreign Sub-Bituminous	n/a	19.15	0.998	1743
Lignite	n/a	15.00	0.999	1464
New Brunswick	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Canadian Bituminous	n/a	26.80	0.988	2239
Foreign Bituminous	n/a	29.82	0.988	2571
Foreign Sub-Bituminous	n/a	19.15	0.998	2352
Lignite	n/a	15.00	0.999	1464
Quebec	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Canadian Bituminous	n/a	28.96	0.988	2239
Foreign Bituminous	n/a	29.82	0.988	2662
Foreign Sub-Bituminous	n/a	19.15	0.998	1865
Lignite	n/a	15.00	0.999	1464
Ontario	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Canadian Bituminous	n/a	25.43	0.988	2239
Foreign Bituminous	n/a	29.82	0.984	2651
Foreign Sub-Bituminous	n/a	19.15	0.998	1865
Lignite	n/a	15.00	0.999	1464
Manitoba	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Canadian Bituminous	n/a	26.02	0.988	2239

Province and Coal Type	Carbon Content	Heat Content	Fraction Oxidized	CO2 Emission Factor
Foreign Bituminous	n/a	29.82	0.988	2651
Foreign Sub-Bituminous	n/a	19.15	0.998	1865
Lignite	n/a	15.00	0.999	1464
Saskatchewan	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Canadian Bituminous	n/a	25.43	0.988	2239
Canadian Sub-Bituminous	n/a	19.15	0.994	1786
Lignite	n/a	15.00	0.996	1469
Alberta	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Canadian Bituminous	n/a	25.43	0.988	2239
Foreign Bituminous	n/a	29.82	0.988	2662
Canadian Sub-Bituminous	n/a	19.15	0.994	1786
Lignite	n/a	15.00	0.999	1464
British Columbia	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Canadian Bituminous	n/a	26.02	0.988	2239
Foreign Bituminous	n/a	29.82	0.988	2662
Canadian Sub-Bituminous	n/a	19.15	0.994	1786
Lignite	n/a	15.00	0.999	1464
All Provinces and Territories	**kg C / GJ**	**GJ / t**		**g CO2 / kg**
Coke	n/a	28.83	1.000	3173
Anthracite	n/a	27.70	0.988	3134
Coke Oven Gas	n/a	19.14	1	687

Source:

Default CO2 Emission Factors: Environment and Climate Change Canada. 2024. National Inventory Report, 1990-2012–Part 2: Greenhouse Gas Sources and Sinks in Canada. Annex 6: Emission Factors, Tables A6.1-10 and A6.1-11. Available online at: canada.ca/ghg-inventory.

Default Heat Content: Statistics Canada, Report on Energy Supply and Demand in Canada, 2019 Revision (May 2022), Energy conversion factors, p. 129 (value for Foreign Bituminous uses the heat content of "Imported bituminous"; value for Foreign Sub-Bituminous uses the heat content of "Sub-bituminous").

Default Carbon Content: Canada-specific carbon content coefficients are not available. If you cannot obtain measured carbon content values specific to your fuels, you should use the default emission factor.

Default Fraction Oxidized: Intergovernmental Panel on Climate Change (IPCC), Guidelines for National Greenhouse Gas Inventories (2006) and Environment and Climate Change Canada. 2024. National Inventory Report, 1990-2012–Part 2: Greenhouse Gas Sources and Sinks in Canada. Annex 6: Emission Factors, Tables A6.1-10 and A6.1-11.

n/a=data not available.

Note: CO2 emission factors from Environment and Climate Change Canada originally included fraction oxidized factors of less than 100% for Solid - Primary Fuels. Values were converted to include a 100% oxidation rate based on the rates used to calculate the original factors.

Table 1.4 Canadian Default Factors for Calculating CH4 and N2O Emissions from Combustion of Natural Gas, Petroleum Products, Coal, and Biomass

Fuel Type	CH4 Emission Factor (Per Unit Mass or Volume)	N2O Emission Factor (Per Unit Mass or Volume)
Natural Gas	**g CH4 / m3**	**g N2O / m3**
Electric Utilities	0.490	0.049
Industrial	0.037	0.033
Producer Consumption (Non-marketable)	6.4	0.060
Producer Consumption (Non-marketable) - Newfoundland and Labrador	0.490	0.060
Pipelines	1.900	0.050
Cement	0.037	0.034
Manufacturing Industries	0.037	0.033
Residential, Construction, Commercial/Institutional, Agriculture	0.037	0.035
Natural Gas Liquids	**g CH4 / L**	**g N2O / L**
Propane (Residential)	0.027	0.108
Propane (All Other Uses)	0.024	0.108
Ethane	0.024	0.108
Butane	0.024	0.108
Refinery LPGs*	0.024	0.108
Refined Petroleum Products	**g CH4 / L**	**g N2O / L**
Light Fuel Oil (Electric Utilities)	0.18	0.031
Light Fuel Oil (Industrial and Producer Consumption)	0.006	0.031
Light Fuel Oil (Residential)	0.026	0.006
Light Fuel Oil (Forestry, Construction, Public Administration, and Commercial/Institutional)	0.026	0.031
Heavy Fuel Oil (Electric Utilities)	0.034	0.064
Heavy Fuel Oil (Industrial and Producer Consumption)	0.12	0.064
Heavy Fuel Oil (Residential, Forestry, Construction, Public Administration, and Commercial/Institutional)	0.057	0.064
Kerosene (Electric Utilities, Industrial, and Producer Consumption)	0.006	0.031
Kerosene (Residential)	0.026	0.006
Kerosene (Forestry, Construction, Public Administration, and Commercial/Institutional)	0.026	0.031
Diesel (Refineries and Others)	0.078	0.022
Diesel (Upgraders)	0.078	0.022

Fuel Type	CH4 Emission Factor (Per Unit Mass or Volume)	N2O Emission Factor (Per Unit Mass or Volume)
Still Gas (Refineries and Others)	0.032	0.00002
Still Gas (Upgraders)	0.000039	0.00002
Motor Gasoline (Unspecified)	0.100	0.02
Petroleum Coke	**g CH4 / L**	**g N2O / L**
Upgrading Facilities	0.12	0.024
Refineries & Others	0.12	0.0275
Coal	**g CH4 / kg**	**g N2O / kg**
Coal (Electric Utilities)	0.02	0.03
Coal (Industry and Heat & Steam Plants)	0.03	0.02
Coal (Residential, Public Administration)	4.00	0.02
Coke	0.03	0.02
Coal (gas)	**g CH4 / m3**	**g N2O / m3**
Coke Oven Gas	0.04	0.04
Biomass	**g CH4 / kg**	**g N2O / kg**
Wood Fuel/Wood Waste (Industrial Combustion)	0.10	0.07
Spent Pulping Liquor (Industrial Combustion)	0.03	0.005
Stoves and Fireplaces (Advanced Technology or Catalytic Control)	5.9	0.12
Stoves and Fireplaces (Conventional Stoves, Fireplaces & Inserts)	12.9	0.12
Pellet Stove	4.12	0.059
Other Wood-burning Equipment	4.12	0.059
Landfill Gas	**kg CH4 / t**	**kg N2O / t**
Landfill Gas (Industrial Combustion)	0.05	0.005
Landfill Gas (Flaring)	3.000	n/a

Source:

Environment and Climate Change Canada. 2024. National Inventory Report, 1990-2022—Part 2: Greenhouse Gas Sources and Sinks in Canada. Annex 6: Emission Factors, Tables A6.1-3, A6.1-5, A6.1-6, A6.1-8, A6.1-9, A6.1-12, A6.6-1, A6.6-2. Available online at: canada.ca/ghg-inventory.

*The CH4 and the N2O emission factors for refinery LPGs are from: Environment Canada, National Inventory Report 1990–2012 Greenhouse Gas Sources and Sinks in Canada (2015). Annex 8: Emission Factors, Table A8-4.

n/a=data not available

Table 1.5 Default CH4 and N2O Emission Factors by Technology Type for the Electricity Generation Sector

Fuel Type and Basic Technology	Configuration	CH4 (g / MMBtu)	N2O (g / MMBtu)
Liquid Fuels			
Residual Fuel Oil/Shale Oil Boilers	Normal Firing	0.8	0.3
Residual Fuel Oil/Shale Oil Boilers	Tangential Firing	0.8	0.3
Gas/Diesel Oil Boilers	Normal Firing	0.9	0.4
Gas/Diesel Oil Boilers	Tangential Firing	0.9	0.4
Large Diesel Oil Engines >600hp (447kW)		4.0	n/a
Solid Fuels			
Pulverized Bituminous Combustion Boilers	Dry Bottom, wall fired	0.7	0.5
Pulverized Bituminous Combustion Boilers	Dry Bottom, tangentially fired	0.7	1.4
Pulverized Bituminous Combustion Boilers	Wet Bottom	0.9	1.4
Bituminous Spreader Stoker Boilers	With and without re-injection	1.0	0.7
Bituminous Fluidized Bed Combustor	Circulating Bed	1.0	61.1
Bituminous Fluidized Bed Combustor	Bubbling Bed	1.0	61.1
Bituminous Cyclone Furnace		0.2	1.6
Lignite Atmospheric Fluidized Bed		n/a	71.2
Natural Gas			
Boilers		0.9	0.9
Gas-Fired Gas Turbines >3MW		3.8	0.9
Large Dual-Fuel Engines		245.0	n/a
Combined Cycle		0.9	2.8
Peat			
Peat Fluidized Bed Combustor	Circulating Bed	3.0	7.0
Peat Fluidized Bed Combustor	Bubbling Bed	3.0	3.0
Biomass			
Wood/Wood Waste Boilers		9.3	5.9
Wood Recovery Boilers		0.8	0.8

Source:

IPCC, Guidelines for National Greenhouse Gas Inventories (2006), Chapter 2: Stationary Combustion, Table 2.6.

Values were converted back from LHV to HHV using IPCC's assumption that LHV are five percent lower than HHV for coal and oil, 10 percent lower for natural gas, and 20 percent lower for dry wood. (The IPCC converted the original factors from units of HHV to LHV, so the same conversion rates used by the IPCC were used here to obtain the original values in units of HHV.) Values were converted from kg/TJ to g/MMBtu using 1 kg = 1000 g and 1 MMBtu = 0.001055 TJ. n/a=data not available.

Table 1.6 Default Factors for Calculating CH4 and N2O Emission from Kilns, Ovens, and Dryers

Industry	Source	CH4 (g / MMBtu)	N2O (g / MMBtu)
Cement, Lime	Kilns – Natural Gas	1.04	n/a
Cement, Lime	Kilns – Oil	1.0	n/a
Cement, Lime	Kilns – Coal	1.0	n/a
Coking, Steel	Coke Oven	1.0	n/a
Chemical Processes, Wood, Asphalt, Copper, Phosphate	Dryer – Natural Gas	1.04	n/a
Chemical Processes, Wood, Asphalt, Copper, Phosphate	Dryer – Oil	1.0	n/a
Chemical Processes, Wood, Asphalt, Copper, Phosphate	Dryer – Coal	1.0	n/a

Source:

IPCC, Guidelines for National Greenhouse Gas Inventories (2006), Chapter 2: Stationary Combustion, Table 2.8.

Values were converted back from LHV to HHV using IPCC's assumption that LHV are five percent lower than HHV for coal and oil and 10 percent lower for natural gas. Values were converted from kg/TJ to g/MMBtu using 1 kg = 1000 g and 1 MMBtu = 0.001055 TJ. n/a=data not available.

Table 1.7 Default Factor for Calculating CH4 and N2O Emissions by Technology Type for the Industrial Sector

Fuel Type and Basic Technology	Configuration	CH4 (g / MMBtu)	N2O (g / MMBtu)
Liquid Fuels			
Residual Fuel Oil Boilers		3.0	0.3
Gas/Diesel Oil Boilers		0.2	0.4
Large Stationary Diesel Oil Engines >600hp (447 kW)		4.0	n/a
Liquefied Petroleum Gases Boilers		0.9	4.0
Solid Fuels			
Other Bituminous/Sub-bituminous Overfeed Stoker Boilers		1.0	0.7
Other Bituminous/Sub-bituminous Underfeed Stoker Boilers		14.0	0.7
Other Bituminous/Sub-bituminous Pulverized	Dry Bottom, wall fired	0.7	0.5
Other Bituminous/Sub-bituminous Pulverized	Dry Bottom, tangentially fired	0.7	1.4
Other Bituminous/Sub-bituminous Pulverized	Wet Bottom	0.9	1.4
Other Bituminous Spreader Stokers		1.0	0.7
Other Bituminous/Sub-bit. Fluidized Bed Combustor	Circulating Bed	1.0	61.1
Other Bituminous/Sub-bit. Fluidized Bed Combustor	Bubbling Bed	1.0	61.1
Natural Gas			
Boilers		0.9	0.9
Gas-Fired Gas Turbines >3MW		3.8	0.9
Natural Gas-fired Reciprocating Engines	2-Stroke Lean Burn	658.0	n/a
Natural Gas-fired Reciprocating Engines	4-Stroke Lean Burn	566.9	n/a
Natural Gas-fired Reciprocating Engines	4-Stroke Rich Burn	104.4	n/a
Biomass			
Wood/Wood Waste Boilers		9.3	5.9

Source:

IPCC, Guidelines for National Greenhouse Gas Inventories (2006), Chapter 2: Stationary Combustion, Table 2.7.

Values were converted from LHV to HHV assuming that LHV are five percent lower than HHV for coal and oil, 10 percent lower for natural gas, and 20 percent lower for dry wood. (The IPCC converted the original factors from units of HHV to LHV, so the same conversion rates used by the IPCC were used here to obtain the original values in units of HHV.) Values were converted from kg/TJ to g/MMBtu using 1 kg = 1000 g and 1 MMBtu = 0.001055 TJ. n/a=data not available.

Table 1.8 Default Factors for Calculating CH4 and N2O Emissions by Technology Type for the Commercial Sector

Fuel Type and Basic Technology	Configuration	CH4 (g / MMBtu)	N2O (g / MMBtu)
Liquid Fuels			
Residual Fuel Oil Boilers		1.4	0.3
Gas/Diesel Oil Boilers		0.7	0.4
Liquefied Petroleum Gases Boilers		0.9	4.0
Solid Fuels			
Other Bituminous/Sub-bituminous Overfeed Stoker Boilers		1.0	0.7
Other Bituminous/Sub-bituminous Underfeed Stoker Boilers		14.0	0.7
Other Bituminous/Sub-bituminous Hand-fed Units		87.2	0.7
Other Bituminous/Sub-bituminous Pulverized Boilers	Dry Bottom, wall fired	0.7	0.5
Other Bituminous/Sub-bituminous Pulverized Boilers	Dry Bottom, tangentially fired	0.7	1.4
Other Bituminous/Sub-bituminous Pulverized Boilers	Wet Bottom	0.9	1.4
Other Bituminous Spreader Stokers		1.0	0.7
Other Bituminous/Sub-bituminous Fluidized Bed Combustor	Circulating Bed	1.0	61.1
Other Bituminous/Sub-bituminous Fluidized Bed Combustor	Bubbling Bed	1.0	61.1
Natural Gas			
Boilers		0.9	0.9
Gas-Fired Gas Turbines >3MWa		3.8	1.3
Biomass			
Wood/Wood Waste Boilers		9.3	5.9

Source:

IPCC, Guidelines for National Greenhouse Gas Inventories (2006), Chapter 2: Stationary Combustion, Table 2.10.

Values were converted from LHV to HHV assuming that LHV are five percent lower than HHV for coal and oil, 10 percent lower for natural gas, and 20 percent lower for dry wood. (The IPCC converted the original factors from units of HHV to LHV, so the same conversion rates used by the IPCC were used here to obtain the original values in units of HHV.) Values were converted from kg/TJ to g/MMBtu using 1 kg = 1000 g and 1 MMBtu = 0.001055 TJ.

Table 1.9 U.S. Default Factors for Calculating CH4 and N2O Emissions by Fuel Type Industrial and Energy Sectors

Fuel Type / End-Use Sector	CH4 (kg / MMBtu)	N2O (kg / MMBtu)
Coal*		
Industrial	1.1E-02	1.6E-03
Energy Industry	1.1E-02	1.6E-03
Coke		
Industrial	1.1E-02	1.6E-03
Energy Industry	1.1E-02	1.6E-03
Petroleum Products		
Industrial	3.0E-3	6.0E-4
Energy Industry	3.0E-3	6.0E-4
Natural Gas		
Industrial	1.0E-3	1.0E-4
Energy Industry	1.0E-3	1.0E-4
Municipal Solid Waste		
Industrial	3.2E-02	4.2E-03
Energy Industry	3.2E-02	4.2E-03
Tires		
Industrial	3.2E-02	4.2E-03
Energy Industry	3.2E-02	4.2E-03
Blast Furnace Gas		
Industrial	2.2E-5	1.0E-4
Energy Industry	2.2E-5	1.0E-4
Coke Oven Gas		
Industrial	4.8E-4	1.0E-4
Energy Industry	4.8E-4	1.0E-4
Biomass Fuels Solid (except Wood and Wood Residuals)		
Industrial	3.2E-02	4.2E-03
Energy Industry	3.2E-02	4.2E-03

Fuel Type / End-Use Sector	CH4 (kg / MMBtu)	N2O (kg / MMBtu)
Wood and Wood Residuals		
Industrial	7.2E-03	3.6E-03
Energy Industry	7.2E-03	3.6E-03
Biogas		
Industrial	3.2E-3	6.3E-4
Energy Industry	3.2E-3	6.3E-4
Biomass Fuels Liquid		
Industrial	1.1E-3	1.1E-4
Energy Industry	1.1E-3	1.1E-4
Pulping Liquors		
Industrial**	1.9E-3	4.2E-4

Source:

CH4 and N2O emission factors per unit energy are from U.S. Environmental Protection Agency (EPA) Title 40 CFR Part 98—Mandatory Greenhouse Gas Reporting. Subchapter C, Table C-2. Those marked with ** are from Table AA-1.

*For coal combustion, organizations who fall within the IPCC "Energy Industry" category can employ a value of 1g of CH4/mmBtu.

Table 1.10 Default Factors for Calculating CH4 and N2O Emissions by Fuel Type for the Residential and Commercial Sectors

Fuel Type / End-Use Sector	CH4 (g / MMBtu)	N2O (g / MMBtu)
Coal		
Residential	300.7	1.5
Commercial	10.0	1.5
Petroleum Products		
Residential	10.0	0.6
Commercial	10.0	0.6
Natural Gas		
Residential	4.7	0.1
Commercial	4.7	0.1
Wood		
Residential	253.2	3.4
Commercial	253.2	3.4

Source:

IPCC, Guidelines for National Greenhouse Gas Inventories (2006), Chapter 2: Stationary Combustion, Tables 2.4 and 2.5.

Values were converted from LHV to HHV assuming that LHV are five percent lower than HHV for coal and oil, 10 percent lower for natural gas, and 20 percent lower for dry wood. (The IPCC converted the original factors from units of HHV to LHV, so the same conversion rates used by the IPCC were used here to obtain the original values in units of HHV.) Values were converted from kg/TJ to g/MMBtu using 1 kg = 1000 g and 1 MMBtu = 0.001055 TJ.

Table 2.1 U.S. Default Factors for Calculating CO2 Emissions from Combustion of Transport Fuels

Fuel Type	Carbon Content (Per Unit Energy)	Heat Content	Fraction Oxidized	CO2 Emission Factor (Per Unit Volume)
Fuels Measured in Gallons	**kg C / MMBtu**	**MMBtu / gallon**		**kg CO2 / gallon**
Gasoline	19.2	0.125	1	8.78
Diesel Fuel	20.2	0.138	1	10.21
Aviation Gasoline	18.9	0.120	1	8.31
Jet Fuel (Jet A or A-1)	19.7	0.135	1	9.75
Kerosene	20.5	0.135	1	10.15
Residual Fuel Oil No. 5	19.9	0.140	1	10.21
Residual Fuel Oil No. 6	20.5	0.150	1	11.27
Crude Oil	20.3	0.138	1	10.29
Biodiesel (B100)	20.1	0.128	1	9.45
Ethanol (E100)	18.7	0.084	1	5.75
Methanol*	n/a	n/a	1	4.10
Liquefied Natural Gas (LNG)	n/a	n/a	1	4.50
Liquefied Petroleum Gas (LPG)	16.8	0.092	1	5.68
Propane (Liquid)	17.1	0.091	1	5.72
Ethane	16.3	0.068	1	4.05
Isobutane	17.7	0.099	1	6.43
Butane	17.7	0.103	1	6.67
Renewable Diesel (R100)**	20.2	0.138	1	10.21
Renewable Natural Gas (RNG)***	n/a	n/a	1	4.50
Fuels Measured in Standard Cubic Feet	**kg C / MMBtu**	**Btu / Standard cubic foot**		**kg CO2 / Standard cubic foot**
Compressed Natural Gas (CNG)	14.5	0	1	0.05444
Propane (Gas)	16.8	2516	1	0.15463
Renewable Natural Gas (CNG)***	14.5	1026	1	0.05444

Source:

Heat content and default emission factors are from U.S. Environmental Protection Agency (EPA) Title 40 CFR Part 98—Mandatory Greenhouse Gas Reporting, Subchapter C, Table C-1. Carbon content derived using the heat content and default emission factor. A fraction oxidized of 1.00 is from the IPCC, Guidelines for National Greenhouse Gas Inventories (2006). CNG and LNG CO2 factors are from U.S. Environmental Protection Agency (EPA) Center for Corporate Climate Leadership GHG Emission Factors Hub (June 2024).

*Methanol emission factor is calculated from the properties of the pure compounds (Source: California Climate Action Registry General Reporting Protocol v. 3.1, January 2009).

** Renewable Diesel (R100) emission factor assumes that chemical properties of renewable diesel are indistinguishable from petroleum-based diesel according to CalEPA Fuels Guidance Document, Version 3.0, October 2018.

*** Renewable Natural Gas (RNG) emission factor assumes that RNG is chemically identical to fossil natural gas according to U.S. Department of Energy Office of Energy Efficiency and Renewable Energy's Alternative Fuels Data Center information on Natural Gas Vehicle Emissions. n/a=data not available. Renewable Natural Gas (CNG) is RNG reported as a gaseous fuel.

Note: Carbon contents are calculated using the following equation: (Emission Factor / (44/12) / Heat Content x Conversion Factor. Heat content factors are based on higher heating values (HHV).

Table 2.2 Canadian Default Factors for Calculating CO2 Emissions from Combustion of Transport Fuels

Fuel Type	Carbon Content (kg C / GJ)	Heat Content	Fraction Oxidized	CO2 Emission Factors
		GJ / kiloliter		g CO2 / L
Motor Gasoline	n/a	33.45	1	2,307.30
Diesel	n/a	38.35	1	2,680.50
Light Fuel Oil	n/a	38.80	1	2,753.00
Heavy Fuel Oil	n/a	42.50	1	3,156.00
Aviation Gasoline	n/a	33.52	1	2,325.40
Aviation Turbo Fuel	n/a	37.40	1	2,559.70
Propane	n/a	25.31	1	1,515.00
Ethanol	n/a	23.42	1	1,508.04
Biodiesel	n/a	35.18	1	2,472.20
Kerosene	n/a	37.68	1	2,559.70
		GJ / megalitre		g CO2 / L
Natural Gas	n/a	39.36	1	1.9

Source:

Default CO2 Emission Factors: Environment Canada, National Inventory Report, 1990-2022: Greenhouse Gas Sources and Sinks in Canada (May 2024) Annex 6: Emission Factors, Table A6.1-15;

Default Heat Content: Statistics Canada, Report on Energy Supply and Demand in Canada; Explanatory Information (November 2024), Energy conversion factors, pp. 14-15;

Default Carbon Content: Not available for Canada. If you cannot obtain measured carbon content values specific to your fuels, you should use the default emission factor.

Default Fraction Oxidized: A value of 1.00 is used following the Intergovernmental Panel on Climate Change (IPCC), Guidelines for National Greenhouse Gas Inventories (2006).

Table 2.3 Canadian Default Factors for Calculating CH4 and N2O Emissions from Mobile Combustion

Vehicle Type	CH4 Emission Factor (g CH4/L)	N2O Emission Factor (g N2O/L)
Light-Duty Gasoline Vehicles (LDGVs)		
Tier 3	0.111	0.007
Tier 2	0.14	0.022
Tier 1	0.23	0.47
Tier 0	0.32	0.66
Oxidation Catalyst	0.52	0.20
Non-Catalytic Controlled	0.46	0.028
Light-Duty Gasoline Trucks (LDGTs)		
Tier 3	0.111	0.007
Tier 2	0.14	0.022
Tier 1	0.24	0.58
Tier 0	0.21	0.66
Oxidation Catalyst	0.43	0.20
Non-Catalytic Controlled	0.56	0.028
Heavy-Duty Gasoline Vehicles (HDGVs)		
Three-Way Catalyst	0.068	0.2
Non-Catalytic Controlled	0.29	0.047
Uncontrolled	0.49	0.084
Gasoline Motorcycles		
Non-Catalytic Controlled	0.77	0.041
Uncontrolled	2.3	0.048
Light-Duty Diesel Vehicles (LDDVs)		
Advanced Control*	0.051	0.22
Moderate Control	0.068	0.21
Uncontrolled	0.10	0.16
Light-Duty Diesel Trucks (LDDTs)		
Advanced Control*	0.068	0.22
Moderate Control	0.068	0.21
Uncontrolled	0.085	0.16
Heavy-Duty Diesel Vehicles (HDDVs)		
Advance Control	0.11	0.151
Moderate Control	0.14	0.082
Uncontrolled	0.15	0.075

Vehicle Type	CH4 Emission Factor (g CH4/L)	N2O Emission Factor (g N2O/L)
Gas Fueled Vehicles		
Natural Gas Vehicles	0.0088	0.00006
Propane Vehicles	0.64	0.028
Railways		
Diesel Train	0.149	1.029
Marine		
Gasoline Boats	0.21931	0.06266
Diesel Ships	0.25193	0.07198
Light Fuel Oil Ships	0.2555	0.073
Heavy Fuel Oil Ships	0.2856	0.0816
Kerosene	0.2471	0.0706
Aviation		
Aviation Gasoline	2.19	0.23
Aviation Turbo Fuel	0.018	0.0711
Renewable Fuels		
Biodiesel	**	**
Ethanol	***	***
Off-Road Vehicles		
Off-road Gasoline 2-stroke	10.56	0.013
Off-road Gasoline 4-stroke	5.08	0.064
Off-road Diesel <19kW	0.073	0.022
Off-road Diesel ≥ 19kW, Tier 1-3	0.073	0.022
Off-road Diesel ≥ 19kW, Tier 4	0.073	0.227
Off-road Natural Gas	0.0088	0.00006
Off-road Propane	0.64	0.087

Source:

Environment Canada, National Inventory Report, 1990-2022: Greenhouse Gas Sources and Sinks in Canada (May 2024) Annex 6: Emission Factors, Table A6.1-15.

*Advanced control diesel emission factors should be used for Tier 2 diesel vehicles.

**Diesel CH4 and N2O emission factors (by mode and technology) shall be used to calculate biodiesel emissions.

***Gasoline CH4 and N2O emission factors (by mode and technology) shall be used to calculate ethanol emissions.

Table 2.4 U.S. Default Factors for Calculating CH4 and N2O Emissions from Highway Vehicles by Technology Type

Vehicle Type/Control Technology	CH4 (g / mi)	N2O (g / mi)
Gasoline Passenger Cars		
EPA Tier 3	0.0055	0.0015
ARB LEV III	0.0045	0.0012
EPA Tier 2	0.0072	0.0048
ARB LEV II	0.0070	0.0043
ARB LEV	0.0100	0.0205
EPA Tier 1	0.0271	0.0429
EPA Tier 0	0.0704	0.0647
Oxidation Catalyst	0.1355	0.0504
Non-Catalyst Control	0.1696	0.0197
Uncontrolled	0.1780	0.0197
Low Emission Vehicles*	0.0105	0.0150
Gasoline Light Duty Trucks		
EPA Tier 3	0.0092	0.0012
ARB LEV III	0.0065	0.0012
EPA Tier 2	0.0100	0.0025
ARB LEV II	0.0084	0.0057
ARB LEV	0.0148	0.0223
EPA Tier 1	0.0452	0.0871
EPA Tier 0	0.0776	0.1056
Oxidation Catalyst	0.1516	0.0639
Non-Catalyst Control	0.1908	0.0218
Uncontrolled	0.2024	0.0220
Low Emission Vehicles*	0.0148	0.0157
Gasoline Heavy-Duty Vehicles		
EPA Tier 3	0.0252	0.0063
ARB LEV III	0.0411	0.0136
EPA Tier 2	0.0297	0.0015
ARB LEV II	0.0391	0.0049
ARB LEV	0.0300	0.0466
EPA Tier 1	0.0655	0.1750

Vehicle Type/Control Technology	CH4 (g / mi)	N2O (g / mi)
EPA Tier 0	0.2630	0.2135
Oxidation Catalyst	0.2356	0.1317
Non-Catalyst Control	0.4181	0.0473
Uncontrolled	0.4604	0.0497
Low Emission Vehicles*	0.0303	0.0320
Diesel Passenger Cars		
Aftertreatment	0.0302	0.0192
Advanced	0.0005	0.0010
Moderate	0.0005	0.0010
Uncontrolled	0.0006	0.0012
Diesel Light-Duty Trucks		
Aftertreatment	0.0290	0.0214
Advanced	0.0009	0.0014
Moderate	0.0009	0.0014
Uncontrolled	0.0011	0.0017
Diesel Medium and Heavy-Duty Trucks and Buses		
Aftertreatment	0.0095	0.0431
Advanced	0.0051	0.0048
Moderate	0.0051	0.0048
Uncontrolled	0.0051	0.0048
Motorcycles		
Advanced	0.007	0.0083
Non-Catalyst Control	0.0000	0.0000
Uncontrolled	0.0070	0.0083

Source:

US Inventory of Greenhouse Gas Emissions and Sinks 1990-2022 (April 2024) Annex 3, Table A-83.

*The CH4 and N2O emissions from Low-Emission Vehicles are from: US Inventory of Greenhouse Gas Emissions and Sinks 1990-2015 (April 2017) Annex 3, Table A-108.

Table 2.5 U.S. Default Factors for Calculating CH4 and N2O Emissions from Highway Vehicles by Model Year

Vehicle Type and Year	CH4 (g / mi)	N2O (g / mi)
Gasoline Passenger Cars		
Model Years 1984-1993	0.0704	0.0647
Model Year 1994	0.0617	0.0603
Model Year 1995	0.0531	0.0560
Model Year 1996	0.0434	0.0503
Model Year 1997	0.0337	0.0446
Model Year 1998	0.0240	0.0389
Model Year 1999	0.0215	0.0355
Model Year 2000	0.0175	0.0304
Model Year 2001	0.0105	0.0212
Model Year 2002	0.0102	0.0207
Model Year 2003	0.0098	0.0185
Model Year 2004	0.0078	0.0085
Model Year 2005	0.0075	0.0067
Model Year 2006	0.0076	0.0075
Model Year 2007	0.0072	0.0052
Model Year 2008	0.0072	0.0049
Model Year 2009	0.0071	0.0046
Model Year 2010	0.0071	0.0046
Model Year 2011	0.0071	0.0046
Model Year 2012	0.0071	0.0046
Model Year 2013	0.0071	0.0046
Model Year 2014	0.0071	0.0046
Model Year 2015	0.0068	0.0042
Model Year 2016	0.0065	0.0038
Model Year 2017	0.0054	0.0018
Model Year 2018	0.0052	0.0016
Model Year 2019	0.0051	0.0015
Model Year 2020	0.005	0.0014

Vehicle Type and Year	CH4 (g / mi)	N2O (g / mi)
Model Year 2021	0.0051	0.0014
Model Year 2022	0.0050	0.0014
Gasoline Light Trucks (Vans, Pickup Trucks, SUVs)		
Model Years 1987-1993	0.0813	0.1035
Model Year 1994	0.0646	0.0982
Model Year 1995	0.0517	0.0908
Model Year 1996	0.0452	0.0871
Model Year 1997	0.0452	0.0871
Model Year 1998	0.0412	0.0787
Model Year 1999	0.0333	0.0618
Model Year 2000	0.0340	0.0631
Model Year 2001	0.0221	0.0379
Model Year 2002	0.0242	0.0424
Model Year 2003	0.0221	0.0373
Model Year 2004	0.0115	0.0088
Model Year 2005	0.0105	0.0064
Model Year 2006	0.0108	0.0080
Model Year 2007	0.0103	0.0061
Model Year 2008	0.0095	0.0036
Model Year 2009	0.0095	0.0036
Model Year 2010	0.0095	0.0035
Model Year 2011	0.0096	0.0034
Model Year 2012	0.0096	0.0033
Model Year 2013	0.0095	0.0035
Model Year 2014	0.0095	0.0033
Model Year 2015	0.0094	0.0031
Model Year 2016	0.0091	0.0029
Model Year 2017	0.0084	0.0018
Model Year 2018	0.0081	0.0015
Model Year 2019	0.0080	0.0013

Vehicle Type and Year	CH4 (g / mi)	N2O (g / mi)
Model Year 2020	0.0079	0.0012
Model Year 2021	0.0079	0.0012
Model Year 2022	0.0079	0.0012
Gasoline Medium and Heavy-Duty Trucks and Buses		
Model Years 1985-1986	0.4090	0.0515
Model Year 1987	0.3675	0.0849
Model Years 1988-1989	0.3492	0.0933
Model Years 1990-1995	0.3246	0.1142
Model Year 1996	0.1278	0.1680
Model Year 1997	0.0924	0.1726
Model Year 1998	0.0655	0.1750
Model Year 1999	0.0648	0.1724
Model Year 2000	0.0630	0.1660
Model Year 2001	0.0577	0.1468
Model Year 2002	0.0634	0.1673
Model Year 2003	0.0602	0.1553
Model Year 2004	0.0298	0.0164
Model Year 2005	0.0297	0.0083
Model Year 2006	0.0299	0.0241
Model Year 2007	0.0322	0.0024
Model Year 2008	0.0340	0.0031
Model Year 2009	0.0339	0.0030
Model Year 2010	0.0320	0.0023
Model Year 2011	0.0304	0.0017
Model Year 2012	0.0313	0.0021
Model Year 2013	0.0313	0.0021
Model Year 2014	0.0315	0.0021
Model Year 2015	0.0332	0.0032
Model Year 2016	0.0321	0.0070
Model Year 2017	0.0329	0.0087

Vehicle Type and Year	CH4 (g / mi)	N2O (g / mi)
Model Year 2018	0.0326	0.0087
Model Year 2019	0.033	0.0091
Model Year 2020	0.0332	0.0100
Model Year 2021	0.0332	0.0100
Model Year 2022	0.3320	0.0100
Diesel Passenger Cars		
Model Years 1960-1982	0.0006	0.0012
Model Years 1983-1995	0.0005	0.0010
Model Years 1996-2006	0.0005	0.0010
Model Years 2007-2022	0.0302	0.0192
Diesel Light Duty Trucks		
Model Years 1960-1982	0.0011	0.0017
Model Years 1983-1995	0.0009	0.0014
Model Years 1996-2006	0.0009	0.0014
Model Years 2007-2022	0.0290	0.0214
Diesel Medium and Heavy-Duty Trucks and Buses		
Model Years 1960-1989	0.0051	0.0048
Model Years 1990-2003	0.0051	0.0048
Model Years 2004-2006	0.0051	0.0048
Model Years 2007-2022	0.0095	0.0431
Motorcycles		
Model Years 1960-1995	0.0070	0.0083
Model Years 1996-2005	0.0000	0.0000
Model Years 2006-2022	0.0070	0.0083

Source:

US Inventory of Greenhouse Gas Emissions and Sinks 1990-2022 (April 2024) Annex 3, Tables A-79 to A-83.

Table 2.6 U.S. Default Factors for Calculating CH4 and N2O Emissions from Alternative Fuel Vehicles

Vehicle Type	CH4 (g / mi)	N2O (g / mi)
Light-Duty Cars		
Methanol-Flex Fuel ICE	0.012	0.004
Ethanol-Flex Fuel ICE	0.012	0.004
CNG ICE	0.120	0.004
CNG Bi-fuel	0.120	0.004
LPG ICE	0.012	0.004
LPG Bi-fuel	0.012	0.004
Biodiesel (BD100)	0.030	0.001
Light-Duty Trucks		
Ethanol-Flex Fuel ICE	0.013	0.005
CNG ICE	0.130	0.005
CNG Bi-fuel	0.130	0.005
LPG ICE	0.013	0.005
LPG Bi-fuel	0.013	0.005
LNG	0.130	0.005
Biodiesel (BD100)	0.054	0.001
Medium Duty Trucks		
CNG ICE	1.786	0.033
CNG Bi-fuel	1.786	0.033
LPG ICE	0.179	0.033
LPG Bi-fuel	0.179	0.033
LNG	1.786	0.033
Biodiesel (BD100)	0.009	0.005
Heavy-Duty Trucks		
Neat Methanol ICE	0.072	0.026
Neat Ethanol ICE	0.072	0.026
CNG ICE	0.921	0.017
LPG ICE	0.092	0.017
LPG Bi-fuel	0.060	0.017
LNG	0.921	0.017
Biodiesel (BD100)	0.009	0.002

Vehicle Type	CH4 (g / mi)	N2O (g / mi)
Buses		
Neat Methanol ICE	0.190	0.029
Neat Ethanol ICE	0.190	0.029
CNG ICE	2.719	0.017
LPG ICE	0.272	0.017
LNG	2.719	0.017
Biodiesel (BD100)	0.009	0.003
Source: US Inventory of Greenhouse Gas Emissions and Sinks 1990-2022 (April 2024) Annex 3, Tables A-85 and A-84.		

Table 2.7 U.S. Default Factors for Calculating CH4 and N2O Emissions from Non-Highway Vehicles

Vehicle Type / Fuel Type	CH4 (g / gallon)	N2O (g / gallon)
Ships and Boats		
Residual Fuel Oil	1.10	0.31
Gasoline 2 Stroke	4.67	0.08
Gasoline 4 Stroke	2.27	0.01
Distillate Fuel Oil (Diesel)	6.51	0.17
Rail		
Diesel Fuel	0.80	0.26
Aircraft		
Jet Fuel	0.00	0.30
Aviation Gasoline	7.06	0.11
Agricultural Equipment		
Gasoline-Equipment 2 Stroke	6.90	0.47
Gasoline-Equipment 4 Stroke	1.93	1.20
Gasoline-Off-road Trucks	1.93	1.20
Diesel-Equipment	1.26	1.07
Diesel-Off-Road Trucks	0.92	0.56
LPG	0.33	0.94
Construction/Mining Equipment		
Gasoline-Equipment 2 Stroke	8.00	0.12
Gasoline-Equipment 4 Stroke	2.86	1.48
Gasoline-Off-Road Trucks	2.86	1.48
Diesel-Equipment	1.01	0.94
Diesel-Off-Road Trucks	0.92	0.56
LPG	0.59	0.50
Lawn and Garden Equipment		
Gasoline-Residential 2 Stroke	6.71	0.49
Gasoline-Residential 4 Stroke	3.03	1.96
Gasoline-Commercial 2 Stroke	7.34	0.31
Gasoline-Commercial 4 Stroke	3.02	1.50
Diesel-Residential	0.67	0.49
Diesel-Commercial	0.67	0.49
LPG	0.37	0.63

Vehicle Type / Fuel Type	CH4 (g / gallon)	N2O (g / gallon)
Airport Equipment		
Gasoline 4 Stroke	1.07	1.12
Diesel	1.98	1.21
LPG	0.37	0.93
Industrial/Commercial Equipment		
Gasoline 2 Stroke	7.30	0.51
Gasoline 4 Stroke	2.81	1.57
Diesel	0.43	0.62
LPG	0.46	0.67
Logging Equipment		
Gasoline 2 Stroke	9.62	-
Gasoline 4 Stroke	3.22	2.05
Diesel	0.49	1.26
Railroad Equipment		
Gasoline 4 Stroke	3.32	1.86
Diesel	0.41	0.97
LPG	2.05	0.01
Recreational Equipment		
Gasoline 2 Stroke	9.86	0.11
Gasoline 4 Stroke	2.74	1.49
Diesel	0.73	0.66
LPG	0.44	0.61

Source:

US Inventory of Greenhouse Gas Emissions and Sinks 1990-2022 (April 2024) Annex 3, Table A-86 and A-87. Original factors converted to g/gallon fuel using fuel density defaults from US Inventory of Greenhouse Gas Emissions and Sinks 1990-2021 (April 2023) Annex 6.

Table 2.8 Default Factors for Calculating LTO Emission for Typical Aircraft

Aircraft	CO2 (kg / LTO)	CH4 (kg / LTO)	N2O (kg / LTO)
A300	5450	0.12	0.2
A310	4760	0.63	0.2
A319	2310	0.06	0.1
A320	2440	0.06	0.1
A321	3020	0.14	0.1
A330-200/300	7050	0.13	0.2
A340-200	5890	0.42	0.2
A340-300	6380	0.39	0.2
A340-500/600	10660	0.01	0.3
707	5890	9.75	0.2
717	2140	0.01	0.1
727-100	3970	0.69	0.1
727-200	4610	0.81	0.1
737-100/200	2740	0.45	0.1
737-300/400/500	2480	0.08	0.1
737-600	2280	0.10	0.1
737-700	2460	0.09	0.1
737-800/900	2780	0.07	0.1
747-100	10140	4.84	0.3
747-200	11370	1.82	0.4
747-300	11080	0.27	0.4
747-400	10240	0.22	0.3
757-200	4320	0.02	0.1
757-300	4630	0.01	0.1
767-200	4620	0.33	0.1
767-300	5610	0.12	0.2
767-400	5520	0.10	0.2
777-200/300	8100	0.07	0.3
DC-10	7290	0.24	0.2

Aircraft	CO2 (kg / LTO)	CH4 (kg / LTO)	N2O (kg / LTO)
DC-8-50/60/70	5360	0.15	0.2
DC-9	2650	0.46	0.1
L-1011	7300	7.40	0.2
MD-11	7290	0.24	0.2
MD-80	3180	0.19	0.1
MD-90	2760	0.01	0.1
TU-134	2930	1.80	0.1
TU-154-M	5960	1.32	0.2
TU-154-B	7030	11.90	0.2
RJ-RJ85	1910	0.13	0.1
BAE 146	1800	0.14	0.1
CRJ-100ER	1060	0.06	0.03
ERJ-145	990	0.06	0.03
Fokker 100/70/28	2390	0.14	0.1
BAC111	2520	0.15	0.1
Dornier 328 Jet	870	0.06	0.03
Gulfstream IV	2160	0.14	0.1
Gulfstream V	1890	0.03	0.1
Yak-42M	2880	0.25	0.1
Cessna 525/560	1070	0.33	0.03
Beech King Air	230	0.06	0.01
DHC8-100	640	0.00	0.02
ATR72-500	620	0.03	0.02

Source:

IPCC, Guidelines for National Greenhouse Gas Inventories (2006), Volume 2: Energy, Chapter 3: Mobile Combustion, Table 3.6.9. LTO = landing/take-off.

Table 2.9 Factors for Estimating CH4 and N2O Emissions from Gasoline and Diesel Vehicles (SEM)

GHG	MT GHG per MT of CO2
CH4	2.49E-05
N2O	2.06E-05

Source:

Derived from US Inventory of Greenhouse Gas Emissions and Sinks 1990-2022 (April 2024), Table 2-13. Only includes data for passenger cars and light-duty trucks.

Table 3.1 U.S. Default Factors for Calculating Emissions from Grid Electricity by eGRID Subregion

eGRID 2020 Subregion	eGRID 2020 Subregion Name	2023 Emission Rates		
		(lbs CO2 / MWh)	(lbs CH4 / GWh)	(lbs N2O / GWh)
AKGD	ASCC Alaska Grid	899.00	86.00	12.00
AKMS	ASCC Miscellaneous	519.45	26.00	4.00
AZNM	WECC Southwest	740.81	41.00	6.00
CAMX	WECC California	436.66	25.00	3.00
ERCT	ERCOT All	738.04	43.00	6.00
FRCC	FRCC All	801.89	42.00	5.00
HIMS	HICC Miscellaneous	1,122.12	146.00	22.00
HIOA	HICC Oahu	1,489.36	134.00	21.00
MROE	MRO East	1,402.01	116.00	17.00
MROW	MRO West	920.02	97.00	14.00
NEWE	NPCC New England	537.24	63	8.00
NWPP	WECC Northwest	631.71	54.00	8.00
NYCW	NPCC NYC/Westchester	974.66	25.00	3.00
NYLI	NPCC Long Island	1,180.68	140.00	18.00
NYUP	NPCC Upstate NY	240.99	11.00	1.00
PRMS	Puerto Rico Miscellaneous	1,542.95	77.00	12.00
RFCE	RFC East	594.74	36.00	5.00
RFCM	RFC Michigan	962.08	82.00	11.00
RFCW	RFC West	911.32	71.00	10.00
RMPA	WECC Rockies	1,036.21	90.00	13.00
SPNO	SPP North	861.93	87.00	12.00

eGRID 2020 Subregion	eGRID 2020 Subregion Name	2023 Emission Rates		
		(lbs CO2 / MWh)	(lbs CH4 / GWh)	(lbs N2O / GWh)
SPSO	SPP South	891.10	55.00	8.00
SRMV	SERC Mississippi Valley	739.42	32.00	4.00
SRMW	SERC Midwest	1,238.31	132.00	19.00
SRSO	SERC South	840.89	55.00	8.00
SRTV	SERC Tennessee Valley	895.69	79.00	11.00
SRVC	SERC Virginia/Carolina	590.23	45.00	6.00
US Territories*	N/A	1,891.57	75.91	17.13

Source: U.S. Environmental Protection Agency (EPA) Year 2023 eGRID 2nd revision (1/17/25) (January 2025: eGRID subregion annual total output emission rates).

Except * from Department of Energy Guidance on Voluntary Reporting of Greenhouse Gases, Form EIA-1605 (2007), Appendix F, Electricity Emission Factors, Table F-1.

Note: US Territories is not an eGRID subregion

Table 3.2 Canadian Default Factors for Calculating Emissions from Grid Electricity by Province

Province	2021 Emission Rates		
	g CO2 / kWh	g CH4 / kWh	g N2O / kWh
Alberta	500	0.06	0.01
British Columbia	13	0.020	0.0008
Manitoba	1.9	0.0003	0.0
New Brunswick	290	0.02	0.005
Newfoundland and Labrador	16	0.0002	0.0
Northwest Territories	160	0.01	0.0
Nova Scotia	650	0.03	0.01
Nunavut	790	0.0	0.0
Ontario	32	0.008	0.001
Prince Edward Island	3.0	0.0002	0.0
Quebec	1.3	0.0	0.0
Saskatchewan	650	0.06	0.02
Yukon	70	0.006	0.0

Source:

Environment and Climate Change Canada, National Inventory Report, 1990-2022: Greenhouse Gas Sources and Sinks in Canada Part 3 (May 2024) Annex 13: Table A13-2 – A13-14.

Table 3.3 Mexican Default Factors for Calculating Emissions from Grid Electricity

Year	Emission Rates (kg CO2e / MWh)
2000	604.1
2001	625
2002	600
2003	571.2
2004	549.6
2005	550.1
2014	454
2015	458
2016	458
2017	582
2018	527
2019	505
2020	494
2021	423
2022	435
2023	438

Sources: Asociación de Técnicos y Profesionistas en Aplicación Energética (ATPAE), 2003, Metodologías para calcular el Coeficiente de Emisión Adecuado para Determinar las Reducciones de GEI Atribuibles a Proyectos de EE/ER – Justificación para la selección de la Metodología, versión final 4.1 (June 2003), proyecto auspiciado por la Agencia Internacional de Estados Unidos para el Desarrollo Internacional, México, D.F., México.

Factors are a national average of all the power plants operating and delivering electricity to the National Electric System and do not include transmission and distribution losses.

Factors for 2002 to 2005 were not calculated with actual data but instead estimated using the Electricity Outlooks published by Mexico's Ministry of Energy.

Factors for 2014 to 2023 are sourced from Registro Nacional de Emisiones (RENE): https://www.gob.mx/semarnat/acciones-y-programas/registro-nacional-de-emisiones-rene

Note: These emission rates are in units of CO2 equivalent (CO2e) and include emissions of CO2, CH4, and N2O.

Table 3.4 Non-North American Default Factors for calculating Emissions from Electricity Generation

Region / Country / Economy	2010 Emission Rates (g CO2 / kWh)	2011 Emission Rates (g CO2 / kWh)
Albania	2	7
Algeria	548	556
Angola	440	390
Argentina	367	390
Armenia	92	123
Australia	841	823
Austria	188	215
Azerbaijan	439	455
Bahrain	640	601
Bangladesh	593	564
Belarus	449	441
Belgium	220	196
Benin	720	722
Bolivia	423	433
Bosnia and Herzegovina	723	794
Botswana	2517	1787
Brazil	87	68
Brunei Darussalam	717	717
Bulgaria	535	591
Cambodia	804	793
Cameroon	207	200
Chile	410	441
Chinese Taipei	624	601
Colombia	176	108
Congo	142	230
Costa Rica	56	64
Côte d'Ivoire	445	437
Croatia	236	334
Cuba	1012	955
Cyprus	697	732

Region / Country / Economy	2010 Emission Rates (g CO2 / kWh)	2011 Emission Rates (g CO2 / kWh)
Czech Republic	589	591
Dem. Rep. of Congo	3	3
Denmark	360	315
Dominican Republic	589	743
DPR of Korea	465	475
Ecuador	389	345
Egypt	450	457
El Salvador	223	243
Eritrea	646	849
Estonia	1014	1086
Ethiopia	7	7
Finland	229	191
France	79	61
FYR of Macedonia	685	811
Gabon	383	378
Georgia	69	102
Germany	461	477
Ghana	259	215
Gibraltar	762	752
Greece	718	720
Guatemala	286	286
Haiti	538	382
Honduras	332	371
Hong Kong, China	723	768
Hungary	317	317
Iceland	0	n/a
India	912	856
Indonesia	709	755
Iraq	1003	903
Ireland	458	427
Islamic Rep. of Iran	565	578

Region / Country / Economy	2010 Emission Rates (g CO2 / kWh)	2011 Emission Rates (g CO2 / kWh)
Israel	689	727
Italy	406	402
Jamaica	711	620
Japan	416	497
Jordan	566	637
Kazakhstan	403	431
Kenya	274	294
Korea	533	545
Kosovo	1287	1109
Kuwait	842	787
Kyrgyzstan	59	45
Latvia	120	133
Lebanon	709	707
Libya	885	636
Lithuania	337	270
Luxembourg	410	387
Malaysia	727	688
Malta	872	862
Mongolia	949	837
Montenegro	405	653
Morocco	718	729
Mozambique	1	1
Myanmar	262	255
Namibia	197	24
Nepal	1	1
Netherlands	415	404
Netherlands Antilles	707	708
New Zealand	150	141
Nicaragua	460	471
Nigeria	405	433
Norway	17	13

Region / Country / Economy	2010 Emission Rates (g CO2 / kWh)	2011 Emission Rates (g CO2 / kWh)
Oman	794	741
Pakistan	425	409
Panama	298	357
Paraguay	n/a	n/a
People's Rep. of China	766	764
Peru	289	297
Philippines	481	492
Poland	781	780
Portugal	255	303
Qatar	494	490
Republic of Moldova	517	486
Romania	413	499
Russian Federation	384	437
Saudi Arabia	737	754
Senegal	637	689
Serbia	718	784
Singapore	499	500
Slovak Republic	197	200
Slovenia	325	338
South Africa	927	869
Spain	238	291
Sri Lanka	379	469
Sudan	344	204
Sweden	30	17
Switzerland	27	30
Syrian Arab Republic	594	602
Tajikistan	14	12
Thailand	513	522
Togo	195	206
Trinidad and Tobago	700	506
Tunisia	463	455

Region / Country / Economy	2010 Emission Rates (g CO2 / kWh)	2011 Emission Rates (g CO2 / kWh)
Turkey	460	472
Turkmenistan	954	983
Ukraine	392	450
United Arab Emirates	598	600
United Kingdom	457	441
United Rep. of Tanzania	329	288
Uruguay	81	197
Uzbekistan	550	559
Venezuela	264	234
Vietnam	432	429
Yemen	655	633
Zambia	3	3
Zimbabwe	660	358

Source:

2010 emission rates from CO2 Emissions from Fuel Combustion Highlights (2012) © OECD/IEA, 2012, CO2 emissions per kWh from electricity and heat generation.

2011 emission rates from CO2 Emissions from Fuel Combustion Highlights (2013) © OECD/IEA, 2013, CO2 emissions per kWh from electricity and heat generation.

Values were converted from tonnes/tWh to g/kWh using 1 tonne = 1,000,000 g and 1 tWh = 1,000,000,000 kWh. n/a=data not available.

Note: Emission rates more recent than 2011 are not publicly available, but are available for purchase from the International Energy Agency.

Table 3.5 Average Cost per Kilowatt Hour by U.S. State

State	2023 Average Retail Price Residential (¢/kWh)	2023 Average Retail Price Commercial (¢/kWh)	2023 Price Industrial (¢/kWh)
AK Total	23.90	20.87	18.70
AL Total	14.63	13.16	7.10
AR Total	12.25	10.34	6.87
AZ Total	14.02	11.79	8.11
CA Total	29.51	23.91	18.64
CO Total	14.30	11.64	8.50
CT Total	29.88	19.99	15.69
DC Total	16.45	16.94	10.85
DE Total	15.73	11.83	7.85
FL Total	15.21	11.95	9.39
GA Total	13.69	10.70	6.88
HI Total	42.39	39.03	35.28
IA Total	13.31	10.33	6.91
ID Total	11.05	8.78	7.17
IL Total	15.71	11.24	8.20
IN Total	14.94	12.55	8.24
KS Total	13.38	10.85	7.64
KY Total	12.65	11.38	6.55
LA Total	11.55	10.45	5.88
MA Total	29.61	19.62	17.88
MD Total	16.60	12.77	9.94
ME Total	27.42	17.88	12.30
MI Total	18.84	13.40	8.16
MN Total	14.73	12.39	9.20
MO Total	12.58	10.14	7.90
MS Total	13.23	12.37	6.96
MT Total	12.54	12.11	7.80
NC Total	12.93	9.67	7.15
ND Total	11.01	7.38	7.37

State	2023 Average Retail Price Residential (¢/kWh)	2023 Average Retail Price Commercial (¢/kWh)	2023 Price Industrial (¢/kWh)
NE Total	11.20	8.76	7.63
NH Total	28.15	20.40	15.76
NJ Total	17.70	14.00	11.68
NM Total	13.85	10.68	5.75
NV Total	16.67	11.91	10.36
NY Total	22.24	18.01	6.87
OH Total	15.38	10.75	7.03
OK Total	12.08	9.34	6.26
OR Total	12.73	9.92	7.52
PA Total	18.10	11.26	7.75
RI Total	27.02	17.68	18.98
SC Total	13.68	10.39	6.68
SD Total	12.32	10.16	8.01
TN Total	12.19	11.80	6.23
TX Total	14.46	8.82	6.60
UT Total	11.20	8.51	6.99
VA Total	14.26	8.95	8.92
VT Total	20.82	18.00	11.27
WA Total	10.98	9.92	6.35
WI Total	16.88	12.76	8.68
WV Total	14.05	11.03	7.24
WY Total	11.46	8.94	7.06

Source:

US Energy Information Administration, Form EIA-861, Annual Electric Power Industry Report. Electric Power Annual 2022, Table 2.10: Average Price of Electricity to Ultimate Customers by End-Use Sector, by State, in Cents per Kilowatt-hour, 2023 and 2022.

Table 3.6 Canadian Energy Intensity by Building Activity

Principal Building Activity	GJ / m2	Electricity / Natural gas split (%)
Office buildings (non-medical)	1.05	12.9/10.8
Medical office buildings	0.91	1/0.8
Elementary or secondary schools	0.91	6.9/8
Assisted daily or residential care facilities	1.44	1.7/2.1
Warehouses	1.04	12.3/10.5
Hotels, motels, or lodges	1.28	4.1/2.9
Hospitals	2.67	48.2/52.5
Food or beverage stores	1.34	8.7/2.6
Non-food retail stores	1.01	12.1/6.2
Other activity or function*	1.16	10.6/11.4

Source:

Statistics Canada, Survey of Commercial and Institutional Energy Use, 2019 (August 2022), Tables 1 and 7.

Energy intensity values in Canada include both electricity (47%) and natural gas (53%) consumption (a small subset of other fuel types is included in the natural gas portion).

Members should apportion their consumption totals between activities accordingly.

*Includes all other commercial/institutional buildings.

Table 3.7 U.S. Electricity and Natural Gas Intensity by Building Activity

Principal Building Activity Annual Intensity	Electricity Intensity (kWh / ft2)	Natural Gas Intensity (ft3 NG/ft2)
Education	9.4	30.8
Food Sales	53.3	69.2
Food Service	43.8	147.6
Health Care	23.8	59.1
Health Care - Inpatient	28.8	77.9
Health Care - Outpatient	17.4	27.8
Lodging	14.4	37
Mercantile	16.7	35.7
Mercantile - Retail (other than mall)	13.7	23.3
Mercantile - Enclosed and strip malls	19.6	44.0
Office	13.6	21.3
Public Assembly	12.1	39.8
Public Order and Safety	13.9	35.5
Religious Worship	4.9	22.2
Service	7.2	41.9
Warehouse and Storage	5.8	18.6
Other	29.1	29.2
Vacant	3.9	19.2

Source:

Energy Information Administration. (2018). Commercial buildings energy consumption survey Commercial buildings energy consumption and expenditures. Washington, DC. Energy Information Administration. Tables C22 and C32 (released December 2022).

Table 3.8 U.S. Utility-Specific CO2 Emission Factors for Purchased Electricity

Utility	Factor Type	CO2 Emission Factor lbs / MWh
2018		
CleanPowerSF	Special Power- Green	110.38
	Special Power- SuperGreen	0.00
Clean Power Alliance	Special Power- 100% Green Power	0.00
	Special Power- 65% Renewable Power	6.01
	Special Power- Clean Power	1.64
	Special Power- Lean Power	10.59
East Bay Community Energy	Special Power - Renewable 100	0.00
	Special Power - Brilliant 100	0.00
	Special Power - Bright Choice	100.75
Metropolitan Water District of Southern California	Wholesale Power	0.00
	Self-consumed Power	394.41
Northern States Power Company (Xcel Energy)	Wholesale Power	806.89
	Special Power- Wind Source	0.00
	Special Power- Renewable Connect	0.00
	Special Power	0.00
	Retail Power	820.12
Pacific Gas & Electric	System Average	206.29
Public Service Company of Colorado (Xcel Energy)	Wholesale Power	1,210.34
	Special Power	0.00
	Retail Power	1,307.34
Sacramento Municipal Utility District	Retail Power	465.17
	Special Power	0.00
	Wholesale Power	590.84
Seattle City Light	Wholesale Power	192.46
	Special Power	0.00
	Retail Power	32.05
Sonoma Clean Power	Special Power - EverGreen	46.02
	Retail Power - CleanStart	98.81
Southwestern Public Service Company (Xcel Energy)	Wholesale Power	1,170.65
	Special Power	0.00
	Retail Power	1,170.65
University of California, Office of the President	System Average	138.17

Utility	Factor Type	CO2 Emission Factor lbs / MWh
2019		
Bonneville Power Administration	System Average	34.42
Clean Power Alliance	Special Power- 100% Green Power	0.00
	Special Power- Clean Power	359.28
	Special Power- Lean Power	594.97
East Bay Community Energy	Special Power - Renewable 100	0.00
	Special Power- Brilliant 100	0.00
	Special Power- Bright Choice	135.10
Metropolitan Water District of Southern California	Wholesale Power	0.00
	Self-consumed Power	234.57
Northern States Power Company (Xcel Energy)	System Average	745.16
	Wholesale Power	745.16
	Special Power- Wind Source®	0.00
	Special Power- Renewable Connect®	0.00
	Special Power	0.00
	Retail Power	751.78
Pacific Gas & Electric	Retail Power	18.66
Public Service Company of Colorado (Xcel Energy)	System Average	1,122.15
	Wholesale Power	1,122.15
	Special Power	0.00
	Retail Power	1,208.13
Sacramento Municipal Utility District	Wholesale Power	632.20
	Special Power	0.00
	Retail Power	374.85
	Self-Consumed Power	527.64
Seattle City Light	Retail Power	41.57
	Special Power	0.00
	Wholesale Power	239.77
Sonoma Clean Power	Special Power- EverGreen	40.90
	Retail Power- CleanStart	39.51
Southwestern Public Service Company (Xcel Energy)	System Average	1,080.26
	Wholesale Power	1,080.26
	Special Power	0.00
	Retail Power	1,102.31

Utility	Factor Type	CO2 Emission Factor lbs / MWh
University of California, Office of the President	System Average	0.00
2020		
Bonneville Power Administration	System Average	28.26
Clean Power Alliance	Special Power- 100% Green Power	0.00
	Special Power- Clean Power	509.07
	Special Power- Lean Power	899.47
Metropolitan Water District of Southern California	Wholesale Power	0.00
	Self-consumed Power	251.34
Northern States Power Company (Xcel Energy)	System Average	596.48
	Wholesale Power	598
	Special Power - Solar Rewards	0
	Special Power - Renewable Connect®	0
	Retail Power	602
Pacific Gas & Electric	Retail Power	160.05
Sacramento Municipal Utility District	Wholesale Power	530.34
	Special Power	0.00
	Retail Power	412.59
	Self-Consumed Power	530.34
Salt River Project	Retail Power	922.00
Seattle City Light	Retail Power	19.64
	Special Power	0.00
	Wholesale Power	295.22
Sonoma Clean Power	Retail Power- CleanStart	76.00
	Special Power- Evergreen	42.36
Southwestern Public Service Company (Xcel Energy)	System Average	983.84
	Wholesale Power	981
	Special Power	0
	Special Power	0
	Retail Power	981
University of California, Office of the President	System Average	0.00
2021		
Bonneville Power Administration	System Average	27.61
Clean Power Alliance	Special Power- 100% Green Power	0.00
	Special Power- Clean Power	501.12

Utility	Factor Type	CO2 Emission Factor lbs / MWh
	Special Power- Lean Power	565.59
Metropolitan Water District of Southern California	Wholesale Power	0.00
Pacific Gas & Electric	Retail Power	98.47
Sacramento Municipal Utility District	Retail Power	522.27
	Self-Consumed Power	503.30
	Special Power	0.00
	Wholesale Power	534.47
Salt River Project	Retail Power	1,020.00
Seattle City Light	Retail Power	23.17
	Special Power - Green Up	0.00
	Wholesale Power	340.86
University of California, Office of the President	System Average	0.00
2022		
Bonneville Power Administration	System Average	25.74
Clean Power Alliance	Special Power	0
	Special Power	489.79
	Special Power	566.15
Pacific Gas & Electric	Retail Power	56.08
Sacramento Municipal Utility District	Retail Power	444.51
	Self-Consumed Power	450.13
	Special Power	0
	Wholesale Power	563.85
Salt River Project	Retail Power	993
University of California, Office of the President	System Average	0

Source:

These emission factors have been reported by TCR members using the Electric Power Sector (EPS) Protocol and the option to develop utility-specific electricity delivery metrics. TCR members who are customers of these utilities can use these verified emission factors when quantifying market-based Scope 2 emissions.

Utility-specific emission factors have been converted from tonnes/MWh to lbs/MWh in order to streamline reporting in CRIS.

Note: The emission factors in this table are updated once per year based on the verified emission factors available at the time of publication. More recent utility-specific emission factors may be available on TCR's website.

Table 3.9 U.S. Green-e® Residual Mix Emissions Rates by eGRID Subregion

eGRID 2021 Subregion	eGRID 2021 Subregion Name	2023 Emission Rates		
		(lbs CO2 / MWh)	(lbs CH4 / GWh)	(lbs N2O / GWh)
AKGD	ASCC Alaska Grid	1066.21	88	12
AKMS	ASCC Miscellaneous	497.56	23	4
AZNM	WECC Southwest	780.27	51	7
CAMX	WECC California	504.88	30	4
ERCT	ERCOT All	867.51	49	7
FRCC	FRCC All	827.80	48	6
HIMS	HICC Miscellaneous	1163.07	124	19
HIOA	HICC Oahu	1586.95	163	25
MROE	MRO East	1488.69	133	19
MROW	MRO West	988.08	102	15
NEWE	NPCC New England	540.52	63	8
NWPP	WECC Northwest	624.43	56	8
NYCW	NPCC NYC/Westchester	886.58	23	3
NYLI	NPCC Long Island	1209.31	135	18
NYUP	NPCC Upstate NY	275.40	15	2
PRMS	Puerto Rico Miscellaneous	1599.92	87	14
RFCE	RFC East	660.43	45	6
RFCM	RFC Michigan	1239.06	116	16
RFCW	RFC West	1008.65	87	12
RMPA	WECC Rockies	1151.74	101	14
SPNO	SPP North	1124.93	100	14
SPSO	SPP South	1125.74	72	10
SRMV	SERC Mississippi Valley	807.09	40	6
SRMW	SERC Midwest	1409.05	151	22
SRSO	SERC South	905.50	64	9
SRTV	SERC Tennessee Valley	939.00	82	12
SRVC	SERC Virginia/Carolina	632.00	47	7

Source:

2024 Green-e® Residual Mix Emissions Rates (2022 Data). CH4 and N2O are from U.S. Environmental Protection Agency (EPA) Year 2022 eGRID 16th edition (January 2024: eGRID subregion annual total output emission rates).

Table 4.1 Default Factors for Calculating Emissions from Refrigeration/Air Conditioning Equipment

Type of Equipment	Refrigerant Capacity (kg)	Installation Emission Factor k (% of capacity)	Operating Emission Factor w (% of capacity/year)	Refrigerant Remaining at Disposal y (% of capacity)	Recovery Efficiency z (% of remaining)
Domestic Refrigeration	0.05 - 0.5	1%	0.50%	80%	70%
Stand-alone Commercial Applications	0.2 - 6	3%	15%	80%	70%
Medium & Large Commercial Refrigeration	50 - 2,000	3%	35%	100%	70%
Transport Refrigeration	3 - 8	1%	50%	50%	70%
Industrial Refrigeration including Food Processing and Cold Storage	10 -10,000	3%	25%	100%	90%
Chillers	10 - 2,000	1%	15%	100%	95%
Residential and Commercial A/C including Heat Pumps	0.5 - 100	1%	10%	80%	80%
Mobile Air Conditioning - Maritime	5.0 - 6,500	0.50%	40%	50%	50%
Mobile Air Conditioning - Railway	10 - 30	0.50%	20%	50%	50%
Mobile Air Conditioning - Buses	4 - 18	0.50%	20%	50%	50%
Mobile Air Conditioning - Other Mobile	0.5 - 2	0.50%	20%	50%	50%

Source:

IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2019), Volume 3: Industrial Processes and Product Use, Table 7.9.

Note: Emission factors above are the most conservative of the range provided by the IPCC. The ranges in capacity are provided for reference. You should use the actual capacity of your equipment. If you do not know your actual capacity, you should use the high end of the range provided (e.g., use 2,000 kg for chillers).

Table 4.2 Default Composition of Refrigerant Blends that Contain HFCs and PFCs

Blend	Constituents	Composition (%)
R-405A	HCFC-22 / HFC-152a / HCFC-142b / PFC-318	(45.0 / 7.0 / 5.5 / 42.5)
R-413A	PFC-218 / HFC-134a / HC-600a	(9.0 / 88.0 / 3.0)
R-508A	HFC-23 / PFC-116	(39.0 / 61.0)
R-508B	HFC-23 / PFC-116	(46.0 / 54.0)
Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3, Table 7.8, page 7.18.		

Table 4.3 U.S. Default Factors for Calculating CO2 Emissions from Geothermal Energy Production

Fuel Type	Carbon Content (Per Unit Energy)	CO2 Emission Factor (Per Unit Energy)
Geothermal	**kg C / MMBtu**	**kg CO2 / MMBtu**
Flash Steam	2.18	7.98
Dry Steam	3.22	11.81
Binary	0.00	0.00
Binary/Flash Steam	0.00	0.00
Source: US Inventory of Greenhouse Gas Emissions and Sinks 1990-2021 (April 2022) Annex 2, Tables A-19, A-20.		

Table 5.1 Global Warming Potential Factors for Required Greenhouse Gases

Common Name	Formula	Chemical Name	SAR	TAR	AR4	AR5	AR6
Carbon dioxide	CO2		1	1	1	1	1
Methane	CH4		21	23	25	28	27
Nitrous oxide	N2O		310	296	298	265	273
Nitrogen trifluoride	NF3		n/a	10,800	17,200	16,100	17,400
Sulfur hexafluoride	SF6		23,900	22,200	22,800	23,500	24,300
Hydrofluorocarbons (HFCs)							
HFC-23 (R-23)	CHF3	trifluoromethane	11,700	12,000	14,800	12,400	14,600
HFC-32 (R-32)	CH2F2	difluoromethane	650	550	675	677	771
HFC-41 (R-41)	CH3F	fluoromethane	150	97	92	116	135
HFC-125 (R-125)	C2HF5	pentafluoroethane	2,800	3,400	3,500	3,170	3,740
HFC-134 (R-134)	C2H2F4	1,1,2,2-tetrafluoroethane	1,000	1,100	1,100	1,120	1,260
HFC-134a (R-134a)	C2H2F4	1,1,1,2-tetrafluoroethane	1,300	1,300	1,430	1,300	1,530
HFC-143 (R-143)	C2H3F3	1,1,2-trifluoroethane	300	330	353	328	364
HFC-143a (R-143a)	C2H3F3	1,1,1-trifluoroethane	3,800	4,300	4,470	4,800	5,810
HFC-152 (R-152)	C2H4F2	1,2-difluoroethane	n/a	43	53	16	21.5
HFC-152a (R-152a)	C2H4F2	1,1-difluoroethane	140	120	124	138	164
HFC-161 (R-161)	C2H5F	fluoroethane	n/a	12	12	4	4.84
HFC-227ea (R-227ea)	C3HF7	1,1,1,2,3,3,3-heptafluoropropane	2,900	3,500	3,220	3,350	3,600
HFC-236cb (R-236cb)	C3H2F6	1,1,1,2,2,3-hexafluoropropane	n/a	1,300	1,340	1,210	1,350
HFC-236ea (R-236ea)	C3H2F6	1,1,1,2,3,3-hexafluoropropane	n/a	1,200	1,370	1,330	1,500
HFC-236fa (R-236fa)	C3H2F6	1,1,1,3,3,3-hexafluoropropane	6,300	9,400	9,810	8,060	8,690
HFC-245ca (R-245ca)	C3H3F5	1,1,2,2,3-pentafluoropropane	560	640	693	716	787
HFC-245fa (R-245fa)	C3H3F5	1,1,1,3,3-pentafluoropropane	n/a	950	1,030	858	962

Common Name	Formula	Chemical Name	SAR	TAR	AR4	AR5	AR6
HFC-365mfc	C4H5F5	1,1,1,3,3-pentafluorobutane	n/a	890	794	804	914
HFC-43-10mee (R- 4310)	C5H2F10	1,1,1,2,3,4,4,5,5,5-decafluoropentane	1,300	1,500	1,640	1,650	1,600
Perfluorocarbons (PFCs)							
PFC-14 (Perfluoromethane)	CF4	tetrafluoromethane	6,500	5,700	7,390	6,630	7,380
PFC-116 (Perfluoroethane)	C2F6	hexafluoroethane	9,200	11,900	12,200	11,100	12,400
PFC-218 (Perfluoropropane)	C3F8	octafluoropropane	7,000	8,600	8,830	8,900	9,290
PFC-C-318 (Perfluorocyclobutane)	c-C4F8	octafluorocyclobutane	8,700	10,000	10,300	9,540	10,200
PFC-3-1-10 (Perfluorobutane)	C4F10	decafluorobutane	7,000	8,600	8,860	9,200	10,000
PFC-4-1-12 (Perfluoropentane)	C5F12	dodecafluoropentane	n/a	8,900	9,160	8,550	9,220
PFC-5-1-14 (Perfluorohexane)	C6F14	tetradecafluorohexane	7,400	9,000	9,300	7,910	8,620
PFC-9-1-18	C10F18		n/a	n/a	>7,500	7,190	7,480

Source:

Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR) published in 1995, Third Assessment Report (TAR) published in 2001, Fourth Assessment Report (AR4) published in 2007, Fifth Assessment Report (AR5) published in 2013, and the Sixth Assessment Report (AR6), published in 2021. AR6 values are from WGI Table 7.SM.7. All defaults 100-year GWP values. For any defaults provided as a range, use exact value provided for the purpose of reporting to TCR. n/a=data not available.

Note: Complete reporters must include emissions of all Kyoto-defined GHGs (including all HFCs and PFCs) in inventory reports. If HFCs or PFCs are emitted that are not listed above, complete reporters must use industry best practices to calculate CO2e from those gases.

Table 5.2 Global Warming Potentials of Refrigerant Blends

Refrigerant Blend	Gas	SAR	TAR	AR4	AR5	AR6
R-401A	HFC	18	16	16	18	21
R-401B	HFC	15	13	14	15	18
R-401C	HFC	21	18	19	21	25
R-402A	HFC	1680	2040	2100	1902	2244
R-402B	HFC	1064	1292	1330	1205	1421
R-403A	PFC	1400	1720	1766	1780	1858
R-403B	PFC	2730	3354	3444	3471	3623
R-404A	HFC	3260	3784	3922	3943	4728
R-407A	HFC	1770	1990	2107	1923	2262
R-407B	HFC	2285	2695	2804	2547	3001
R-407C	HFC	1526	1653	1774	1624	1908
R-407D	HFC	1428	1503	1627	1487	1748
R-407E	HFC	1363	1428	1552	1425	1672
R-407F	HFC	1555	1705	1825	1674	1965
R-407G	HFC	1321	1334	1463	1331	1566
R-407H	HFC	1314	1371	1495	1378	1615
R-407I	HFC	1301	1332	1459	1337	1570
R-408A	HFC	1944	2216	2301	2430	2934
R-410A	HFC	1725	1975	2088	1924	2256
R-410B	HFC	1833	2118	2229	2048	2404
R-411A	HFC	15	13	14	15	18
R-411B	HFC	4	4	4	4	5
R-412A	PFC	350	430	442	445	465
R-415A	HFC	25	22	22	25	30
R-415B	HFC	105	90	93	104	123
R-416A	HFC	767	767	844	767	903
R-417A	HFC	1955	2234	2346	2127	2508
R-417B	HFC	2450	2924	3027	2742	3235
R-417C	HFC	1570	1687	1809	1643	1935
R-418A	HFC	4	3	3	3	4
R-419A	HFC	2403	2865	2967	2688	3171
R-419B	HFC	1982	2273	2384	2161	2548
R-420A	HFC	1144	1144	1258	1144	1346

Refrigerant Blend	Gas	SAR	TAR	AR4	AR5	AR6
R-421A	HFC	2170	2518	2631	2385	2812
R-421B	HFC	2575	3085	3190	2890	3409
R-422A	HFC	2532	3043	3143	2847	3359
R-422B	HFC	2086	2416	2526	2290	2700
R-422C	HFC	2491	2983	3085	2794	3296
R-422D	HFC	2232	2623	2729	2473	2917
R-422E	HFC	2135	2483	2592	2350	2770
R-423A	HFC	2060	2345	2280	2274	2513
R-424A	HFC	2025	2328	2440	2212	2608
R-425A	HFC	1372	1425	1505	1431	1638
R-426A	HFC	1352	1382	1508	1371	1614
R-427A	HFC	1828	2013	2138	2024	2397
R-427C	HFC	1763	1938	2063	1962	2321
R-428A	HFC	2930	3495	3607	3417	4061
R-429A	HFC	14	12	12	14	16
R-430A	HFC	106	91	94	105	125
R-431A	HFC	41	35	36	40	48
R-434A	HFC	2662	3131	3245	3075	3654
R-435A	HFC	28	24	25	28	33
R-437A	HFC	1567	1684	1805	1639	1930
R-438A	HFC	1890	2151	2264	2059	2425
R-439A	HFC	1641	1873	1983	1828	2143
R-440A	HFC	158	139	144	156	185
R-442A	HFC	1609	1793	1888	1754	2042
R-444A	HFC	85	72	87	88	101
R-444B	HFC	284	240	293	295	336
R-445A	HFC	117	117	129	117	138
R-446A	HFC	442	374	459	460	524
R-447A	HFC	540	493	582	571	655
R-447B	HFC	666	646	739	714	823
R-448A	HFC	1170	1300	1386	1273	1494
R-449A	HFC	1184	1308	1396	1282	1504
R-449B	HFC	1199	1320	1411	1296	1521
R-449C	HFC	1067	1167	1250	1146	1346

Refrigerant Blend	Gas	SAR	TAR	AR4	AR5	AR6
R-450A	HFC	546	546	601	546	643
R-451A	HFC	133	133	146	133	156
R-451B	HFC	146	146	160	146	171
R-452A	HFC	1724	2067	2139	1945	2291
R-452B	HFC	632	607	697	675	778
R-452C	HFC	1789	2143	2219	2018	2378
R-453A	HFC	1534	1664	1765	1636	1887
R-454A	HFC	228	193	236	237	270
R-454B	HFC	448	379	465	466	531
R-454C	HFC	140	118	145	146	166
R-455A	HFC	140	118	145	146	166
R-456A	HFC	624	618	684	626	735
R-457A	HFC	131	113	136	138	158
R-457B	HFC	242	205	249	251	286
R-457C	HFC	69	59	69	71	82
R-458A	HFC	1457	1576	1650	1564	1299
R-460A	HFC	1716	2016	2101	1912	2252
R-460B	HFC	1142	1264	1350	1242	1457
R-460C	HFC	684	697	762	694	817
R-461A	HFC	2291	2676	2767	2567	3017
R-462A	HFC	1883	2136	2249	2060	2430
R-463A	HFC	1256	1400	1493	1377	1614
R-464A	HFC	1106	1277	1321	1240	1434
R-465A	HFC	137	116	142	142	162
R-466A	HFC	641	661	733	696	808
R-467A	HFC	1224	1232	1359	1249	1464
R-468A	HFC	140	118	145	146	166
R-468B	HFC	85	72	88	88	100
R-468C	HFC	273	231	284	284	324
R-469A	HFC	1121	1284	1357	1251	1466
R-470A	HFC	821	936	976	909	1049
R-470B	HFC	639	738	748	716	799
R-471A	HFC	125	151	138	144	156
R-472A	HFC	325	313	353	329	384

Refrigerant Blend	Gas	SAR	TAR	AR4	AR5	AR6
R-472B	HFC	481	471	525	484	567
R-473A	HFC	1450	1540	1831	1558	1835
R-475A	HFC	559	559	615	559	658
R-476A	HFC	130	130	143	130	153
R-500	HFC	37	31	32	36	43
R-503	HFC	4692	4812	5935	4972	5855
R-504	HFC	313	265	325	326	372
R-507 or R-507A	HFC	3300	3850	3985	3985	4775
R-509	PFC	3780	4644	4768	4806	5017
R-509A	PFC	3920	4816	4945	4984	5202
R-512A	HFC	198	179	189	196	232
R-513A	HFC	572	572	629	572	673
R-513B	HFC	540	540	593	540	635
R-515A	HFC	348	420	386	402	432
R-515B	HFC	258	312	287	298	320
R-516A	HFC	130	127	139	130	153

Source:

Refrigerant blend GWPs are calculated using a weighted average from the blend composition and the IPCC GWP values. The blend compositions are from ASHRAE Standard 15-2022. The GWP values are 100- year values from the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR) published in 1995, Third Assessment Report (TAR) published in 2001, Fourth Assessment Report (AR4) published in 2007, Fifth Assessment Report (AR5) published in 2013, and Sixth Assessment Report (AR6) published in 2021.

Conversion Factors

Mass			
1 pound (lb) =	453.6 grams (g)	0.4536 kilograms (kg)	0.0004536 metric tons
1 kilogram (kg) =	1,000 grams (g)	2.2046 pounds (lb)	0.001 metric tons
1 short ton (ton) =	2,000 pounds (lb)	907.18 kilograms (kg)	0.9072 metric tons
1 metric ton =	2,204.62 pounds (lb)	1,000 kilograms (kg)	1.1023 short tons
Volume			
1 cubic foot (ft^3) =	7.4805 U.S. gallons (gal)	0.1781 barrels (bbl)	
1 cubic foot (ft^3) =	28.32 liters (L)	0.02832 cubic meters (m^3)	
1 U.S. gallon (gal) =	0.0238 barrels (bbl)	3.785 liters (L)	0.003785 cubic meters (m^3)
1 barrel (bbl) =	42 U.S. gallons (gal)	158.99 liters (L)	0.1589 cubic meters (m^3)
1 liter (L) =	0.001 cubic meters (m^3)	0.2642 U.S. gallons (gal)	0.0063 barrels (bbl)
1 cubic meter (m^3) =	6.2897 barrels (bbl)	264.17 U.S. gallons (gal)	1,000 liters (L)
Energy			
1 kilowatt hour (kWh) =	3,412 Btu (Btu)	3,600 kilojoules (KJ)	
1 megajoule (MJ) =	0.001 gigajoules (GJ)		
1 gigajoule (GJ) =	0.9478 million Btu (MMBtu)	277.8 kilowatt hours (kWh)	
1 British thermal unit (Btu) =	1,055 joules (J)	1.055 kilojoules (KJ)	
1 million Btu (MMBtu) =	1.055 gigajoules (GJ)	293 kilowatt hours (kWh)	
1 therm =	100,000 Btu	0.1055 gigajoules (GJ)	29.3 kilowatt hours (kWh)
Other			
kilo =	1,000		
mega =	1,000,000		
giga =	1,000,000,000		
tera =	1,000,000,000,000		
peta =	1,000,000,000,000,000		
1 mile =	1.609 kilometers		
1 metric ton carbon (C) =	$^{44}/_{12}$ metric tons CO_2		