



**Emission Factors for Greenhouse Gas Inventories**

Last Modified: January 15, 2025

Blue text indicates an update from the 2024 version of this document.

Typically, greenhouse gas emissions are reported in units of carbon dioxide equivalent (CO<sub>2</sub>e). Gases are converted to CO<sub>2</sub>e by multiplying by their global warming potential (GWP). In most cases, the emission factors listed in this document generally have not been converted to CO<sub>2</sub>e. To do so, multiply the emissions by the corresponding GWP listed in the table below.

Gas	100-Year GWP
CH <sub>4</sub>	28
N <sub>2</sub> O	265

Source: Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report (AR5), 2013. See the source note to Table 1 for further explanation.

**Table 1 Stationary Combustion**

Fuel Type	Heat Content (HHV) mmBtu per short ton	CO <sub>2</sub> Factor kg CO <sub>2</sub> per mmBtu	CH <sub>4</sub> Factor g CH <sub>4</sub> per mmBtu	N <sub>2</sub> O Factor g N <sub>2</sub> O per mmBtu	CO <sub>2</sub> Factor kg CO <sub>2</sub> per short ton	CH <sub>4</sub> Factor g CH <sub>4</sub> per short ton	N <sub>2</sub> O Factor g N <sub>2</sub> O per short ton
<b>Coal and Coke</b>							
Anthracite	25.09	103.69	11	1.6	2,602	276	40
Bituminous	24.93	93.25	11	1.6	2,325	274	40
Sub-bituminous	17.25	97.17	11	1.6	1,676	190	28
Lignite	14.21	97.72	11	1.6	1,389	156	23
Mixed (Commercial Sector)	21.39	94.27	11	1.6	2,016	235	34
Mixed (Electric Power Sector)	19.73	95.52	11	1.6	1,885	217	32
Mixed (Industrial Coking)	26.28	93.90	11	1.6	2,468	289	42
Mixed (Industrial Sector)	22.35	94.67	11	1.6	2,116	246	36
Coal Coke	24.80	113.67	11	1.6	2,815	273	40
<b>Other Fuels - Solid</b>							
Municipal Solid Waste	9.95	90.70	32	4.2	902	318	42
Petroleum Coke (Solid)	30.00	102.41	32	4.2	3,072	860	128
Plastics	38.00	75.00	32	4.2	2,850	1,216	160
Tires	28.00	85.97	32	4.2	2,407	896	118
<b>Biomass Fuels - Solid</b>							
Agricultural Byproducts	8.25	118.17	32	4.2	975	264	35
Peat	8.00	111.84	32	4.2	895	256	34
Solid Byproducts	10.39	105.51	32	4.2	1,096	332	44
Wood and Wood Residuals	17.48	93.80	7.2	3.6	1,640	126	63
<b>Natural Gas</b>							
Natural Gas	0.001026	53.06	1.0	0.10	0.05444	0.00103	0.00010
<b>Other Fuels - Gaseous</b>							
Blast Furnace Gas	0.000092	274.32	0.022	0.10	0.02524	0.0000202	0.000009
Coke Oven Gas	0.000599	46.85	0.48	0.10	0.02066	0.000268	0.000060
Fuel Gas	0.001388	59.00	3.0	0.60	0.08189	0.004164	0.000833
Propane Gas	0.002516	61.46	3.0	0.60	0.18463	0.007548	0.001510
<b>Biomass Fuels - Gaseous</b>							
Landfill Gas	0.000485	52.07	3.2	0.63	0.02524	0.001552	0.000306
Other Biomass Gases	0.000655	52.07	3.2	0.63	0.034106	0.002096	0.000413
<b>Petroleum Products</b>							
Asphalt and Road Oil	0.158	75.35	3.0	0.60	11.91	0.47	0.09
Aviation Gasoline	0.120	69.25	3.0	0.60	8.31	0.36	0.07
Butane	0.103	64.77	3.0	0.60	6.87	0.31	0.06
Butylene	0.102	69.72	3.0	0.60	7.22	0.32	0.06
Crude Oil	0.139	74.54	3.0	0.60	10.29	0.41	0.08
Distillate Fuel Oil No. 1	0.139	73.25	3.0	0.60	10.18	0.42	0.08
Distillate Fuel Oil No. 2	0.139	73.96	3.0	0.60	10.21	0.41	0.08
Distillate Fuel Oil No. 4	0.146	75.04	3.0	0.60	10.96	0.44	0.09
Ethane	0.068	59.60	3.0	0.60	4.05	0.20	0.04
Ethylene	0.068	65.96	3.0	0.60	3.83	0.17	0.03
Heavy Gas Oils	0.148	74.92	3.0	0.60	11.09	0.44	0.09
Isobutane	0.099	64.94	3.0	0.60	6.43	0.30	0.06
Isobutylene	0.103	66.86	3.0	0.60	7.09	0.31	0.06
Kerosene	0.135	73.20	3.0	0.60	10.15	0.41	0.08
Kerosene-Type Jet Fuel	0.135	72.22	3.0	0.60	9.75	0.41	0.08
Liquefied Petroleum Gases (LPG)	0.092	61.71	3.0	0.60	5.68	0.28	0.06
Lubricants	0.144	74.27	3.0	0.60	10.69	0.43	0.09
Motor Gasoline	0.125	70.22	3.0	0.60	8.78	0.38	0.08
Naphtha (c-401 den F)	0.125	68.02	3.0	0.60	8.50	0.38	0.08
Natural Gasoline	0.110	66.88	3.0	0.60	7.38	0.33	0.07
Other Oil (c-401 den F)	0.139	75.22	3.0	0.60	10.59	0.42	0.08
Pentanes Plus	0.110	70.02	3.0	0.60	7.70	0.33	0.07
Petrochemical Feedstocks	0.125	71.02	3.0	0.60	8.86	0.38	0.08
Propane	0.091	62.97	3.0	0.60	5.72	0.27	0.05
Propylene	0.091	67.77	3.0	0.60	6.17	0.27	0.05
Residual Fuel Oil No. 5	0.140	72.93	3.0	0.60	10.21	0.42	0.08
Residual Fuel Oil No. 6	0.150	75.10	3.0	0.60	11.27	0.45	0.09
Special Naphtha	0.125	73.34	3.0	0.60	9.04	0.38	0.08
Unfinished Oils	0.139	74.54	3.0	0.60	10.36	0.42	0.08
Used Oil	0.138	74.00	3.0	0.60	10.21	0.41	0.08
<b>Biomass Fuels - Liquid</b>							
Biodiesel (100%)	0.128	73.84	1.1	0.11	9.45	0.14	0.01
Ethanol (100%)	0.084	66.44	-1.1	0.11	5.75	0.09	0.01
Rendized Animal Fat	0.125	73.96	1.1	0.11	9.88	0.14	0.01
Vegetable Oil	0.120	81.55	1.1	0.11	9.79	0.13	0.01
<b>Biomass Fuels - Kraft Pulping Liquor, by Wood Furnish</b>							
North American Softwood		84.4	1.9	0.42			
North American Hardwood		83.7	1.9	0.42			
Baobab		95.5	1.9	0.42			
Bamboo		83.7	1.9	0.42			
Slaw		85.1	1.9	0.42			

Source: Federal Register EPA, 40 CFR Part 98; e-CFR, (see link below). Table C-1 and Table C-2 (78 FR 71950, Nov. 29, 2013, as amended at 81 FR 89252, Dec. 9, 2016), Table AA-1 (78 FR 71965, Nov. 29, 2013). <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98>

Notes: Emission factors are per unit of heat content using higher heating values (HHV). If heat content is available from the fuel supplier, it is preferable to use that value. If not, default heat contents are provided. All CO<sub>2</sub> emission factors assume that 100 percent of the carbon content of the fuel is oxidized to CO<sub>2</sub>, as is recommended by the Intergovernmental Panel on Climate Change (IPCC). The CH<sub>4</sub> and N<sub>2</sub>O emission factors provided represent emissions in terms of fuel type and by end-use sector (i.e., residential, commercial, industrial, electricity generation). Please see the Center for Corporate Climate Leadership's guidance document on Direct Emissions from Stationary Combustion Sources for guidance on how to include biomass fuels in an organization's greenhouse gas inventory. <https://www.epa.gov/sites/default/files/2020-12/documents/stationaryemissions.pdf>

The factors represented in the table above represent combustion emissions only and do not represent upstream emissions.

**Table 2 Mobile Combustion CO<sub>2</sub>**

Fuel Type	kg CO <sub>2</sub> per unit	Unit
Aviation Gasoline	8.31	gallon
Biodiesel (100%)	9.45	gallon
Compressed Natural Gas (CNG)	0.05444	scf
Diesel Fuel	10.21	gallon
Ethanol (100%)	5.75	gallon
Kerosene-Type Jet Fuel	9.75	gallon
Liquefied Natural Gas (LNG)	4.59	gallon
Liquefied Petroleum Gases (LPG)	5.68	gallon
Motor Gasoline	8.78	gallon
Residual Fuel Oil	11.27	gallon

Source: Federal Register EPA, 40 CFR Part 98; e-CFR, (see link below), Table C-1 (78 FR 1950, Nov. 23, 2013, as amended at 81 FR 89252, Dec. 9, 2016) <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98>

Notes: LNG: The factor was developed based on the CO<sub>2</sub> factor (kg CO<sub>2</sub> per mmBtu) for Natural Gas from Table 1 and the higher heating value (HHV) LNG fuel density factor (lb/gallon) from the R&D GREET1 2024 Model, Argonne National Laboratory published January 10, 2025 (Fuel\_Specs worksheet).

More information on GREET can be found here: <https://greet.anl.gov/>  
Please see the Center for Corporate Climate Leadership's guidance document on Direct Emissions from Stationary Combustion Sources for guidance on how to include biomass fuels in an organization's greenhouse gas inventory. <https://www.eca.gov/sites/default/files/2025-12/documents/stationaryemissions.pdf>  
The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

**Table 3 Mobile Combustion CH<sub>4</sub> and N<sub>2</sub>O for On-Road Gasoline Vehicles**

Vehicle Type	Model Year	CH <sub>4</sub> Factor (g CH <sub>4</sub> / vehicle-mile)	N <sub>2</sub> O Factor (g N <sub>2</sub> O / vehicle-mile)
Gasoline Passenger Cars	1973-1974	0.1595	0.0197
	1975	0.1423	0.0443
	1976-1977	0.1406	0.0458
	1978-1979	0.1389	0.0473
	1980	0.1326	0.0489
	1981	0.0802	0.0626
	1982	0.0795	0.0627
	1983	0.0782	0.0630
	1984-1993	0.0704	0.0647
	1994	0.0617	0.0603
	1995	0.0531	0.0560
	1996	0.0434	0.0503
	1997	0.0337	0.0446
	1998	0.0240	0.0389
	1999	0.0215	0.0355
	2000	0.0175	0.0304
	2001	0.0105	0.0212
	2002	0.0102	0.0207
	2003	0.0095	0.0181
	2004	0.0078	0.0085
	2005	0.0075	0.0067
	2006	0.0078	0.0075
2007	0.0072	0.0052	
2008	0.0072	0.0049	
2009	0.0071	0.0046	
2010	0.0071	0.0046	
2011	0.0071	0.0046	
2012	0.0071	0.0046	
2013	0.0071	0.0046	
2014	0.0071	0.0046	
2015	0.0068	0.0042	
2016	0.0065	0.0038	
2017	0.0054	0.0018	
2018	0.0052	0.0016	
2019	0.0051	0.0015	
2020	0.0050	0.0014	
2021	0.0051	0.0014	
2022	0.0050	0.0014	
Gasoline Light-Duty Trucks (Vans, Pickup Trucks, SUVs)	1973-1974	0.1908	0.0218
	1975	0.1634	0.0513
	1976	0.1594	0.0555
	1977-1978	0.1614	0.0534
	1979-1980	0.1584	0.0555
	1981	0.1479	0.0680
	1982	0.1442	0.0681
	1983	0.1368	0.0722
	1984	0.1294	0.0764
	1985	0.1220	0.0806
	1986	0.1146	0.0848
	1987-1993	0.0813	0.1038
	1994	0.0646	0.0982
	1995	0.0517	0.0908
	1996	0.0452	0.0871
	1997	0.0452	0.0871
	1998	0.0412	0.0787
	1999	0.0333	0.0618
	2000	0.0340	0.0631
	2001	0.0221	0.0379
	2002	0.0242	0.0424
	2003	0.0221	0.0373
2004	0.0115	0.0088	
2005	0.0105	0.0064	
2006	0.0108	0.0080	
2007	0.0103	0.0061	
2008	0.0095	0.0036	
2009	0.0095	0.0036	
2010	0.0095	0.0036	
2011	0.0096	0.0034	
2012	0.0096	0.0033	
2013	0.0095	0.0035	
2014	0.0095	0.0033	
2015	0.0094	0.0031	
2016	0.0091	0.0029	
2017	0.0084	0.0018	
2018	0.0081	0.0015	
2019	0.0080	0.0013	
2020	0.0079	0.0012	
2021	0.0079	0.0012	
2022	0.0079	0.0012	
Gasoline Heavy-Duty Vehicles	1980	0.4604	0.0497
	1981-1984	0.4492	0.0538
	1985-1986	0.4090	0.0515
	1987	0.3675	0.0849
	1988-1989	0.3492	0.0933
	1990-1995	0.3246	0.1142
	1996	0.1278	0.1680
	1997	0.0924	0.1726
	1998	0.0855	0.1750
	1999	0.0648	0.1724
	2000	0.0630	0.1660
	2001	0.0577	0.1498
	2002	0.0634	0.1673
	2003	0.0602	0.1553
	2004	0.0288	0.0164
	2005	0.0297	0.0083
	2006	0.0299	0.0241
	2007	0.0322	0.0015
	2008	0.0340	0.0015
	2009	0.0339	0.0015
	2010	0.0320	0.0015
	2011	0.0304	0.0015
2012	0.0313	0.0015	
2013	0.0313	0.0015	
2014	0.0315	0.0015	
2015	0.0322	0.0021	
2016	0.0321	0.0061	
2017	0.0329	0.0084	
2018	0.0326	0.0082	
2019	0.0330	0.0081	
2020	0.0332	0.0100	
2021	0.0332	0.0100	
2022	0.0332	0.0100	
Gasoline Motorcycles	1960-1995	0.0030	0.0000
	1996-2025	0.0070	0.0070

Source: EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes). All values are calculated from Tables A-79 through A-83. <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>

Notes: The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

**Table 4 Mobile Combustion CH<sub>4</sub> and N<sub>2</sub>O for On-Road Diesel and Alternative Fuel Vehicles**

Vehicle Type	Fuel Type	Model Year	CH <sub>4</sub> Factor (g CH <sub>4</sub> / vehicle-mile)	N <sub>2</sub> O Factor (g N <sub>2</sub> O / vehicle-mile)	
Passenger Cars	Diesel	1960-1982	0.0006	0.0012	
		1983-2006	0.0005	0.0010	
		2007-2022	0.0002	0.0002	
Light-Duty Trucks	Diesel	1960-1982	0.0011	0.0017	
		1983-2006	0.0009	0.0014	
		2007-2022	0.0004	0.0004	
Medium- and Heavy-Duty Vehicles	Diesel	1960-1982	0.0061	0.0048	
		1983-2006	0.0095	0.0431	
		2007-2022	0.0120	0.0040	
Light-Duty Cars	Methanol		0.0120	0.0040	
		CNG		0.1200	0.0040
			LPG		0.0120
Light-Duty Trucks	Biodiesel		0.0130	0.0010	
		Ethanol		0.0130	0.0050
			CNG		0.1300
Medium-Duty Trucks	LPG		0.0130	0.0050	
		LNG		0.1300	0.0050
			Biodiesel		0.0540
Heavy-Duty Trucks	CNG		1.7880	0.0030	
		LPG		1.7880	0.0030
			Biodiesel		0.0030
Buses	Methanol		0.0720	0.0250	
		Ethanol		0.0720	0.0250
			CNG		0.9210
	LPG		0.0920	0.0170	
		LNG		0.9210	0.0170
			Biodiesel		0.0090
	Methanol		0.1300	0.0290	
		Ethanol		0.1300	0.0170
			CNG		2.7190
	LPG		0.2720	0.0170	
		LNG		2.7190	0.0170
			Biodiesel		0.0090

Source: EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes). All values are calculated from Tables A-84 through A-85. <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>

Notes:

The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

**Table 5 Mobile Combustion CH<sub>4</sub> and N<sub>2</sub>O for Non-Road Vehicles**

Vehicle Type	Fuel Type	CH <sub>4</sub> Factor (g CH <sub>4</sub> / gallon)	N <sub>2</sub> O Factor (g N <sub>2</sub> O / 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
Locomotives	Diesel	6.51	0.17
	Diesel	0.80	0.26
Aircraft	Jet Fuel	0	0.30
	Aviation Gasoline	7.06	0.11
Agricultural Equipment <sup>a</sup>	Gasoline (2 stroke)	6.50	0.47
	Gasoline (4 stroke)	1.93	1.20
	Gasoline Off-Road Trucks	1.93	1.20
Construction/Mining Equipment <sup>b</sup>	Diesel Equipment	1.20	1.07
	Diesel Off-Road Trucks	0.93	0.56
	LPG	0.33	0.84
Lawn and Garden Equipment	Gasoline (2 stroke)	6.00	0.12
	Gasoline (4 stroke)	2.88	1.48
	Gasoline Off-Road Trucks	2.88	1.48
Airport Equipment	Diesel Equipment	1.01	0.94
	Diesel Off-Road Trucks	0.93	0.56
	LPG	0.69	0.50
Industrial/Commercial Equipment	Gasoline (2 stroke)	7.34	0.31
	Gasoline (4 stroke)	3.02	1.50
	Diesel	0.67	0.49
Logging Equipment	LPG	0.37	0.83
	Gasoline	1.07	1.12
	Diesel	1.58	1.24
Railroad Equipment	LPG	0.37	0.83
	Gasoline (2 stroke)	7.30	0.51
	Gasoline (4 stroke)	2.81	1.57
Recreational Equipment	Diesel	0.93	0.82
	LPG	0.66	0.66
	Gasoline (2 stroke)	6.62	0
Railroad Equipment	Gasoline (4 stroke)	3.22	2.05
	Diesel	0.49	1.26
	Gasoline	3.32	1.86
Recreational Equipment	Diesel	1.41	0.01
	LPG	2.05	0.01
	Gasoline (2 stroke)	6.86	0.11
Recreational Equipment	Gasoline (4 stroke)	2.74	1.48
	Diesel	0.73	0.66
	LPG	0.41	0.61

Source: EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes). All values are calculated from Tables A-86 and A-87. <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>

Notes:

The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

<sup>a</sup> includes equipment, such as tractors and combines, as well as fuel consumption from trucks that are used off-road in agriculture.

<sup>b</sup> includes equipment, such as cranes, dumpers, and excavators, as well as fuel consumption from trucks that are used off-road in construction.

**Table 6 Electricity**

eGRID Subregion Acronym	eGRID Subregion Name	Total Output Emission Factors			Non-BaseLoad Emission Factors			Grid Gross Loss (%)
		CO <sub>2</sub> Factor (lb CO <sub>2</sub> / MWh)	CH <sub>4</sub> Factor (lb CH <sub>4</sub> / MWh)	N <sub>2</sub> O Factor (lb N <sub>2</sub> O / MWh)	CO <sub>2</sub> Factor (lb CO <sub>2</sub> / MWh)	CH <sub>4</sub> Factor (lb CH <sub>4</sub> / MWh)	N <sub>2</sub> O Factor (lb N <sub>2</sub> O / MWh)	
AKGD	ASCC Alaska Grid	899.0	0.008	0.012	1.0771	0.116	0.016	4.1%
AKMS	ASCC Miscellaneous	519.4	0.026	0.004	1.548.6	0.067	0.012	4.1%
AZNM	WECC Southwest	749.8	0.041	0.006	1.260.4	0.067	0.009	4.1%
CAMX	WECC California	436.7	0.025	0.003	1.034.0	0.051	0.007	4.1%
ERCT	ERCOG All	736.9	0.043	0.006	1.264.8	0.076	0.010	4.2%
FRCC	FRCC All	891.9	0.042	0.005	1.034.0	0.045	0.006	4.2%
HMS	HCC Miscellaneous	1,122.1	0.146	0.022	1,586.4	0.170	0.027	4.2%
HDA	HCC Ohio	1,489.4	0.154	0.021	1,753.4	0.159	0.025	4.2%
MROE	MRO East	1,402.0	0.116	0.017	1,713.8	0.161	0.023	4.2%
MROW	MRO West	920.0	0.067	0.014	1,776.6	0.180	0.026	4.2%
NEWE	NPCC New England	537.2	0.003	0.006	885.2	0.087	0.009	4.2%
NWPP	WECC Northwest	631.2	0.054	0.006	1,613.4	0.146	0.021	4.1%
NYCW	NPCC NYC/Weichester	874.7	0.025	0.003	1,008.9	0.020	0.002	4.2%
NYLI	NPCC Long Island	1,180.7	0.140	0.018	1,316.6	0.050	0.006	4.2%
NYUP	NPCC Upstate NY	241.0	0.011	0.001	899.1	0.041	0.005	4.2%
PRMS	Puerto Rico Miscellaneous	1,543.0	0.077	0.012	1,638.7	0.072	0.012	4.2%
RFC E	RFC East	584.7	0.036	0.005	1,175.5	0.077	0.010	4.2%
RFCM	RFC Michigan	962.1	0.092	0.011	1,508.1	0.144	0.020	4.2%
RFCW	RFC West	911.3	0.071	0.010	1,757.5	0.161	0.023	4.2%
RMPA	WECC Rockies	1,036.0	0.080	0.013	1,620.6	0.124	0.018	4.1%
SPNO	SPP North	861.9	0.087	0.012	1,832.1	0.188	0.027	4.2%
SPSO	SPP South	891.1	0.055	0.006	1,508.4	0.095	0.013	4.2%
SRMV	SERC Mississippi Valley	739.4	0.032	0.004	1,145.5	0.061	0.008	4.2%
SRMW	SERC Midwest	1,238.3	0.132	0.019	1,818.6	0.180	0.027	4.2%
SRSO	SERC South	849.8	0.055	0.006	1,386.0	0.096	0.014	4.2%
SRTV	SERC Tennessee Valley	895.7	0.079	0.011	1,665.6	0.154	0.022	4.2%
SRVC	SERC Virginia/Carolina	590.2	0.045	0.006	1,286.8	0.100	0.014	4.2%
US Average	US Average	771.5	0.067	0.008	1,383.7	0.104	0.015	4.2%

Source: EPA eGRID2023, January 2025 (Summary Tables - Table 1. Subregion Output Emission Rates) [https://www.epa.gov/system/files/documents/2025-01/eGRID2023\\_summary\\_tables.xlsx](https://www.epa.gov/system/files/documents/2025-01/eGRID2023_summary_tables.xlsx)

Notes:

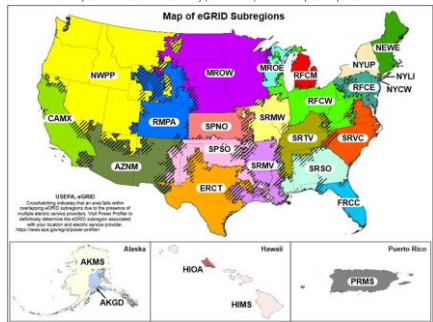
Total output emission factors can be used as default factors for estimating GHG emissions from electricity use when developing a carbon footprint or emissions inventory.

Annual non-base-load output emission factors should not be used when developing a carbon footprint or emissions inventory, but can be used to estimate GHG emissions reductions on the grid from changes in electricity use.

Grid gross loss % factors provide the Transmission & Distribution loss rates for electricity only, and should not be applied to scope 2 emissions for an end-user. They can assist in calculating one component of Scope 3 Fuel- and Energy-Related Activities emissions, Activity C.

For technical information, reference the EPA's eGRID Technical Guide: [https://www.epa.gov/system/files/documents/2025-01/eGRID2023\\_technical\\_guide.pdf](https://www.epa.gov/system/files/documents/2025-01/eGRID2023_technical_guide.pdf)

The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.



**Table 7 Steam and Heat**

	CO <sub>2</sub> Factor (kg CO <sub>2</sub> / mmBtu)	CH <sub>4</sub> Factor (g CH <sub>4</sub> / mmBtu)	N <sub>2</sub> O Factor (g N <sub>2</sub> O / mmBtu)
Steam and Heat	66.33	1.250	0.125

**Notes:**  
Emission factors are per mmBtu of steam or heat purchased. These factors assume natural gas fuel is used to generate steam or heat at 80 percent thermal efficiency. The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

**Scope 3 Emission Factors**

Scope 3 emission factors provided below are aligned with the Greenhouse Gas Protocol Technical Guidance for Calculating Scope 3 Emissions, version 1.0 (Scope 3 Calculation Guidance). Where applicable, the specific calculation method is referenced. Refer to the Scope 3 Calculation Guidance for more information:  
<http://www.ghaprotocol.org/scope-3-technical-calculation-guidance>

**Table 8 Scope 3 Category 4: Upstream Transportation and Distribution and Category 9: Downstream Transportation and Distribution**

These factors are intended for use in the distance-based method defined in the Scope 3 Calculation Guidance. If fuel data are available, then the fuel-based method should be used, with factors from Tables 2 through 5.

Vehicle Type	CO <sub>2</sub> Factor (kg CO <sub>2</sub> / unit)	CH <sub>4</sub> Factor (g CH <sub>4</sub> / unit)	N <sub>2</sub> O Factor (g N <sub>2</sub> O / unit)	Units
Medium- and Heavy-Duty Truck	1.248	0.0115	0.0379	vehicle-mile
Passenger Car <sup>A</sup>	0.297	0.0059	0.0053	vehicle-mile
Light-Duty Truck <sup>B</sup>	0.354	0.0105	0.0088	vehicle-mile
Medium- and Heavy-Duty Truck <sup>C</sup>	0.186	0.0016	0.0054	short ton-mile
Rail	0.021	0.0015	0.0005	short ton-mile
Waterborne Craft	0.077	0.0310	0.0030	short ton-mile
Aircraft	1.088	0	0.0334	short ton-mile

**Source:**  
CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions data for on-road vehicles are from Table 2-13 of the EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022.  
Vehicle-mile data for on-road vehicles are from Tables A-71- A-73 of the EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes).  
CO<sub>2</sub>e emissions data for non-road vehicles are based on Table A-93 of the EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes), which are distributed into CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions based on fuel/vehicle emission factors. Freight ton-mile data are from Table 1-50 of the Bureau of Transportation Statistics, National Transportation Statistics (2024): 2022 data.  
**Notes:**  
Vehicle-mile factors are appropriate to use when the entire vehicle is dedicated to transporting the reporting company's product. Ton-mile factors are appropriate when the vehicle is shared with products from other companies. The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.  
<sup>A</sup> Passenger cars are automobiles used primarily to transport 12 people or less for personal travel, and are less than 8,500 lbs in gross vehicle weight.  
<sup>B</sup> Light-duty trucks are vehicles that primarily transport passengers such as sport utility vehicles (SUVs) and minivans. This category also includes vehicles used for transporting light-weight cargo which are equipped with special features such as four-wheel drive for off-road operation. The gross vehicle weight normally ranges around 8,500 pounds or less.  
<sup>C</sup> Medium- and heavy-duty trucks are vehicles with a gross vehicle weight of more than around 8,500 pounds, such as single unit trucks, combination trucks, tractor-trailers, and box trucks used for freight transportation. In addition, this category includes some vehicles that are not typically used for freight movement such as service and utility trucks.

**Table 9 Scope 3 Category 5: Waste Generated in Operations and Category 12: End-of-Life Treatment of Sold Products**

These factors are intended for use in the waste-type-specific method or the average-data method defined in the Scope 3 Calculation Guidance for category 5 and category 12. Choose the appropriate material and disposal method from the table below. For the average-data method, use one of the mixed material types, such as mixed MSW.

Material	Metric Tons CO <sub>2</sub> e / Short Ton Material					
	Recycled <sup>A</sup>	Landfilled <sup>B</sup>	Combusted <sup>C</sup>	Composted <sup>D</sup>	Anaerobically Digested (Dry Digestate with Curing)	Anaerobically Digested (Wet Digestate with Curing)
Aluminum Cans	0.06	0.02	0.01	NA	NA	NA
Aluminum Ingot	0.04	0.02	0.01	NA	NA	NA
Steel Cans	0.32	0.02	0.01	NA	NA	NA
Copper Wire	0.18	0.02	0.01	NA	NA	NA
Glass	0.05	0.02	0.01	NA	NA	NA
HDPE	0.21	0.02	2.80	NA	NA	NA
LDPE	NA	0.02	2.80	NA	NA	NA
PET	0.23	0.02	2.05	NA	NA	NA
LDPE	NA	0.02	2.80	NA	NA	NA
PP	0.20	0.02	2.80	NA	NA	NA
PS	NA	0.02	3.02	NA	NA	NA
PVC	NA	0.02	1.26	NA	NA	NA
PLA	NA	0.02	0.01	0.13	NA	NA
Corrugated Containers	0.11	1.00	0.05	NA	NA	NA
Magazines/Third-class mail	0.02	0.46	0.05	NA	NA	NA
Newspaper	0.02	0.39	0.05	NA	NA	NA
Office Paper	0.02	1.41	0.05	NA	NA	NA
Phonebooks	0.04	0.39	0.05	NA	NA	NA
Textbooks	0.04	1.41	0.05	NA	NA	NA
Dimensional Lumber	NA	0.17	0.05	NA	NA	NA
Medium-density Fiberboard	NA	0.07	0.05	NA	NA	NA
Food Waste (non-meat)	NA	0.87	0.05	0.11	0.14	0.11
Food Waste (meat only)	NA	0.69	0.05	0.11	0.14	0.11
Beef	NA	0.64	0.05	0.11	0.14	0.11
Butlry	NA	0.73	0.05	0.11	0.14	0.11
Grains	NA	2.08	0.05	0.11	0.14	0.11
Bread	NA	1.49	0.05	0.11	0.14	0.11
Fruits and Vegetables	NA	0.28	0.05	0.11	0.14	0.11
Dairy Products	NA	0.72	0.05	0.11	0.14	0.11
Yard Trimmings	NA	0.36	0.05	0.14	0.11	NA
Grass	NA	0.28	0.05	0.14	0.09	NA
Leaves	NA	0.28	0.05	0.14	0.12	NA
Branches	NA	0.58	0.05	0.14	0.15	NA
Mixed Paper (general)	0.07	0.89	0.05	NA	NA	NA
Mixed Paper (primarily residential)	0.07	0.86	0.05	NA	NA	NA
Mixed Paper (primarily from offices)	0.03	0.84	0.05	NA	NA	NA
Mixed Metals	0.23	0.02	0.01	NA	NA	NA
Mixed Plastics	0.22	0.02	2.34	NA	NA	NA
Mixed Recyclables	0.09	0.75	0.11	NA	NA	NA
Food Waste	NA	0.68	0.05	0.11	0.14	NA
Mixed Organics	NA	0.54	0.05	0.13	NA	NA
Mixed MSW	NA	0.58	0.43	NA	NA	NA
Carpet	NA	0.02	1.68	NA	NA	NA
Desktop CPU	0.01	0.02	0.40	NA	NA	NA
Portable Electronic Devices	0.02	0.02	0.88	NA	NA	NA
Flat-panel Displays	0.02	0.02	0.74	NA	NA	NA
CRT Displays	NA	0.02	0.64	NA	NA	NA
Electronic Peripherals	0.05	0.02	2.23	NA	NA	NA
Hard-copy Devices	0.01	0.02	1.92	NA	NA	NA
Mixed Electronics	0.02	0.02	0.96	NA	NA	NA
Clay Bricks	NA	0.02	NA	NA	NA	NA
Concrete	0.01	0.02	NA	NA	NA	NA
Fly Ash	0.01	0.02	NA	NA	NA	NA
Tires	0.10	0.02	2.21	NA	NA	NA
Asphalt Concrete	0.04	0.02	NA	NA	NA	NA
Asphalt Shingles	0.03	0.02	0.70	NA	NA	NA
Drywall	NA	0.02	NA	NA	NA	NA
Fiberglass Insulation	0.05	0.02	NA	NA	NA	NA
Structural Steel	0.04	0.02	NA	NA	NA	NA
Vinyl Flooring	NA	0.02	0.29	NA	NA	NA
Wood Flooring	NA	0.18	0.08	NA	NA	NA

**Source:**  
U.S. Environmental Protection Agency, Office of Resource Conservation and Recovery (December 2023) Documentation for Greenhouse Gas Emission and Energy Factors used in the [Waste Reduction Model \(WARM\)](#). Factors from tables provided in the Management Practices Chapters and Background Chapters.

**Notes:**  
These factors do not include avoided emissions impact from any of the disposal methods. This exclusion is an adjustment to the life-cycle factors in the WARM tool. Thus the waste factors presented above will not directly match the factors published in the WARM tool. All the factors presented above include transportation emissions, which are optional in the Scope 3 Calculation Guidance, with an assumed average distance traveled to the processing facility.  
ANA GWP values are used to convert all waste emission factors into CO<sub>2</sub>e.  
Short ton = 2000 lbs.  
<sup>A</sup> Recycling emissions do not include avoided emissions associated with process energy, transportation energy, process non-energy, or forest carbon storage. Recycling emissions include transport to recycling facility and sorting of recycled materials at material recovery facility.  
<sup>B</sup> Landfilling emissions do not include avoided emissions associated with energy recovery or landfill carbon sequestration. Landfilling emissions include transport to landfill, equipment use at landfill, and landfill CH<sub>4</sub> emissions from anaerobic decomposition of biogenic carbon compounds. Landfill CH<sub>4</sub> is based on typical landfill gas collection practices, average landfill moisture conditions, and U.S.-average non-baseload electricity grid mix.  
<sup>C</sup> Combustion emissions do not include avoided emissions associated with displaced electric utility generation or decreased energy requirements for production processes using recycled inputs. Combustion emissions include transport to waste-to-energy facility and combustion-related non-biogenic CO<sub>2</sub> and N<sub>2</sub>O.  
<sup>D</sup> Composting emissions do not include avoided emissions associated with fertilizer offset or soil carbon storage. Composting emissions include transport to compost facility, equipment use at compost facility, and CH<sub>4</sub> and N<sub>2</sub>O emissions during composting.  
<sup>E</sup> Anaerobically Digested (Dry and Wet Digestate with Curing) emissions do not include avoided emissions associated with displaced electric utility generation, soil carbon storage, or avoided fertilizer application. Anaerobically Digested (Dry and Wet Digestate with Curing) emissions include transport to the anaerobic digester facility, equipment use at the anaerobic digester facility, biogas leakage at the digester, emissions released during the curing and land application process, and fugitive emissions during the curing and after land application.

**Table 10 Scope 3 Category 6: Business Travel and Category 7: Employee Commuting**

These factors are intended for use in the distance-based method defined in the Scope 3 Calculation Guidance. If fuel data are available, then the fuel-based method should be used, with factors from Tables 2 through 5.

Vehicle Type	CO <sub>2</sub> Factor (kg CO <sub>2</sub> / unit)	CH <sub>4</sub> Factor (g CH <sub>4</sub> / unit)	N <sub>2</sub> O Factor (g N <sub>2</sub> O / unit)	Units
Passenger Car <sup>a</sup>	0.257	0.0059	0.0053	vehicle-mile
Light-Duty Truck <sup>b</sup>	0.384	0.0109	0.0108	vehicle-mile
Motorcycle	0.388	0.0888	0.0188	vehicle-mile
Intercity Rail - Northeast Corridor <sup>c</sup>	0.023	0.0010	0.0001	passenger-mile
Intercity Rail - Other Routes <sup>c</sup>	0.149	0.0120	0.0040	passenger-mile
Intercity Rail - National Average <sup>c</sup>	0.098	0.0060	0.0020	passenger-mile
Commuter Rail <sup>d</sup>	0.153	0.0105	0.0026	passenger-mile
Transit Rail (i.e. Subway, Tram) <sup>e</sup>	0.083	0.0075	0.0010	passenger-mile
Bus	0.066	0.0046	0.0019	passenger-mile
Air Travel - Short Haul (< 300 miles)	0.207	0.0064	0.0066	passenger-mile
Air Travel - Medium Haul (>= 300 miles, < 2300 miles)	0.129	0.0006	0.0041	passenger-mile
Air Travel - Long Haul (>= 2300 miles)	0.163	0.0006	0.0052	passenger-mile

**Source:** CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions data for highway vehicles are from Table 2-13 of the EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022. Vehicle-miles data for on-road vehicles are from Tables A-71 - A-73 of the EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes). Passenger-miles data for buses are from Table MA.1 of the Federal Highway Administration Highway Statistics (2024): 2022 data. Fuel consumption data and passenger-miles data for rail are from Tables A.14 - A.16, 10-10, and 7.3 - 7.4 of the Transportation Energy Data Book: Edition 40 (2022): 2019 data. Fuel consumption was converted to emissions by using fuel and electricity emission factors presented in the tables above. Intercity Rail factors from communication with Amtrak, December 2024, based on 2023 data. Air Travel factors from 2022 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting, Version 2.0 June 2022. Defra air travel emission factors held constant from 2022 release (2018 activity data) to more accurately reflect the current state of business travel as the 2023 and 2024 Defra release reflects significantly reduced load factors during COVID-19.

**Notes:**  
 The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.  
<sup>a</sup> Passenger cars are automobiles used primarily to transport 1-2 people or less for personal travel, and are less than 8,500 lbs in gross vehicle weight.  
<sup>b</sup> Light-duty trucks are vehicles that primarily transport passengers such as sport utility vehicles (SUVs) and minivans. This category also includes vehicles used for transporting light-weight cargo which are equipped with special features such as four-wheel drive for off-road operation. The gross vehicle weight normally ranges around 8,500 pounds or less.  
<sup>c</sup> Intercity rail: Amtrak long-distance rail between major cities. Northeast Corridor extends from Boston to Washington D.C. Other Routes are all routes outside the Northeast Corridor.  
<sup>d</sup> Commuter rail: rail service between a central city and adjacent suburbs (also called regional rail or suburban rail).  
<sup>e</sup> Transit rail: rail typically within an urban center, such as subways, elevated railways, metropolitan railways (metro), streetcars, trolley cars, and tramsways.

**Global Warming Potential**

**Table 11 Global Warming Potential (GWP)**

Industrial Designation or Common Name	Chemical Formula	100-Year GWP
Carbon dioxide	CO <sub>2</sub>	1
Methane	CH <sub>4</sub>	28
Nitrous oxide	N <sub>2</sub> O	265
HFC-23	CHF <sub>3</sub>	12,400
HFC-32	CH <sub>2</sub> F <sub>2</sub>	677
HFC-41	CH <sub>3</sub> F	116
HFC-125	CHF <sub>2</sub> CF <sub>3</sub>	3,170
HFC-134	CHF <sub>2</sub> CH <sub>2</sub> F	1,120
HFC-134a	CH <sub>2</sub> FCF <sub>3</sub>	1,300
HFC-143	CH <sub>2</sub> FCF <sub>2</sub>	328
HFC-143a	CH <sub>3</sub> CF <sub>3</sub>	4,800
HFC-152	CH <sub>2</sub> FCF <sub>2</sub> H	16
HFC-152a	CH <sub>2</sub> CF <sub>2</sub>	138
HFC-191	CH <sub>3</sub> CH <sub>2</sub> F	4
HFC-227aa	CF <sub>3</sub> CH <sub>2</sub> CF <sub>3</sub>	3,360
HFC-236cb	CH <sub>2</sub> FCF <sub>2</sub> CF <sub>3</sub>	1,210
HFC-236ea	CHF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>	1,330
HFC-236fa	CF <sub>3</sub> CH <sub>2</sub> CF <sub>3</sub>	8,060
HFC-245ca	CH <sub>2</sub> FCF <sub>2</sub> CH <sub>2</sub> F	716
HFC-245fa	CHF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>	858
HFC-365mle	CH <sub>2</sub> FCF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>	804
HFC-43-10mea	CF <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CF <sub>2</sub> CF <sub>3</sub>	1,850
Sulfur hexafluoride	SF <sub>6</sub>	23,500
Nitrogen trifluoride	NF <sub>3</sub>	16,100
PFC-14	CF <sub>4</sub>	6,630
PFC-116	C <sub>2</sub> F <sub>6</sub>	11,100
PFC-218	C <sub>3</sub> F <sub>8</sub>	8,900
PFC-318	c-C <sub>4</sub> F <sub>8</sub>	9,540
PFC-4110	C <sub>4</sub> F <sub>10</sub>	9,200
PFC-4112	C <sub>4</sub> F <sub>10</sub>	8,550
PFC-61-14	C <sub>6</sub> F <sub>14</sub>	7,910
PFC-61-18	C <sub>6</sub> F <sub>18</sub>	7,190

**Source:** 100-year GWP values from IPCC Fifth Assessment Report (AR5), 2013, Chapter 8, Table A.8.1, Lifetimes, Radiative Efficiencies and Metric Values. IPCC AR5 was published in 2013 and is among the most current and comprehensive peer-reviewed assessments of climate change. AR5 provides revised GWP values of several GHGs relative to the values provided in previous assessment reports, following advances in scientific knowledge on the radiative efficiencies and atmospheric lifetimes of these GHGs.

**Table 12 Global Warming Potential (GWP) for Blended Refrigerants**

ASHRAE #	100-year GWP	Blend Composition
R-401A	18	53% HCFC-22, 34% HCFC-124, 13% HFC-152a
R-401B	15	51% HCFC-22, 28% HCFC-124, 11% HFC-152a
R-401C	21	33% HCFC-22, 52% HCFC-124, 15% HFC-152a
R-402A	1,902	38% HCFC-22, 60% HFC-125, 2% propane
R-402B	1,205	50% HCFC-22, 38% HFC-125, 2% propane
R-403B	3,471	56% HCFC-22, 38% PFC-218, 5% propane
R-404A	3,943	44% HFC-125, 4% HFC-134a, 52% HFC-143a
R-406A	0	50% HFC-22, 41% HFC-142b, 4% isobutane
R-407A	1,923	20% HFC-32, 40% HFC-125, 40% HFC-134a
R-407B	2,547	10% HFC-32, 70% HFC-125, 20% HFC-134a
R-407C	1,624	23% HFC-32, 25% HFC-125, 52% HFC-134a
R-407D	1,487	15% HFC-32, 15% HFC-125, 70% HFC-134a
R-408A	2,430	47% HCFC-22, 7% HFC-125, 46% HFC-143a
R-409A	0	60% HCFC-22, 25% HCFC-124, 15% HCFC-142b
R-410A	1,924	50% HFC-32, 50% HFC-125
R-410B	2,048	45% HFC-32, 55% HFC-125
R-411A	15	87.5% HCFC-22, 11% HFC-152a, 1.5% propylene
R-411B	4	84% HCFC-22, 3% HFC-152a, 3% propylene
R-414A	0	51% HCFC-22, 28.5% HCFC-124, 16.5% HCFC-142b, 4% isobutane
R-414B	0	50% HCFC-22, 39% HCFC-124, 9.5% HCFC-142b, 1.5% isobutane
R-417A	2,127	46.6% HFC-125, 50% HFC-134a, 3.4% butane
R-422A	2,847	85.1% HFC-125, 11.5% HFC-134a, 3.4% isobutane
R-422D	2,473	85.1% HFC-125, 31.5% HFC-134a, 3.4% isobutane
R-424A	3,104	50.5% HFC-125, 47% HFC-134a, 1% butane, 0.9% isobutane, 0.6% isopentane
R-426A	1,371	5.1% HFC-125, 83% HFC-134a, 1.3% butane, 0.6% isobutane
R-428A	3,417	17.5% HFC-125, 20% HFC-143a, 1.8% isobutane, 0.6% propane
R-434A	3,075	63.2% HFC-125, 16% HFC-134a, 18% HFC-143a, 2.8% isobutane
R-507A	3,985	50% HFC-125, 50% HFC-143a
R-508A	11,607	30% HFC-23, 61% PFC-116
R-508B	11,698	46% HFC-23, 54% PFC-116

**Source:** 100-year GWP values from IPCC Fifth Assessment Report (AR5), 2013, Chapter 8, Table A.8.1, Lifetimes, Radiative Efficiencies and Metric Values. GWP values of blended refrigerants are based only on their HFC and PFC constituents, which are based on data from <https://www.epa.gov/snaps/compositions-refrigerant-blends>.