



CARBON FOOTPRINT

COUNTRY SPECIFIC ELECTRICITY GRID GREENHOUSE GAS EMISSION FACTORS

Last Updated: February 2023

Key terms

- **Dual reporting** – Reporting both location-based and market-based emissions.
- **Generation** – This is the emissions factor for the fuels burned to provide you with the energy that you have directly used. This will be part of your “Scope 2” emissions, although you have directly used the energy, the emissions occurred at a power station, where the fuel was burned.
- **Location-based reporting** – Calculating your emissions based on where your site is, using the fuel mixes from power stations local to you.
- **Market-based reporting** – Calculating your emissions based on the consumer choices you have made, e.g. using a green or renewable tariff, so that you only purchase the energy from renewable sources.
- **Production mix** – These are emissions factors based on the mix of fuels used by power stations in the area. Use these for location-based reporting.
- **Residual mix** – These are emissions factors based on the mix of fuels used by power stations in the area where the energy from certain fuels that has been sold to specific consumers has been taken out. For example, people using green or renewable energy tariffs have bought energy that comes from only renewable sources. Therefore, these values can be used for market-based reporting when you have not bought energy from a specific mix of fuels.
- **Scope 1** – Emissions that occurred from burning fuel in assets under your control, e.g. on your sites or in your vehicles.
- **Scope 2** – Emissions that occurred out of your control but as a result of energy you have directly consumed.
- **Scope 3** – Emissions that occurred in your supply chain.
- **Transmission & distribution** – This is the emissions factor for the energy generated to move the energy you used around the grid to get to your site. This will be part of your “Scope 3” emissions, as the energy associated with these emissions was neither consumed nor generated on your site, but is used as a result of energy consumed on your site.

COUNTRY SPECIFIC ELECTRICITY FACTORS – 2022

The following grid electricity emissions factors are used in our online calculators. Countries and territories are ordered alphabetically and grouped by geographic area.

Grouping	Country	Production fuel mix factor (kgCO _{2e} per kWh)	Residual fuel mix factor (kgCO _{2e} per kWh)	Source	Year	Comments
Africa	South Africa	0.8665	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
Asia	China (PR)	0.5572	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
	Hong Kong (China)	0.7100 or 0.6500	-	Hong Kong Electric Company (2021) or CLP Group (2021) These two companies supply different areas of HK so check which one you need.	2020	Combined generation and T&D factor
	India	0.7132	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
	Indonesia	0.7848	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
	Japan	0.4615	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
	Korea (Republic)	0.4113	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
	Singapore	0.408	-	Singapore Energy Market Authority (EMA)	2021	Electricity Grid Emissions Factors
	Thailand	Gen = 0.407 T&D = 0.0390	-	Energy Policy and Planning Office (EPPO) Thai Government Ministry of Energy	2022	Generation Factor T&D = Consumption – Generation
Australasia	Australia	Gen = 0.68 T&D = 0.09	-	Australian Government	2020	2020 (published in 2023)
	New Zealand	Gen = 0.103 T&D = 0.011	-	Measuring Emissions Factors Summary 2020	2020	Emission factors published in 2022, based on 2020 national inventory.

Grouping	Country	Production fuel mix factor (kgCO ₂ e per kWh)	Residual fuel mix factor (kgCO ₂ e per kWh)	Source	Year	Comments
Middle East	Saudi Arabia	0.6142	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
	Turkey	0.4261	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
	United Arab Emirates	Gen = 0.4010 T&D = 0.01379	-	Dubai Electricity & Water Authority (sustainability report 2021)	2020	Generation factor only
North & Central America	Canada	0.11081	-	UN Framework Convention on Climate Change	2020 (published 2022)	Combined generation and distribution factor. Regional factors are available. See separate table below.
	Mexico	0.3	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
	United States	0.373138	-	US Env Protection Agency (EPA) eGrid	2020 (published 2022)	Combined generation and distribution factor. Regional factors are available. See separate table below.
South America	Argentina	0.2881	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
	Brazil	0.1295	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
Europe	Austria	0.11847	-	Association of Issuing Bodies (AIB) 2022	2021	Production mix factor
	Bosnia & Herzgovina	0.55852	0.55852	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Belgium	0.12264	0.14919	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Bulgaria	0.40412	0.40412	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Croatia	0.20052	0.46650	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Cyprus	0.62296	0.62507	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Czech Republic	0.50671	0.54996	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor

Grouping	Country	Production fuel mix factor (kgCO _{2e} per kWh)	Residual fuel mix factor (kgCO _{2e} per kWh)	Source	Year	Comments
	Denmark	0.18134	0.52932	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Estonia	0.61613	0.63658	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Finland	0.09584	0.28532	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	France	0.04098	0.04857	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Germany	0.37764	0.61784	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Greece	0.33664	0.44463	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Hungary	0.22397	0.27626	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Iceland	0.00010	0.42348	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Ireland	0.37710	0.57009	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Italy	0.30685	0.45657	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Latvia	0.21965	0.30258	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Lithuania	0.21852	0.38450	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Luxembourg	0.09883	0.40306	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Malta	0.66069	0.62366	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Netherlands	0.37040	0.45074	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Norway	0.00449	0.40491	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Poland	0.77659	0.85021	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Portugal	0.16418	0.28106	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Romania	0.27746	0.28165	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Russian Federation	0.3218	-	Climate Transparency (2022 Report)	2021	Emissions intensity of the power sector
	Serbia	0.69508	0.76374	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Slovakia	0.16549	0.18462	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Slovenia	0.21685	0.56544	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Spain	0.15330	0.29583	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Sweden	0.00767	0.07663	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	Switzerland	0.01163	0.01915	Association of Issuing Bodies (AIB) 2022	2021	Production & residual mix factor
	United Kingdom	Gen: 0.19338 T&D: 0.01769	0.35117	Production: UK Govt – Defra/BEIS (2022)	2021 (2020-21 Data)	Generation & transmission & distribution factors
Residual: Association of Issuing Bodies (AIB) 2022				2021		Residual mix factor

UNITED STATES REGIONAL FACTORS (BY STATE)

Regional factors are sourced directly from the United States Environmental Protection Agency’s (EPA) eGrid database.

<https://www.epa.gov/egrid> 2020 factors, published January 2022. **Next set due to be published in 2023.**

State	Grid	Generation Factor (kgCO ₂ e per kWh)	T&D Factor (kgCO ₂ e per kWh)	Year
UNITED STATES		0.373138	0.0241	2020 (published 2022)
Alaska (AK)	ASCC & ASCC Misc. - Alaska Grid	0.43823	0.025505	2020 (published 2022)
Alabama (AL)	SERC - South	0.32707	0.018305	2020 (published 2022)
Arkansas (AR)	SERC - South	0.43150	0.024149	2020 (published 2022)
Arizona (AZ)	WECC - Southwest	0.33429	0.018709	2020 (published 2022)
California (CA)	WECC- California	0.20553	0.011503	2020 (published 2022)
Colorado (CO)	WECC - Rockies	0.55304	0.030951	2020 (published 2022)
Connecticut (CT)	NPCC - New England	0.24030	0.013449	2020 (published 2022)
Washington DC (DC)	RFC - East	0.36338	0.020337	2020 (published 2022)
Delaware (DE)	RFC - East	0.34248	0.019167	2020 (published 2022)
Florida (FL)	FRCC - All	0.38200	0.021379	2020 (published 2022)
Georgia (GA)	SERC - South	0.32818	0.018367	2020 (published 2022)
Hawaii (HI)	HICC - Misc. & Oahu	0.69241	0.041075	2020 (published 2022)
Iowa (IA)	MRO - East	0.27905	0.015617	2020 (published 2022)
Idaho (ID)	WECC - Rockies	0.09679	0.005417	2020 (published 2022)
Illinois (IL)	MRO- East	0.25240	0.014126	2020 (published 2022)
Indiana (IN)	RFC - West	0.70282	0.039334	2020 (published 2022)
Kansas (KS)	SPP- North	0.36478	0.020415	2020 (published 2022)
Kentucky (KY)	SERC - Tennessee Valley	0.76425	0.042772	2020 (published 2022)
Louisiana (LA)	SERC - South	0.34552	0.019337	2020 (published 2022)
Massachusetts (MA)	NPCC - New England	0.39912	0.022337	2020 (published 2022)
Maryland (MD)	RFC - East	0.29271	0.016382	2020 (published 2022)
Maine (ME)	NPCC - New England	0.10350	0.005793	2020 (published 2022)
Michigan (MI)	RFC - Michigan	0.42548	0.023813	2020 (published 2022)
Minnesota (MN)	MRO - East	0.34943	0.019556	2020 (published 2022)
Missouri (MO)	SERC - South	0.73410	0.041085	2020 (published 2022)
Mississippi (MS)	SERC - South	0.40557	0.022698	2020 (published 2022)

State	Grid	Generation Factor (kgCO ₂ e per kWh)	T&D Factor (kgCO ₂ e per kWh)	Year
UNITED STATES		0.373138	0.0241	2020 (published 2022)
Montana (MT)	WECC - Rockies	0.41396	0.023168	2020 (published 2022)
North Carolina (NC)	SERC - Virginia/Carolinas	0.29413	0.016461	2020 (published 2022)
North Dakota (ND)	MRO-West	0.62965	0.035239	2020 (published 2022)
Nebraska (NE)	MRO-West	0.54461	0.03048	2020 (published 2022)
New Hampshire (NH)	NPCC - New England	0.11244	0.006293	2020 (published 2022)
New Jersey (NJ)	RFC - East	0.22330	0.012497	2020 (published 2022)
New Mexico (NM)	WECC - Southwest	0.57147	0.031983	2020 (published 2022)
Nevada (NV)	WECC - Rockies	0.32505	0.018192	2020 (published 2022)
New York (NY)	NPCC - LI, NYC, & Upstate NY	0.18901	0.010578	2020 (published 2022)
Ohio (OH)	RFC - West	0.56848	0.031815	2020 (published 2022)
Oklahoma (OK)	SPP- South	0.32144	0.01799	2020 (published 2022)
Oregon (OR)	WECC - Northwest	0.15495	0.008672	2020 (published 2022)
Pennsylvania (PA)	RFC - West	0.31639	0.017707	2020 (published 2022)
Rhode Island (RI)	NPCC - New England	0.37537	0.021008	2020 (published 2022)
South Carolina (SC)	SERC - Virginia/Carolinas	0.23308	0.013045	2020 (published 2022)
South Dakota (SD)	MRO-West	0.15449	0.008646	2020 (published 2022)
Tennessee (TN)	SERC - Tennessee Valley	0.25919	0.014506	2020 (published 2022)
Texas (TX)	ERCOT - All	0.38896	0.021336	2020 (published 2022)
Utah (UT)	WECC - Rockies	0.71022	0.039748	2020 (published 2022)
Virginia (VA)	SERC - Virginia/Carolinas	0.29250	0.01637	2020 (published 2022)
Vermont (VT)	NPCC - New England	0.01375	0.000769	2020 (published 2022)
Washington (WA)	WECC - Northwest	0.09674	0.005414	2020 (published 2022)
Wisconsin (WI)	MRO - East	0.54069	0.03026	2020 (published 2022)
West Virginia (WV)	SERC - Virginia/Carolinas	0.87304	0.048861	2020 (published 2022)
Wyoming (WY)	WECC - Rockies	0.90270	0.05052	2020 (published 2022)

CANADA REGIONAL FACTORS (BY PROVINCE)

Province factors sourced from Canada's latest submission to the UN Framework Convention on Climate Change.

State	Generation Factor (kgCO _{2e} per kWh)	T&D Factor (kgCO _{2e} per kWh)	Year
Canada	0.11081	Negligible	2020 (published 2022)
Alberta (AB)	0.58433	0.05	2020 (published 2022)
British Columbia (BC)	0.007315	0.0011	2020 (published 2022)
Manitoba (MB)	0.0011028	0.0001	2020 (published 2022)
New Brunswick (NB)	0.2919	0.01	2020 (published 2022)
Newfoundland and Labrador (NL)	0.0240084	0.001	2020 (published 2022)
Nova Scotia (NS)	0.67349	0.05	2020 (published 2022)
Northwest Territories (NT)	0.18028	Negligible	2020 (published 2022)
Nunavut (NU)	0.76	0.05	2020 (published 2022)
Ontario (ON)	0.025433	Negligible	2020 (published 2022)
Prince Edward Island (PE)	0	Negligible	2020 (published 2022)
Quebec (QC)	0.0015	0.0003	2020 (published 2022)
Saskatchewan (SK)	0.57433	0.05	2020 (published 2022)
Yukon Territory (YT)	0.100336	0.010	2020 (published 2022)

AUSTRALIA REGIONAL FACTORS (BY STATE)

State specific factors are sourced from publicly available emissions factors published by the Australian Government to support annual GHG measurements.

This was updated using the report published in February 2023 report.

State	Generation Factor (kgCO _{2e} per kWh)	T&D Factor (kgCO _{2e} per kWh)	Year
AUSTRALIA	<i>0.68</i>	<i>0.09</i>	2020 (published in 2023)
Australian Capital Territory	0.73	0.06	2020 (published in 2023)
New South Wales	0.73	0.06	2020 (published in 2023)
Northern Territory	0.54	0.07	2020 (published in 2023)
Northern Territory – Darwin Katherine Interconnected System (DKIS)	0.54	0.07	2020 (published in 2023)
Queensland	0.73	0.15	2020 (published in 2023)
South Australia	0.25	0.08	2020 (published in 2023)
Tasmania	0.17	0.01	2020 (published in 2023)
Victoria	0.85	0.07	2020 (published in 2023)
Western Australia – North Western Interconnected System (NWIS)	0.58	Not available	2020 (published in 2023)
Western Australia – South West Interconnected System (SWIS)	0.51	0.04	2020 (published in 2023)

Sources of Emissions Factors:

- **AIB (2022). 2021 European Residual Mix** - Results of the calculation of Residual Mixes for the calendar year 2021 (Version 1.0, 2022-05-31)
<https://www.aib-net.org/facts/european-residual-mix/2021>
- **Australian Government Dept of Environment & Energy Emissions Factors**
 - Table 1 for regional factors (February 2023 report) [Australian National Greenhouse Accounts Factors \(dceew.gov.au\)](https://www.dceew.gov.au)
- **Climate Transparency (2022)** – Country profiles, page 9 - <https://www.climate-transparency.org/g20-climate-performance/g20report2022#1531904804037-423d5c88-a7a7>
- **Defra/BEIS 2022 Emissions Factors** (June 2022) - <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022>
- **Dubai Electricity & Water Authority (DEWA) (2021)** -
<https://www.dewa.gov.ae/~media/Files/Customr/Sustainability Reports/DEWA Sustainability Report 2021.ashx>
- **Hong Kong**
 - Power generation is managed by two major companies: Hong Kong Electric Company (supplies HK Island and Lamma Island) and CLP Power Hong Kong Ltd (supplies Kowloon, New Territories and outlying islands except Lamma Island).
https://en.wikipedia.org/wiki/Electricity_sector_in_Hong_Kong
 - HK Electric
 - 2021 Sustainability Report, page 17
https://www.hkelectric.com/en/CorporateSocialResponsibility/CorporateSocialResponsibility_CDD/Documents/SR2021E.pdf
 - CLP Power Hong Kong

- 2021 annual report, page 78 https://www.clpgroup.com/content/dam/clp-group/channels/sustainability/document/sustainability-report/2021/CLP_Sustainability_Report_2021_en.pdf.coredownload.pdf
- **New Zealand Government Ministry for the Environment**
 - 2020 factors (published Aug 2022) – <https://environment.govt.nz/assets/publications/Measuring-emissions-guidance-August-2022/Summary-PDF-Measuring-emissions-guidance-August-2022.pdf>
- **Singapore - Energy Market Authority (EMA)**
 - https://www.ema.gov.sg/statistic.aspx?sta_sid=20140729MPY03nTHx2a1
 - PDF available for download at the above URL
- **Thai Government Ministry of Energy – Energy Policy and Planning Office (EPPO)**
 - [CO2 Statistic \(eppo.go.th\)](https://www.epppo.go.th/CO2-Statistic)
 - Table 9.1-15: CO2 Emission per kWh
- **United Nations Framework Convention on Climate Change (UNFCCC)**
 - <https://unfccc.int/ghg-inventories-annex-i-parties/2021>
 - **Canada** – download ‘NIR’ (national inventory report) (Published: 15 Apr 2021). Page 60 onwards on ‘Part 3’ document.
- **United States EPA eGrid Database**
 - 2020 factors (Published: Jan 2022)
 - <https://www.epa.gov/egrid/historical-egrid-data>
 - EFs converted from lbs/MWh to kg/kWh and calculated T&D factors