Data Methodology

This document covers our methodology for the following datasets:

- Electricity **generation** (TWh)
- Electricity **net imports** (TWh)
- Electricity **demand** (TWh)
- Installed power generation **capacity** (GW)
- **Emissions** from electricity generation (Million tonnes of carbon dioxide equivalent, Mt CO_2e)

All data is available to download for free on the Ember website. It is provided on an 'as is' basis, and is assembled using the best data available to us at any given time. Every effort has been made to ensure accuracy, and where possible we compare multiple sources to confirm their agreement. We take no responsibility for errors.

If you notice an issue or have any suggestions, comments, or questions, please do contact us at data@ember-energy.org.

Contents

Definitions

Datasets

Our core data covers the following subjects:

- Electricity **generation** (TWh), provided both by fuel type and aggregated
- Electricity **net imports** (TWh)
- Electricity **demand** (TWh), calculated as the sum of power production and net imports
- Installed power generation **capacity** (GW), broken down by fuel type
- **Emissions** from electricity generation (Mt CO_2e), calculated from IPCC emissions factors

Fuel Types

In our global dataset, fuel data is mapped into nine generation types: *Bioenergy*, *Coal*, *Gas*, *Hydro*, *Nuclear*, *Other Fossil*, *Other Renewables*, *Solar*, and *Wind*. In our European dataset, *Coal* is further split into *Hard Coal* and *Lignite*, and *Wind* into *Onshore* and *Offshore* wind. More information on mapping for different sources and countries is below.

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[1] Solar includes both solar thermal and solar photovoltaic generation, and where possible distributed solar generation is included.
[2] Where possible, Hydro generation excludes any contribution from pumped hydro generation.
[3] Bioenergy is classified as renewable, but caveats are attached. See below for details.
[4] Other Renewables generation includes geothermal, tidal and wave generation.
[5] Other Fossil generation includes generation from oil and petroleum products, as well as manufactured gases and waste.

Bioenergy has typically been assumed (by the IPCC, the IEA, and many others) to be a renewable energy source, in that forest and energy crops can be regrown and replenished, unlike fossil fuels. It is included in many governmental climate targets, including EU renewable energy legislation, and so Ember includes it in “renewable” to allow easy comparison with legislated targets.

However, the climate impact of bioenergy is highly dependent on the feedstock, how it was sourced and what would have happened had the feedstock not been burnt for energy. Current bioenergy sustainability criteria, including those of the EU, generally do not sufficiently regulate out high-risk feedstocks and therefore electricity generation from bioenergy cannot be automatically assumed to deliver similar climate benefits to other renewables sources. Given the availability of risk-free alternatives to generating electricity such as wind and solar, Ember advocates for countries to minimise or eliminate the inclusion of large-scale bioenergy in the power sector. For more information please see our reports: Understanding the Cost of the Drax BECCS Plant to UK Consumers (May 2021), The Burning Question (June 2020), and Playing with Fire (December 2019).

Electricity Generation and Net Imports

Overview

Ember releases time series data of power **generation**, broken down by fuel type, and power **imports**. These figures are then combined to produce a total power **demand** time series for each country. "% share" values refer to the share of generation (this does not include net imports) and not the share of consumption unless otherwise specified. We provide data for 215 countries from 2000, and where possible have gathered the latest data using annual and monthly national reporting.

Compiling a full dataset requires using data at multiple timescales. Annual generation data is collected from both national and multi-country sources. For the most recent years, data is often not available. In these cases we use monthly data, which is reported on a shorter lag, to estimate the latest annual generation.

Power data is gathered in a wide variety of formats from multiple sources. In addition to this reconciliation, our data requires considerable cleaning and adjustment of the raw data reported. An overview of our methods is below.

Methods

Annual data

Annual data is generally available until 2024. It is gathered from the *Key Sources* described below. We aim to report all annual generation data as gross generation.

Net imports are available until 2024 for all countries. In cases where generation data exists for 2024, but imports do not, imports are carried forward. Where net import data is not

available for any years, values are assumed to be zero: we note these cases in *Country-specific Methodology*.

Projected monthly data

In several cases monthly data is reported on a lagged basis, or data may not be available. In these cases, incomplete months are projected based on both seasonal and interannual trends. We aim to produce sensible figures (i.e. roughly what would be expected by eye), rather than trying to accurately account for e.g. unusual weather conditions in a given month. Projected data is not released for individual countries on a monthly level, but can play a small role in some monthly regional and country-level annual figures.

The approach uses a series of ARIMA models organised as follows:

- Demand is projected using projected GDP from the world bank as an exogenous variable
- Non-dispatchable generation sources are projected. For this purpose we assume wind, solar, hydro, nuclear, and other renewables are not dispatchable
- Residual demand is calculated to be met by dispatchable generation and imports. Dispatchable generation (coal, gas, other fossil, and bio) is projected using residual demand as an exogenous variable
- Residual demand is recalculated to be met by imports. Imports are projected using this residual demand as an exogenous variable, with magnitude bounded at their historical maximum plus 10%.
- If there is any remaining discrepancy between projected demand and the sum of projected generation and imports, dispatchable generation is scaled to remove this

Estimating latest yearly data

Monthly data does not always align well with annual data: different types of generation may be included in different scales, or coverage may differ. Where conflicts occur, annual data is generally more accurate. As such, we project latest generation data by applying absolute changes by fuel from available annualised monthly data to historical annual values. In the few cases where a specific fuel is not available in monthly data, it is treated as having shown no change in the annualised projection. As such, note that simply summing up monthly values **will not produce the same results** as our annual values for any given year.

Thermal disaggregation

Some countries do not report disaggregated generation from fossil fuels; this disaggregation was performed by Ember. If possible, the split between fossil fuels is estimated using the ratios of fossil generation types in the IEA's monthly electricity generation statistics. If this is not available, we use the split between fossil fuels on an annual basis from the Energy Institute (EI) statistical review of world energy (formerly

produced by BP). This approach covers the majority of global generation. Finally, capacity ratios are used to disaggregate any remaining countries.

Regional and world estimates

Although our data covers the vast majority of the world's electricity generation for 2024, data is not available for all countries. As such, regional and world figures for this year are estimated. Values for missing years for a given country are estimated based on historical trends of demand and generation from individual sources by country. Monthly regional estimates are calculated based on these annual figures. Electricity imports and exports are included in estimates for EU regional demand values, but not elsewhere.

Key Sources

Eurostat

Annual European data up to the end of 2024 is taken from the European Commission's Eurostat annual data for most European countries included in our data. This data is thoroughly quality assured and represents *gross* generation, including auxiliary power used in generator function. Historical net import data is also acquired from Eurostat.

Eurostat also provides monthly generation data for most countries. In general we do not prefer this data, as it is reported with some delay and is of poorer quality than Eurostat annual data. It is used in a few cases, specified in *Country-specific Methodology*.

European Network of Transmission Systems Operators for Electricity (ENTSO-E)

The bulk of our monthly European power data is sourced from the ENTSO-E transparency platform, which provides hourly (or more frequent) generation by fuel type for most European countries. ENTSO-E reports *net* generation, excluding auxiliary power.

In some cases ENTSO-E data is unavailable, and in others there are known quality issues which make using another source necessary for some or all fuel types. Nationally reported sources are preferred; in three cases we use Eurostat monthly data and project several months forward. All European countries using any non-ENTSO-E sources or projections are described below.

Energy Institute (EI)

EI data is available for most of the 31 geographies, including most of the world's largest power sectors. It therefore covers the majority of generation in our global historical annual

data, including compiled generation by fuel type from a range of national sources. EI data represents *gross* generation.

U.S. Energy Information Administration (EIA)

EIA data covers most geographies not included in Eurostat or EI, and includes compiled generation by fuel type from a range of national sources. EIA data represents *gross* generation.

Caveats

While we make every effort to ensure the accuracy of our data, there are consistent challenges with source data. Major issues include:

Captive power

Industrial sites often have their own thermal generating resources, which in some countries can be a large proportion of generation from certain fuels. This data is generally included in national yearly statistics, but may be excluded from monthly statistics, particularly in cases where reporting is based on TSO data. We include this data whenever possible; where we are aware of significant captive generation that is not reported, it is noted in country-specific methodology below.

Distributed generation

Distributed generation refers to small generating resources not connected directly to the high-voltage grid. These resources are very rarely metered, and their generation can only be reported as an estimate. These resources include mostly:

- Small thermal resources, such as diesel generators, bagasse generators, and reciprocating gas engines. These resources are globally widespread but are more prominent in countries with less developed grids, and are less likely to be reported in such countries.
- Solar PV, which has been growing very rapidly in recent years. Reporting of distributed PV is inconsistent: in some cases it is fully estimated, in others only grid feed-in is reported, and often it is excluded from official statistics. In certain cases we make efforts to model or account for this generation; these cases are noted in country-specific methodology below.

Installed Capacity

Overview

Capacity represents the maximum nameplate output for different fuel types in a country. It is very rare for high quality capacity data to be available from national sources for all years. Additionally, national data tends to be aggregated by fuel type inconsistently across countries, making it difficult to make comparisons. As such, we take our data from three main sources, detailed below.

Most fuel types are consistently available in our sources, but data for Other Fossil is less consistent and is taken from where it is of the highest quality. In a few cases, we are not able to gather any data of acceptable quality for Other Fossil capacity. As a result, our capacity ratios are incorrect; more detail is given in *Country-specific Methodology*.

Solar PV capacity can be reported as either AC or DC. IRENA requests countries to report AC, but responses are inconsistent and figures are in DC for many countries. Care should therefore be taken when comparing between countries, and where global aggregate figures are required we tend to use IEA or BNEF data.

Key Sources

Global Energy Monitor (GEM)

GEM maintains trackers containing their best knowledge of all current global coal and gas power plants with capacity greater than 50 MW, both operational and retired. We use these trackers to build capacity histories by country. This method has caveats:

- GEM reports *gross* capacity, where other sources report *net* capacity for other fuel types. Capacity is therefore not perfectly comparable.
- GEM's gas tracker does not include plants which were retired before 2020, meaning that historical time series may be underestimated in some cases.
- Some countries have a substantial amount of co-firing capacity: plants which can burn either gas or some other fuel depending on necessity and availability. It is not possible to accurately disaggregate this capacity, as it varies by plant; we therefore take all co-firing capacity as being gas. This approach can lead to inaccuracies in a number of Middle Eastern countries, where these plants are common.

International Renewable Energy Agency (IRENA)

IRENA publishes detailed capacity data through the IRENASTAT portal, which we use for all non-fossil generation. Where we believe data quality is better, we also use IRENA data for

coal, gas and other fossil capacity. Fossil capacity is not always disaggregated; where this is the case, we assign unspecified capacity to either coal, gas or other fossil. Details are provided in the country-specific methodology.

Emissions from Electricity Generation

Note that the below methodology is our standard approach to calculating emissions. In certain cases, such as our 2022 European Electricity Review, other approaches may be used. This will be noted where it is the case, and specific methodologies will be made available for such datasets.

Overview

Ember's calculations for emissions are continually improving, but may be conservative or otherwise uncertain in ways we describe below. These figures aim to include full lifecycle emissions including upstream methane, supply chain and manufacturing emissions, and include all gases, converted into CO2 equivalent over a 100-year timescale.

Emissions can vary over time as power station efficiency changes, and as different fuel qualities are used. Therefore, we report emissions values by fuel type, and emissions intensity by country. These values are calculated by multiplying our generation numbers by emissions factors taken from a number of sources, detailed below. We aim where possible to capture variance between geographies and over time in emissions intensity from different fuels. **If you have any comments or suggestions for improvement, please email data@ember-energy.org.**

Our sources and methodology for different fuels are described below. All factors we use are for net generation. Where we report gross generation, we adjust our factors by 6% for thermal fuel sources and 1% for others, following a standard conversion approach.

Coal

Data is taken from Gibon et al. 2022 (UNECE) and the Global Energy Monitor Coal Plant Tracker (GEM). UNECE provides lifecycle emissions factors for different fuel types for the year 2020 for each REMIND region. UNECE reports values for different technologies using bituminous coal. We derive factors for different coal grades based on IPCC 2005 direct combustion emissions factors. Using country-level annual technology and coal grade mixes from GEM capacity data, we estimate blended emissions factors per country per year for coal. Where data is available distinguishing between hard coal and lignite, we calculate emissions separately for these and sum them to give our published coal value.

Gas

Country-level factors are taken from Jordaan et al. 2022, and are for generation for the year 2017. Two sets of factors are provided; we use the ones that attempt to account for combined heat and power. For smaller countries where no data is available, a world average number is used.

Nuclear and wind

We use region-level data from UNECE.

Bioenergy, hydro, solar, other renewables and other fossil fuels

We use data from the IPCC AR5 WG3 Annex III (2014). These are global estimates for the year 2020; we use midpoint lifecycle factors. These are:

- Bioenergy: 230 g/kWh
- Hydro: 24 g/kWh
- Solar: 48 g/kWh
- Other renewables: 38g/kWh
- Other fossil: 700/kWh

Caveats

This approach attempts to account for some geographical and temporal variance in emissions factors. It is a work in progress, and figures may differ from reality for a number of reasons. Some of these are listed below:

- **Coal**: UNECE base factors are for coal plants in the year 2020. They do not capture operational efficiency losses associated with older plants or intra-technology efficiency differences. Finally, we make assumptions to derive factors for coal grades other than lignite, including identical combustion efficiencies and upstream emissions per MWh generated.
- **Gas**: Our gas factors are specific to the year 2017, so do not account for temporal variations in plant efficiencies or methane leakage rates. The methodology in Jordaan et al. 2022 also prefers to underestimate methane emissions where there is doubt. In general there is very significant uncertainty around methane emissions rates, even in countries that prioritise collecting this data. Some authors believe that emissions rates are significantly higher than assumed in our factors.
- **Time horizon:** Upstream methane emissions for gas and coal generation are calculated on a long-term basis assuming methane is 21 times as potent as CO2. However, the short-term impact of methane is actually four times higher, at 86 times the potency of CO2. See this page for more information.

- **Solar and wind**: Recent efficiency improvements have seen wind and solar emissions intensity drop, as energy output has increased relative to emissions from manufacturing. Our numbers may therefore be higher than reality. We also do not currently capture geographical variation in emissions intensity within REMIND regions; this can be significant, as countries with lower annual solar capacity factors will have proportionately higher lifecycle emissions.
- **Bioenergy**: Our value is very likely to be a significant underestimate of the actual emissions caused by bioenergy generation. The emissions intensity of bioenergy is highly dependent on the feedstock, how it was sourced, and what would have happened had the feedstock not been burnt for energy. The IPCC figure we use is for dedicated energy crops and crop residues, rather than the much more commonly used woody or forest biomass, which has been shown to carry a greater risk of high-carbon outcomes. In certain cases, bioenergy can have a carbon intensity significantly greater than coal. Bioenergy is also frequently cofired with fossil fuels. We have disaggregated these wherever possible, but in certain cases recorded bioenergy generation may include some co-firing. In these circumstances, actual emissions will be higher than we estimate.
- **Hydro and other renewables**: Hydropower emissions are generally very low, but can vary based on emissions during construction and biogenic emissions, and so in a small number of cases can be much higher than our value. Similarly, other renewable sources such as geothermal can in rare outlier cases have high emissions.
- **Gross and net generation**: In the EU, we report net generation for monthly data and gross generation for yearly data. For gross generation, we perform the conversion described above, which may introduce some error.
- **Combined heat and power (CHP):** In many cases, thermal power plants produce both heat and electricity. Our coal factors are based on only the electricity produced by such plants, ignoring heat. It may not therefore be fair for our dataset to include all emissions attributed to co-firing plants, which actually have greater efficiency than reported when considering total useful energy output. Our gas factors account for CHP.

Country-specific Methodology

Historical sources are reported for all countries in our dataset below, along with sources used for recent years where they exist. In almost all cases recent year sources are monthly data, combined with historical annual data according to the approach outlined in *Methods*; exceptions are noted. Any further relevant information is included on a per-country basis.

Abbreviations

- *EIA*: U.S Energy Information Administration
- *EI*: Energy Institute
- *ENTSO-E*: European Network of Transmission Systems Operators for Electricity
- *GEM*: Global Energy Monitor
- *IEA*: International Energy Agency
- *IRENA*: International Renewable Energy Agency

Afghanistan

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Albania

Sources

Eurostat, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

Algeria

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

American Samoa

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Angola

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.
- Angola has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Antigua and Barbuda

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Argentina

Sources

EIA, Compañia Administradora Del Mercado Mayorista Eléctrico (CAMMESA), IEA, EI, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI.
- Annual net imports are taken from the EIA.
- Monthly generation and net imports are taken from CAMMESA. Gas and Coal generation are aggregated in this data, so are disaggregated based on ratios of fossil generation from IEA monthly generation data.
- Argentina shares the Yacyreta Hydro power plant with Paraguay. Argentina's yearly generation data only includes generation that is attributable to Argentina and not the entire generation output of the plant, while monthly data includes the entire output.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA.

Armenia

Sources

EIA, Council Commonwealth of Independent States Electric Power Council (CIS), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Quarterly generation data and net imports are taken from CIS. Monthly generation and net imports are derived from monthly demand reported by CIS.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.
- Armenia has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Aruba

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Australia

Sources

EI, OpenNEM Project, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from EI.
- Monthly electricity generation is taken from OpenNEM, and includes data for both the National Electricity Market (NEM) as well as the South West Interconnected System (SWIS) in Western Australia.
- Gas generation is significantly lower in monthly data than annual. The underreporting is largely concentrated on missing generation from Western Australia. Solar generation is also lower in monthly data, in large part due to the underreporting of low-voltage "medium" solar.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Austria

Sources

Eurostat, ENTSO-E, Energie-Control (E-Control), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E, except for Hydro which is based on Eurostat data and Solar is taken from E-Control.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Azerbaijan

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Azerbaijan has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Bahamas

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Bahrain

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

Bangladesh

Sources

EIA, Power Grid Company of Bangladesh (PGCB), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly electricity generation and net imports are taken from the PGCB.
- Electricity net import data for Bangladesh only includes net imports from India.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Barbados

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Belarus

Sources

EIA, Council Commonwealth of Independent States Electric Power Council (CIS), IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Quarterly generation data and net imports are taken from CIS. Monthly generation and net imports are derived from monthly demand reported by CIS.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Belarus has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Belgium

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E.

Installed Capacity

- Coal and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Belize

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Benin

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

Bermuda

Sources

EIA, GEM

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from GEM.

Bhutan

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Bolivia

Sources

EIA, Comité Nacional de Despacho de Carga (CNDC), IRENA

Electricity Generation

- Annual electricity generation and net imports are taken from the EIA.
- Monthly generation data is taken from CNDC. Thermal data is reported aggregated; known Bioenergy units are disaggregated from this, with other generation assumed to be Gas.
- Bolivia opened an interconnector with Argentina in 2023, which is not yet covered in our data.

Installed Capacity

- All capacity data is taken from IRENA.

Bosnia Herzegovina

Sources

IRENA, EIA, Eurostat, ENTSO-E, GEM

Electricity Generation and Net Imports

- Annual electricity generation is taken from IRENA. Annual net imports are taken from the EIA.
- Monthly generation and net imports are taken from ENTSO-E. Monthly solar generation is taken from Eurostat.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be coal.

Botswana

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Brazil

Sources

EIA, Operador Nacional do Sistema Eléctrico (ONS), EI, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI. Annual net imports are taken from the EIA. Net imports are carried forward from the last year available in EIA data.
- Monthly electricity generation is taken from ONS.
- Brazil shares the Itaipu hydroelectric dam with Paraguay, with ownership of power produced split evenly between the two countries. In monthly data, each country instead reports the power they *consumed* from the dam.
- Bioenergy (mostly sugarcane) is generally not scheduled by ONS, so is underreported in monthly data. Distributed Solar PV generation is reported by ONS from May 2023; values before this are estimated by Ember based on yearly data.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Brunei Darussalam

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Bulgaria

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Hard Coal.

Burkina Faso

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Burundi

Sources

EIA, Institut de Statistiques et d'Etudes Economiques du Burundi (ISTEEBU), IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Cabo Verde

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Cambodia

Sources

EIA, Electrical Authority of Cambodia (EAC), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA until 2023. Data for subsequent years is estimated based on EAC reports.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Cameroon

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Canada

Sources

EIA, Statistics Canada (STATCAN), Canada Energy Regulator (CER), IEA, EI, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI.
- Annual net imports are taken from the EIA.

- Monthly electricity generation is taken from STATCAN. Gas and Coal generation is reported by technology rather than fuel type, so requires some disaggregation. This is performed using ratios of fossil generation from IEA monthly generation data.
- Monthly net imports are taken from CER.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.
- Canada has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Cayman Islands

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Central African Republic

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Chad

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Chile

Sources

EIA, Coordinador Eléctrico Nacional (CEN), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly electricity generation is taken from CEN.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

China

Sources

EI, EIA, China Electricity Council (CEC), National Bureau of Statistics of China (NBS), General Administration of Customs PRC (GACC), IEA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI. This data is based on annual data from the China Electricity Council, with some adjustments made to fossil generation. Solar, Wind and Nuclear generation for 2023 are directly taken from NBS.
- Annual net imports are taken from the EIA.
- Monthly Thermal, Hydro and Nuclear generation are taken from NBS. Thermal generation is disaggregated using IEA monthly generation data.
- NBS only reports generation from corporations with annual revenue above RMB 20m, and reports the annual growth % of generation from these businesses. This has two consequences:
    - Small and new businesses are missing. We revise previous year figures based on the growth rate of these enterprises, and estimate current figures based on the average correction factor per fuel.

    - Wind and solar generation are significantly underreported, as distributed solar is not included in the statistics and there are more small enterprises in these industries. We correct these values by scaling to annually reported CEC data. Correction factors scale by month to ensure continuity across years, with factors for the most recent year estimated from linear regression of previous year factors.
- Monthly net imports are taken from GACC

Installed Capacity

- Coal and gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be coal.

Colombia

Sources

EIA, Compañía Expertos en Mercados (XM), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly generation is taken from XM.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA.
- Colombia has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Comoros

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Congo (DRC)

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Congo

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

Cook Islands

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Costa Rica

Sources

EIA, Centro Nacional de Control de Energía (CNCE), IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly electricity generation and net imports are taken from CNCE. This data is unlikely to include rooftop solar generation, so may undercount solar.

Installed Capacity

- All capacity data is taken from IRENA.

Côte d'Ivoire

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.
- Côte d'Ivoire has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Croatia

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E. Solar generation is estimated by applying a scaling factor which is based on the monthly ratio of non-solar hour demand change to solar hour demand change. This scaling is to account for missing behind-the-meter solar.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Cuba

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Cyprus

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from Eurostat.
- Monthly electricity generation is taken from Eurostat monthly data, with recent months projected forward. Nationally reported data is available from the Cyprus Transmission System Operator (TSOC), but it is not sufficiently disaggregated by fuel type for our use.

Installed Capacity

- Other Fossil capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Hard Coal.

Czechia

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Hard Coal.

Denmark

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Djibouti

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Dominica

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Dominican Republic

Sources

EIA, Ministry for Energy and Mines (MEM), GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.
- Monthly electricity generation is taken from MEM.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA.

Ecuador

Sources

EIA, Agencia de Regulación y Control de Energía y Recursos Naturales no Renovables (ARCONEL), IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly electricity generation and net imports are taken from ARCONEL.
- Thermal generation data is disaggregated in monthly data, but some plants have mixed combustion between Gas and Other Fossil. Consumption by fuel type is known for these plants; we split them using EIA conversion factors.

Installed Capacity

- All capacity data is taken from IRENA.

Egypt

Sources

EIA, Egyptera, Egyptian Central Agency for Public Mobilization and Statistics (CAMPAS), New and Renewable Energy Authority (NREA), EI, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI.
- Annual net imports are taken from the EIA.
- Monthly renewable generation data is taken from Egyptera until the end of 2019, and from NREA from 2020 on.
- Monthly fossil generation data is taken from Egyptera until May 2023. From then on, fossil generation is calculated as total generation (from CAPMAS) minus renewable generation (from NREA). This fossil value is disaggregated based on annual generation fossil ratios.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.
- Egypt has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity ratios for these fuels may be imprecise.

El Salvador

Sources

EIA, National Energy Council (CNE), Superintendencia General De Electricidad y Telecomunicaciones (SIGET), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly electricity generation is taken from CNE until 2021. From 2022 onwards, monthly generation and net imports and taken from SIGET.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Equatorial Guinea

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Eritrea

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Estonia

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E. Bioenergy and Other Fossil generation between May and September 2022 are estimated due to inaccurate reporting from ENTSO-E.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Eswatini

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Ethiopia

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA. Unknown fossil generation reported by IRENA is assumed to be Other Fossil.

Installed Capacity

- All capacity data is taken from IRENA.

Falkland Islands [Malvinas]

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Faroe Islands

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Fiji

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Finland

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken in part from ENTSO-E. Finnish data in ENTSO-E is known to undercount Bioenergy, and to show low volatility compared to expectation. We therefore take Bioenergy, Solar, Gas, Wind and Hydro from Eurostat monthly data.
- Data is also available in national Finnish Energy statistics, which Eurostat figures are taken from.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

France

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E.

Installed Capacity

- Coal and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- France has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity ratios for these fuels may be imprecise.

French Guiana

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from IRENA.

Installed Capacity

- Other Fossil capacity is taken from GEM. All other capacity data is taken from IRENA.

French Polynesia

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Gabon

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

Gambia

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Georgia

Sources

EIA, Georgian State Electrosystem (GSE), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly electricity generation and net imports are taken from GSE.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.
- Georgia has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Germany

Sources

Eurostat, EI, IRENA, ENTSO-E, Energy-Charts, Agora Energiewende, GEM

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat. Gas and Solar data is taken from EI. Wind data is taken from IRENA in order to capture a split between on and offshore generation.

- Monthly Gas and Solar electricity generation are taken from Energy-Charts in order to capture estimates for captive and distributed generation respectively. Other fuels are taken from Agora Energiewende. Net imports are taken from ENTSO-E.

Installed Capacity

- Coal, gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Ghana

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.
- Ghana has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Gibraltar

Sources

EIA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- No capacity data is available.

Greece

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E.
- Other Fossil generation is not reported in monthly data.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Greenland

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Grenada

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Guadeloupe

Sources

GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from IRENA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Guam

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Guatemala

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Guinea

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Guinea-Bissau

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Guyana

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All other capacity data is taken from IRENA.

Haiti

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Honduras

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Hong Kong

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.
- Hong Kong has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Hungary

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E. Solar generation is taken from Eurostat.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Iceland

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

India

Sources

EI, EIA, National Power Portal (CEA), Grid-India *formerly Power System Operation Corporation* (POSOCO), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI. Annual net imports are taken from the EIA.
- Monthly generation is taken from CEA.
- Monthly electricity net imports from 2019 to 2023 March are taken from monthly reports of POSOCO. Imports from 2024 April are calculated by aggregating daily imports to the monthly level from their daily reporting.
- Monthly Coal generation data covers only power fed into the grid. It is therefore lower than annual data, which includes captive industrial generation.
- An overview of subnational data is available here.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Indonesia

Sources

EI, IRENA, Ministry of Energy and Mineral Resources (ESDM), EIA, GEM

Electricity Generation and Net Imports

- Annual electricity generation for all fuels excluding Bioenergy and Other Renewables are taken from EI.
- Annual generation from Bioenergy and Other Renewables are taken from IRENA.
- ESDM publishes annual data each year. We use this for previous year data when it becomes available, as it is more up to date than other sources. National annual reporting does not include captive generation of Coal.
- In recent years, Indonesia has seen significant increases in industrial coal consumption without corresponding increases in reported generation. We suspect that there is a large amount of unreported captive generation at nickel production facilities.
- Annual net imports are taken from ESDM.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.
- Indonesia has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Iran

Sources

EI, Tavanir, EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI.
- Annual net imports are taken from the EIA.
- Monthly generation and import data are taken from Tavanir. Fossil generation is reported aggregated in this data, and disaggregated using the ratios of reported fuel consumption for power generation. Wind, Solar and Nuclear generation cannot be disaggregated, so are excluded from monthly data and carried forward from the last year available in EI data.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.
- Iran has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Iraq

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas and Other Fossil are taken from GEM. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Iraq has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Ireland

Sources

Eurostat, ENTSO-E, Sustainable Energy Authority of Ireland (SEAI), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Since early 2022, reporting to ENTSO-E has been erratic. Monthly electricity generation and net imports from 2010 are therefore taken from SEAI.

Installed Capacity

- Coal, Gas and Other Fossil capacity are from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Israel

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Israel has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Italy

Sources

Eurostat, ENTSO-E, Terna, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation is taken largely from ENTSO-E. Other Fossil generation reported by ENTSO-E is assumed to be Gas. ENTSO-E's reporting of Bioenergy, Solar, and net imports are also known to be inaccurate, so this data is taken from the Italian Grid Operator Terna.

Installed Capacity

- Coal and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Jamaica

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.
- Jamaica has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Japan

Sources

EI, Agency for Natural Resources and Energy (ENECHO), Renewable Energy Institute (REI), GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from EI.
- Monthly electricity generation from 2018 is taken largely from ENECHO. This source is reported on a lag, with recent months unavailable. REI data is therefore used to estimate ENECHO data for recent months, applying absolute changes to the most recent value in the same way as recent annual data is estimated.
- Up until March 2024, REI fossil data is aggregated. It is disaggregated using ENECHO data, with recent months using the most recent ENECHO ratio available. From April 2024 onwards, REI reports disaggregated fossil generation.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Jordan

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Jordan has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Kazakhstan

Sources

EI, EIA, IEA, Samruk, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI.
- Annual net imports are taken from the EIA.
- Monthly electricity generation is taken from Samruk. Fossil generation is disaggregated based on ratios of fossil generation from IEA monthly generation data.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Hard Coal.
- Kazakhstan has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Kenya

Sources

EIA, Kenya National Bureau of Statistics (KNBS), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly electricity generation and net imports are taken from KNBS. Fossil generation is reported aggregated. We therefore disaggregate fossil generation using thermal ratios from annual capacity data.

Installed Capacity

- Other Fossil capacity is taken from GEM. All other capacity is taken from IRENA.

Kiribati

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Kosovo

Sources

Eurostat, IRENA, ENTSO-E, Kosovo Agency of Statistic (ASK), GEM

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat. Wind data is taken from IRENA.
- Monthly electricity generation is taken from ASK. Monthly net imports are taken from ENTSO-E.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Hard Coal.

Kuwait

Sources

EIA, Ministry of Electricity and Water and Renewable Energy (MEW), IEA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.
- Monthly electricity generation is taken from MEW. Generation is not disaggregated, and is assumed to be all fossil. It is disaggregated based on ratios of fossil generation from annual generation data.

Installed Capacity

- All capacity data is taken from IRENA.
- Kuwait has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Kyrgyzstan

Sources

EIA, Council Commonwealth of Independent States Electric Power Council (CIS), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Quarterly generation data and net imports are taken from CIS. Monthly generation and net imports are derived from monthly demand reported by CIS.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Lao

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Latvia

Sources

Eurostat, ENTSO-E, IRENA, Augstsprieguma Tīkls AS (AST)

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E, except for Solar which is taken from AST.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Lebanon

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas and Other Fossil capacity are from GEM. All other capacity data is taken from IRENA.
- Lebanon has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Lesotho

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Liberia

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Libya

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.
- Libya has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Lithuania

Sources

Eurostat, ENTSO-E, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Luxembourg

Sources

Eurostat, ENTSO-E, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly generation and net imports are taken from ENTSO-E.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Macao

Sources

EIA, GEM

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM.
- Macao has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Madagascar

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Malawi

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Malaysia

Sources

EI, Grid System Operator (GSO), Department of Statistics Malaysia (eStatistik), EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI.
- Monthly generation and flows for Peninsular Malaysia are taken from GSO.
- Monthly total generation for Sabah and Sarawak is taken from eStatistik. This is disaggregated based on annual generation for these regions, also taken from eStatistik.
- Annual net imports are taken from the EIA.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Maldives

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

Mali

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Malta

Sources

Eurostat, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly generation is taken from Eurostat.
- Monthly net imports are taken from ENTSO-E.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Martinique

Sources

GEM, IRENA

Electricity Generation

- Annual electricity generation until 2021 is taken from IRENA.

Installed Capacity

- Other Fossil capacity is taken from GEM. All other capacity data is taken from IRENA.

Mauritania

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Mauritius

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Mexico

Sources

EIA, Centro Nacional de Control de Energía (CNCE), IEA, EI, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI. Annual net imports are taken from the EIA.
- Monthly generation data is taken from CNCE. Thermal generation is aggregated in this data, so is disaggregated based on ratios of fossil generation from IEA monthly generation data.

Installed Capacity

- Coal and Gas are taken from GEM. All other capacity data is taken from IRENA.

Moldova

Sources

EIA, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA. Eurostat data exists for this period, but differs from other sources due to the exclusion of generation originating in Transnistria.
- Monthly electricity generation and net imports are taken from ENTSO-E.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Moldova has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Mongolia

Sources

EIA, General Statistical Database Mongolia (GSDB), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly generation data is taken from GSDB. Thermal generation is reported aggregated, and is assumed to be Coal. Renewable generation is similarly aggregated, and is assumed to be Wind.
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Installed Capacity

- Coal capacity is taken from GEM. All other capacity is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be coal.

Montenegro

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E. Solar generation is taken from Eurostat.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity is taken from IRENA.

Montserrat

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Morocco

Sources

EIA, ENTSO-E, GEM, IRENA, Haut Commissariat au Plan (HCP)

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA. Unknown fossil generation reported by IRENA is assumed to be Hard Coal.
- Monthly electricity generation is taken from HCP. Fossil generation for this data is disaggregated using thermal ratios from capacity data.
- Monthly net imports are taken from ENTSO-E.

Installed Capacity

- Coal, Gas and Other Fossil are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Coal.

Mozambique

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity is taken from IRENA.
- Mozambique has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Myanmar

Sources

EIA, Myanmar Statistical Information Service (MMSIS), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly electricity generation is taken from MMSIS.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA.

Namibia

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity is taken from IRENA.

Nauru

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Nepal

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Netherlands

Sources

Eurostat, ENTSO-E, Statistics Netherlands (CBS), Nationaal Energie Dashboard (NED), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from Eurostat.
- Annual net imports are taken from ENTSO-E.
- Monthly generation data is taken from CBS until 2021. From 2022 onwards, hourly generation data from NED is aggregated to monthly generation.
- Monthly net imports are taken from ENTSO-E.

Installed Capacity

- Coal, Gas and Other Fossil capacity are from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Hard Coal.

New Caledonia

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

New Zealand

Sources

EIA, Electricity Authority Te Mana Hiko (EMI), GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.
- Monthly generation data is taken from EMI. This data doesn't include Solar generation.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Coal.

Nicaragua

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Other Fossil capacity is taken from GEM. All other capacity data is taken from IRENA.

Niger

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Nigeria

Sources

EIA, Transmission Company of Nigeria (TCN), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly generation is taken from TCN. All thermal power generation is assumed to be Gas. Distributed generation, including Solar, is not captured in monthly data.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA.

Niue

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

North Korea

Sources

EIA, Korean Statistical Information Service (KOSIS), IRENA

Electricity Generation

- Annual electricity generation from 2003 is taken from the KOSIS. Hydro and Coal data until 2002 is taken from IRENA. Other Fossil data until 2002 is taken from EIA.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Coal.

North Macedonia

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation is taken from Eurostat.
- Monthly net imports are taken from ENTSO-E.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Norway

Sources

Eurostat, ENTSO-E, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.

Oman

Sources

EIA, National Centre for Statistics and Information (NCSI), GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.
- Aggregated monthly electricity generation data is taken from NCSI. Thermal data is disaggregated with yearly generation data.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Oman has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Pakistan

Sources

EIA, National Electric Power Regulatory Authority (NEPRA), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly generation data is taken from NEPRA. Distributed Solar generation is not captured in these statistics and is estimated by Ember; detailed methodology here. Distributed fossil generation is also not captured.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Pakistan has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Palestine, State of

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- No fossil capacity data is available. All other capacity data is taken from IRENA.
- Palestine has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity ratios for these fuels may be imprecise.

Panama

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity is taken from IRENA.

Papua New Guinea

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil reported by IRENA is assumed to be Other Fossil.

Paraguay

Sources

EIA, IRENA, Sie Paraguay, Vice Ministry of Mines and Energy (SSME)

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly generation is taken from SSME. While Sie Paraguay reports disaggregated generation, it only provides this data for 2020 to 2022. For 2019 and 2023, we disaggregate total monthly electricity consumption carrying backwards the most recent data for Bioenergy and Other Fossil, and assuming the rest is Hydro. This assumption is feasible because Paraguay's Bioenergy and Other Fossil generation have remained stable over many years.

Installed Capacity

- All capacity data is taken from IRENA.

Peru

Sources

EIA, Comité de Operación Económica del Sistema Interconectado (COES), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly generation is taken from COES.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Philippines

Sources

EIA, National Grid Corporation of the Philippines (NGCP), GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.
- Monthly generation is taken from NGCP. Both "Biogas" and "Renewable (Biomass)" as reported from the source are classified as Bioenergy.

Installed Capacity

- Coal and Gas are taken from GEM. All other capacity data is taken from IRENA.

Poland

Sources

Eurostat, Instrat, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly generation and net imports are taken from ENTSO-E. Monthly solar generation until June2020 is taken from the electricity statistics provider ARE via Instrat, and ENTSO_E thereafter

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil reported by IRENA is assumed to be Hard Coal.

Portugal

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E. Solar generation is estimated by applying a scaling factor which is based on the monthly ratio of non-solar hour demand change to solar hour demand change. This scaling is to account for missing behind-the-meter solar.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Puerto Rico

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

- Monthly generation is taken from the EIA.

Installed Capacity

- Gas and Other Fossil capacity are taken from IRENA. All other capacity data is taken from IRENA.

Qatar

Sources

EIA, Planning and Statistics Authority (PSA), GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.
- Monthly electricity generation is taken from PSA. This data is not disaggregated; all generation is assigned to Gas.

Installed Capacity

- Gas capacity data is taken from GEM. All other capacity data is taken from IRENA.

Réunion

Sources

IRENA

Electricity Generation

- Annual electricity generation is taken from IRENA.

Installed Capacity

- All capacity data is taken from IRENA.

Romania

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.

- Monthly electricity generation and net imports are taken from ENTSO-E. Solar generation is estimated by applying a scaling factor which is based on the monthly ratio of non-solar hour demand change to solar hour demand change. This scaling is to account for missing behind-the-meter solar.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Hard Coal.

Russia

Sources

EI, EIA, Russian Power System Operator (SO-UPS), Rosstat, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI. Annual net imports are taken from the EIA.
- Monthly generation from 2019 to late 2022 is taken from SO-UPS. Monthly fossil generation data is disaggregated using ratios of fossil fuels from annual EI generation data. Data since is taken from Rosstat, with small scalings to match with SO-UPS.
- Monthly net imports are taken from ENTSO-E. Russian net imports therefore do not include trade with Asian countries.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Russia has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Rwanda

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Saint Helena, Ascension and Tristan da Cunha

Sources

EIA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- No capacity data is available.

Saint Kitts and Nevis

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Saint Lucia

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Saint Pierre and Miquelon

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Saint Vincent and the Grenadines

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Samoa

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Sâo Tome and Principe

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Saudi Arabia

Sources

EI, EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI. Annual net imports are taken from the EIA.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Saudi Arabia has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Senegal

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity is taken from IRENA.
- Senegal has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Serbia

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E, except for Wind which is only taken from ENTSO-E for 2023 onwards and Eurostat for previous years.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Hard Coal.
- Serbia has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Seychelles

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All other capacity data is taken from IRENA..

Sierra Leone

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Singapore

Sources

EIA, Energy Market Authority (EMA), Energy Market Company (EMC), Statistics Singapore, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation from 2003 is calculated by applying the annual power generation mix provided by EMA to gross annual power production data provided by Statistics Singapore. Annual net import data is from EMC. Data for 2000 - 2002 is taken from the EIA.
- Monthly generation data from 2009 is taken from EMA, with thermal data provided partially aggregated. Our fuel mapping excludes Bioenergy in monthly data, as this provides only a very small proportion of generation.
- Singapore established market arrangements for importing electricity in 2022. Net imports are taken from EMC.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

Slovakia

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E.

Installed Capacity

- Coal is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil reported by IRENA is assumed to be Gas.

Slovenia

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E. Solar generation is estimated by applying a scaling factor which is based on the monthly ratio of non-solar hour demand change to solar hour demand change. This scaling is to account for missing behind-the-meter solar.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil reported by IRENA is assumed to be Hard Coal.
- Slovenia has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Solomon Islands

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Somalia

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Other Fossil capacity is taken from GEM. All other capacity data is taken from IRENA.

South Africa

Sources

EI, EIA, Eskom, Statistics South Africa (STATSSA), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI. Annual net imports are taken from the EIA.
- Monthly generation data is taken from Eskom, with Solar generation estimated based on Eskom monthly distributed capacity data. Coal generation is underreported in Eskom data; load data from STATSSA is therefore used to adjust for the missing generation.
- Monthly net imports are taken from STATSSA.

Installed Capacity

- Coal, Gas and Other Fossil are from GEM. All other capacity data is taken from IRENA.

South Korea

Sources

EI, Korea Electric Power Corporation (KEPCO), GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from EI.
- Monthly generation data is taken from KEPCO.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil reported by IRENA is assumed to be Gas.

South Sudan

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Spain

Sources

Eurostat, ENTSO-E, Spanish System Operator Information System (eSIOS), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation is taken from ENTSO-E.
- Spanish import data is incomplete in ENTSO-E, as it does not include trade with non-EU countries such as Morocco. Monthly net imports are calculated from flow data taken from eSIOS.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Sri Lanka

Sources

IRENA, GEM

Electricity Generation

- Annual electricity generation is taken from IRENA.
- Unknown fossil generation reported by IRENA is assumed to be Other Fossil.

Installed Capacity

- Coal, Gas and Other Fossil are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.
- Sri Lanka has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Sudan

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Suriname

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Sweden

Sources

Eurostat, ENTSO-E, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from Eurostat.
- Monthly electricity generation and net imports are taken from ENTSO-E. ENTSO-E reported Other Fossil is mapped to Bioenergy.

Installed Capacity

- Coal and Gas are taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Switzerland

Sources

IRENA, EIA, Ministry of Energy (BfE), ENTSO-E

Electricity Generation and Net Imports

- Annual electricity generation is taken from IRENA.
- Annual net imports are taken from the EIA.
- Monthly electricity generation is taken from BfE, net imports are taken from ENTSO-E.

Installed Capacity

- All capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Other Fossil.

Syria

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal, Gas and Other Fossil are taken from GEM. All other capacity is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Syria has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Taiwan

Sources

EIA, Government of Taiwan, Bureau of Energy (MOEA) via E-Stat Dashboard, EI, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from EI.
- Monthly electricity generation is taken from MOEA.

Installed Capacity

- Coal and Gas capacity are from GEM. All other capacity data is taken from IRENA.

Tajikistan

Sources

EIA, Council Commonwealth of Independent States Electric Power Council (CIS), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Quarterly generation data and net imports are taken from CIS. Monthly generation and net imports are derived from monthly demand reported by CIS.

Installed Capacity

- Coal and Gas are taken from GEM. All other capacity data is taken from IRENA.
- Tajikistan has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Tanzania

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Thailand

Sources

EIA, Department of Alternative Energy Development and Efficiency (DEDE), Electricity Generating Authority of Thailand (EGAT), EI, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI. Annual net imports are taken from the EIA.
- Monthly generation data is taken from the DEDE and EGAT. EGAT covers all fossil and hydropower generation, but reports renewable generation as an aggregate. DEDE

breaks down renewables into Solar and Wind; we compare these values with EGAT total renewables to derive Bioenergy.
- Monthly net imports are taken from DEDE.

Installed Capacity

- Coal and Gas are taken from GEM. All other capacity is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Thailand has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Togo

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.
- Togo has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Tonga

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Trinidad and Tobago

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

Tunisia

Sources

EIA, Statistiques Tunisie, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly generation data is taken from Statistiques Tunisie monthly bulletins, which can be lagged by several months.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Tunisia has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Türkiye

Sources

Eurostat, Energy Exchange Istanbul (EPIAS), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation until 2018 and net imports are taken from Eurostat. From 2018 onwards, annual generation is the sum of monthly generation from EPIAS.
- Monthly generation and net imports are downloaded from EPIAS. Licensed and unlicensed generation data are combined.

Installed Capacity

- Coal, Gas and Other Fossil capacity are taken from GEM. All other capacity data is taken from IRENA.

Turkmenistan

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

Turks and Caicos Islands

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Other Fossil capacity is taken from IRENA. All other capacity data is taken from IRENA.

Uganda

Sources

EIA, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Other Fossil capacity is taken from IRENA. All other capacity data is taken from IRENA.

Ukraine

Sources

EI, ENTSO-E, UKRENERGO, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI.
- Ukraine reports electricity generation to UKRENERGO, and in early 2022 began reporting to ENTSO-E. Monthly net imports are taken from ENTSO-E. For security reasons, data has not been published since November 2022.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Hard Coal.
- Ukraine has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

United Arab Emirates

Sources

EIA, EI, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI.
- Annual net imports are taken from the EIA.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity is taken from IRENA.
- The UAE has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

United Kingdom

Sources

EI, Eurostat, Department for Energy Security and Net Zero (DESNZ), National Grid ESO (ESO), Elexon Balancing Mechanism Reporting Service (BMRS), University of Sheffield, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI. Wind generation is taken from DESNZ.
- Annual net imports are taken from Eurostat.
- Monthly generation data only covers Great Britain, and excludes Northern Ireland. It is taken from ESO, with Wind disaggregated into onshore and offshore based on BMRS and DESNZ, and Solar generation from Sheffield solar group. Captive and small thermal generation is excluded, which is significant for Bioenergy and Gas.
- Monthly net imports are taken from Elexon BMRS.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Hard Coal.

United States

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Monthly generation and net imports are taken from the EIA. The EIA reports monthly generation data in two separate datasets: Monthly data for all 50 states and monthly data for the lower 48 states (excludes Hawaii and Alaska). Data for all 50 states is reported on a 3 month lag whereas data for the lower 48 states is reported without lag. Missing months from the data for all 50 states is estimated using the recent changes observed in data from the lower 48 dataset.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity is taken from IRENA.
- The USA has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Uruguay

Sources

EIA, Usinas y Transmisiones Eléctricas (UTE), IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

- Monthly generation and net imports are taken from UTE.

Installed Capacity

- Gas and Other Fossil capacity are taken from IRENA. All other capacity is taken from IRENA.
- Uruguay has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Uzbekistan

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Gas.
- Uzbekistan has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Vanuatu

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Other Fossil capacity is taken from IRENA. All other capacity is taken from IRENA.

Venezuela

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.
- Gas may be overestimated, and Other Fossil underestimated, as the ratios used for disaggregation of fossil generation data are subject to poor data availability.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity is taken from IRENA.
- Venezuela has a significant proportion of co-firing Gas/Other Fossil capacity. As a result, our capacity figures for these fuels may be imprecise.

Viet Nam

Sources

EI, EIA, Viet Nam Electricity (EVN), GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation is taken from EI.
- Annual net imports are taken from the EIA.
- Monthly generation data is taken from the EVN, but is reported inconsistently, with substantial missing data, particularly between the months of November to January. Interpolation is therefore required to produce a monthly time series. This process produces adequate results for most fuel types, but wind data before 2022 should be treated with caution due to intermittent reporting.
- Monthly net imports cannot be calculated, and are assumed to be zero.

Installed Capacity

- Coal and Gas capacity are taken from GEM. All other capacity is taken from IRENA. Unknown fossil capacity reported by IRENA is assumed to be Coal.

Virgin Islands (British)

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Virgin Islands (U.S.)

Sources

EIA, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- All capacity data is taken from IRENA.

Western Sahara

Sources

EIA, GEM

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Other Fossil capacity is taken from GEM.

Yemen

Sources

EIA, GEM, IRENA

Electricity Generation

- Annual electricity generation is taken from the EIA.

Installed Capacity

- Gas capacity is taken from GEM. All other capacity data is taken from IRENA.

Zambia

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.

Zimbabwe

Sources

EIA, GEM, IRENA

Electricity Generation and Net Imports

- Annual electricity generation and net imports are taken from the EIA.

Installed Capacity

- Coal capacity is taken from GEM. All other capacity data is taken from IRENA.