RENEWABLES INFORMATION
2023 EDITION

Database documentation

This documentation provides support information for the IEA *Renewables Information* database. This document can be found online at: http://wds.iea.org/wds/pdf/ren_documentation.pdf.

Please address your inquiries to renewaq@iea.org.

Table of contents

Changes from last edition 4

Database structure 4

Flow definitions 7

Product definitions 27

Geographical coverage 34

Country notes and sources 47

Units and conversions 121

Abbreviations 127

Changes from last edition

Geographical coverage

Lithuania became an IEA member in February 2022. Accordingly, Lithuania is included in the IEA Total aggregate for data starting in 1990.

Latvia, which is currently seeking accession to full IEA membership (Accession country), and Kenya and Senegal which joined the IEA as Association countries in June 2023, are now included in the IEA and Accession/Association countries aggregate (IEAFAMILY) in the RENWORLDBAL.IVT and RENWORLDBES.IVT files.

Database structure

The database *Renewables Information* includes annual data for:

OECD and selected countries files

- countries: 38 OECD countries, 14 non-OECD countries
  and 7 regional aggregates (see section *Geographical coverage*);
- years: 1990-2021 (countries and regions)
  2022 (provisional energy supply and partial demand data)

RENOECDBAL.IVT OECD and selected countries, Renewables Balance
(GWh, TJ, ktoe)
Energy balances in matrix form (18 products; 78 flows)
Electricity and heat output by type of producer (10 flows)

RENOECDBES.IVT OECD and selected countries, Renewables Supply
and Consumption (GWh, TJ, kt)
Energy statistics in matrix form (36 products; 78 flows)
Electricity and heat output by type of producer (10 flows)

RENOECDCAP.IVT OECD and selected countries, Net Capacity –
Renewables (MW_e, m^2, MW_{th})
Electrical capacity in matrix form (20 products)
Solar collector surface and thermal capacity (2 products)

RENOECDEXP.IVT OECD and selected countries, Exports by destination (kt)
OECD member and selected countries' exports by destination in matrix form (165 country destinations)
Liquid biofuels and wood pellets (6 products)

RENOECDIMP.IVT OECD and selected countries, Imports by origin (kt)
OECD member and selected countries' imports by origin in matrix form (165 country origins)
Liquid biofuels and wood pellets (6 products)

WORLD files (Updated July 2023)

- countries: 153 countries and 22 regional aggregates (see section *Geographical coverage*);
- years: 1990-2021 (countries and regions)
  2022 (provisional energy supply and electricity generation for selected countries);

RENWORLDBAL.IVT WORLD, Renewables and Waste Energy Supply (GWh, TJ, ktoe)
Energy balances in matrix form
(153 countries + 22 aggregates; 18 products; 7 flows)
Electricity and heat output (2 flows)
This edition includes data through 2021 and provisional data for 2022.

RENWORLDBES.IVT WORLD, Renewables and Waste Statistics (GWh, TJ, kt)
Energy statistics in matrix form
(153 countries + 22 aggregates; 16 products; 7 flows)
Electricity and heat output (2 flows)
This edition includes data through 2021 and provisional data for 2022.

Data for 2022 are based on the official mini-questionnaire submissions of countries. However, some data have been estimated by the IEA Secretariat.

Differences may exist for OECD countries and aggregates between RENWORLDBAL and RENWORLDBES compared to RENOECDBAL and RENOECDBES in shared flows and the interactive specific information (such as country notes or product definitions) provided for each element. This also means that the information provided in this documentation may supersede the interactive information found in RENWORLDBAL and RENWORLDBES.

Flow definitions

OECD, Renewables Balance (ktoe): RENOECDBAL.IVT
WORLD, Renewables and Waste Energy Supply: RENWORLDBAL.IVT

Supply

Flow	Short name	Definition
Production	INDPROD	Comprises the production of primary energy, i.e. hard coal, lignite/brown coal, peat, crude oil, NGLs, natural gas, combustible renewables and waste, nuclear, hydro, geothermal, solar and the heat from heat pumps that is extracted from the ambient environment (only heat generated from heat pumps that is sold to third parties is included in the energy balance). Production is calculated after removal of impurities (e.g. sulphur from natural gas). Calculation of production of hydro, geothermal, etc. and nuclear electricity is explained in the section *Units and conversions*.
Imports	IMPORTS	Comprise amounts having crossed the national territorial boundaries of the country whether or not customs clearance has taken place.
Exports	EXPORTS	Comprise amounts having crossed the national territorial boundaries of the country whether or not customs clearance has taken place.
International marine bunkers	MARBUNK	Covers those quantities delivered to ships of all flags that are engaged in international navigation. The international navigation may take place at sea, on inland lakes and waterways, and in coastal waters. Consumption by ships engaged in domestic navigation is excluded. The domestic/international split is determined on the basis of port of departure and port of arrival, and not by the flag or nationality of the ship. Consumption by fishing vessels and by military forces is also excluded. See *domestic navigation*, *fishing* and *other non-specified*. *International marine bunkers* are excluded from the *supply* at the country and regional level, but not for world, where they are included in *transport* under *World marine bunkers*.
International aviation bunkers	AVBUNK	Includes deliveries of aviation fuels to aircraft for international aviation. Fuels used by airlines for their road vehicles are excluded. The domestic/international splits are determined on the basis of departure and landing locations and not by the nationality of the airline. For many countries this incorrectly excludes fuel used by domestically owned carriers for their international departures. *International aviation bunkers* are excluded from the *supply* at the country and regional level, but not for world, where they are included in *transport* under *World aviation bunkers.*

Flow	Short name	Definition
Stock changes	STOCKCHA	Reflects the difference between opening stock levels on the first day of the year and closing levels on the last day of the year of stocks on national territory held by producers, importers, energy transformation industries and large consumers. A stock build is shown as a negative number, and a stock draw as a positive number.
Total energy supply	TES	Total energy supply (TES) is made up of production + imports - exports - international marine bunkers – international aviation bunkers ± stock changes. For World, TES is defined as production + imports - exports ± stock changes. Note, exports, bunkers and stock changes incorporate the algebraic sign directly in the number. This flow was formerly known as “Total Primary Energy Supply”.
Transfers	TRANSFER	Comprises *interproduct transfers*, *products transferred* and *recycled products*. *Interproduct transfers* results from reclassification of products either because their specification has changed or because they are blended into another product, e.g. kerosene may be reclassified as gasoil after blending with the latter in order to meet its winter diesel specification. The net balance of *interproduct transfers* is zero. *Products transferred* is intended for oil products imported for further processing in refineries. For example, fuel oil imported for upgrading in a refinery is transferred to the feedstocks category. *Recycled products* are finished products which pass a second time through the marketing network, **after** having been once delivered to final consumers (e.g. used lubricants which are reprocessed).
Statistical differences	STATDIFF	Includes the sum of the unexplained statistical differences for individual fuels, as they appear in the basic energy statistics. It also includes the statistical differences that arise because of the variety of conversion factors in the coal and oil columns.

Transformation processes

Flow	Short name	Definition
Transformation processes	TOTTRANF	The transformation processes comprises the conversion of primary forms of energy to secondary and further transformation (e.g. coking coal to coke, crude oil to petroleum products, and heavy fuel oil to electricity).
Main activity producer electricity plants	MAINELEC	Refers to plants which are designed to produce electricity only. If one or more units of the plant is a CHP unit (and the inputs and outputs cannot be distinguished on a unit basis) then the whole plant is designated as a CHP plant. Main activity producers (formerly referred to as public supply undertakings) generate electricity for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.
Autoproducer electricity plants	AUTOELEC	Refers to plants which are designed to produce electricity only. If one or more units of the plant is a CHP unit (and the inputs and outputs cannot be distinguished on a unit basis) then the whole plant is designated as a CHP plant. Autoproducer undertakings generate electricity wholly or partly for their own use as an activity which supports their primary activity. They may be privately or publicly owned.
Main activity producer CHP plants	MAINCHP	Refers to plants which are designed to produce both heat and electricity (sometimes referred to as co-generation power stations). If possible, fuel inputs and electricity/heat outputs are on a unit basis rather than on a plant basis. However, if data are not available on a unit basis, the conventions for defining a CHP plant noted above are adopted. Main activity producers (formerly referred to as public supply undertakings) generate electricity and/or heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.
Autoproducer CHP plants	AUTOCHP	Refers to plants which are designed to produce both heat and electricity (sometimes referred to as co-generation power stations). If possible, fuel inputs and electricity/heat outputs are on a unit basis rather than on a plant basis. However, if data are not available on a unit basis, the conventions for defining a CHP plant noted above are adopted. Note that for autoproducer CHP plants, all fuel inputs to electricity production are taken into account, while only the part of fuel inputs to heat sold is shown. Fuel inputs for the production of heat consumed within the autoproducer's establishment are not included here but are included with figures for the final consumption of fuels in the appropriate consuming sector. Autoproducer undertakings generate electricity and/or heat, wholly or partly for their own use as an activity which supports their primary activity. They may be privately or publicly owned.
Main activity producer heat plants	MAINHEAT	Refers to plants (including heat pumps and electric boilers) designed to produce heat only and who sell heat to a third party (e.g. residential, commercial or industrial consumers) under the provisions of a contract. Main activity producers (formerly referred to as public supply undertakings) generate heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.

Flow	Short name	Definition
Autoproducer heat plants	AUTOHEAT	Refers to plants (including heat pumps and electric boilers) designed to produce heat only and who sell heat to a third party (e.g. residential, commercial or industrial consumers) under the provisions of a contract. Autoproducer undertakings generate heat, wholly or partly for their own use as an activity which supports their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.
Heat pumps	THEAT	Includes heat produced by heat pumps in the transformation processes. Heat pumps that are operated within the residential sector where the heat is not sold are not considered a transformation process and are not included here – the electricity consumption would appear as residential use.
Electric boilers	TBOILER	Includes electric boilers used to produce heat.
Chemical heat for electricity production	TELE	Includes heat from chemical processes that is used to generate electricity.
Blast furnaces	TBLASTFUR	Includes the production of town gas, blast furnace gas and oxygen steel furnace gas. The production of pig-iron from iron ore in blast furnaces uses fuels for supporting the blast furnace charge and providing heat and carbon for the reduction of the iron ore. Accounting for the calorific content of the fuels entering the process is a complex matter as transformation (into blast furnace gas) and consumption (heat of combustion) occur simultaneously. Some carbon is also retained in the pig-iron; almost all of this reappears later in the oxygen steel furnace gas (or converter gas) when the pig-iron is converted to steel. In the 1992/1993 annual questionnaires, Member Countries were asked for the first time to report in the *transformation processes* the quantities of all fuels (e.g. pulverised coal injection [PCI] coal, coke oven coke, natural gas and oil) entering blast furnaces and the quantity of blast furnace gas and oxygen steel furnace gas produced. The Secretariat then needed to split these inputs into the transformation and consumption components. The transformation component is shown in the row *blast furnaces* in the column appropriate for the fuel, and the consumption component is shown in the row *iron and steel*, in the column appropriate for the fuel. The Secretariat decided to assume transformation efficiency such that the carbon input into the blast furnaces should equal the carbon output. This is roughly equivalent to assuming an energy transformation efficiency of 40%.
Gas works	TGASWKS	Includes the manufacture of town gas. *Note: in the summary balances this item also includes other gases blended with natural gas (TBLENDGAS).*
Coke ovens	TCOKEOVS	Includes the manufacture of coke and coke oven gas.
Patent fuel plants	TPATFUEL	Includes the manufacture of patent fuels.
BKB plants/PB plants	TBKB	Includes the manufacture of BKB and peat briquettes.
Oil refineries	TREFINER	Includes the manufacture of finished petroleum products.
Petrochemical plants	TPETCHEM	Covers backflows returned from the petrochemical sector. Note that backflows from oil products that are used for non-energy purposes (i.e. white spirit and lubricants) are not included here, but in non-energy use.

Flow	Short name	Definition
Coal liquefaction plants	TCOALLIQ	Includes coal, oil and tar sands used to produce synthetic oil.
Gas-to-liquids (GTL) plants	TGTL	Includes natural gas used as feedstock for the conversion to liquids, e.g. the quantities of fuel entering the methanol product process for transformation into methanol.
For blended natural gas	TBLENDGAS	Includes other gases that are blended with natural gas.
Charcoal production plants	TCHARCOAL	Includes the transformation of solid biofuels into charcoal.
Non-specified (transformation)	TNONSPEC	Includes other non-specified transformation.

Energy industry and losses

Flow	Short name	Definition
Energy industry	TOTENGY	Energy industry own use covers the amount of fuels used by the energy producing industries (e.g. for heating, lighting and operation of all equipment used in the extraction process, for traction and for distribution). It includes energy consumed by energy industries for heating, pumping, traction and lighting purposes [ISIC Rev. 4 Divisions 05, 06, 19 and 35, Group 091 and Classes 0892 and 0721].
Coal mines	EMINES	Represents the energy which is used directly within the coal industry for hard coal and lignite mining. It excludes coal burned in pithead power stations (included under electricity plants in transformation processes) and free allocations to miners and their families (considered as part of household consumption and therefore included under *residential*).
Oil and gas extraction	EOILGASEX	Represents the energy which is used for oil and gas extraction. Flared gas is not included.
Blast furnaces	EBLASTFUR	Represents the energy which is used in blast furnaces.
Gas works	EGASWKS	Represents the energy which is used in gas works.
Gasification plants for biogases	EBIOGAS	Represents own consumption of biogases necessary to support temperatures needed for anaerobic fermentation.
Coke ovens	ECOKEOVS	Represents the energy used in coke ovens.
Patent fuel plants	EPATFUEL	Represents the energy used in patent fuel plants.
BKB plants/PB Plants	EBKB	Represents the energy used in BKB and peat briquette plants.
Oil refineries	EREFINER	Represents the energy used in oil refineries.
Coal liquefaction plants	ECOALLIQ	Represents the energy used in coal liquefaction plants.
Liquefaction (LNG) / regasification plants	ELNG	Represents the energy used in LNG and regasification plants.
Gas-to-liquids (GTL) plants	EGTL	Represents the energy used in gas-to-liquids plants.
Own use in electricity, CHP and heat plants	EPOWERPLT	Represents the energy used in main activity producer electricity, CHP and heat plants.
Used for pumped storage	EPUMPST	Represents electricity consumed in hydro-electric plants for pumped storage.
Nuclear industry	ENUC	Represents the energy used in the nuclear industry.
Charcoal production plants	ECHARCOAL	Represents the energy used in charcoal production plants.
Non-specified (energy)	ENONSPEC	Represents use in non-specified energy sector.
Losses	DISTLOSS	Losses in energy distribution, transmission and transport.

Final Consumption

Flow	Short name	Definition
Total final consumption	TFC	Equal to the sum of the consumption in the end-use sectors. Energy used for transformation processes and for own use of the energy producing industries is excluded. Final consumption reflects for the most part deliveries to consumers (see note on *stock changes*). Backflows from the petrochemical plants are not included in final consumption (see *from other sources* under supply and *petrochemical plants* in transformation). *Starting with the 2009 edition, international aviation bunkers is no longer included in final consumption at the country level.*
Industry	TOTIND	Industry consumption is specified as follows: (energy used for transport by industry is not included here but is reported under transport).
Mining and quarrying	MINING	[ISIC Divisions 07 and 08 and Group 099 (NACE Divisions 07 and 08 + Group 09.9)] Mining (excluding fuels) and quarrying.
Construction	CONSTRUC	[ISIC Division 41 and 43]
Manufacturing	MANUFACT	Manufacturing refers to the sum of the following industrial sub-sectors: Iron and Steel: Chemical and petrochemical: Non-ferrous metals Non-metallic minerals Transport equipment Machinery Food and tobacco Paper, pulp and printing Wood and wood products Textile and leather Definitions of the sub-sectors themselves can be found under the listing for each respective sub-sector below.
Iron and steel	IRONSTL	[ISIC Group 241 and Class 2431]
Chemical and petrochemical	CHEMICAL	[ISIC Division 20 and 21] Excluding petrochemical feedstocks.
Non-ferrous metals	NONFERR	[ISIC Group 242 and Class 2432] Basic industries.
Non-metallic minerals	NONMET	[ISIC Division 23] Such as glass, ceramic, cement, etc.
Transport equipment	TRANSEQ	[ISIC Divisions 29 and 30]
Machinery	MACHINE	[ISIC Divisions 25 to 28] Fabricated metal products, machinery and equipment other than transport equipment.
Food and tobacco	FOODPRO	[ISIC Divisions 10 to 12]
Paper, pulp and print	PAPERPRO	[ISIC Divisions 17 and 18]
Wood and wood products	WOODPRO	[ISIC Division 16] Wood and wood products other than pulp and paper.

Flow	Short name	Definition
Textile and leather	TEXTILES	[ISIC Divisions 13 to 15]
Non-specified (industry)	INONSPEC	Including but not limited to: [ISIC Divisions 22, 31 and 32] Any industry not included above. Note: Most countries have difficulties supplying an industrial breakdown for all fuels. In these cases, the *non-specified* industry row has been used. Regional aggregates of industrial consumption should therefore be used with caution.
Transport	TOTTRANS	Consumption in the transport sector covers all transport activity (in mobile engines) regardless of the economic sector to which it is contributing [ISIC Divisions 49 to 51], and is specified as follows:
Domestic aviation	DOMESAIR	Includes deliveries of aviation fuels to aircraft for domestic aviation - commercial, private, agricultural, etc. It includes use for purposes other than flying, e.g. bench testing of engines, but not airline use of fuel for road transport. The domestic/ international split is determined on the basis of departure and landing locations and not by the nationality of the airline. Note that this may include journeys of considerable length between two airports in a country (e.g. San Francisco to Honolulu). For many countries this incorrectly includes fuel used by domestically owned carriers for outbound international traffic.
Road	ROAD	Includes fuels used in road vehicles as well as agricultural and industrial highway use. Excludes military consumption as well as motor gasoline used in stationary engines and diesel oil for use in tractors that are not for highway use.
Rail	RAIL	Includes quantities used in rail traffic, including industrial railways.
Pipeline transport	PIPELINE	Includes energy used in the support and operation of pipelines transporting gases, liquids, slurries and other commodities, including the energy used for pump stations and maintenance of the pipeline. Energy for the pipeline distribution of natural or manufactured gas, hot water or steam (ISIC Division 35) from the distributor to final users is excluded and is reported in the *energy sector*, while the energy used for the final distribution of water (ISIC Division 36) to household, industrial, commercial and other users is included in *commercial/public services*. Losses occurring during the transport between distributor and final users are reported as *losses*.
Domestic navigation	DOMESNAV	Includes fuels delivered to vessels of all flags not engaged in international navigation (see *international marine bunkers*). The domestic/international split is determined on the basis of port of departure and port of arrival and not by the flag or nationality of the ship. Note that this may include journeys of considerable length between two ports in a country (e.g. San Francisco to Honolulu). Fuel used for ocean, coastal and inland fishing and military consumption are excluded.
Non-specified (transport)	TRNONSPE	Includes all transport not elsewhere specified. Note: *International marine bunkers* are shown in *Supply* and are not included in the transport sector as part of final consumption, except for the world total (see note on *supply*).

Flow	Short name	Definition
Residential	RESIDENT	Includes consumption by households, excluding fuels used for transport. Includes households with employed persons [ISIC Division 97] which is a small part of total residential consumption.
Commercial and public services	COMMPUB	[ISIC Divisions 33, 36-39, 45-47, 52, 53, 55-56, 58-66, 68-75, 77-82, 84 (excluding Class 8422), 85-88, 90-96 and 99]
Agriculture and forestry	AGRICULT	Includes deliveries to users classified as agriculture, hunting and forestry by the ISIC, and therefore includes energy consumed by such users whether for traction (excluding agricultural highway use), power or heating (agricultural and domestic) [ISIC Divisions 01 and 02].
Fishing	FISHING	Includes fuels used for inland, coastal and deep-sea fishing. Fishing covers fuels delivered to ships of all flags that have refuelled in the country (including international fishing) as well as energy used in the fishing industry [ISIC Division 03]. *Prior to last year, fishing was included with agriculture/forestry and this may continue to be the case for some countries*.
Final consumption not elsewhere specified	ONONSPEC	Includes all fuel use not elsewhere specified as well as consumption in the above-designated categories for which separate figures have not been provided. Military fuel use for all mobile and stationary consumption is included here (e.g. ships, aircraft, road and energy used in living quarters) regardless of whether the fuel delivered is for the military of that country or for the military of another country.

Electricity output (GWh)

Flow	Short name	Definition
Electricity output	ELOUTPUT	Shows the total number of GWh generated by power plants separated into electricity plants and CHP plants. Contrary to the *Basic Energy Statistics*, electricity production for hydro pumped storage is excluded.
Electricity output-main activity producer electricity plants	ELMAINE	Shows the total number of GWh generated by main activity producer electricity plants.
Electricity output-autoproducer electricity plants	ELAUTOE	Shows the total number of GWh generated by autoproducer electricity plants.
Electricity output-main activity producer CHP plants	ELMAINC	Shows the total number of GWh generated by main activity producer CHP plants.
Electricity output-autoproducer CHP plants	ELAUTOC	Shows the total number of GWh generated by autoproducer CHP plants.

Heat output (TJ)

Flow	Short name	Definition
Heat output	HEATOUT	Shows the total number of TJ generated by power plants separated into CHP plants and heat plants.
Heat output-main activity producer CHP plants	HEMAINC	Shows the total number of TJ generated by main activity producer CHP plants.
Heat output-autoproducer CHP plants	HEAUTOC	Shows the total number of TJ generated by autoproducer CHP plants.
Heat output-main activity producer heat plant	HEMAINH	Shows the total number of TJ generated by activity producer heat plant.
Heat output-autoproducer heat plants	HEAUTOH	Shows the total number of TJ generated by autoproducer heat plants.

OECD, Renewables Supply and Consumption : RENOECDBES.IVT
WORLD, Renewables and Waste Energy Statistics: RENWORLDBES.IVT

Supply

Flow	Short name	Definition
Production	INDPROD	Refers to the quantities of fuels extracted or produced, calculated after any operation for removal of inert matter or impurities (e.g. sulphur from natural gas). For “other hydrocarbons” (shown with crude oil), production includes synthetic crude oil (including mineral oil extracted from bituminous minerals such as oil shale and tar sands, etc.). Production of secondary oil products represents the gross refinery output. Secondary coal products and gases represent the output from coke ovens, gas works, blast furnaces and other transformation processes.
Imports	IMPORTS	Comprises amounts having crossed the national territorial boundaries of the country whether or not customs clearance has taken place.
Exports	EXPORTS	Comprises amounts having crossed the national territorial boundaries of the country whether or not customs clearance has taken place.
International marine bunkers	MARBUNK	Covers those quantities delivered to ships of all flags that are engaged in international navigation. The international navigation may take place at sea, on inland lakes and waterways, and in coastal waters. Consumption by ships engaged in domestic navigation is excluded. The domestic/international split is determined on the basis of port of departure and port of arrival, and not by the flag or nationality of the ship. Consumption by fishing vessels and by military forces is also excluded. See definitions of *transport*, *fishing*, and *other non-specified*. *International marine bunkers* are excluded from the *supply* at the country and regional level, but not for world, where they are included in *transport* under *World marine bunkers*.
International aviation bunkers	AVBUNK	Includes deliveries of aviation fuels to aircrafts for international aviation. Fuels used by airlines for their road vehicles are excluded. The domestic/international split is determined on the basis of departure and landing locations and not by the nationality of the airline. For many countries this incorrectly excludes fuel used by domestically owned carriers for their international departures. *International aviation bunkers* are excluded from the *supply* at the country and regional level, but not for world, where they are included in *transport* under *World aviation bunkers*.
Stock changes	STOCKCHA	Reflects the difference between opening stock levels on the first day of the year and closing levels on the last day of the year of stocks on national territory held by producers, importers, energy transformation industries and large consumers. Oil and gas stock changes in pipelines are not taken into account. With the exception of large users mentioned above, changes in final users' stocks are not taken into account. A stock build is shown as a negative number, and a stock draw as a positive number.

Flow	Short name	Definition
Domestic supply	DOMSUP	Defined as *production* + *from other sources* + *imports* - *exports* - *international marine bunkers* – *international aviation bunkers* ± *stock changes*. Note, exports, bunkers and stock changes incorporate the algebraic sign directly in the number.
Transfers	TRANSFER	Comprises *interproduct transfers*, *products transferred* and *recycled products*. *Interproduct transfers* results from reclassification of products either because their specification has changed or because they are blended into another product, e.g. kerosene may be reclassified as gasoil after blending with the latter in order to meet its winter diesel specification. The net balance of *interproduct transfers* is zero. *Products transferred* is intended for petroleum products imported for further processing in refineries. For example, fuel oil imported for upgrading in a refinery is transferred to the feedstocks category. *Recycled products* are finished products which pass a second time through the marketing network, **after** having been once delivered to final consumers (e.g. used lubricants which are reprocessed).
Statistical differences	STATDIFF	Defined as deliveries to *final consumption* + use for *transformation* and consumption within the *energy industry* + *losses* - *domestic supply* - *transfers*. Statistical differences arise because the data for the individual components of supply are often derived from different data sources by the national administration. Furthermore, the inclusion of changes in some large consumers' stocks in the supply part of the balance introduces distortions which also contribute to the statistical differences.

Transformation processes

Flow	Short name	Definition
Transformation processes	TOTTRANF	The transformation processes comprises the conversion of primary forms of energy to secondary and further transformation (e.g. coking coal to coke, crude oil to petroleum products, and heavy fuel oil to electricity).
Main activity producer electricity plants	MAINELEC	Refers to plants which are designed to produce electricity only. If one or more units of the plant is a CHP unit (and the inputs and outputs cannot be distinguished on a unit basis) then the whole plant is designated as a CHP plant. Main activity producers (formerly referred to as public supply undertakings) generate electricity for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.
Autoproducer electricity plants	AUTOELEC	Refers to plants which are designed to produce electricity only. If one or more units of the plant is a CHP unit (and the inputs and outputs cannot be distinguished on a unit basis) then the whole plant is designated as a CHP plant. Autoproducer undertakings generate electricity wholly or partly for their own use as an activity which supports their primary activity. They may be privately or publicly owned.
Main activity producer CHP plants	MAINCHP	Refers to plants which are designed to produce both heat and electricity (sometimes referred to as co-generation power stations). If possible, fuel inputs and electricity/heat outputs are on a unit basis rather than on a plant basis. However, if data are not available on a unit basis, the convention for defining a CHP plant noted above should be adopted. Main activity producers (formerly referred to as public supply undertakings) generate electricity and/or heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.
Autoproducer CHP plants	AUTOCHP	Refers to plants which are designed to produce both heat and electricity (sometimes referred to as co-generation power stations). If possible, fuel inputs and electricity/heat outputs are on a unit basis rather than on a plant basis. However, if data are not available on a unit basis, the convention for defining a CHP plant noted above should be adopted. Note that for autoproducer CHP plants, all fuel inputs to electricity production are taken into account, while only the part of fuel inputs to heat sold is shown. Fuel inputs for the production of heat consumed within the autoproducer's establishment are not included here but are included with figures for the final consumption of fuels in the appropriate consuming sector. Autoproducer undertakings generate electricity and/or heat, wholly or partly for their own use as an activity which supports their primary activity. They may be privately or publicly owned.
Main activity producer heat plants	MAINHEAT	Refers to plants (including heat pumps and electric boilers) designed to produce heat only and who sell heat to a third party (e.g. residential, commercial or industrial consumers) under the provisions of a contract. Main activity producers (formerly referred to as public supply undertakings) generate heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.

Flow	Short name	Definition
Autoproducer heat plants	AUTOHEAT	Refers to plants (including heat pumps and electric boilers) designed to produce heat only and who sell heat to a third party (e.g. residential, commercial or industrial consumers) under the provisions of a contract. Autoproducer undertakings generate heat, wholly or partly for their own use as an activity which supports their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.
Heat pumps	THEAT	Includes heat produced by heat pumps in the transformation processes. Heat pumps that are operated within the residential sector where the heat is not sold are not considered a transformation process and are not included here – the electricity consumption would appear as residential use.
Electric boilers	TBOILER	Includes electric boilers used to produce heat.
Chemical heat for electricity production	TELE	Includes heat from chemical processes that is used to generate electricity.
Blast furnaces	TBLASTFUR	Includes the production of recovered gases (e.g. blast furnace gas and oxygen steel furnace gas). The production of pig-iron from iron ore in blast furnaces uses fuels for supporting the blast furnace charge and providing heat and carbon for the reduction of the iron ore. Accounting for the calorific content of the fuels entering the process is a complex matter as transformation (into blast furnace gas) and consumption (heat of combustion) occur simultaneously. Some carbon is also retained in the pig-iron; almost all of this reappears later in the oxygen steel furnace gas (or converter gas) when the pig-iron is converted to steel. In the 1992/1993 annual questionnaires, Member Countries were asked for the first time to report in the *transformation processes* the quantities of all fuels (e.g. pulverised coal injection [PCI] coal, coke oven coke, natural gas and oil) entering blast furnaces and the quantity of blast furnace gas and oxygen steel furnace gas produced. The Secretariat then needed to split these inputs into the transformation and consumption components. The transformation component is shown in the row *blast furnaces* in the column appropriate for the fuel, and the consumption component is shown in the row *iron and steel*, in the column appropriate for the fuel. The Secretariat decided to assume a transformation efficiency such that the carbon input into the blast furnaces should equal the carbon output. This is roughly equivalent to assuming an energy transformation efficiency of 40%.
Gas works	TGASWKS	Includes the quantities of fuels used for the production of town gas.
Coke ovens	TCOKEOVS	Includes the use of fuels for the manufacture of coke and coke oven gas.
Patent fuel plants	TPATFUEL	Includes the use of fuels for the manufacture of patent fuels
BKB plants/PB plants	TBKB	Includes the use of fuels for the manufacture of BKB and peat briquettes.
Oil refineries	TREFINER	Includes the manufacture of finished petroleum products.

Flow	Short name	Definition
Petrochemical plants	TPETCHEM	Includes backflows returned from the petrochemical sector. Note that backflows from oil products that are used for non-energy purposes (i.e. white spirit and lubricants) are not included here, but in non-energy use.
Coal liquefaction plants	TCOALLIQ	Includes coal, oil and tar sands used to produce synthetic oil.
Gas-to-liquids (GTL) plants	TGTL	Includes natural gas used as feedstock for the conversion to liquids, e.g. the quantities of fuel entering the methanol product process for transformation into methanol.
For blended natural gas	TBLENDGAS	Includes other gases that are blended with natural gas.
Charcoal production plants	TCHARCOAL	Includes the transformation of primary solid biofuels into charcoal.
Non-specified (transformation) in the detailed balances	TNONSPEC	Includes other non-specified transformation.

Energy industry and losses

Flow	Short name	Definition
Energy industry	TOTENGY	The energy industry covers the amount of fuels used by the energy producing industries (e.g. for heating, lighting and operation of all equipment used in the extraction process, for traction and for distribution). Energy producing industries' own use includes energy consumed by transformation industries for heating, pumping, traction and lighting purposes [ISIC Rev. 4 Divisions 05, 06, 19 and 35, Group 091 and Classes 0892 and 0721].
Coal mines	EMINES	Represents the energy which is used directly within the coal industry for hard coal and lignite mining. It excludes coal burned in pithead power stations (included under electricity plants in the transformation processes) and free allocations to miners and their families (considered as part of household consumption and therefore included under residential).
Oil and gas extraction	EOILGASEX	Represents the energy which is used for oil and gas extraction. Flared gas is not included.
Blast furnaces	EBLASTFUR	Represents the energy which is used in blast furnaces.
Gas works	EGASWKS	Represents the energy which is used in gas works.
Gasification plants for biogases	EBIOGAS	Represents own consumption of biogases necessary to support temperatures needed for anaerobic fermentation.
Coke ovens	ECOKEOVS	Represents the energy used in coke ovens.
Patent fuel plants	EPATFUEL	Represents the energy used in patent fuel plants.
BKB plants	EBKB	Represents the energy used in BKB and peat briquette plants.
Oil refineries	EREFINER	Represents the energy used in Oil refineries.
Coal liquefaction plants	ECOALLIQ	Represents the energy used in coal liquefaction plants.
Liquefaction (LNG) / regasification plants	ELNG	Represents the energy used in LNG and regasification plants.
Gas-to-liquids (GTL) plants	EGTL	Represents the energy used in gas-to-liquids plants.
Own use in electricity, CHP and heat plants	EPOWERPLT	Represents the energy used in main activity producer electricity, CHP and heat plants.
Pumped storage plants	EPUMPST	Represents electricity consumed in hydro-electric plants for pumped storage.
Nuclear industry	ENUC	Represents the energy used in the nuclear industry.
Charcoal production plants	ECHARCOAL	Represents the energy used in charcoal production plants.
Non-specified (energy)	ENONSPEC	Represents use in non-specified energy sector.
Losses	DISTLOSS	Losses in energy distribution, transmission and transport.

Final consumption

Flow	Short name	Definition
Final consumption	FINCONS	Equal to the sum of the consumption in the end-use sectors. Energy used for transformation and for own use of the energy producing industries is excluded. Final consumption reflects for the most part deliveries to consumers (see note on *stock changes*). Backflows from the petrochemical plants are not included in final consumption (see *from other sources* under supply and *petrochemical plants* in the transformation processes). *Starting with the 2009 edition, international aviation bunkers is no longer included in final consumption at the country level.*
Industry	TOTIND	Consumption of the industry sector is specified in the following sub-sectors (energy used for transport by industry is not included here but is reported under transport):
Mining and quarrying	MINING	[ISIC Divisions 07 and 08 and Group 099 (NACE Divisions 07 and 08 + Group 09.9)] Mining (excluding fuels) and quarrying.
Construction	CONSTRUC	[ISIC and NACE Rev.4 Division 41 to 43]
Manufacturing	MANUFACT	Manufacturing refers to the sum of the following industrial sub-sectors: • Iron and Steel: • Chemical and petrochemical: • Non-ferrous metals • Non-metallic minerals • Transport equipment • Machinery • Food and tobacco • Paper, pulp and printing • Wood and wood products • Textile and leather Definitions of the sub-sectors themselves can be found under the listing for each respective sub-sector below.
Iron and steel	IRONSTL	[ISIC Group 241 and Class 2431]
Chemical and petrochemical	CHEMICAL	[ISIC Division 20 and 21] Excluding petrochemical feedstocks.
Non-ferrous metals	NONFERR	[ISIC Group 242 and Class 2432] Basic industries.
Non-metallic minerals	NONMET	[ISIC Division 23] Such as glass, ceramic, cement, etc.
Transport equipment	TRANSEQ	[ISIC Divisions 29 and 30]
Machinery	MACHINE	[ISIC Divisions 25 to 28] Fabricated metal products, machinery and equipment other than transport equipment.
Food and tobacco	FOODPRO	[ISIC Divisions 10 to 12]
Paper, pulp and print	PAPERPRO	[ISIC Divisions 17 and 18]
Wood and wood products	WOODPRO	[ISIC Division 16] Wood and wood products other than pulp and paper.
Textile and leather	TEXTILES	[ISIC Divisions 13 to 15]

Flow	Short name	Definition
Non-specified (industry)	INONSPEC	Including but not limited to: [ISIC Divisions 22, 31 and 32] Any industry not included above. Note: Most countries have difficulties supplying an industrial breakdown for all fuels. In these cases, the *non-specified* industry row has been used. Regional aggregates of industrial consumption should therefore be used with caution.
Transport	TOTTRANS	Consumption in the transport sector covers all transport activity (in mobile engines) regardless of the economic sector to which it is contributing [ISIC Divisions 49 to 51], and is specified as follows:
Domestic aviation	DOMESAIR	Includes deliveries of aviation fuels to aircraft for domestic aviation - commercial, private, agricultural, etc. It includes use for purposes other than flying, e.g. bench testing of engines, but not airline use of fuel for road transport. The domestic/ international split should be determined on the basis of departure and landing locations and not by the nationality of the airline. Note that this may include journeys of considerable length between two airports in a country (e.g. San Francisco to Honolulu). For many countries this incorrectly includes fuel used by domestically owned carriers for outbound international traffic;
Road	ROAD	Includes fuels used in road vehicles as well as agricultural and industrial highway use. Excludes military consumption as well as motor gasoline used in stationary engines and diesel oil for use in tractors that are not for highway use;
Rail	RAIL	Includes quantities used in rail traffic, including industrial railways;
Pipeline transport	PIPELINE	Includes energy used in the support and operation of pipelines transporting gases, liquids, slurries and other commodities, including the energy used for pump stations and maintenance of the pipeline. Energy for the pipeline distribution of natural or manufactured gas, hot water or steam (ISIC Division 35) from the distributor to final users is excluded and should be reported in the *energy sector*, while the energy used for the final distribution of water (ISIC Division 36) to household, industrial, commercial and other users should be included in *commercial/ public services*. Losses occurring during the transport between distributor and final users should be reported as *losses*;
Domestic navigation	DOMESNAV	Includes fuels delivered to vessels of all flags not engaged in international navigation (see *international marine bunkers*). The domestic/international split should be determined on the basis of port of departure and port of arrival and not by the flag or nationality of the ship. Note that this may include journeys of considerable length between two ports in a country (e.g. San Francisco to Honolulu). Fuel used for ocean, coastal and inland fishing and military consumption are excluded;
Non-specified (transport)	TRNONSPE	Includes all transport not elsewhere specified. Note: *International marine bunkers* are shown in *Supply* and are not included in the transport sector as part of final consumption.
Residential	RESIDENT	Includes consumption by households, excluding fuels used for transport. Includes households with employed persons [ISIC Division 97 and 98], which is a small part of total residential consumption.

Flow	Short name	Definition
Commercial and public services	COMMPUB	[ISIC Divisions 33, 36-39, 45-47, 52, 53, 55-56, 58-66, 68-75, 77-82, 84 (excluding Class 8422), 85-88, 90-96 and 99]
Agriculture/forestry	AGRICULT	Includes deliveries to users classified as agriculture, hunting and forestry by the ISIC, and therefore includes energy consumed by such users whether for traction (excluding agricultural highway use), power or heating (agricultural and domestic) [ISIC Divisions 01 and 02].
Fishing	FISHING	Includes fuels used for inland, coastal and deep-sea fishing. Fishing covers fuels delivered to ships of all flags that have refuelled in the country (including international fishing) as well as energy used in the fishing industry [ISIC Division 03]. Prior to 2007 edition, fishing was included with agriculture/forestry and this may continue to be the case for some countries.
Final consumption not elsewhere specified	ONONSPEC	Includes all fuel use not elsewhere specified as well as consumption in the above-designated categories for which separate figures have not been provided. Military fuel use for all mobile and stationary consumption is included here (e.g. ships, aircraft, road and energy used in living quarters) regardless of whether the fuel delivered is for the military of that country or for the military of another country.

Electricity output (GWh)

Flow	Short name	Definition
Electricity output	ELOUTPUT	Shows the total number of GWh generated by power plants separated into electricity plants and CHP plants.
Electricity output-main activity producer electricity plants	ELMAINE	Shows the total number of GWh generated by main activity producer electricity plants.
Electricity output-autoproducer electricity plants	ELAUTOE	Shows the total number of GWh generated by autoproducer electricity plants.
Electricity output-main activity producer CHP plants	ELMAINC	Shows the total number of GWh generated by main activity producer CHP plants.
Electricity output-autoproducer CHP plants	ELAUTOC	Shows the total number of GWh generated by autoproducer CHP plants.

Heat output (TJ)

Flow	Short name	Definition
Heat output	HEATOUT	Shows the total amount of TJ generated by power plants separated into CHP plants and heat plants.
Heat output-main activity producer CHP plants	HEMAINC	Shows the total amount of TJ generated by main activity producer CHP plants.
Heat output-autoproducer CHP plants	HEAUTOC	Shows the total amount of TJ generated by auto-producer CHP plants.
Heat output-main activity producer heat plants	HEMAINH	Shows the total amount of TJ generated by main activity producer heat plants.
Heat output-autoproducer heat plants	HEAUTOH	Shows the total amount of TJ generated by autoproducer heat plants.

Product definitions

Biofuels and Waste

Product	Short name	Definition
Industrial waste	INDWASTE	Industrial waste of non-renewable origin consists of solid and liquid products (e.g. tyres) combusted directly, usually in specialised plants, to produce heat and/or power. Renewable industrial waste is not included here, but with solid biofuels, biogas or liquid biofuels.
Municipal waste	MUNWASTE	Municipal waste consists of products that are combusted directly to produce heat and/or power and comprises wastes produced by households, industry, hospitals and the tertiary sector that are collected by local authorities for incineration at specific installations. Municipal waste is split into renewable and non-renewable.
Municipal waste (renewable)	MUNWASTER	The renewable part of municipal waste.
Municipal waste (non-renewable)	MUNWASTEN	The non-renewable part of municipal waste.
Solid biofuels (excluding charcoal)	PRIMSBIO	Solid biofuels are defined as any plant matter used directly as fuel or converted into other forms before combustion. This covers a multitude of woody materials generated by industrial process or provided directly by forestry and agriculture (firewood, wood chips, bark, sawdust, shavings, chips, sulphite lyes *also known as black liquor*, animal materials/wastes, industrial waste (renewable) and other solid biofuels). This category excludes charcoal. Note that for biofuels, only the amounts of biomass specifically used for energy purposes (a small part of the total) are included in the energy statistics. Therefore, the non-energy use of biomass is not taken into consideration and the quantities are null by definition.
Fuelwood, wood residues and by-products	WOODETC	Fuelwood or firewood (in log, brushwood, pellet or chip form) obtained from natural or managed forests or isolated trees. Also included are wood residues used as fuel and in which the original composition of wood is retained. Charcoal and black liquor are excluded.
Memo: wood pellets	PELLETS	Wood pellets are a cylindrical product which has been agglomerated from wood residues by compression with or without the addition of a small quantity of binder. The pellets have a diameter not exceeding 25 mm and a length not exceeding 45 mm.
Black liquor	BLACKLIQ	Energy from the alkaline-spent liquor obtained from the digesters during the production of sulphate or soda pulp required for paper manufacture.
Bagasse	BAGASSE	Fuel obtained from the fibre which remains after juice extraction in sugar cane processing.

Product	Short name	Definition
Animal waste	ANIMALW	Energy from excreta of animals, meat and fish residues which, when dry, are used directly as a fuel. This excludes waste used in anaerobic fermentation plants. Fuel gases from these plants are included under biogases.
Industrial waste (renewable)	INDWASTER	Solid renewable portion of industrial waste combusted directly at specific installations for meaningful energy purposes (for example natural rubber in waste rubber tires or natural fibres in textile wastes). The quantity of fuel used is reported on a net calorific value basis. Note that the liquid or gaseous portions of industrial wastes (renewable) are included under liquid biofuels or biogases, respectively.
Other vegetal materials and residuals	OBIOSOL	Biofuels not specified elsewhere and including straw, vegetable husks, ground nut shells, pruning brushwood, olive pomace and other wastes arising from the maintenance, cropping and processing of plants.
Charcoal	CHARCOAL	Covers the solid residue of the destructive distillation and pyrolysis of wood and other vegetal material. Since charcoal is a secondary product, its treatment is slightly different than that of the other primary biofuels. Production of charcoal (an output in the transformation process) is offset by the inputs of primary biofuels into the charcoal production process. The losses from this process are included in the transformation processes. Other supply (e.g. trade and stock changes) as well as consumption are aggregated directly with the primary biofuels. In some countries, only primary biofuels are reported.
Biogases	BIOGASES	Biogases are gases arising from the anaerobic fermentation of biomass and the gasification of solid biomass (including biomass in wastes). The biogases from anaerobic fermentation are composed principally of methane and carbon dioxide and comprise landfill gas, sewage sludge gas and other biogases from anaerobic fermentation. Biogases can also be produced from thermal processes (by gasification or pyrolysis) of biomass and are mixtures containing hydrogen and carbon monoxide (usually known as syngas) along with other components. These gases may be further processed to modify their composition and can be further processed to produce substitute natural gas. Biogases are used mainly as a fuel but can be used as a chemical feedstock.
Landfill gas	LANDFILL	Covers gas formed by digestion of landfilled waste.
Sludge gas	SLUDGEGS	Covers gas produced from the anaerobic fermentation of sewage sludge.
Other biogases from anaerobic processes	OBIOGAS	Covers gases such as biogases produced from the anaerobic fermentation of animal slurries and of waste abattoirs, breweries and other agro-food industries.
Biogases from thermal processes	BGTHERM	Biogases produced from thermal processes (by gasification or pyrolysis) of biomass.

Product	Short name	Definition
Biogasoline	BIOGASOL	Biogasoline includes bioethanol (ethanol produced from biomass and/or the biodegradable fraction of waste), biomethanol (methanol produced from biomass and/or the biodegradable fraction of waste), bioETBE (ethyl-tertio-butyl-ether produced on the basis of bioethanol; the percentage by volume of bioETBE that is calculated as biofuel is 47%) and bioMTBE (methyl-tertio-butyl-ether produced on the basis of biomethanol: the percentage by volume of bioMTBE that is calculated as biofuel is 36%). Biogasoline includes the amounts that are blended into the gasoline – it does not include the total volume of gasoline into which the biogasoline is blended.
Memo: bioethanol	MBIOETHANL	Bioethanol portion of biogasoline. Generally, ethanol produced from biomass and/or the biodegradable fraction of waste.
Biodiesels	BIODIESEL	Biodiesels includes biodiesel (a methyl-ester produced from vegetable or animal oil, of diesel quality), biodimethylether (dimethylether produced from biomass), Fischer Tropsch (Fischer Tropsch produced from biomass), cold pressed bio-oil (oil produced from oil seed through mechanical processing only) and all other liquid biofuels which are added to, blended with or used straight as transport diesel. Biodiesels includes the amounts that are blended into the diesel – it does not include the total volume of diesel into which the biodiesel is blended.
Bio Jet Kerosene	BIOJETKERO	Liquid biofuels suitable to be blended with or replace jet kerosene from fossil origin.
Other liquid biofuels	OBIOLIQ	Liquid biofuels not included in either biodiesel or biogasoline.
Total all energy sources	TOTAL	Total of all energy sources includes coal, oil, gas, renewables and waste, electricity, heat and others.

Electricity and Heat

Flow	Short name	Definition
Hydro	HYDRO	Hydro power represents the potential and kinetic energy of water converted into electricity in hydroelectric plants. In **RENOECDBAL** and **RENWORLDBAL** – Electricity production from pumped storage is not included in the energy balance. In **RENOECDBES** and **RENWORLDBES** - Electricity production from pumped storage is included. In **RENOECDCAP** - Electric capacity from all pumped storage is included. This should be equal to the sum of pure hydro, mixed hydro and pure pumped hydro, but sometimes these categories are not available in some countries, so care should be taken when comparing the sum of pure hydro, mixed hydro and pure pumped hydro to hydro.
Pure hydro	HYDPURE	Pure hydro plants that only use direct natural water inflow and have no capacity for hydro pump storage (pumping water uphill).
of which: run-of-river	HYDPURER	In pure hydro plants, the portion of electricity generation where the natural flow and elevation drop of a river are used.
Mixed hydro	HYDMIXED	Mixed hydro plants have natural water inflow into an upper reservoir where part or all equipment can be used for pumping water uphill; the electricity generated is a consequence of both natural water inflow and water previously pumped uphill.
of which: pumping	HYDMIXEDP	In mixed hydro plants, the portion of electricity generated in pumped hydro mode.
Pure pumped hydro	HYDPUMP	Pure pumped storage plants with no natural inflow, producing electricity only from water previously pumped uphill.
Geothermal	GEOTHERM	Geothermal energy is the energy available as heat emitted from within the earth's crust, usually in the form of hot water or steam. It is exploited at suitable sites: for electricity generation using dry stream or high enthalpy brine after flashing directly as heat for district heating, agriculture, etc.
Solar photovoltaic	SOLARPV	Electricity from photovoltaic cells.
Solar thermal	SOLARTH	Solar energy is the solar radiation exploited for hot water production and electricity generation, by: • flat plate collectors, mainly of the thermosiphon type, for domestic hot water or for the seasonal heating of swimming pools • solar thermal-electric plants Passive solar energy for the direct heating, cooling and lighting of dwellings or other buildings is not included.
Tide, wave and ocean	TIDE	Tide, wave and ocean category represents the mechanical energy derived from tidal movement, wave motion or ocean current and exploited for electricity generation.

Flow	Short name	Definition
Wind	WIND	Wind energy represents the kinetic energy of wind exploited for electricity generation in wind turbines. Care should be taken when comparing the sum of onshore wind and offshore wind to wind for product, flow or country aggregates due to the lack of data availability for both onshore and offshore wind for all countries and flows.
Onshore wind	WINDON	Production of electricity by wind in locations offshore. Care should be taken when comparing the sum of onshore wind and offshore wind to wind for product, flow or country aggregates due to the lack of data availability for both onshore and offshore wind for all countries and flows.
Offshore wind	WINDOFF	Production of electricity by wind in locations offshore (e.g. sea, ocean and artificial islands). In relation to offshore wind production outside of the territorial waters of the concerned territory, all installations located in the exclusive economic zone of a country shall be taken into account. Care should be taken when comparing the sum of onshore wind and offshore wind to wind for product, flow or country aggregates due to the lack of data availability for both onshore and offshore wind for all countries and flows.

Net Capacity - Renewables (MW_e): RENOECDCAP.IVT

Renewable Capacity

Flow	Short name	Definition
Total capacity (MWe)	TOTALCAP	The net maximum capacity is the maximum active power that can be supplied, continuously, with all plant running, at the point of outlet (i.e. after taking the power supplies for the station auxiliaries and allowing for the losses in those transformers considered integral to the station). This assumes no restriction of interconnection to the network. The net maximum electricity-generating capacity represents the sum of all individual plants' maximum capacities available to run continuously throughout a prolonged period of operation in a day. The reported figures relate to the maximum capacities on 31st of December (except for some fiscal year exceptions, see geographical coverage and country notes) and are expressed in megawatts (MW). The reported electrical capacity includes both electricity (only) and CHP plants.
Hydro	HYDRO	This should be equal to the sum of the electrical capacities of pure hydro, mixed hydro and pure pumped hydro, but sometimes these categories are not available in some countries and only hydro is reported, so care should be taken when comparing the sum of pure hydro, mixed hydro and pure pumped hydro to hydro.
Pure hydro	HYDPURE	Is equal to the electrical capacity of pure hydro plants.
of which: run-of-river	HYDPURER	Is equal to the electrical capacity of pure hydro, of which: run-of-river plants.
Mixed hydro	HYDMIXED	Is equal to the electrical capacity of mixed hydro plants.
Pure pumped storage	HYDPUMP	Is equal to the electrical capacity of pure pumped hydro plants.
Geothermal	GEOTHERM	Is equal to the electrical capacity of geothermal plants.
Solar photovoltaic	SOLARPV	Is equal to the electrical capacity of solar photovoltaic plants.
Solar thermal	SOLARTH	Is equal to the electrical capacity of solar thermal plants.
Tide, wave and ocean	TIDE	Is equal to the electrical capacity of tide, wave and ocean plants.
Wind	WIND	Is equal to the electrical capacity of wind energy.
Onshore wind	WINDON	Is equal to the electrical capacity of onshore wind energy.
Offshore wind	WINDOFF	Is equal to the electrical capacity of offshore wind energy.
Industrial waste	INDWASTE	Is equal to the electrical capacity of industrial waste plants.
Municipal waste	MUNWASTE	Includes the electrical capacity of renewable municipal waste and non-renewable municipal waste plants.
Solid biofuels	SBIOMASS	Is equal to the electrical capacity of primary solid biofuels plants.

Flow	Short name	Definition
Biogases	BIOGASES	Is equal to the electrical capacity of plants running on landfill gas, sludge gas, and other biogases from anaerobic and thermal processes.
Biodiesel	BIODIESEL	Is equal to the electrical capacity of biodiesel plants.
Biogasoline	BIOGASOL	Is equal to the electrical capacity of biogasoline plants.
Other liquid biofuels	OBIOLIQ	Is equal to the electrical capacity of liquid biofuels plants, not included in biodiesels plants.
Solar collector surface (1000 m^2)	SOLARSUR	Accumulated surface area of all solar collectors; glazed and unglazed collectors, flat-plate and vacuum tube with a liquid or air as the energy carrier, in 1000 m^2.
Cap. of solar collectors (MW_{th})	SOLARTHSQ	Converted at 0.7 kWth/m^2 of solar collector area, as estimated by the IEA Solar Heating & Cooling Programme.

Geographical coverage

Geographical divisions

This document is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Country/Region	Short name	Definition
Australia	AUSTRALI	Excludes the overseas territories. Data are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 July Y-1 and ends on 30 June Y are labelled as year Y.
Austria	AUSTRIA	
Belgium	BELGIUM	
Canada	CANADA	
Chile	CHILE	Chile is currently seeking accession to full IEA membership (Accession country), therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for the entire time series.
Colombia	COLOMBIA	Colombia joined the OECD in April 2020; data are now included in the OECD aggregates. Colombia is currently seeking accession to full IEA membership (Accession country), therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for the entire time series.
Costa Rica	COSTARICA	Costa Rica joined the OECD in May 2021; data are now included in the applicable OECD aggregates.
Czech Republic	CZECH	
Denmark	DENMARK	Excludes Greenland and the Faroe Islands.
Estonia	ESTONIA	Estonia joined the IEA in May 2014. Data are included starting in 1990.
Finland	FINLAND	
France	FRANCE	From 2011 data onwards, France now includes Monaco, and the following overseas departments (Guadeloupe; French Guiana; Martinique; Mayotte; and Réunion); and excludes the overseas collectivities (New Caledonia; French Polynesia; Saint Barthélemy; Saint Martin; Saint Pierre and Miquelon; and Wallis and Futuna). Prior to 2011, France includes Monaco and excludes the following overseas departments and territories: Guadeloupe; French Guiana; Martinique; Mayotte and Réunion; New Caledonia; French Polynesia; Saint

		Barthélemy; Saint Martin; Saint Pierre and Miquelon; and Wallis and Futuna.
Germany	GERMANY	
Greece	GREECE	
Hungary	HUNGARY	
Iceland	ICELAND	
Ireland	IRELAND	
Israel	ISRAEL	The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law. Israel is currently seeking accession to full IEA membership (Accession country), therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for the entire time series.
Italy	ITALY	Includes San Marino and the Holy See.
Japan	JAPAN	Includes Okinawa. Starting in 1990, data are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 April Y and ends on 31 March Y+1 are labelled as year Y.
Korea	KOREA	
Latvia	LATVIA	Data are included starting in 1990. Prior to 1990, data for Latvia are included in Former Soviet Union in the publication of World Energy Statistics.
Lithuania	LITHUANIA	Lithuania joined the IEA in February 2022. It is included in the IEA and Accession/Association countries aggregate (IEA family), for data starting in 1990 and for the entire time series.
Luxembourg	LUXEMBOU	
Mexico	MEXICO	
Netherlands	NETHLAND	Excludes Suriname, Aruba and the other former Netherlands Antilles (Bonaire, Curaçao, Saba, Saint Eustatius and Sint Maarten).
New Zealand	NZ	
Norway	NORWAY	
Poland	POLAND	
Portugal	PORTUGAL	Includes the Azores and Madeira.
Slovak Republic	SLOVAKIA	
Slovenia	SLOVENIA	Data start in 1990. Prior to that, they are included within Former Yugoslavia.

Spain	SPAIN	Includes the Canary Islands.
Sweden	SWEDEN	
Switzerland	SWITLAND	Includes Liechtenstein for oil data. Data for other fuels do not include Liechtenstein.
Republic of Turkiye	TURKEY	
United Kingdom	UK	Shipments of coal and oil to the Channel Islands and the Isle of Man from the United Kingdom are not classed as exports. Supplies of coal and oil to these islands are, therefore, included as part of UK supply. Exports of natural gas to the Isle of Man are included with the exports to Ireland.
United States	USA	Includes the 50 states and the District of Columbia but generally excludes all territories, and all trade between the U.S. and its territories. Oil statistics include Guam, Puerto Rico and the United States Virgin Islands; trade statistics for coal include international trade to and from Puerto Rico and the United States Virgin Islands. Starting with 2017 data, electricity statistics include Puerto Rico, for electricity production and capacity.
OECD Total	OECDTOT	Includes Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, the Republic of Turkiye, United Kingdom and United States.
OECD Americas	OECDAM	Includes Canada, Chile, Colombia, Costa Rica, Mexico and the United States.
OECD Asia Oceania	OECDAO	Includes Australia, Israel, Japan, Korea and New Zealand.
OECD Europe	OECDEUR	Includes Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, the Republic of Turkiye and United Kingdom.
IEA Total	IEATOT	Includes Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, the Republic of Turkiye, United Kingdom and the United States.
The IEA and Accession/ Association countries	IEAFAMILY	Includes: IEA member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Lithuania; Korea, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, the Republic of Türkiye, the

		United Kingdom and the United States; Accession countries: Chile, Colombia, Israel and Latvia; Association countries: Argentina, Brazil, the People's Republic of China, Egypt, India, Indonesia, Kenya, Morocco, Senegal, Singapore, South Africa, Thailand, and Ukraine.
Algeria	ALGERIA	
Angola	ANGOLA	
Benin	BENIN	
Botswana	BOTSWANA	
Cameroon	CAMEROON	
Congo	CONGO	
Democratic Rep. of Congo	CONGOREP	
Cote d'Ivoire	COTEIVOIRE	
Egypt	EGYPT	Data for Egypt are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 July Y and ends on 30 June Y+1 are labelled as year Y. Egypt is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series.
Eritrea	ERITREA	Data for Eritrea are available from 1992. Prior to that, they are included in Ethiopia.
Kingdom of Eswatini	ESWATINI	
Ethiopia	ETHIOPIA	Ethiopia includes Eritrea prior to 1992.
Equatorial Guinea	EQGUINEA	
Gabon	GABON	
Ghana	GHANA	
Kenya	KENYA	Kenya is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series. Electricity data are reported on a fiscal year basis, beginning on the 1 July Y and ending on the 30 June of Y+1.
Libya	LIBYA	
Madagascar	MADAGASCAR	
Mauritius	MAURITIUS	

Morocco	MOROCCO	Morocco is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series.
Mozambique	MOZAMBIQUE	
Namibia	NAMIBIA	Electricity data are reported on a fiscal year basis. By convention data for the fiscal year that starts on 1 July Y and ends on 31 June Y+1 are labelled as year Y. Data for Namibia are available starting in 1991. Prior to that, data are included in Other Africa.
Niger	NIGER	
Nigeria	NIGERIA	
Rwanda	RWANDA	
Senegal	SENEGAL	Senegal is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series.
South Africa	SOUTHAFRIC	South Africa joined the IEA as an Association country in November 2018.
South Sudan	SSUDAN	Data for South Sudan are available from 2012. Prior to 2012, they are included in Sudan.
Sudan	SUDAN	South Sudan became an independent country on 9 July 2011. From 2012, data for South Sudan are reported separately.
United Republic of Tanzania	TANZANIA	Oil data are reported on a fiscal year basis, beginning on the 1 July Y and ending on the 30 June Y+1.
Togo	TOGO	
Tunisia	TUNISIA	
Uganda	UGANDA	
Zambia	ZAMBIA	
Zimbabwe	ZIMBABWE	
Other Africa	OTHERAFRIC	Includes Burkina Faso; Burundi; Cape Verde; Central African Republic; Chad; Comoros; Djibouti; Gambia; Guinea; Guinea-Bissau; Lesotho; Liberia; Malawi; Mali; Mauritania; Namibia (until 1990); Réunion (until 2010); Sao Tome and Principe; Seychelles; Sierra Leone; and Somalia.
Africa	AFRICA	Includes Algeria; Angola; Benin; Botswana; Cameroon; Republic of Congo (Congo); Côte d'Ivoire; Democratic Republic of Congo; Egypt; Equatorial Guinea; Eritrea; the Kingdom of Eswatini; Ethiopia; Gabon; Ghana; Kenya; Libya; Madagascar; Mauritius; Morocco; Mozambique; Namibia (from 1991); Niger; Nigeria; Rwanda; Senegal; South Africa; South

		Sudan; Sudan, United Republic of Tanzania (Tanzania); Togo; Tunisia; Uganda; Zambia; Zimbabwe and **Other Africa.** Note that Africa is identical to Memo: Africa (UN).
Argentina	ARGENTINA	Argentina is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series.
Bolivia	BOLIVIA	
Brazil	BRAZIL	Brazil is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series.
Cuba	CUBA	
Curaçao	CURACAO	The Netherlands Antilles was dissolved on 10 October 2010, resulting in two new constituent countries, Curaçao and Sint Maarten, with the remaining islands joining the Netherlands as special municipalities. From 2012 onwards, data now account for the energy statistics of Curaçao Island only. Prior to 2012, data remain unchanged and still cover the entire territory of the former Netherlands Antilles.
Dominican Republic	DOMINICANR	
Ecuador	ECUADOR	
El Salvador	ELSALVADOR	
Guatemala	GUATEMALA	
Guyana	GUYANA	
Haiti	HAITI	
Honduras	HONDURAS	
Jamaica	JAMAICA	
Nicaragua	NICARAGUA	
Panama	PANAMA	
Paraguay	PARAGUAY	
Peru	PERU	
Suriname	SURINAME	Data for Suriname are available starting in 2000. Prior to that, they are included in Other Non-OECD Americas.
Trinidad and Tobago	TRINIDAD	
Uruguay	URUGUAY	
Venezuela	VENEZUELA	

Other Non-OECD Americas	OTHERLATIN	Includes Anguilla, Antigua and Barbuda; Aruba; the Bahamas; Barbados; Belize; Bermuda; Bonaire (from 2012); the British Virgin Islands; the Cayman Islands; Dominica; the Falkland Islands (Malvinas); French Guiana (until 2010); Grenada; Guadeloupe (until 2010); Martinique (until 2010); Montserrat; Puerto Rico (for natural gas and – up to 2016 data - electricity); Saint Eustatius (from 2012); Saint Kitts and Nevis; Saint Lucia; Saint Pierre and Miquelon; Saint Vincent and the Grenadines; Sint Maarten (from 2012); Suriname (until 1999); the Turks and Caicos Islands.
Non-OECD Americas	LATINAMERI	Includes Argentina; Plurinational State of Bolivia (Bolivia); Brazil; Cuba; Curaçao[1]; the Dominican Republic; Ecuador; El Salvador; Guatemala; Haiti; Honduras; Jamaica; Nicaragua; Panama; Paraguay; Peru; Suriname (from 2000), Trinidad and Tobago; Uruguay; the Bolivarian Republic of Venezuela (Venezuela) and Other Non-OECD Americas.
Bangladesh	BANGLADESH	Data are reported on a fiscal year basis. By convention data for the fiscal year that starts on 1 July Y-1 and ends on 30 June Y are labelled as year Y.
Brunei	BRUNEI	
Cambodia	CAMBODIA	Data for Cambodia are available starting in 1995. Prior to that, they are included in Other Asia.
India	INDIA	Data are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 April Y and ends on 31 March Y+1 are labelled as year Y. This convention is different from the one used by Government of India, whereby fiscal year starts on 1 April Y and ends on 31 March Y+1 are labelled as year Y+1. India is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series.
Indonesia	INDONESIA	Indonesia is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series.
DPR of Korea	KOREADPR	
Lao People's Democratic Republic	LAO	
Malaysia	MALAYSIA	
Mongolia	MONGOLIA	

[1]. The Netherlands Antilles was dissolved on 10 October 2010 resulting in two new 'constituent countries' (Curaçao and Sint Maarten) with the other islands joining The Netherlands as 'special municipalities'. However, due to lack of detailed data the IEA secretariat's data and estimates under the 'Netherlands Antilles' still refer to the whole territory of the Netherlands Antilles as it was known prior to 10 October 2010 up to the end of 2011. Data refer only to the island of Curaçao from 2012. The other islands of the former Netherlands Antilles are added to Other Non-OECD Americas from 2012.

Myanmar	MYANMAR	Data are reported on a fiscal year basis. By convention data for the fiscal year that starts on 1 April Y and ends on 31 March Y+1 are labelled as year Y.
Nepal	NEPAL	Data are reported on a fiscal year basis. By convention data for the fiscal year that starts on 1 July Y and ends on 30 June Y+1 are labelled as year Y.
Pakistan	PAKISTAN	Data are reported on a fiscal year basis. By convention fiscal year Y/Y+1 is labelled as year Y.
Philippines	PHILIPPINE	
Singapore	SINGAPORE	Singapore is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series.
Sri Lanka	SRILANKA	
Chinese Taipei	TAIPEI	
Thailand	THAILAND	Thailand is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series.
Vietnam	VIETNAM	
Other non-OECD Asia	OTHERASIA	Includes Afghanistan; Bhutan; Cambodia (until 1994); Cook Islands; Timor-Leste; Fiji; French Polynesia; Kiribati; Macau, China; Maldives; New Caledonia; Palau (from 1994); Papua New Guinea; Samoa; Solomon Islands; Tonga; and Vanuatu.
Non-OECD Asia excluding China	ASIA	Includes Bangladesh; Brunei Darussalam; Cambodia (from 1995); India; Indonesia; Democratic People's Republic of Korea (DPRK); Malaysia; Mongolia; Myanmar; Nepal; Pakistan; Philippines; Singapore; Sri Lanka; Chinese Taipei; Thailand; Viet Nam and Other non-OECD Asia.
People's Republic of China	CHINA	People's Republic of China is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1971 and for the entire time series.
Hong Kong, China	HONGKONG	
China	CHINAREG	Includes the (People's Republic of) China; and Hong Kong, China.
Albania	ALBANIA	
Armenia	ARMENIA	
Azerbaijan	AZERBAIJAN	
Belarus	BELARUS	

Bosnia and Herzegovina	BOSNIAHERZ	
Bulgaria	BULGARIA	
Croatia	CROATIA	
Cyprus	CYPRUS	Note by the Republic of Turkiye: *The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. The Republic of Turkiye recognizes the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, the Republic of Turkiye shall preserve its position concerning the "Cyprus issue".* Note by all the European Union Member States of the OECD and the European Union: *The Republic of Cyprus is recognised by all members of the United Nations with the exception of the Republic of Turkiye. The information in this report relates to the area under the effective control of the Government of the Republic of Cyprus.*
Georgia	GEORGIA	
Gibraltar	GIBRALTAR	
Kazakhstan	KAZAKHSTAN	
Kosovo	KOSOVO	Data for Kosovo are available starting in 2000. Between 1990 and 1999, data for Kosovo are included in Serbia. Prior to 1990, they are included in Former Yugoslavia.
Kyrgyzstan	KYRGYZSTAN	
Malta	MALTA	
Republic of Moldova	MOLDOVA	
Montenegro	MONTENEGRO	Data for Montenegro are available starting in 2005. Between 1990 and 2004, data for Montenegro are included in Serbia.
Republic of North Macedonia	NORTHMACED	Data for the Republic of North Macedonia are available starting in 1990. Prior to that, they are included in Former Yugoslavia.
Romania	ROMANIA	
Russia	RUSSIA	
Serbia	SERBIA	Serbia includes Montenegro until 2004 and Kosovo until 1999.
Tajikistan	TAJIKISTAN	
Turkmenistan	TURKMENIST	
Ukraine	UKRAINE	Data for Ukraine are available starting in 1990. Prior to that, they are included in Former Soviet Union.

		Ukraine is currently an IEA Association country, therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for data starting in 1990 and for the entire time series.
Uzbekistan	UZBEKISTAN	
Non-OECD Europe and Eurasia	EURASIA	Includes Albania; Armenia; Azerbaijan; Belarus; Bosnia and Herzegovina; Bulgaria; Croatia; Cyprus ; ; Georgia; Gibraltar; Kazakhstan; Kosovo; Kyrgyzstan; Malta; Republic of Moldova (Moldova); Montenegro; the Republic of North Macedonia; Romania; Russian Federation (Russia); Serbia[2] ; Tajikistan; Turkmenistan; Ukraine; Uzbekistan; Former Soviet Union and Former Yugoslavia.
Bahrain	BAHRAIN	
Islamic Republic of Iran	IRAN	Data are reported according to the Iranian calendar year. By convention data for the year that starts on 20 March Y and ends on 19 March Y+1 are labelled as year Y.
Iraq	IRAQ	
Jordan	JORDAN	
Kuwait	KUWAIT	
Lebanon	LEBANON	
Oman	OMAN	
Qatar	QATAR	
Saudi Arabia	SAUDIARABI	
Syria	SYRIA	
United Arab Emirates	UAE	
Yemen	YEMEN	
Middle East	MIDDLEEAST	Includes Bahrain; Islamic Republic of Iran (Iran); Iraq; Jordan; Kuwait; Lebanon; Oman; Qatar; Saudi Arabia; Syrian Arab Republic (Syria); United Arab Emirates; and Yemen.
Non-OECD Total	NONOECDTOT	Includes all Non-OECD countries.
World marine and aviation bunkers	WORLDBUNK	Due to the structure of the database and the specific nature of international marine and aviation bunkers, including CO_2 emissions, World marine and aviation bunkers are reported both as a flow and as an entity similar to a country or a region. World marine and aviation bunkers represent the sum of international marine and aviation bunkers from all countries. Therefore, World marine and aviation bunkers are not applicable for individual countries and regions, and they are included in the transport for the world total.

[4.] Serbia includes Montenegro until 2004 and Kosovo until 1999.

World	WORLD	Includes OECD Total; Africa; Non-OECD Americas; Non-OECD Asia (excluding China); China (People's Republic of China and Hong Kong, China); Non-OECD Europe and Eurasia; Middle East; World aviation bunkers and World marine bunkers. It is also the sum of Africa, Americas, Asia, Europe, Oceania, World aviation bunkers and World marine bunkers.
Africa (UN)	AFRICATOT	Includes Algeria; Angola; Benin; Botswana; Burkina Faso; Burundi; Cabo Verde; Cameroon; Central African Republic; Chad; Comoros; the Republic of the Congo (Congo); Côte d'Ivoire; the Democratic Republic of the Congo; Djibouti; Egypt; Equatorial Guinea; Eritrea; the Kingdom of Eswatini; Ethiopia; Gabon; Gambia; Ghana; Guinea; Guinea-Bissau; Kenya; Lesotho; Liberia; Libya; Madagascar; Malawi; Mali; Mauritania; Mauritius; Morocco; Mozambique; Namibia; Niger; Nigeria; Réunion (until 2010); Rwanda; Sao Tome and Principe; Senegal; the Seychelles; Sierra Leone; Somalia; South Africa; South Sudan (from 2012); Sudan; the United Republic of Tanzania (Tanzania); Togo; Tunisia; Uganda; Zambia; Zimbabwe.
Americas (UN)	AMERICAS	Includes Antigua and Barbuda; Argentina; Aruba; the Bahamas; Barbados; Belize; Bermuda; the Plurinational State of Bolivia (Bolivia); Bonaire (from 2012); the British Virgin Islands; Brazil; Canada; the Cayman Islands; Chile; Colombia; Costa Rica; Cuba; Curaçao ; Dominica; the Dominican Republic; Ecuador; El Salvador; the Falkland Islands (Malvinas); Guatemala; French Guiana (until 2010); Grenada; Guadeloupe (until 2010); Guyana; Haiti; Honduras; Jamaica; Martinique (until 2010); Mexico; Montserrat; Nicaragua; Panama; Paraguay; Peru; Puerto Rico; Saba (from 2012); Saint Kitts and Nevis; Saint Lucia; Saint Pierre and Miquelon; Saint Vincent and the Grenadines; Sint Eustatius (from 2012); Sint Maarten (from 2012); Suriname; Trinidad and Tobago; the Turks and Caicos Islands; the United States; Uruguay; the Bolivarian Republic of Venezuela (Venezuela).
Asia (UN)	ASIATOT	Includes (from 1990) includes Afghanistan; Armenia; Azerbaijan; Bahrain; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; the People's Republic of China; Cyprus ; Georgia; Hong Kong, China; India; Indonesia; the Islamic Republic of Iran; Iraq; Israel ; Japan; Jordan; the Democratic People's Republic of Korea; Korea; Kazakhstan; Kuwait; Kyrgyzstan; Lao People's Democratic Republic; Lebanon; Macau, China; Malaysia; the Maldives; Mongolia; Myanmar; Nepal; Oman; Pakistan; the Philippines; Qatar; Saudi Arabia; Singapore; Sri Lanka; the Syrian Arab Republic; Tajikistan; Chinese Taipei; Thailand; Timor-Leste; the Republic of Turkiye; Turkmenistan; the United Arab Emirates; Uzbekistan; Viet Nam; and Yemen.
Europe (UN)	EUROPE	Includes (from 1990) includes Albania; Austria; Belarus; Belgium; Bosnia and Herzegovina; Bulgaria; Croatia; the Czech Republic; Denmark; Estonia; Finland; France ; Germany; Gibraltar; Greece; Hungary; Iceland; Ireland; Italy; Kosovo ; Latvia;

		Lithuania; Luxembourg; Malta; the Republic of Moldova (Moldova); Montenegro; the Netherlands; the Republic of North Macedonia; Norway; Poland; Portugal; Romania; the Russian Federation; Serbia ; the Slovak Republic; Slovenia; Spain; Sweden; Switzerland; Ukraine; the United Kingdom.
Oceania (UN)	OCEANIA	Includes Australia; New Zealand; Cook Islands; Fiji; French Polynesia; Kiribati; New Caledonia; Palau; Papua New Guinea; Samoa; the Solomon Islands; Tonga; Vanuatu.
Memo: European Union - 27	EU27_2020	Includes Austria; Belgium; Bulgaria; Croatia; Cyprus; the Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Latvia; Lithuania; Luxembourg; Malta; the Netherlands; Poland; Portugal; Romania; the Slovak Republic; Slovenia; Spain and Sweden. Refers to the EU28 aggregate with the exclusion of the United Kingdom.
Memo: European Union - 28	EU28	Includes Austria; Belgium; Bulgaria; Croatia; Cyprus; the Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Latvia; Lithuania; Luxembourg; Malta; the Netherlands; Poland; Portugal; Romania; the Slovak Republic; Slovenia; Spain; Sweden and the United Kingdom. As of the 1st of February 2020, the United Kingdom (UK) is no longer part of the European Union (EU) and has entered into a transition period until 31 December 2020. In this publication, the UK is still included in the EU28 aggregate. However, it is excluded from the EU27_2020 aggregate.

Please note that the following countries have not been considered:

Non-OECD Europe and Eurasia: Andorra; Faroe Islands (after 1990); Liechtenstein20 (except for oil data); Svalbard; Jan Mayen Islands;

Africa: British Indian Ocean Territory; French Southern and Antarctic Lands; Mayotte; Saint Helena; Western Sahara;

Non-OECD Americas: Bouvet Island; Saint Barthélemy; Greenland (after 1990); Saint Martin (French Part); South Georgia and the South Sandwich Islands;

Antarctica;

Non-OECD Asia excluding China: American Samoa; Cocos (Keeling) Islands; Christmas Island; Heard Island and McDonald Islands; Marshall Islands; Micronesia (Federated States of); Nauru; Niue; Norfolk Island; Northern Mariana Islands; Pitcairn; Tokelau; Tuvalu; United States Minor Outlying Islands; Wallis and Futuna Islands.

Fiscal year

This table lists the countries for which data are reported on a fiscal year basis. More information on beginning and end of fiscal years by country is reported in the column 'Definition'.
This document is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area. In this publication, 'country' refers to country, economy or territory, as case may be. Data start in 1960 for OECD countries and in 1971 for non-OECD countries and regional aggregates, unless otherwise specified.

Country/Region	Short name	Definition
Australia	AUSTRALI	Data are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 July Y-1 and ends on 30 June Y are labelled as year Y.
Bangladesh	BANGLADESH	Data are reported on a fiscal year basis. By convention data for the fiscal year that starts on 1 July Y-1 and ends on 30 June Y are labelled as year Y.
Egypt	EGYPT	Data are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 July Y and ends on 30 June Y+1 are labelled as year Y.
Ethiopia	ETHIOPIA	Data are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 July Y and ends on 30 June Y+1 are labelled as year Y.
India	INDIA	Data are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 April Y and ends on 31 March Y+1 are labelled as year Y. This convention is different from the one used by Government of India, whereby fiscal year starts on 1 April Y and ends on 31 March Y+1 are labelled as year Y+1.
Islamic Republic of Iran	IRAN	Data are reported according to the Iranian calendar year. By convention data for the year that starts on 20 March Y and ends on 19 March Y+1 are labelled as year Y.
Japan	JAPAN	Starting 1990, data are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 April Y and ends on 31 March Y+1 are labelled as year Y.
Myanmar	MYANMAR	Data are reported on a fiscal year basis. By convention data for the fiscal year that starts on 1 April Y and ends on 31 March Y+1 are labelled as year Y.
Namibia	NAMIBIA	Electricity data are reported on a fiscal year basis. By convention data for the fiscal year that starts on 1 July Y and ends on 31 June Y+1 are labelled as year Y.
Nepal	NEPAL	Data are reported on a fiscal year basis. By convention data for the fiscal year that starts on 1 July Y and ends on 30 June Y+1 are labelled as year Y.
Pakistan	PAKISTAN	Data are reported on a fiscal year basis. By convention data for the fiscal year that starts on 1 July Y and ends on 30 June Y+1 are labelled as year Y.
South Africa	SOUTHAFRIC	Nuclear and Hydro electricity generation data are reported on a fiscal year basis, beginning on the 1 April Y and ending on 31 March Y+1.
United Republic of Tanzania	TANZANIA	Oil data are reported on a fiscal year basis, beginning on 1 July Y and ending on 30 June Y+1.

Country notes and sources

General notes

Energy data for OECD countries are submitted by all OECD Member countries to the IEA secretariat in a common format and methodology to allow for international comparisons.

One general issue regarding renewable statistics is that the variety of definitions for the word “renewable” may not refer to the same energy sources. Some of the definitions of renewable energy used by national and international bodies include specific renewables technologies such as large hydro, geothermal, peat, municipal waste or industrial waste while others exclude them. Similarly, renewables may or may not include non-commercial biofuels, which has substantial effects regarding renewable data for developing countries.

The Renewable Energy Working Party of the International Energy Agency set down the following broad definition:

“Renewable Energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly or indirectly from the sun, or from heat generated deep within the earth. Included in the definition is energy generated from solar, wind, biofuels, geothermal, hydropower and ocean resources, and biofuels and hydrogen derived from renewable resources.”

Therefore, in this publication the renewable products are: hydro (large, medium and small), geothermal, solar photovoltaic, solar thermal, tide, wave, ocean, wind, solid biofuels, biogases, liquid biofuels and renewable municipal waste.

It follows that total renewables does not include industrial waste, non-renewable municipal waste, waste heat, net heat generated by heat pumps, and electricity generated with hydro pumped storage.

While some OECD member countries accept industrial waste and non-renewable municipal waste as renewable energy sources, many countries exclude them on the grounds that they are not biodegradable. Under the IEA methodology, industrial waste and non-renewable municipal waste are excluded from the definition of renewable energy sources. However, these data are included in this publication in order to account for the full range of statistics collected in the Annual Renewables and Waste Questionnaire.

Even though data quality improves with each new edition due to the continuous efforts of the IEA in partnership with national administrations, it is important to

highlight that difficulties exist in the collection of some data. As a result, there can be breaks in the time series for the countries.

For example, one continuing problem is the breakdown between municipal waste and industrial waste. In some countries industrial waste statistics are not of the same quality as those for other products, because renewables and waste data collection systems were not in place in many countries in the early 1990s. Furthermore, the breakdown between the renewable and non-renewable portions of municipal waste is sometimes not known and as a result is based on estimates. The breakdown is important because most countries include the renewable (biodegradable) part of municipal waste in their renewables definition, while they exclude the remainder. The classification of waste as renewable is also important because the non-renewable component is counted when calculating CO_2 emissions. In cases where the breakdown of municipal waste into renewable and non-renewable components was not reported, the IEA Secretariat estimated equal shares of renewable and non-renewable components.

Data collection from off-grid systems that work independently or are connected to a local distribution system remains a problem. These systems are frequently omitted in national statistics due to difficulties in collecting these data. This is, for example, the case regarding solar energy data, where for a number of countries, production and capacity are likely to be considerably higher than indicated in this publication. Collection of the data presents national governments with some unique challenges. Renewable energy systems tend to be smaller than conventional systems, and harder to track. Operators tend to be more diverse and more numerous.

Many systems are connected to the grid at the distribution level, rather than at the transmission level, and so do not require interconnection permits. National governments are seeking to improve data collection methods to capture the total nature of their renewable energies. In general, the dispersion of renewables and waste production, specifically off-grid production (such as domestic solar collectors and/or small wind turbines), creates transparency and measurement problems. Thus, the nature and structure of the renewables energy market impedes data quality and reliability when compared to that of the traditional fossil fuels, which mainly produce heat and electricity in grid-connected plants.

This report is focused on the data from 1990 onward, due to the limited availability of data prior to 1990. Non-commercial biofuels are included in the IEA definition, but data are not always complete. Electricity from fuel cells using hydrogen from renewable, as well as non-renewable, sources is not included in this publication due to a lack of reliable information.

When using these data, special attention should also be given to the percentage that renewables represents in TES in countries where the net trade of electricity is large and also represents a significant percentage. In these cases, the high net imports of electricity can heavily influence the percentage of renewables in TES.

Statistics of non-OECD countries presented in this publication are based on data available at the time of publishing and may differ from the final non-OECD data to be published in *World Energy Balances*.

Additional information on the methodologies and reporting conventions used here are included in the notes in *World Energy Balances*.

Australia

Source

Department of Industry, Science, Energy and Resources, Canberra.

General notes

Excludes the overseas territories.

Data are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 July Y-1 and ends on 30 June Y are labelled as year Y.

A large **biogas** production facility did not report any production in 2016-2017. In 2017, this led to reductions in the consumption of **biogases** in auto CHP plants and the commercial and public services sector.

Increases in indigenous production of **solid biofuels** since 2014 are related to incentives under the Renewable Energy Target legislation, which went into effect in 2001, and aims to increase the share of electricity generation from renewable sources. More information is available here: http://www.cleanenergyregulator.gov.au/RET

The data for **biogasoline** and **biodiesel** are not available before 2003 and 2004 respectively.

There are breaks in the time series for many data between 2002 and 2003 due to the adoption of the National Greenhouse and Energy Reporting (NGER) data as the main energy consumption data source for the Australian Energy Statistics.

In 2002, the Australian administration started to use a new survey methodology and reclassified the types of plants between main activity producers and autoproducers.

From 1996, a different industry consumption breakdown for **biofuels and waste** is available and leads to breaks in time series.

Supply

Indigenous production of **biodiesel** decreased substantially starting with 2016 data because one of major **biodiesel** producers ceased production in January 2016. The trend continues with 2017 and 2018 data, when, according to Bioenergy Australia, low oil prices and higher feedstock prices created a difficult market for the remaining biodiesel producers.

Indigenous production of **biogasoline (ethanol)** has decreased since the Ethanol Production Grants Programme ended on 30 June 2015. On 1 July 2015, the fuel

excise on domestically produced ethanol was reduced to zero and will be increased by 2.5 cents per litre until it reaches 12.5 cents per litre. More information is available here: http://biomassproducer.com.au/markets/bioenergy-markets-in-australia/ethanol/#.Wwf7Le6FOUk. Additionally, 2017 data were also affected by low oil prices.

Biogas production data at sewage treatment works are not available.

The production data of electricity from **wind** are available from 1994.

Transformation

In the 2018 edition, new methodologies were introduced by the Australian administration for reporting electricity production from solar sources. First, the methodology for reporting electricity production from **solar PV** and **solar thermal** was changed between 2009 and 2010, resulting in a break in time series. Prior to 2010, the ratio of electricity production from **solar thermal** to total solar was assumed to be the same each year. After 2010, **solar PV** autoproducer electricity production is the residual after the main activity **solar PV** and **solar thermal** are deducted from total solar production. There is an additional break in time series between 2013 and 2014 for **solar** production when a new methodology for determining large-scale **solar PV** production was introduced for main activity **solar PV** plants.

Electricity production from **solar PV** starts in 1992 and from **solar thermal** in 2003.

Prior to 1995, electricity production from **biogases** is included in natural gas.

Consumption

In the 2018 edition, **solid biofuels** were revised back to 2010 by the Australian administration, expanding the scope from the revisions in the 2016 and 2017 editions to indigenous production and consumption sectors which weren't previously revised. This results in a break in time series between 2009 and 2010.

In the 2017 edition of this publication, there has been a revision to the time series of **solid biofuels** consumption in "Paper, pulp and printing" sector. This time series has been revised back to 2010 resulting in break in time series between 2009 and 2010.

In the 2016 edition of this publication, the Australian administration revised **primary solid biofuels** back to 2010 which impact mostly final consumption in Food and Tobacco. This created breaks in time series.

The consumption data of **biogases** in industry is not available before 2003.

Austria

Source

Bundesanstalt Statistik Österreich, Vienna.

General notes

Starting with the 2016 edition, widespread data revisions were received due to enhanced reporting for 2005 onwards as a consequence of the Austrian Energy Efficiency Act (Bundes-Energieeffizienzgesetz). For some time series, these revisions were extrapolated back to 1990. As a consequence, there may be breaks between 2004 and 2005, and 1989 and 1990. For more details on the methodologies in the revisions in the energy balance, there is more information here: http://www.statistik.at/wcm/idc/idcplg?IdcService=GET_PDF_FILE&RevisionSelectionMethod=LatestReleased&dDocName=036412. For more details on the methodologies related to consumption in households, there is more information here: http://www.statistik.at/wcm/idc/idcplg?IdcService=GET_PDF_FILE&RevisionSelectionMethod=LatestReleased&dDocName=078265

Data for **solar photovoltaic** and **wind** are available from 1993.

Transformation

Electricity plants data may include some CHP plants operating in electricity only mode.

Electricity production from **geothermal** main electricity plants only refers to electricity that is fed into the grid. Total production is not known as these plants are below the reporting threshold.

Fluctuating efficiencies from year to year for **solid biofuel** and **industrial waste** plants are related to operational decisions which are governed by a formula described in the *Standard documentation Meta information on Energy balances for Austria and the Laender of Austria* published in June 2016 on the Statistics Austria website (link above).

In the 2018 edition, electricity production from **municipal waste** main activity electricity plants was revised from 2003-2009. Additionally, electricity production from **municipal waste** main activity CHP plants was revised in 2014.

A large autoproducer electricity plant was reclassified as an autoproducer CHP plant and therefore creates a break in time series for **municipal waste** in 2011.

Due to a change in the survey methodology, the heat produced in small plants (capacity inferior to 1 MW) is not reported starting in 2002.

Prior to 2002, data for **biogases** only include plants of 1 MW or larger.

Electricity generation from **geothermal** started in 2002.

Consumption

In the 2016 edition, improvement in the iron and steel industry data have allowed more precision in the consumption, among other for **industrial wastes** in blast furnaces.

In the 2016 edition, the consumption of **solid biofuels** in the residential sector was revised down from 2005 data.

Belgium

Source

Observatoire de l'Energie, Brussels.

General notes

Renewable **municipal wastes** include a share of renewable **industrial wastes**.

In the 2023 edition, Belgium revised data back to 2004 due to improved data availability and change of methodology.

No information on **wood pellets** and **animal waste** is available prior to 2012.

Data for **biodiesels** and **biogasoline** are available starting in 2009.

In the 2022 edition, charcoal was significantly revised starting from 2010 due to the utilization of a new data source.

Supply

Data on pure **biogasoline** and **biodiesels** trade are not available for 2009 and 2010.

Renewable **municipal wastes** indigenous production is adjusted due to confidentiality reasons starting in 2021 back to 2010.

Solid biofuels indigenous production including Other vegetal material and residues are adjusted due to confidentiality reasons starting in 2021 back to 2010.

Transformation

In 2015, part of the law regulating the blending of biodiesel with diesel was temporarily suspended but in 2016, this law was reinstated.

2009 was the first year of **offshore wind** production in Belgium. 2010 is the first year data are available.

No information is available on heat production in main activity CHP plants for **industrial waste** in 2007.

In 2003, combustion of **municipal waste** for electricity and heat generation purposes increased significantly. However, because a large portion of the heat produced is not used (sold), plant efficiencies dropped significantly between 2002 and 2003.

In 2000, most autoproducer electricity plants using **combustible fuels** were re-classified as autoproducer CHP plants; the heat production from these plants was used for internal industrial processes and not sold to third parties until 2005.

For 1998 and 1999, electricity production at CHP plants with annual heat output below 0.5 TJ is reported with electricity only plants.

Consumption

Industrial Waste consumption in the Industry sector comprising Iron and steel, Chemical and petrochemical, Non-ferrous metals, Machinery, Paper, pulp and printing, Wood and wood products and Textiles and leather as well as Commercial and public services and Agriculture/Forestry are adjusted when needed due to confidentiality reasons starting in 2021 back to 2010.

Biodiesel consumption in the Industry sector comprising Chemical and petrochemical, Machinery, Food, beverages and tobacco, Not elsewhere specified (Industry) as well as Commercial and public services, Residential and Agriculture/Forestry are adjusted when needed due to confidentiality reasons starting in 2021 back to 2010.

Biogas consumption in the Industry sector comprising Chemical and petrochemical, Machinery, Food, beverages and tobacco and Paper, pulp and printing are adjusted when needed due to confidentiality reasons starting in 2021 back to 2010.

Renewable **municipal wastes** in the Industry sector comprising Paper, pulp and printing and Textiles and leather are adjusted or removed when needed due to confidentiality reasons starting in 2021 back to 2010.

Solid biofuels in the Industry sector comprising Machinery, Paper, pulp and printing and Not elsewhere specified (Industry) are adjusted or removed when needed due to confidentiality reasons starting in 2021 back to 2010.

Consumption of **bioethanol** increased in 2017 due to legislation which went into effect on 1 January 2017 which increased the blending obligation for gasoline products.

Industrial waste consumption in the chemical sector started in 2011.

Other liquid biofuels consumed in power plants reported before 2011 can include **biodiesel**.

New data on consumption cause breaks in time series for **primary solid biofuels** between 2011 and 2012.

Canada

Source

Natural Resources Canada, Ottawa.

General notes

In the 2023 edition, some values for biogases, renewable municipal waste and non-renewable municipal waste were revised. The revisions are mainly in the transformation sector and cover the years 1990-2021.

In the 2022 edition, **solid biofuels** were significantly revised starting from 2016 due to the utilization of new data sources. This may lead to data breaks in the transformation sector between 2015 and 2016.

Starting in 2009, a new data source has been used by Canadian administration for electricity production from **solar**, **wind**, and **tide**. This new source covers production from **solar** and **wind** only from plants with capacity higher than 500 kW.

The IEA Secretariat has estimated the data for **biogases, industrial and municipal waste** from 1990 to 2004, **biogasoline (ethanol)** from 1998 to 2004 based on information supplied by Natural Resources Canada.

Supply

Canadian **biodiesel** production increased significantly in 2014 because a large producer came online at the end of 2013. In 2016 again, there was big increase in production of **biodiesel** due to a large plant coming online in Alberta. This is also the reason for the increase in export, as Canada exports most of its **biodiesel** to the US.

There were no exports of **biogasoline** between 2013 and 2019.

Transformation

In the 2016 edition of this publication, there was a reclassification from autoproducer to main activity producer for plants fuelled by **biogases** and **municipal waste**.

In the 2016 edition of this publication, the electrical capacity of **solid biofuels** revised back to 2005, which makes break in time series between 2004 and 2005.

Only gross maximum electrical capacity is available.

Production capacity figures for **biodiesel** and **biogasoline** are available starting from 2016.

Consumption

In the 2022 edition, due to the utilisation of new data sources, data breaks are visible between 2004 and 2005 for **solid biofuels**.

Chile

Source

Energía Abierta, Comisión Nacional de Energía, Ministerio de Energía, Santiago.

General notes

Chile is currently seeking accession to full IEA membership (Accession country), therefore it is included in the IEA and Accession/Association countries aggregate (IEA Family), for the entire time series.

In 2023 edition, 2022p geothermal data have been estimated by the IEA Secretariat.

The Chilean administration applied a new revised methodology for *final consumption* of **primary solid biofuels**. This may lead to breaks in time series between 2013 and 2014.

Charcoal production and consumption have been estimated by the IEA Secretariat until 2013 and in 2020. From 2014 data, **solid biofuels** input to **charcoal** production plant is estimated.

The split of electricity generation by main activity and autoproducer by fuel was estimated by the Chilean administration for the period 1990 to 2003.

From 1990, consumption in paper and pulp includes forestry and consumption in agriculture is included in non-specified industry.

Supply

In 2021, there is no supply, transformation or energy/end use of Charcoal and Municipal Waste.

Production of **landfill gas** ceased from 2001 - 2014 as landfill sites stopped producing adequate gas to continue collection.

Solar thermal heat production has been estimated by the IEA Secretariat until 2017 using data published by Chilean ministry of energy.

Transformation

In 2021, the input in main activity producer electricity – solar thermal and the solar collectors installed surface have been estimated by IEA secretariat

In the 2022 edition, the solar PV capacity breakdown has been estimated by the IEA Secretariat.

Electricity production from **geothermal** started at Cerro Pabellón in 2017.

Biofuels are co-fired with other fuels for electricity production. For plants where multiple fuels are used for electricity production, capacities are reported under the dominant fuel.

Regarding electricity generation from **solar PV** and **wind**, Chilean administration applied a new methodology for 2014 and this resulted in breaks in time series between 2013 and 2014. The revision for the previous years is pending.

A new survey on primary **solid biofuels** causes breaks in production and input to autoproducer CHP between 2011 and 2012.

Data for heat production in CHP and heat plants are not available.

Consumption

Solar thermal consumption data are not available so all consumption data are allocated to the non-specified (other) sector.

Colombia

Source

Ministry of Mines and Energy, Bogota.

General notes

2021 data are estimated by the IEA Secretariat based on OLADE and the Federación Nacional de Biocombustibles de Colombia for liquid biofuels.

Colombia joined the OECD in April 2020 and submitted questionnaires starting with the 2019 data cycle. Historical revisions were not provided and some breaks in the time series can appear for 2018/2019. Minor revisions occurred for years 1990-2018, leading to minor breaks in the time series for 1989/1990.

Transformation

In the 2022 edition, **solar PV** capacity for 2019 and 2020 was estimated by the IEA Secretariat.

Costa Rica

Source

Ministry of Environment and Energy, San josé.

General notes

Costa Rica joined the OECD in May 2021 and submitted questionnaires starting with the 2020 data cycle. Historical revisions were provided starting from 2016. Some breaks in the time series can appear for 2015/2016 and the most significant regard **solar PV**, **solid biofuels** and **charcoal**.

Transformation

Electricity generation from **Solar PV** electricity auto-producers is available starting from 2016.

Solid biofuels CHP auto-producers are classified as electricity auto-producers before 2016.

Czech Republic

Source

Ministry of Industry and Trade, Prague.

General notes

The restructuring of the Czech electricity market leads to breaks in the time series in all sectors between 1998 and 1999.

Data for **municipal waste** and **solid biofuels** are not available prior to 1990 and **liquid biofuels** data are not available prior to 1992.

Transformation

In the 2021 edition, there were revisions for **solar thermal** from 2006 to 2018.

Starting in 2016, a main activity producer CHP incineration plant fired by **municipal waste** was in test operation at Chotikov.

In 2012, a main activity producer electricity plant using **solid biofuels** started to produce heat and was reclassified as main activity CHP plant.

Data on **biogases** used in main activity producer CHP and autoproducer heat plants start in 1997.

Industrial waste use in main activity producer electricity plants is included with **solid biofuels** from 1996.

Consumption

The increase in the consumption of **industrial wastes (non-renewable)** in the *non-metallic minerals* sector in 2018 is related to increased demand from cement companies.

Starting in 2016, an increased excise duty was imposed on **biofuels**, causing a decline in consumption.

In the 2017 edition, due to a new survey in households made by the Czech Statistical Office in 2015 (ENERGO 2015), **solid biofuels** consumption in residential sector has been considerably revised upwards since 1990.

Hospital waste previously reported as **municipal waste** is reported under **industrial waste** since 2008.

New survey systems cause breaks in final consumption in 1999 and in 2002. Breaks in both supply and consumption of biofuels and waste occur again in 2003.

Data for direct use of **solar** energy are available from 2003.

Denmark

Source

Danish Energy Agency, Copenhagen.

General notes

Greenland and the Faroe Islands territories are not included.

In the 2014 edition, total heat production was revised back to 1994, due to the availability of new data for heat production from **liquid biofuels**.

Supply

In the 2015 edition, the Danish administration revised the **geothermal heat** production from 1990 to 2009.

From 2012, **biodiesel** production is confidential and gathered with imports.

Transformation

In the 2022 edition, the 2020 input and output values of heat autoproducers that consume **biogases** were estimated by the IEA secretariat.

In the 2020 edition, there are revisions from 2010 to 2017 for **solid biofuels**, **biogases** and **solar thermal**.

Biodiesels and **biogasoline** consumption for electricity and heat production are reported under **other liquid biofuels**, for confidentiality reasons.

Data for **other liquid biofuels** main activity heat plants are available from 1994.

Due to the high number of heating companies burning **wood chips** that are equipped with boilers with flue-gas condensation, the **solid biofuels** heat plants show a high efficiency.

Fish oil used in main activity producer heat plants is included with **solid biofuels**.

For some years, heat plants for **municipal wastes, solid biofuels** and **biogases** show efficiencies larger than 100%, on a net calorific value basis, due to the use of condensing boilers that recover the latent heat of vaporisation. In addition, in one plant a tiny amount of waste oil is co-fired with other fuels and this leads to high efficiencies for municipal waste.

Based on the reported indigenous production of **solar thermal** collectors and installed surface of these, a decline in specific production [kWh/m2] is observed. The main reason is that the sources of the production data and installed surface

are different from each other. The production data originates from the “energy-producer-survey” that misses some of the newly established installations. The Danish administration expects that this divergence will probably become smaller each year.

Consumption

In the 2023 April edition, **primary solid biofuels** data were significantly revised due to information coming from a new industrial survey.

In the 2020 edition, the consumption of **municipal wastes** in the *commercial and public services sector* for 2017 data was revised.

In the 2016 edition, the Danish statistics revised energy consumption in industry sectors causing some breaks in **solid biofuels** consumption between 2010 and 2011.

The data on the consumption of **municipal waste** in the industry sector are delayed by one year and the Danish administration duplicates the previous year’s data for the most recent year until the data become available.

Estonia

Source

Statistics Estonia, Tallinn.

General notes

Estonia joined the IEA in May 2014. Data are included starting in 1990.

Data for Estonia are available starting in 1990. Prior to that, they are included in the Former Soviet Union in World Energy Statistics.

Data for **biogases** include **landfill gas** starting in 2005.

Transformation

For plants where multiple fuels are used for electricity production, capacities are reported under the dominant fuel.

In the 2018 edition, the surge in main activity heat from **solid biofuels** was related to reclassification from autoproducer heat plants, where previously autoproducer own use heat and associated fuel inputs are not reported, and the fuel consumption appears in the main economic activity of the autoproducer.

Finland

Source

Statistics Finland, Helsinki.

General notes

A new survey system and a reclassification of the data lead to breaks in the time series between 1999 and 2000 for most products and sectors. The new survey system is more detailed and has better product coverage, especially in electricity, CHP and heat production, as well as in industry.

Prior to 2004, industrial waste also included other energy forms such as hydrogen, heat from chemical processes, natural gas and blast furnace gas.

Data for **biogases** and **industrial waste** are available from 1996.

Supply

In 2023 edition, **solid biofuels** trade methodology was revised. The administration reported that the new estimation method was developed in cooperation with the Natural Resources Institute Finland (Luke) and that was not possible to revise the time series before 2018. Therefore, data breaks might appear between 2017 and 2018.

Due to confidentiality reasons, the **biodiesel** production includes trade figures and stock changes starting with 2015 data. Regarding **biogasoline**, import covers production, exports and stock changes.

Transformation

In 2020, heat generation from **solid biofuels** heat autoproducers plants increased greatly because one large plant changed its industrial category, from energy sector to industry sector (paper, pulp and printing). However, it continued to sell about the same amount of heat to a chemical industry.

The use of **charcoal** in blast furnaces started in 2018 on a test basis. In 2020, this product was stopped being used in these kind of plants.

The capacities of co-firing plants are reported under the dominant fuel.

The amount of **biodiesel** used for blending with diesel fell greatly in 2016 after record levels for the past two years. Annual variation in the consumption of biofuels is possible and caused by Finland's biofuel legislation, which gives distributors the possibility to fulfil the bio obligation flexibly in advance.

In the 2016 edition, the allocation of **solar photovoltaic** between main activity and autoproducer plants was revised.

In 2014, the new consumption of **other liquid biofuels** in main activity electricity plant corresponds to biopyrolisis oil made from wood chips.

The increase in heat production from **municipal waste** in 2014 is due to the opening of a new plant.

Heat output from autoproducer CHP plants is available starting in 1996 and from autoproducer heat plants starting in 2000.

Before 1999, all electricity production from autoproducers running on **fuelwood** is allocated to CHP plants.

Prior to 1992, outputs from the use of combustible renewables and waste to generate electricity and/or heat were included in peat. Therefore, the IEA Secretariat estimated the breakdown of outputs from **municipal waste** and **solid biofuels** based on reported inputs.

Consumption

In 2023 edition, plants **industrial waste** and **municipal waste** were reclassified from ”Not elsewhere specified” to ”Commercial and Public Services” for the entire time series starting in 2000 and 2008, respectively.

In 2020, **solid biofuel** consumption in the chemical sector decreased greatly because one industry stopped using a wood-based fuel.

Starting in 2017, the large increase of **biogas** consumption in the *paper, pulp and printing* industry is due to a change in process in the industry. Wood was gasified and replaced **natural gas** or **oil**.

France

Source

SDES, Ministry of Ecology, Sustainable Development and Energy, Paris.

General notes

From 2011 data onwards, France now includes Monaco, and the following overseas departments (Guadeloupe; French Guiana; Martinique; Mayotte; and Réunion); and excludes the overseas collectivities (New Caledonia; French Polynesia; Saint Barthélemy; Saint Martin; Saint Pierre and Miquelon; and Wallis and Futuna). Prior to 2011, France includes Monaco and excludes the following overseas departments and territories: Guadeloupe; French Guiana; Martinique; Mayotte and Reunion; New Caledonia; French Polynesia; Saint Barthélemy; Saint Martin; Saint Pierre and Miquelon; and Wallis and Futuna.

In the July 2022 edition, the admnistration updated the methodology for **bioethanol** trade thanks to the availability of a new source. 2019 and 2020 data will be revised in future editions.

In the 2018 edition, following an analysis of **biogases** in the energy sector by the French administration, there are revisions in **biogas** indigenous production, inputs to the transformation sector, heat production and final consumption back to 2005. Electricity production from **biogases** is revised back to 2011. This causes breaks in time series between 2004 and 2005 as well as 2010 and 2011.

Indigenous production, transformation and final consumption of **industrial waste** are reported from 2013. In the 2018 edition, indigenous production and transformation of **industrial waste** were added from 2007 - 2012. It follows that there is a break in time series between 2012 and 2013.

In the 2018 edition, **solid biofuels'** indigenous production and inputs to main activity and autoproducer heat plants have been revised back to 2007 Electricity production has been revised back to 2013. This causes breaks in time series between 2006 and 2007 as well as 2012 and 2013.

In the 2018 edition, indigenous production and inputs to main activity heat plants have been revised back to 2007 for **municipal waste**. Electricity production has been revised back to 2011. This causes breaks in time series between 2006 and 2007 as well as 2010 and 2011. Prior to 2007, production and consumption of **industrial waste** were included in **municipal waste.**

In 2014, a new survey on **solid biofuels** and **biogases** causes breaks in time series between 2013 and 2014. **Biogas** was previously reported under **Solid biofuels**.

Prior to 2005, all the **geothermal** heat consumption was reported as direct use. From 2005 data, some quantities are reported as output of heat plants, resulting in breaks in time series for production, transformation and consumption.

Transformation

Electricity plants data may include some CHP plants operating in electricity only mode. And heat plants data may include some CHP plants operating in heat only mode.

In the 2018 edition, electricity production from **hydro** was revised back to the year 2000, in some cases only amounting to plant reclassification.

Data for heat produced from combustible fuels in heat only plants are available starting from 2012.

Electricity production from **geothermal** started in 2011 and stopped in 2012 due to the maintenance of the only plant.

From 2011, all **photovoltaic** plants with capacity above 1 MWp are considered as main activity producers, while all plants with capacity below that value are considered autoproducers.

Plants using **municipal waste** were reclassified as autoproducer CHP plants from 1995, which leads to a break in time series. Breaks in time series in 2005 for **municipal waste** and **solid biofuels** are caused by sectoral reclassifications.

Data on electricity production from **wind** is available from 1990.

Consumption

From 2012, the energy consumption is more detailed due to a new national survey.

Production and consumption of **industrial waste** are reported from 2013. Prior to that, they were included in **municipal waste**.

A revision of the **solid biofuels** and **biogases** time series created breaks in the direct use time series between 2004 and 2005.

The breakdown of the final energy consumption of **biogases** was estimated by the French administration from 1970 to 2003.

Germany

Source

Federal Ministry for Economic Affairs and Energy, Berlin.

General notes

Germany started to report injection of **biogas** in the natural gas grid in 2021 only. Previously, the biogas blended with natural gas was reported under biogas. For this reason, several energy flows dropped significantly in 2021.

In the 2020 edition, there was a revision of nearly all renewables data back to 2003, basically related to error correction and new information. This leads to a break in series between 2002 and 2003.

Starting with the 2020 edition, final consumption in the *agriculture* sector is now reported separately. Previously, it was included in *commercial and public services*.

Changes in the reporting system lead to breaks in time series between 1996 and 1997, 2002 and 2003, 2006 and 2007 and between 2010 and 2011.

Starting in 2008, **municipal waste** and **industrial waste** data were collected separately. This leads to breaks in the time series between 2007 and 2008.

Data from 2007 incorporates a new methodology for reporting heat. From 2007 onwards all heat production in autoproducers is considered as non-sold (i.e. for self-use). Therefore, inputs of combustible renewables and waste for heat production are no longer reported in the transformation sector and appear in final energy consumption, broken down by sector, in 2007. More information on district heat also became available in 2007, resulting in increased inputs to main activity heat plants starting in 2007. These issues combined to cause breaks in the transformation and final consumption time series between 2006 and 2007.

Data on **geothermal** heat production and direct consumption were revised by the German administration and are only available starting in 2003.

GDP figures prior to 1991 are based on conversions made by the German Institute for Economic Research (Deutsches Institut für Wirtschaftsforschung) and the former Statistical Office of the GDR (Statistisches Amt der DDR).

Supply

Trade data for **biogasoline** are available from 2004 and for **biodiesels** from 2003.

Transformation

From 2018 onwards, own use of electricity at main electricity **geothermal** plants includes electricity used for pumping.

For 2018, the increase in electricity output from **solar PV** was in part due to higher than average solar radiation during that year.

Industrial wastes are co-fired with other fuels for electricity production. For plants where multiple fuels are used for electricity production, capacities are reported under the dominant fuel.

Due to a reclassification of **wind** energy and **solar photovoltaic** in the official data of the German Federal Statistical Office since 2011, the production is now only reported under main activity producer plants.

Prior to 2003 electricity production in electricity plants includes production from CHP plants and heat production in CHP plants includes production from heat plants.

In some instances, electricity generation from **hydroelectricity**, **solar** and **wind** in autoproducer electricity plants are confidential or non-available and therefore are included in main activity producer electricity plants.

Consumption

Increased consumption of **industrial wastes (non-renewable**) in the *non-metallic minerals* sector in 2018 is related to increased cement production due to a high level of activity in the construction sector.

For **solid biofuels** consumption in the commercial and public services sector, new data were derived in cooperation with the Federal Research Institute for Rural Areas, Forestry and Fisheries by applying a different calculation approach based on the total demand for material and energy use of the resource wood in Germany. This had resulted in breaks in time series between 2013 and 2014.

Greece

Source

Ministry for Environment and Energy, Athens.

General notes

New information on **solid biofuels** is available from 1996 and leads to breaks between 1995 and 1996.

Data for **biofuels and waste** input and output to transformation are available from 1992.

Data for **biogases** are available from 1990 and data for **industrial waste** from 1992.

Supply

In 2020, **geothermal** production decreased greatly because wellness centres, reported in commercial and public services, did not operate fully because of the pandemic.

Transformation

In the 2020 edition, revisions for 1998 – 2017 of the indigenous production of **solar thermal** are the result of a revision of the latest data on **solar thermal** efficiency.

In 2018, the increase in efficiency at **industrial waste (non-renewable)** -fired Autoproducer CHP plants was due to increased generation of unsold heat.

The big increase in delivery of **industrial wastes** to autoproducer CHP plant in 2010 is mainly due to the opening of a new plant.

Inputs of **solid biofuels** to **charcoal** production are estimated for 2007 to 2010 by the IEA Secretariat assuming an efficiency of 40%.

Industrial waste used in autoproducer CHP plants decreased substantially in 2006 because a plant closed.

Consumption

Solid biofuels consumption in commercial/public services is included in residential until 2011.

The consumption of **solid biofuels** in the paper, pulp and printing industry is not available from 2003 to 2012.

Direct use of **geothermal heat** in residential is available starting in 2004.

Hungary

Source

Hungarian Energy and Public Utility Regulatory Authority, Budapest.

General notes

Data for **biogases** are available from 2000; for **industrial waste** from 2003; for **biodiesel** production from 2007.

Data for **wind** and **solar thermal** are available from 2001.

The Hungarian administration reclassified some of their plants between 1996 and 2000, which caused some breaks in the time series.

Supply

A 2012 change in **biogasoline** reporting methodology results in break in time series between 2011 and 2012.

Transformation

In 2019, some breaks in series occur for plants fired by **biogas** and **solid biofuels** due to changes in plant classifications, and CHP methodologies.

In 2017, a new **geothermal** power plant began operations.

For 2017 onwards, inputs and outputs from power plants are reported at a unit level, while for prior years, data are reported at a plant level. As a result, breaks in series are observed between 2016 and 2017. In particular, for heat output from **industrial waste** at autoproducer CHP and autoproducer heat plants.

For 2017, the decline in heat production from **industrial waste** is partly due to the reclassification of a main activity producer as an autoproducer.

In 2014, some CHP plants running on **Industrial waste** and **solid biofuels** produced only heat and were reclassified to heat plants.

From 2014 data, more data suppliers were involved in the process, causing new autoproducer time series to appear for **geothermal** and **industrial waste** plants.

Data on electricity and heat production from **solid biofuels** in autoproducer CHP plants are available from 1995.

Geothermal heat production from main activity producer heat plants is also available from 1995.

Consumption

In 2019, increased consumption in the non-metallic minerals sector for **solid biofuels** and **municipal wastes** is related to fuel switching from coal.

In the 2018 edition, the Hungarian authority has revised **solid biofuels** consumption in other sectors back to 2005 based on the new survey from Hungarian Central Statistical Office (HCSO). This resulted in break in series between 2004 and 2005.

A new reporting methodology for the direct use of **geothermal** energy was applied from 2014 resulting in break in time series between 2013 and 2014.

Data for direct use of **geothermal heat** are available from 1990.

Iceland

Source

National Energy Authority, Reykjavík.

General notes

In the 2023 edition, municipal waste was significantly revised according to new data coming from the Environment Agency of Iceland.

2021 **biodiesel** data are zero since the product was imported blended with fossil fuels products.

In the 2022 and 2023 edition, **geothermal** data related to the demand side of the commodity balance were revised starting from 2007. Therefore, data breaks might appear between 2006 and 2007.

In the 2022 edition, **biogas** data were revised starting from 2016. Data breaks may appear between 2015 and 2016.

In the 2022 edition, **biogasoline** data were removed since the product is imported blended with gasoline.

Energy industry own use of electricity refers mainly to the use of electricity by the **geothermal** industry to pump **geothermal** water from underground sources.

2013 is the first year of data availability for the supply and consumption of **solid biofuels**.

Supply

In 2020, **biodiesel** imports decreased because part of the imports were already blended with diesel.

Transformation

The rise in **heat** in 2018 is due to an increase in the number of residential and commercial connections to new and existing district heating networks.

The increase in **geothermal** electricity production in 2018 is due to a new 90MW power plant, half of which came online in 2017, and half in 2018.

From 2016 onwards, the decline in electricity production from *wind* is due to a combination of lower wind speeds and lower installed capacity.

Gross heat production from **geothermal** sources increased by 30% from 2015 to 2016. This is due to more accurate reporting from Reykjavik Energy about the temperature of delivered and returned water, rather than physical increases in

supply or generation. Revisions to historical data may be forthcoming in future editions

From 2013 data, the Hellisheidi **geothermal** power plant, previously reported under main activity electricity plant, was categorised as main activity CHP plant. This explains the leap between 2012 and 2013.

The increase in **hydroelectric** and **geothermal** electricity production and capacity between 2007 and 2008 is due to the expansion of the aluminium industry.

The use of **municipal waste** to produce heat is available from 1993 and stops in 2010.

In 2002, the increase of heat produced by **geothermal** was due to the installation of a third unit at the Nesjavellir CHP power plant.

In 1998, 60 MW of generating capacity was installed in the **geothermal** CHP plant at Nesjavellir. Since the plant was inoperable for four months, production of **geothermal heat** is almost same with 1997. The extra electricity capacity caused electricity production from **geothermal** to almost double over the same period.

Electricity production from **geothermal** sources in main activity producer CHP plants is available from 1992.

Consumption

In the 2022 edition, **biodiesel** consumption data were removed because the product was used blended with diesel.

Revisions in the direct use of **geothermal heat** from 2007 create breaks in time series between 2006 and 2007.

Biogases used for transport purposes were reported for the first time in 2007.

The **geothermal** consumption on industrial sector is reported under non-specified industry, as the Icelandic administration decided not to estimate the allocation amongst the sub-sectors of industry.

Ireland

Sources

Department of Communications, Energy and Natural Resources, Dublin.

Sustainable Energy Authority of Ireland, Cork.

General notes

Data for **municipal waste** are available from 2009.

Data for **solid biofuels** and **biogases** are available from 1990.

The **solid biofuels** capacity only refers to CHP. The electricity generated by **solid biofuels** from main activity producer electricity plants, refers to a 118 MW co-firing plant using milled peat and biomass. As the primary fuel is peat, this capacity is reported under peat.

Supply

In 2022 edition, **biogasoline** production figures were revised. The production started in 2017.

Bioethanol produced from whey appears for the first time in 2021.

In 2020, a new **biodiesel** plant began to produce.

In the 2019 edition, revisions were made by the Irish administration for the indigenous production of **solar thermal** for the years 2011 – 2016.

Due to increased demand from a second waste to energy electricity plant which began operation in 2017, indigenous production of **municipal waste** increased sharply starting in late 2017.

Prior to 2011, production and trade of **biogasoline** and **biodiesels** cannot be distinguished due to confidentiality issues.

Transformation

In 2022 edition, 2019 **solar PV** generation figures were significantly revised.

In 2020, **biogas** started to be blended with natural gas in the main network.

Starting in 2016, the increase of electricity production of **solid biofuels** is a result of a decarbonisation programme and comes from a plant which is co-firing peat and biomass.

In 2012 and 2013, the renewable fraction of tyre-derived fuel (12%) used by a cement plant was reported by the administration under **renewable municipal waste**; the non-renewable fraction (88%) was reported under **industrial waste**.

In 2012, a new main activity electricity plant burning **municipal waste** (the Meath plant) started operation

There is no **Pumped Hydro** capacity reported in 2010 and 2011 due to the fact that Ireland's pumped storage station, Turlough Hill, was taken offline for an over-haul late in 2010 and did not come back online until February 2012.

Electricity production from **wind** begins in 1992 and from **biogases** in 1996.

Consumption

In the 2022 edition, **biogas** consumption in the food, beverages and tobacco sector was revised.

The Biofuels Obligation Scheme places an obligation on suppliers of mineral oil to ensure that 8.695% (by volume) of the **gas/diesel oil** they place on the market in Ireland is produced from renewable sources, e.g. **bioethanol** and **biodiesel**. The obligation was increased from the 1st January, 2017, previously it was 6.383%.

Despite the Biofuels Obligation Scheme, **bioethanol** consumption decreased in 2017 because there was a reduction in overall motor gasoline use and fuel tourism.

Increases in **biodiesel** consumption in 2017 are related to the Biofuels Obligation Scheme and increases in road freight, which is heavily dependent on **diesel oil**.

The consumption of pure **biodiesel** in the industry sector and in the road transport refers to one site, which is no longer in operation since 2014.

Data for direct use of **solar thermal** heat are available from 1990.

Israel

Source

Israel Central Bureau of Statistics, Jerusalem.

General notes

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli administration. The use of such data by the OECD and/or the IEA is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

2022p data are estimated by IEA Secretariat.

Data on imports and consumption of **charcoal** are estimated since 1992 using data from the Forestry Production and Trade database from the Food and Agriculture Organization of the United Nations.

Data on production and consumption of **primary solid biofuels** are estimated since 2012 using data from the Forestry Production and Trade database from the Food and Agriculture Organization of the United Nations.

In the 2022 edition, the **wastes** commodity balances are reported starting from 2015. The values have been estimated based on the Israeli energy balance.

Transformation

In 2019, the 'Ashalim Solar Thermal Power Station' started to generate electricity. Starting from 2019, the electricity generation values reported in total main activity producer electricity plants, due to confidentiality reasons, represent only this plant. Please see the note below.

Starting from 2017 data, due to confidentiality reasons, electricity production reported under auto producer **wind** includes generation from main activity **wind,** total **hydro,** and autoproducer **biogases.**

For 2016 data, due to confidentiality reasons, electricity production reported under **solar PV** auto-producer electricity plants includes **hydro** and **wind** electricity generation.

Hydroelectricity production data for 2012 were estimated based on the previous years.

Electricity production from **wind** begins in 2001.

Consumption

Solar thermal production and direct consumption were estimated by the IEA Secretariat between 2012 and 2017, using data published in the IEA-Solar Heating and Cooling Programme Annual Report. These estimations may create breaks in time series between 2011 and 2012.

Italy

Sources

Gestore dei Servizi Energetici - GSE S.p.A., Rome.

General notes

San Marino and the Holy See territories are included.

The methodology of data collection for the **geothermal** sector changed in 2010, causing a break in time series between 2009 and 2010.

A change in methodology leads to breaks in time series for industry and transformation between 2003 and 2004.

Supply

Biogasoline includes bio-ETBE.

From 2014, a distinction between trade and production became available for other liquids biofuels.

Transformation

In the 2022 edition, electricity output from autoproducer **wind** was reported for the first time in several years due to a reclassification of the producer type.

In the 2022 edition, a **solid biofuels** CHP autoproducer plant was reclassified from autoproducer to main activity producer. This led to a decrease in input and output from CHP autoproducer plants in 2020.

In 2018, a new biomethane plant was installed leading to increases in **biogas** blending with **natural gas**.

For 2018, the decrease in electricity output from s**olar PV** was due to lower than solar irradiation.

2017 is the first year that **biogas** is blended with natural gas.

The methodology of data collection for **photovoltaic** electricity production changed in 2009 and the distinction between main activity and autoproducer plants could not be determined, causing a break in the time series.

In 2008, data for **biofuels and waste** were reclassified, which results in several breaks in the time series for transformation.

Heat production is reported starting in 2004 and includes self-generation in industry.

Up to 2003, **solid biofuels** capacity includes industrial waste capacity.

From 2000 onwards, the Italian administration defines electricity and heat production from autoproducers as generation from producers that consume more than 70% of their own electricity production. However, for the 2000 to 2002 period, all electricity production from autoproducers is reported with main activity producers.

Consumption

From 2018 data onwards, the increase in **biodiesel** demand is related to blending obligations.

The final consumption of **biogas** has been constant from 2013 to 2016 as these figures are the result of a survey which is not carried out annually.

In the 2016 edition, the methodology used to calculate **solid biofuels** consumption in the residential sector for 2002 to 2014 was updated and this created a break in time series between 2001 and 2002. This also affects the indigenous production of **solid biofuels**. The revisions were limited backwards to 2002 because of reliability issues.

Japan

Source

The Institute of Energy Economics Japan, Tokyo.

General notes

Okinawa is included in Japan statistics.
Starting in 1990, data are reported on a fiscal year basis. By convention, data for the fiscal year that starts on 1 April Y and ends on 31 March Y+1 are labelled as year Y.

In the 2023 edition, 2022p production data for biogasoline is 0 and bioethanol data make their first appearance. Historical bioethanol figures will be reported in the next publication.

In the 2019 edition, data for Japan were revised back to 1990 based on new methodology.

Solar collectors surface is estimated by the IEA secretariat back to 2003 consistent with current and past reports of the IEA Solar Heating and Cooling Programme “Solar Heat Worldwide”.

Consumption data for commercial/public services may include consumption in small and medium-size industries. The Japanese administration expects that this shortcoming be corrected in the near future.

There was a large revision in **municipal waste** data in the 2016 edition of this publication. This revision has removed data for **municipal waste** for the entire time series up to 2010, which create breaks in time series between 2009 and 2010.

For **municipal waste** data, the breakdown between renewable and non-renewable **municipal waste** is estimated by the IEA Secretariat.

Transformation

The split between electricity generation from onshore and offshore **wind** plants is not available. The entire generation is reported under wind onshore because the offshore capacity is only around 2% of the total wind capacity for the entire time series.

The Japanese Administrations attributes heat outputs (with the exception of heat from electric boilers) to individual fuels based on their share of inputs, assuming efficiencies are 100% or less. As a result, fuel-specific transformation efficiencies may not reflect actual efficiencies.

Electricity production from **mixed hydro** plants is not available and has been split between **pure hydro** and **pure pumped storage**.

The capacities of co-firing plants are reported under the dominant fuel.

Input data of **solid biofuels** to **charcoal** production are estimated by the IEA Secretariat assuming an efficiency of 40%.

Data on heat produced for sale by autoproducer heat plants are not available.

Electricity and heat produced in CHP plants are not included in the CHP data time series, but instead are reported as separate electricity or heat components.

Heat production from **geothermal** and **solar thermal** sources in Japan is not reported by the Japanese administration.

In the 2017 edition, the Japanese administration revised electrical capacity for combustible fuels back to 2003 creating breaks in time series between 2002 and 2003.

Due to the data availability, **municipal waste** plant generation capacity includes plants operating on **black liquor** since 2012. Prior to 2012, **black liquor** capacity was included under **solid biofuels** capacity.

Autoproducer **solar photovoltaic** capacity is derived from data from the Japanese administration as well as the IEA Photovoltaic Power Systems Programme (IEA-PVPS) report, “National Survey Report of PV Power Applications in JAPAN 2020“.

Large increases in 2016 of main activity electricity generation from **solar PV** and **wind** are due to reclassification from autoproducer status after liberalisation of the Japanese power market in April 2016.

The **industrial waste** consumption in the transformation sector (non-specified) surged in 2013, because of the increase in use of waste plastics for coke production.

Prior to 1998, the electricity produced using TRT technology (Top pressure Recovery Turbines) was included with electricity generated from **wood, wood waste** and other **solid waste**.

Data on electricity production from **wind** began in 1993.

Consumption

In the 2020 edition, there are revisions in the consumption of **solar thermal** in the *commercial and public services* and *residential* sectors in 1990 - 2004.

Korea

Source

Korea Energy Economics Institute, Ulsan.

General notes

Due to the change of reporting methodology, breaks in time series may occur between 2013-2014 and 2014-2015.

Prior to 2009, autoproducer heat production includes amounts of unsold heat.

Data for 2002 onwards have been reported on a different basis, causing breaks in series between 2001 and 2002, especially for inputs and outputs to electricity generation and consumption in the iron and steel industry. The Korean administration is planning to revise the historical series as time and resources permit.

Electricity statistics from 1971 to 1993 have been estimated by the IEA Secretariat based on the Korean National Statistics. Data from 1994 have been submitted by the Korean administration. This leads to breaks in time series between 1993 and 1994. Before 1994, electricity production from main activity producer CHP plants is included with main activity producer electricity only plants. Heat data are available starting in 1993.

Transformation

Inputs to autoproducer heat plants have been estimated by the IEA Secretariat because of efficiency issues for **municipal waste** prior to 2011 and in 2012 and for **biogas** in 2008, 2011 and 2012.

New plants were included in the Korean survey creating breaks in time series in 2011.

In 2007, some main activity heat plants and autoproducers in the commercial/public services sector were reclassified as main activity CHP plants, resulting in a break in the time series between 2006 and 2007 for **biogases**.

Prior to 2007, the consumption of **landfill gas** in main activity CHP plants may have been included in main activity heat plants. Difficulties in ownership classification are also the reason **landfill gas** data only appears one time in the commercial and public services sector in 2006.

Between 1993 and 1999, the breakdown of heat output by type of fuel was estimated by the IEA Secretariat. In 2000, the Korean administration started to report heat statistics for some heat plants which were not reported before.

Consumption

Data for direct use of **geothermal heat** are available from 2002. **Geothermal** direct use data are overstated as it refers to heat production by **geothermal** heat pumps, which include inputs of electricity and/or gas in the transformation process.

Latvia

Source

Central Statistical Bureau, Riga.

General notes

Data for Latvia are available starting in 1990. Prior to that, they are included in Former Soviet Union in the publication of *World Energy Statistics*.

Supply

For 2018 data, the increase in the indigenous production of **solid biofuels** is due to wood pellet production.

For 2017, higher rainfall resulted in a significant increase in electricity output from **hydro,** and a decrease in both imports of electricity and output from **combustible fuels**.

In 2017, a **biodiesel** producer exported amounts produced in 2017 and also some amounts from stocks.

Transformation

Heat production from **solid biofuels** has increased in 2021 due to a colder heating season. Moreover, many heat producers have increased their input of biofuels compared to other fossil fuels.

In 2019, the first large-scale main activity **solar thermal** district heating plant opened in Latvia.

From 2012 to 2015, electrical capacity of **solar photovoltaic** was not reported, because capacity was under 0.5 MW. For the same reason, electrical capacity of **biodiesel** for 2010 to 2015 was not reported.

From 2012 onwards, the increase in electricity production from **solid biofuels** is due to the deployment of six new main activity producer CHP plants running on **wood chips**.

From 2010 - 2012, electrical capacity of **biodiesel** was not reported, because capacity was under 0.5 MW.

Due to a reclassification in 2004, there was break in time series of electricity production from autoproducer electricity plant fuelled by **biogas** between 2003 and 2004.

Consumption

The increase in inland consumption of **biodiesel** in 2018 data are related to the implementation of favourable legislation (the “Biofuel Law”).

From 2014 to 2017, **biodiesel** consumption has been decreasing due to policies which support the sale of arctic diesel fuel without renewable additives.

Lithuania

Source

Statistics Lithuania, Vilnius.

General notes

In 2019, the increase in the indigenous production of **industrial waste (non-renewable)** is the result of increased data availability.

Data for Lithuania are available starting in 1990. Prior to that, they are included in Former Soviet Union in the publication World Energy Statistics.

Supply

The production of **charcoal** has been over-estimated prior to 2017 due to the fact that it was not possible to report data less than 1 kt.

Starting from 2016, some **industrial waste (renewable)** was collected via sorting. These wastes consist of non-recyclable paper, textiles and wood wastes and their production is included in **solid biofuels**.

Transformation

In 2020, the *Kaunas Cogeneration Power Plant*, which produces energy from **industrial** and **municipal waste**, became operational. This led to an increase of heat and electricity generated from these products.

In March 2017, the *Geoterma* **geothermal** heat plant, the only geothermal heat plant in Lithuania, closed down.

The *Fortum Klaipėda* CHP plant produces electricity and heat from **industrial waste (non-renewable)**, **municipal waste** and **solid biofuels** since the end of 2013. Since its inception, structural optimisation has been sought. Additionally, before 2016, calorific values of the fuels were calculated by taking samples of fuels and after this period, calculations were made from steam. For these reasons, there are fluctuations in fuel inputs, energy production and fuel ratios between **industrial waste (non-renewable)**, **municipal waste** and **solid biofuels** since 2013.

In 2013, an incinerator combusting **industrial waste (non-renewable)** and **municipal waste** began operations.

Luxembourg

Source

STATEC, Institut national de la statistique et des études économiques du Grand-Duché du Luxembourg, Luxembourg.

General notes

There was a fire at the co-digestion plant Itzig in September 2018. The plant was not reopened until October 2019, causing a decrease in **biogas** production (specifically: **other biogases from anaerobic fermentation**).

Most of the **hydro** production shown for Luxembourg is from the Vianden **pumped storage** plant and is exported directly to Germany.

The Luxembourgian administration started including trade figure of **wood chips** in trade figure of **Solid biofuels** from 2015 data. This creates breaks in time series between 2014 and 2015.

Data for **solar thermal** are available starting in 2001 and for **solar PV** starting in 2000.

Data on **solid biofuels** are available from 1992.

Supply

In 2015, imports and exports of **solid biofuel** figure includes the trade of wood chips**.**

Transformation

In the end of 2018, there was a fire in one of the main **biogas** plants and it has been off for most of 2019. The most notable effect has been on biogas blending.

There were some repairs on the upper basin of the **pumped storage** site at Vianden in 2019 leading to a reduction in electricity production. The full storage capacity was not available during this period.

The production of electricity from **solid biofuels** from 2013 corresponds to the opening of a new plant burning **wood wastes**.

In 2011, the blending of **biogases** with **natural gas** started.

Data on electricity production from **biogases** are available from 1998 and heat production from 2010.

Consumption

In the 2023 edition, values for **ambient heat** in the Residential sector were revised back to 2013 due to a new data source.

Mexico

Source

Secretaría de Energía (SENER), Mexico City.

General notes

2021 and 2022p data were estimated by the IEA Secretariat.

The Mexican administration believes the fuels categorised as **industrial wastes (non-renewable)** are likely residual gas. More investigation is needed.

The Mexican administration submitted data directly by questionnaire for the first time with 1992 data. As a result, some breaks in time series may occur between 1991 and 1992. For prior years, data are partly estimated based on the publication Balance Nacional - Energía.

Supply

Prior to 2017 data, some **bagasse** production has been attributed to **other vegetal materials and residues**. This causes a break in series between 2016 and 2017. Revisions prior to 2017 are expected in the future.

Data for **bagasse** production is available from 2008.

Data on the production of **sewage sludge gas** are available from 1997.

Transformation

In the 2022 edition, **solar PV** capacity data for 2019 and 2020 and **wind** capacity for 2020 were estimated by the IEA Secretariat.

The decrease in electricity produced from **wind** in 2017 data is due to an earthquake which damaged infrastructure in the south of the country.

Electricity production from **solid biofuels** and **biogases** data are available respectively from 1991 and 1997.

Data on electricity production from **wind** and **solar photovoltaic** are available from 1990.

In 2012, a main activity **solar photovoltaic** power plant has been commissioned and so electricity production data can be seen in the relative tables.

Consumption

Increased consumption in the industry and transformation sectors for **solid biofuels** in 2017 is attributed to **bagasse**.

Data for **solid biofuels** used in autoproducer electricity plants from 1991 to 2005 have been estimated by the Mexican administration.

Data on **biogases** consumption are available from 1997.

Direct use of **solar thermal heat** is available from 1990.

Netherlands

Source

Statistics Netherlands, The Hague.

General notes

Suriname, Aruba and the other former Netherlands Antilles (Bonaire, Curaçao, Saba, Saint Eustatius and Sint Maarten) are excluded.

Statistics Netherlands has conducted reviews and revisions of their energy balance three times; in 2005, 2011 and 2015. The 2005 revisions were to improve basic energy statistics, particularly with respect to carbon and CO_2 reporting, while the 2011 revisions were part of a harmonization program with international energy statistics. The 2015 revisions were the result of increased data collection, availability of new source information, and further alignment with international energy definitions. More details are available here: www.cbs.nl.

Supply

Increases in **biodiesel** production for 2017 are related to increased capacity of existing plants and increased demand.

From 2009 to 2012, and again from 2014 the production and trade of pure **biogasoline** were confidential; net imports were estimated by the Dutch administration based on consumption.

Trade data for **municipal waste** are available from 2011.

Transformation

Solid biofuels electricity plants load factor may be greater than 100% because this product is used also in coal power plants whose capacity is not considered as solid biofuels.

In 2020, two large **wind** off-shore plants became operational.

Data on electricity and heat output from **industrial waste** are available from 2019. Historical revisions are pending.

The imports of **wood pellets** are up in 2018 due to the renewed subsidy for co-firing of biomass at energy plants.

For 2018, the increase in electricity output from **solar PV** and autoproducer electricity plants is in part due to the inclusion of **solar PV** on industry surveys.

For 2018, the declines in heat generation from **municipal waste**, and heat used for electricity generation, and the increase in electricity output from municipal waste, are due to a change in ownership of a company which sold heat.

In 2017, the increase in heat production from **solid biofuels** in main activity CHP plants is because there were two additional companies reporting data.

All **municipal solid waste** autoproducer electricity and heat only plants have been reclassified by Statistics Netherlands as autoproducers CHP from 2012, causing breaks in the time series.

Prior to 2008, a few small autoproducer electricity plants using **solid biofuels** were included with main activity plants for reasons of confidentiality.

In 2006, for **municipal waste** some plants changed ownership and were reclassified from electricity only to CHP plants as they started heat projects.

For **biofuels and waste**, all electricity and heat produced prior to 1995 is included in CHP plants.

Electricity production from **solar photovoltaic** is available from 1990.

Heat produced from **biofuels and waste** is available from 1990.

Consumption

In the 2020 edition, there was a revision from 1990 to 2017 of the consumption of **solid biofuels** in the residential sector.

In 2018, there were four new **geothermal** installations producing heat which warmed greenhouses. As in the past, these would be categorised in the agriculture/forestry sector.

From 2014, a better allocation of heat own use was available for **biogas** digester prewarming, and in **municipal waste** burning plants for flue gas cleaning.

The final consumption of **solid biomass** in the residential and agriculture sector increased in 2014 due to the results of new surveys and parameters.

Direct use of **geothermal heat** in agriculture/forestry starting in 2008 is due to a new project extracting deep **geothermal heat.** The heat produced has been used for heating greenhouses.

New Zealand

Source

Ministry of Business, Innovation and Employment, Wellington.

General notes

In 2023 edition, 2022p data are a result of a new data collection methodology. Historical time series may be revised in next editions.

In the 2022 edition, extensive revisions related to **solid biofuels** use in the wood and pulp and paper industries were made. This saw the reallocation of some use from final consumption to autoproducers, in particular **black liquor** which had previously been included in final consumption.

In the 2020 edition, extensive revisions were made for the time series back to 1990. The majority of the revisions were related to transiting the New Zealand data system from excel based to R based. For **solar PV**, the source data, Electricity Market Information, changed their entire time series.

For the 2019 edition, the New Zealand administration submitted extensive revisions back to 1990 following an internal review of their systems and methodologies.

Due to improved wood data collection starting with 2016 data, increases in **solid biofuels** in transformation, supply and consumption may not be a true increase but more representative of increased data survey respondents. This results in a break in time series between 2015 and 2016.

Prior to 1994, data refer to fiscal year (April 1993 to March 1994 for 1993). From 1994 data refer to calendar year.

Transformation

In the 2022 edition, data on electricity production from **geothermal** were significantly revised by the New Zealand administration following an internal review of systems and methodologies.

In the 2019 edition, data on electricity production from **biogases** were significantly revised by the New Zealand administration following an internal review of systems and methodologies.

Electricity production from autoproducer **geothermal** plants data is available from 1990.

The New Zealand administration has updated efficiencies for electricity production from **geothermal heat** from 10% to 15% from 1990 onwards; this causes a break in the time series between 1989 and 1990.

Consumption

In the 2020 edition, the repetition of data is an estimate by the New Zealand administration for the consumption of **biogases** in the *food, beverages and tobacco* sector for the years 1990 to 2018 due to unavailability of data. The same is true for the consumption of **biogases** in the *commercial and public services* sector from 2007 to 2018.

In the 2018 edition, **electricity** consumption generated by autoproducer electricity and CHP plant in the *Commercial and public services* sector for 2002 to 2016 have been estimated by the IEA Secretariat, based on revised biogas data, submitted in the Renewables and Waste questionnaire.

Data on direct use of **geothermal heat** are available from 1990 and direct use of **solar thermal heat** from 2002.

Norway

Source

Statistics Norway, Oslo.

General notes

Some of the data reported under **solid biofuels excluding charcoal** includes **charcoal**. Efforts are being made by the Norwegian administration to separate this data in the future.

In the 2018 edition, data for Norway were revised back to 2010, following the introduction of a new system for energy balances and energy accounts. Breaks in series may appear between 2009 and 2010 as a result. For more detailed information regarding the methodological changes, please refer to the documentation of statistics production since statistics year 2010 on the Statistics Norway website. At the time of writing, the document was available in Norwegian as “Dokumentasjon av statistikkproduksjonen fra statistikkår 2010 og fremover”.

Prior to 2007, equal shares of renewable and non-renewable **municipal waste** were estimated because the actual split was not known.

Data for **industrial waste** and **biogases** are available from 1991.

Supply

The data for the indigenous production of **biogases** is based on consumption data.

Liquid biofuels imports data are available starting in 2006.

Transformation

In the 2022 edition, the electricity generation from **solar PV** includes only the part delivered to the grid. The electricity generated for self-consumption of grid-connected and off-grid installations, which is estimated to be around 80% of the total, is not reported. In addition, the administration does not have detailed information on solar PV capacity plant sizes and report everything on the <20 kW tier because is the type of installation most used. The administration will revise this data in future editions.

Increased heat production from **biogases** and **other liquid biofuels** in 2018 is related to replacing fossil fuels.

For 2017, the apparent increase in heat output from **solid biofuel**-fired Main CHP plants is due to a plant reclassification.

Breaks in the time series between 1996 and 1997 and between 2001 and 2002 and now 2009 and 2010 are due to a reclassification of main activity producers and autoproducers. This includes the apparent cessation of autoproducer pumped hydro and hydro electricity generation since 2010, where this generation has been reclassified as main activity in the 2018 edition.

In the 2016 edition, Norway corrected the **industrial waste** consumption in heat plants, and reclassified some the corresponding heat output under other sources.

For 2003 to 2009, estimates of **solar thermal collector** capacity were made by the IEA Secretariat using data published in the IEA-Solar Heating and Cooling Programme Annual Report.

Heat production from **biogas** data are available from 1995.

Electricity production from **wind** data are available from 1993.

Consumption

Since January 2020 it is required that **bio jet kerosene** makes up 0.5 per cent of the total fuel used in aviation. However, these figures are available from 2021 onwards.

Distribution losses for **biogases** are included in commercial/public services prior to 2003.

Poland

Source

Central Statistical Office, Warsaw.

General notes

In the 2022 edition, **solid biofuels** data was significantly revised for 2018 and 2019. This creates a data break between 2017 and 2018.

Several breaks in the **industrial wastes** time series are caused by difficulties in the classification of wastes.

In the 2018 edition, **solid biofuels** were corrected for 2015 data.

There is a break in time series between 2015 and 2016 for **biogases** due to re-classification from autoproducer to main activity plants.

The increases in **municipal wastes** starting in 2016 are related to two new plants.

Data on **biodiesels** are available from 2005, **biogasoline** from 2003, and **other liquid biofuels** from 2009.

In 2008, a new questionnaire was launched which increased the coverage of renewable and waste data.

In 1993 and 1995, new estimation methodologies were used for **solid biofuels** data and this creates a break in time series between 1992/1993 and 1994/1995.

Supply

Under current Polish law, only producers and importers of **biodiesel** are obliged to fulfil the National Indicative Target of share of biofuels in the total usage of transportation fuels. Since the regulation is currently not applied to retail distributors they, for economic reason, rather export the **biodiesel** than sell it domestically. This results in low domestic consumption and increase of exports in 2016.

Production of **other liquid biofuels** increased in 2015 because new companies started to report their biofuel production to the Polish administration.

Transformation

Industrial waste is used as a secondary fuel in plants to generate electricity (co-firing). For this reason, electricity generation data is reported but not industrial waste capacity. Also, **solid biofuels** are used in plants which primary fuel is bituminous coal. This leads to capacity factor greater than 100%.

For 2019, the increase in electricity output from **industrial waste** was in part due to the opening of a new waste-to-energy plant in late 2018.

In 2017, heat production from autoproducer CHP and heat plants burning **municipal wastes** increased due to two new plants.

For plants where multiple fuels are used for electricity production, capacities are reported under the dominant fuel.

In 2019, electricity output from **solid biofuels** increased following the introduction of a new state support scheme. State support for biomass co-firing was reduced in 2016, resulting in electricity production from **solid biofuels** falling during this period.

In 2008, a number of CHP plants were reclassified from autoproducer to main activity producer due to an industry re-organisation.

Prior to 2010, heat supply and consumption can include autoproducers unsold heat. Previous attempts to address such issue may have caused breaks for heat production and fuel in autoproducer heat plants (1993) and in autoproducer CHP plants, and for heat consumption in industry sub-sectors.

Before 2000, industrial wastes were used interchangeably with light fuel oil in some plants, which might result in breaks in the time series.

Consumption

The decrease in the consumption of **biodiesel** in the road sector in 2017 is related to an unfavourable pricing scheme on the domestic market, causing consumers to choose **diesel** and producers to export or blend the **biodiesel** they produced.

The consumption of **solid biofuels** in non-metallic minerals decreased in 2017 because modern clinker ovens have been replacing **solid biofuels** with **municipal wastes**.

Increases in consumption of **biodiesel** in 2016 are related to a policy change in the middle of the year.

Data for **biogases** refer only to the gas from fermentation of biomass.

Data for direct use of **geothermal heat** are available from 2000 and direct use of **solar thermal** heat in commercial/public services from 2002 and in residential from 2009.

Until 1998, data for **industrial waste** include **other recovered gases** which have to be reported in Coal questionnaire, causing a break between 1997 and 1998.

Between 1992 and 1993, due to data availability, there is a large increase in **solid biofuels** for residential, commercial/public services and agriculture/forestry.

Portugal

Source

Direcção Geral de Energia e Geologia, Lisbon.

General notes

The Azores and Madeira and Madeira are included.

The production capacity of **other liquid biofuels** for the years 2006 to 2012 are estimated by the Portuguese administration.

Data are available from 1994 for **biogases**, from 1999 for **municipal waste** and from 2003 for **industrial waste**.

Data for **solid biofuels** were revised by the National administration from 1990 to 2001, which may result in breaks in time series between 1989 and 1990.

Transformation

In 2020, an off-shore **wind** plant was installed.

The large decrease in electricity output from **hydro** in 2017 is due to decreased rainfall.

For 2016 data onwards, **heat** and **electricity** production from chemical sources have been reclassified as autoproducer CHP production from **industrial waste**, causing breaks in the industrial waste time series between 2015 and 2016.

The power station that burns **industrial waste** started to work as a CHP plant in 2007, whereas previously it was only producing electricity.

In 2007, some power plants that were previously reported as main activity CHP have been reclassified as autoproducer CHP.

New plants fuelled by **solid biofuels** and by **municipal waste** started in 1999.

Data for production of electricity from **solar photovoltaic** and **wind** are available from 1989.

Consumption

The use of **biogasoline** for blending decreased with 2017 data because it is no longer compulsory to use biofuels in gasoline.

Data on **solid biofuels** were further revised based on a new survey on industry, resulting in breaks in sub-sectoral consumption for 2012.

Between 2009 and 2010 a new survey on energy consumption in households creates a break in time series in the **solid biofuels** consumption in residential time series.

Data for direct use of **solar thermal heat** are available from 1989 and direct use of **geothermal heat** from 1994.

Slovak Republic

Source

Statistical Office of the Slovak Republic, Bratislava.

General notes

The Slovak Republic became a separate state in 1993 and harmonised its statistics to EU standards in 2000. These two facts lead to several breaks in time series between 1992 and 1993, and between 2000 and 2001.

Data for **solar photovoltaic** are available from 2010.

Prior to 2001, the data reported as **industrial waste** include **biogases** and **municipal waste**.

Transformation

Starting from 2020 **municipal waste** use in autoproducer electricity plants and autoproducter heat plants isreported under autoproducer CHP.

Starting from 2019, the efficiency of heat production using **biogas** at main activity plants is far below the expected range. The Slovak Administration is investigating these issues. Revisions are pending.

Electricity and heat production from combustible fuels from 1990 to 2000 have been estimated based on the data on fuel used for electricity and heat plants reported in the annual fuel questionnaires.

Prior to 2001, electricity generation from primary **solid biofuels**, municipal **waste** and **biogases** are included with **industrial waste**.

Consumption

Consumption of **solid biofuels** in the *commercial and public services* sector increased because there were many new reporting units.

Data for direct use of **geothermal heat** are available from 2001 and direct use of **solar thermal heat** from 2005.

Slovenia

Source

Statistical Office of the Republic of Slovenia, Ljubljana.

General notes

Data for Slovenia are available starting in 1990. Prior to that, they are included in Former Yugoslavia in World Energy Statistics.

A new energy data collection system was implemented in January 2001, causing some breaks in time series between 1999 and 2000.

Supply

Solar PV autoproducer electricity production in Slovenia contains from 2019 onwards the share of self-consumption from Residential and Commercial and public services. This has not been the case between 2015 and 2018.

Consumption

For 2020, the direct use of **geothermal** heat decreased because of the temporary closure of health resorts and thermal recreation centres due to the pandemic. The pandemic almost completely stopped the spa-thermal-tourism activity in mid-March 2020 and significantly reduced its activity for a significant part of the year.

Increases in consumption of **biodiesel** starting from 2017 are the result of an amended energy policy, which went into effect in mid-2017.

The break in time series between 2008 and 2009 for **solid biofuels** is due to revisions based on a new household survey which is to be carried out on an annual basis.

Direct use of **solar thermal** and **geothermal heat** is available from 2009.

Breaks in total final consumption for **industrial waste** prior to 2008 are a result of a sectoral reclassification.

Spain

Source

Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO).

General notes

Spain statistics includes the Canary Islands.

In the 2023 edition, revisions of the historical time series of **biofuels, heat pumps solar thermal** and **wastes** were revised thanks to the availability of new data.

In the 2022 edition, revisions of the historical time series of final energy consumption sectors were carried out. In particular **geothermal**, **solid biofuels**, **biogas** and **wastes** were revised thanks to the availability of new studies. This leads to data breaks in the time series.

New reporting systems were implemented in 2000 and again in 2006 which resulted in a reclassification of many plants from main activity to autoproducer and vice versa. This leads to breaks in the time series for the transformation sector and final consumption sectors between 1999 and 2000 and again between 2005 and 2006.

The Spanish administration verifies that production and consumption of **industrial waste (non-renewable)** existed from 2001 - 2008 but data are not available. Prior to 2008 data, **industrial waste (non-renewable)** data were included with **solid biofuels**. A revision of the historical time series is expected in the future.

Prior to 2018 data, **other liquid biofuels** data were included with **solid biofuels**. A revision of the historical time series is expected in the future.

Transformation

In 2021 consumption of solid biofuels in MAP electricity increased due to a new plant becoming operative.

In the 2022 edition, thanks to a split of paper **industrial waste** between renewable and non-renewable, some units reports industrial waste in electricity autoproducers. For this reason, in 2020 the electricity generation increased greatly. In addition, in 2020 a CHP plant reported generation from hydrogen produced through membrane systems using salt water reservoirs. This product has been allocated to industrial waste since non-renewable electricity is used. For 2023 edition, it has been reported as “other sources”.

In the 2022 edition, **hydro** and **biogases** capacity data was revised due to the availability of new studies. In addition, the **solar collector** surface was revised thanks to a change in the administration methodology. In the new procedure, the old units decomissioning, considering a 20-year lifetime, is now taken into account.

In 2019, electricity production from autoproducer **solar** increased due to implementation of a new regulation incentivising prosumption.

In the 2020 edition, electricity generation for **wind** was revised from 1998 – 2017.

2017 is the first year that data are available for the blending of **biogas** with natural gas. An update to the time series is expected in the future.

Based on studies from the Institute of Cork, Wood and Charcoal (IPROCOR), the efficiency of **charcoal** production plants is assumed to be 20%.

Since January 2013, the tax exemption for biofuels has expired, and the mandatory **biodiesel** blending target has been reduced from 7% to 4.1%, causing a significant decrease in the amount of pure **biodiesel** sent to blending.

From 2013 data, a revision of the industry sector of some companies causes breaks in time series for **solid biofuels**, **municipal wastes** and **biogases**.

A reclassification of plants from main activity to autoproducer in 2008 has led to breaks in electricity production between 2008 and 2009.

The National Energy Commission reclassified plants that consume **biogases**, leading to breaks in time series between 2007 and 2008.

Data for electricity from **solar thermal** plants are available from 2007.

Prior to 2006, inputs of **biogases** used to generate process heat by autoproducers were included as inputs to transformation when they should have been reported in the appropriate industry in final consumption.

From 2005, residential rooftop **solar photovoltaic** electricity production data are included in main activity electricity plants according to the Spanish administration classification; previously they were reported under autoproducer.

Electricity production from **wind** and **solar** are reported from 1989 when data became available.

Consumption

In the 2022 edition, concentrated **solar** energy applications for thermal uses were included in the final consumption sectors.

Increased consumption of **biofuels** from 2016 to 2017 is a result of increased demand for motor gasoline/diesel.

Prior to 2006, inputs of **biogases** used to generate process heat were erroneously included as inputs to transformation when they should have been reported in the appropriate industry in final consumption.

The breakdown of **solid biofuels** direct use in the industry sector prior to 1999 is not available.

Data for direct use of **geothermal and solar thermal heat** are available from 1990.

Sweden

Sources

Statistics Sweden, Örebro.

Swedish Energy Agency, Eskilstuna.

General notes

In the 2022 edition, the administration adopted a new data source for energy consumption in industry. This has caused breaks in the time series and the presence of new flows in 2020 in particular for **solid biofuels**, **other liquid biofuels** and **biogases**.

New data in the 2020 edition for **biodiesel** in *industry, transport* and *other sectors* for 2005 – 2017 are related to a new survey.

There are some breaks in time series between 2015 and 2016 in **pumped hydro**, **industrial waste** and **other liquid biofuels** figures due to the lack of data. The figures are expected to be modified in the 2018 edition.

From 1990 to 2006, **municipal waste** was reported as 60% non-renewable and 40% renewable. In 2007, reanalysis of the waste revealed the content was 40% non-renewable and 60% renewable. This was reanalysed again starting from 2016 data, when the result of the analysis revealed the split should be 52% renewable and 48% non-renewable. This results in breaks in the time series between 2006 and 2007 and also 2015 and 2016 for both renewable and non-renewable **municipal waste**.

In the 2018 edition, data for **biodiesels** were revised from 2006 to 2015 while **biogasoline** and **bioethanol** were revised from 2005 to 2015. The revisions affected indigenous production due to increased information about net trade, as well as the transformation sector, for blending with motor gasoline/diesel/kerosene and consumption in the road sector.

Supply

In the 2022 edition, for **industrial waste** data the administration adopted the figures from the survey “Quarterly Fuel Statistic“ while in the past the “Energy use in manufacturing industry“ was used. This led to a break in the time series between 2019 and 2020.

Due to a change of tax regulations in 2017, it was no longer profitable to produce fatty acid methyl ester (FAME) in the same capacity as before, so there was a

drop in **biodiesel** production. This drop in production was substituted by imports to meet increased demand.

In the 2019 edition, trade data for **municipal wastes** was included starting with 2002 data.

In the 2018 edition, trade data were added for **primary solid biofuels** starting from 2012. As the net trade used to be reported together with indigenous production, this has resulted in a downward revision of indigenous production for 2012 – 2015.

Transformation

In the 2022 edition, electricity generation from **industrial waste** is reported but no capacity installed is shown. This is because industrial waste is a secondary product used in other non-specified plants.

In the 2022 edition, **biogas** blended in the main gas grid is reported for the first time.

For 2017, electricity production and capacity for **hydro** plants are reported according to a revised methodology. As a result, breaks occur between 2016 and 2017. Prior to 2017, the production and capacity of **mixed hydro** plants are split between **pure hydro** and **pure pumped storage**. Historical revisions are pending.

Heat production from **solid biofuels** in autoproducer CHP includes waste heat and chemical heat.

For 2012 and 2013, small quantities of **bio-methanol** used to produce electricity are included in **other liquid biofuels**, under production, as well as input and output of autoproducer CHP.

Prior to 1992, data on electricity production from **biogases** are included with **solid biofuels**.

Consumption

In 2023 edition, several final consumption flows are confidential. However, their total value is reported in the flow not elsewhere specified thus the reported total final consumption is correct.

In the 2022 edition, **industrial waste** consumption in the industry sector non-specified flow appears for the first time. Disaggregated data will be available in future editions.

In the 2021 edition, there are revisions in the consumption of **solid biofuels** in the agriculture/forestry sector starting in 2005 resulting in a break in series between

2004 and 2005. These revisions remove double counting with the residential sector.

Increased consumption of **biogases** in the industry sector in 2018 was because several industries switched from **natural gas** to **biogases.**

Changes in tax regulations as of 1 July, 2018 has contributed to decreased consumption of **biodiesel** in 2018 data.

Due to confidentiality issues, **solid biofuels** consumption in food, beverages and tobacco is reported with paper, pulp and printing for 2014 data.

Consumption data by sector for **biogases** are available from 2011.

In 2011, there was a change in the reporting methodology for consumption of **solid biofuels and waste** in the residential sector, which is responsible for breaks in concerned time series between 2010 and 2011.

Data on direct use of **solar thermal** are available from 1989.

For **biogases**, the *residential* sector is used as a residual.

Switzerland

Sources

Swiss Federal Office of Energy (SFOE), Ittigen.

Carbura, Swiss Organisation for Stockholding of Liquid Fuels, Zurich.

General notes

From 1999, data on consumption result from a new survey and are not comparable with data of previous years.

Supply

Due to favourable taxation in Switzerland, the imports of **biodiesel** and **bioethanol** intended to be blended with oil products increased significantly from 2016 to 2017.

Due to a new program launched in September 2014 in which CO2 emissions due to traffic can be compensated by substituting fossil gasoline and diesel by biofuels, the imports and road consumption of **biodiesels** and **biogasoline** increased sharply starting in 2015.

Transformation

For 2020, the drastic decrease of **landfill gas** production is due to the shutdown of a plant.

In the 2020 edition, some significant revisions were made to input of **industrial waste (non-renewable)** to autoproducer CHP plants, for 2013 to 2015, because one plant operator corrected its fuel input.

The capacity reported for **biogases** only refers to the sum of capacities of **landfill** and **sewage sludge gas**.

In 2016, two new **pumped hydroelectric** plants went into operation.

In 2015, the big decrease seen in electricity and heat production from **industrial wastes** is due to one large main activity CHP plant significantly reduced their activity. In 2016, this plant was fully shut down.

From 2012, the **municipal waste** autoproducer plant previously reported as electricity plant met the CHP requirements and was reclassified as such.

Biogas is no longer being used for heat production as of 2011.

The autoproducer heat plant that produced heat for sale using **municipal waste** was closed in 2006.

Electricity production from **wind** data are available from 1996 and from 1990 for **solar photovoltaic**.

Consumption

Starting in 2018, several agricultural **biogas** plants installed a system to measure heat production. Previously, it was estimated. Due to measurements, they realised they produce much more heat than estimated. This creates a break in series between 2017 and 2018 data.

Consumption data for **biogases** in the transport sector are available from 1996 to 2012 as a **biogas** fuel station had stopped selling **biogas** in 2013.

Data for direct use of **geothermal heat** and **solar thermal heat** are available from 1990.

Turkiye

Source

Ministry of Energy and Natural Resources *(Enerji ve Tabii Kaynaklar Bakanlığı)*, Ankara.

General notes

The Turkish administration only intermittently surveys **renewables and waste** used for power and heat. Due to this fact, some breaks may appear in the **biofuels and waste** time series.

In the 2006 edition, the Turkish Statistical Office started providing electricity and heat output on the basis of a new survey that revised time series back to 2000. This causes breaks in the time series between 1999 and 2000. Not all of the input time series have been revised.

In 1995, the Turkish administration reclassified auto-producer plants by type and source to be consistent with IEA definitions. This caused breaks between 1994 and 1995 for electricity production.

Transformation

Biodiesel blending with **diesel** increased in 2018 because there was a new policy requiring that **diesel** be blended with 5% **biodiesel**.

In 2017, the increase in electricity production from **solar PV** main activity producers is related to new plants coming online, mostly unlicensed.

In 2017, the increase in electricity production in main activity producers burning **solid biofuels** is related to new plants.

Data on electricity generated from **biofuels** are available from 1991.

Electricity production from **wind** is available starting in 1998.

Consumption

Starting with 2018 data, new sub-sector data in the industry sector for **industrial waste (non-renewable)** and **solid biofuels** is available as a result of a new survey. Backward revisions will not be available in the future.

Prior to 1998, consumption in the **wood and wood products** sector includes that of the paper, pulp and printing industry.

United Kingdom

Source

Department for Business, Energy and Industrial Strategy (BEIS), London.

General notes

In 2023 edition, the large revision shown in **solar thermal** 2022p data is due to a change of methodology. The time series will be revised back to 2008 in the next publication.

In 2023 edition, **municipal waste**, **primary solid biofuels** and **biogases** 2022p data are revised due to a change in sectoral allocation methodology. The data break will disappear once 2021 will be revised in the next publication.

In 2023 edition, all series for **industrial waste** have been back corrected to 2008.

In the 2022 edition, **solid biofuels** data have been revised from 2008. Domestic wood consumption has seen a significant downward revision following a survey undertaken by the UK's Department for the Environment, Food, and Rural Affairs (Defra).

In the 2022 edition, **industrial waste** data have been revised starting from 2018. For this reason, data breaks appear between 2017 and 2018.

In the 2021 edition, revisions from 2015 onward in **municipal wastes** reflect a reclassification from **non-renewable** to **renewable** based on the renewable portion of tires.

In the 2017 edition, the UK government revised the data time series for **municipal waste** and **solid biofuels** back to 2001. As a result, breaks in time series may occur between 2000 and 2001.

The launch of a feed-in-tariff scheme in April 2010 resulted in a rapid increase of capacity and corresponding electricity production growth from **solar PV** in the following years

Supply

In the 2022 edition, **pellets** data have been revised from 2009 following an investigation into the data.

In 2009, the **biogasoline** production was above the reported production capacity. This is due to the fact that the capacity had reduced at the end of the year, due to closure.

Transformation

In 2023 edition, **municipal waste** electricity from electricity autoproducers has been revised back to 2008 to separate out the contribution of CHP plants. Also data for **solid biofuels** related to CHP plants have been revised.

The spike in the time series for **wind** auto-producers in 2019 is because the generation for a large plant was recorded as autoproducer but in 2020 it was moved to “main activity producer”. The reason for this is that the plant was not covered by the survey of major power producers until 2020 so administrative data was used in 2019.

Data for **off-grid solar PV** are currently not available in the United Kingdom but the addition of this data is expected in the future.

From 2015, the UK administration started collecting data from the main activity **solar PV** companies. Prior to this, all data were included under autoproducers.

The consumption of **solid biofuels** has increased in 2015, as the largest power station in the UK half-way through the year converted a further unit from **coal** to **biomass**, plus the previously converted unit had a full year of operation in 2015 rather than just the last few months of 2014.

Prior to 2013, due to data confidentiality reasons, one or two main-activity **municipal waste** plants had to be included within the autoproducer plant category. Since 2013, as there have been at least three main-activity companies, these plants have been reclassified from autoproducer plant to main activity electricity plant, with some CHP plants included under main electricity due to confidentiality reasons.

New data for electricity production from main activity electricity **wind** plant became available in 2007.

Heat production started to be reported from 2008 onward.

Electricity production data for **solar PV** are available from 1999.

Consumption

In the 2021 edition, **solar thermal** reclassifications from residential to commercial and public services in 2016 – 2018 represent new data on heating for public swimming pools.

In the 2018 edition, following a review of the consumption of **biogases** and **municipal wastes** for 2015 and 2016 data, data that were allocated to other sectors have been reallocated to the industry sectors. This has caused a break in time

series between 2014 and 2015. A review prior to 2015 is expected in the next cycle.

The UK administration undertook a survey of domestic wood consumption in 2015 and revised figures back to 2008. This resulted in breaks in time series for solid biofuels consumption in residential sector between 2007 and 2008.

Trade

Trade by country is not available for **liquid biofuels** but BEIS is working on improving this.

United States

Source

U.S. Energy Information Administration, Washington DC.

General notes

USA statistics includes the 50 states and the District of Columbia but generally excludes all territories, and all trade between the U.S. and its territories.

Starting with 2017 data, electricity statistics include Puerto Rico, for electricity production and capacity.

Starting with 2017 data, electricity production and capacity data include Puerto Rico.

The EIA assumes all **industrial waste** is non-renewable.

Capacity is net summer capacity.

Due to the change in reporting methodology for **liquid biofuels**, breaks in time series occur between 2009 and 2010. This is especially noticeable in the **biodiesel** time series.

Solar PV electricity production reported for main activity producers refers only for grid-connected central power stations. The IEA Secretariat estimated US **photovoltaic (PV)** electricity generation from autoproducers starting in 1999 by multiplying the dispersed and distributed **PV** capacity estimated by the US administration by an average capacity factor of 12%. The capacity factor was based on a report published in 2007 by the IEA Photovoltaic Power Systems Programme, Cost and Performance Trends in Grid-Connected Photovoltaic Systems and Case Studies.

Geothermal supply and inputs to transformation data are estimated by the IEA Secretariat starting in 2009 because of efficiency discrepancies.

Data on **liquid biofuels** became available in 1993.

Data on **industrial waste** and gas from **biomass** for 1990 and 1991 were estimated by IEA Secretariat.

Supply

Indigenous production of **industrial waste** has been decreasing since May 2014 due to reclassification, resulting in a break in series between 2013 and 2014.

Indigenous production of **biodiesel** is estimated by the IEA Secretariat in 2010 based on the EIA's Monthly Energy Report.

Transformation

The EIA collects generation and consumption data from all plants 1 MW or more in capacity.

Offshore wind production began in 2016.

Starting in 2015, many plants did not report **industrial waste** capacity as a primary energy source. This results in break in time series between 2014 and 2015.

From 2007 to 2009, **industrial waste** includes recovered heat from industrial processes. From 2010, the electricity produced from recovered heat is reported under other sources.

The **solar collector surface** figures are estimated by IEA Secretariat from 2010 – 2015, and by the EIA since 2016.

In the 2009 edition, the US administration changed their methodology for calculating heat production in CHP plants, and revised data back to 2006. This leads to breaks in time series between 2005 and 2006.

For the United States, prior to 2000, autoproducers include small and independent power producers, which under IEA definitions are considered main activity producers.

Prior to 1999, **solar thermal electricity** production includes generation from natural gas because some natural gas units are attached to **solar thermal** plants and their production could not be separated.

In the 2003 edition, the US administration reclassified some plants to autoproducers. This reclassification causes more breaks between 1998 and 1999.

Heat production data for **solid biofuels** became available in 1991.

Consumption

There is a break in series for **geothermal** and **solar thermal** direct use data between 2017 and 2018 as a new methodology for reporting these data was adopted with 2018 data. There is an additional break in series between 2018 and 2019 data for **geothermal** direct use data because the methodology changed again.

Due to an improved estimation methodology, there are some breaks in time series of the industrial and other sectors between 2009 and 2010 for many fuels types: For the industrial sector, this can be found in **geothermal**, **biogases** and **industrial waste** (paper, pulp and printing). For other sectors, breaks can be shown in **geothermal** and **solar thermal**.

Prior to 2008, heat produced by heat pumps was reported as **geothermal** use in residential and commercial/public services.

Direct use of **solar thermal heat** in residential is available from 1999.

Due to problems in reporting, there are numerous breaks in time series for the US data, particularly in 1992, 1999, 2001 and 2002. Care should be taken when evaluating consumption by sector since inputs of fuel to autoproducers are included in final consumption for some years. No data are available for most energy products in the construction and mining and quarrying industries.

Units and conversions

Primary energy conventions

When constructing an energy balance, it is necessary to adopt conventions for primary energy from several sources, such as nuclear, geothermal, solar, hydro, wind, etc. The two types of assumptions that have to be made are described below.

Choice of the primary energy form

For each of these sources, there is a need to define the form of primary energy to be considered; for instance, in the case of hydro energy, a choice must be made between the kinetic energy of falling water and the electricity produced. For photovoltaic electricity, the choice is between the solar radiation received and the electricity produced.

The principle adopted by the IEA is that the primary energy form should be the first energy form downstream in the production process for which multiple energy uses are practical. The application of this principle leads to the choice of the following primary energy forms:

Heat from geothermal and solar thermal;

Electricity from hydropower, wind, tide/wave/ocean and solar photovoltaic.

Calculation of the primary energy equivalent

There are essentially two methods that can be used to calculate the primary energy equivalent of the above energy sources: the partial substitution method and the physical energy content method.

The partial substitution method: In this method, the primary energy equivalent of the above sources of electricity generation represents the amount of energy that would be necessary to generate an identical amount of electricity in conventional thermal power plants. The primary energy equivalent is calculated using an average generating efficiency of these plants. This method has several shortcomings, including the difficulty in choosing an appropriate generating efficiency and the fact that the partial substitution method is not relevant for countries with a high share of hydroelectricity. For these reasons, the IEA has, as most of the international organizations have, adopted the physical energy content method.

The physical energy content method: This method uses the physical energy content of the primary energy source as the primary energy equivalent. As a consequence, there is an obvious link between the principles adopted in defining the primary energy forms of energy sources and the primary energy equivalent of these sources.

For instance, in the case of solar thermal and geothermal electricity production, where heat is selected as the primary energy form by the IEA, the primary energy equivalent is the quantity of heat generated in the geothermal or solar thermal plant for electricity generation. In the case of hydropower, wind, tide and solar PV, where electricity is selected as the primary energy form, the primary energy equivalent is the physical energy content of the electricity generated in the plant, which amounts to assuming an efficiency of 100%.

For geothermal, if no country-specific information was reported, the primary energy equivalent is calculated as follows:

10% for geothermal electricity

50% for geothermal heat

33% for solar thermal electricity

100% for solar thermal heat

Since these two types of energy balances differ significantly in the treatment of electricity from solar, hydro, wind, etc., the share of renewables in total energy supply will appear to be very different depending on the method used. As a result, when looking at the percentages of various energy sources in total supply, it is important to understand the underlying conventions that were used to calculate the primary energy balances.

Units

Original units

Electricity is expressed in gigawatt hours and heat is expressed in terajoules.

Non-combustible renewables have original units of their primary energy form (see Primary energy conventions for the primary energy form of non-combustible renewables).

Primary solid biofuels, biogases, municipal waste, and industrial waste are presented in their original units in terajoules on a net calorific basis. The Secretariat does not receive information on volumes and other characteristics of these fuels.

Liquid biofuels and charcoal have original units in 1000 tonnes.

Energy balance units

The IEA energy balance methodology is based on the net calorific content of the energy commodities and a common unit of account. The units of account adopted by the IEA are TJ and the tonne of oil equivalent (toe) which is defined as 10^7 kilocalories (41.868 gigajoules). This quantity of energy is, within a few percent, equal to the net heat content of 1 tonne of crude oil. Throughout this publication 1 tonne means 1 metric ton or 1000 kg.

Conversion (from original units to toe)

The change from using the original units to tonnes of oil equivalent implies choosing coefficients of equivalence between different forms and sources of energy. This problem can be approached in many different ways. For example, one could adopt a single equivalence for each major primary energy source in all countries, *e.g.* 29 307 kJ/kg (7 000 kcal/kg) for hard coal, 41 868 kJ/kg (10 000 kcal/kg) for oil, etc.

The main objection to this method is that it results in distortions since there can be a wide spread between calorific values of fuels (i.e. liquid biofuels) in different countries.

For charcoal, biogasoline, biodiesels and other liquid biofuels, specific factors have been used for production, imports and exports based on consultations with experts from the national administrations.

The balances are expressed in terms of “net” calorific value. The difference between the “net” and the “gross” calorific value for each fuel is the latent heat of vaporisation of the water produced during combustion of the fuel. For coal and oil, net calorific value is about 5% less than gross, for most forms of natural and manufactured gas the difference is 9-10%, while for electricity and heat there is no difference as the concept has no meaning in this case. The use of net calorific value is consistent with the practice of the Statistical Offices of the European Communities and the United Nations.

Electricity data are converted from original units of gigawatt hours to million tonnes of oil equivalent using the relationship: 1 terawatt hour = 0.086 Mtoe.

Biofuels and waste

Data for primary solid biofuels, biogases, municipal waste and industrial waste are converted from original units in terajoules to energy balance units in tonne of oil equivalent using 1 terajoule = 0.00002388 Mtoe.

Data for charcoal and liquid biofuels are converted from original units in tonnes to energy balance units in tonne of oil equivalent using the average net calorific values given at the end of this section. Unless country-specific information has been provided, data are converted using the following average net calorific values:

Charcoal: 30 800 kJ/kg

Biogasoline: 26 800 kJ/kg

Biodiesels: 36 800 kJ/kg

Other liquid biofuels: 36 800 kJ/kg

Electricity

Figures for electricity production, trade, and final consumption are calculated using the energy content of the electricity (i.e. at a rate of 1 TWh = 0.086 Mtoe).

Hydroelectricity production and electricity produced by other non-thermal means (wind, tide/wave/ocean, photovoltaic, etc.) are accounted for similarly using 1 TWh = 0.086 Mtoe.

The primary energy equivalent of nuclear electricity is calculated from the gross generation by assuming a 33% conversion efficiency, i.e. 1 TWh = (0.086 ÷ 0.33) Mtoe.

In the case of electricity produced from geothermal heat, if the actual geothermal efficiency is not known, then the primary equivalent is calculated assuming an efficiency of 10%, so 1 TWh = (0.086 ÷ 0.1) Mtoe.

Heat

Information on heat is supplied in terajoules (TJ) and 1 TJ = 0.00002388 Mtoe.

In the case of heat produced in a geothermal plant, if the actual geothermal efficiency is not known, then the primary equivalent is calculated assuming an efficiency of 50%, so 1 TWh = (0.086 ÷ 0.5) Mtoe.

For direct use of geothermal and solar thermal heat, all the heat consumed is accounted for in production and consumption.

General conversion factors for energy

To	TJ	Gcal	Mtoe	MBtu	GWh
From:	multiply by:				
terajoule (TJ)	1	2.388×10^{2}	2.388×10^{-5}	9.478×10^{2}	2.778×10^{-1}
gigacalorie (Gcal)	4.187×10^{-3}	1	1.000×10^{-7}	3.968	1.163×10^{-3}
million tonnes of oil equivalent (Mtoe)	4.187×10^{4}	1.000×10^{7}	1	3.968×10^{7}	1.163×10^{4}
million British thermal units (MBtu)	1.055×10^{-3}	2.520×10^{-1}	2.520×10^{-8}	1	2.931×10^{-4}
gigawatt hour (GWh)	3.600	8.598×10^{2}	8.598×10^{-5}	3.412×10^{3}	1

Conversion factors for mass

To	kg	t	lt	st	lb
From:	multiply by:				
kilogramme (kg)	1	1.000×10^{-3}	9.842×10^{-4}	1.102×10^{-3}	2.205
tonne (t)	1.000×10^{3}	1	9.842×10^{-1}	1.102	2.205×10^{3}
long ton (lt)	1.016×10^{3}	1.016	1	1.120	2.240×10^{3}
short ton (st)	9.072×10^{2}	9.072×10^{-1}	8.929×10^{-1}	1	2.000×10^{3}
pound (lb)	4.536×10^{-1}	4.536×10^{-4}	4.464×10^{-4}	5.000×10^{-4}	1

Conversion factors for volume

To	gal U.S.	gal U.K.	bbl	ft^3	l	m^3
From:	multiply by:					
U.S. gallon (gal U.S.)	1	8.327×10^{-1}	2.381×10^{-2}	1.337×10^{-1}	3.785	3.785×10^{-3}
U.K. gallon (gal U.K.)	1.201	1	2.859×10^{-2}	1.605×10^{-1}	4.546	4.546×10^{-3}
barrel (bbl)	4.200×10^{1}	3.497×10^{1}	1	5.615	1.590×10^{2}	1.590×10^{-1}
cubic foot (ft^3)	7.481	6.229	1.781×10^{-1}	1	2.832×10^{1}	2.832×10^{-2}
litre (l)	2.642×10^{-1}	2.200×10^{-1}	6.290×10^{-3}	3.531×10^{-2}	1	1.000×10^{-3}
cubic metre (m^3)	2.642×10^{2}	2.200×10^{2}	6.290	3.531×10^{1}	1.000×10^{3}	1

Decimal prefixes

10^{1}	deca (da)	10^{-1}	deci (d)
10^{2}	hecto (h)	10^{-2}	centi (c)
10^{3}	kilo (k)	10^{-3}	milli (m)
10^{6}	mega (M)	10^{-6}	micro (μ)
10^{9}	giga (G)	10^{-9}	nano (n)
10^{12}	tera (T)	10^{-12}	pico (p)
10^{15}	peta (P)	10^{-15}	femto (f)
10^{18}	exa (E)	10^{-18}	atto (a)

Abbreviations

kW	:	kilowatt
kWp	:	kilowatt peak
kW_{th}	:	kilowatt thermal
GW	:	gigawatt
MW	:	megawatt (electric)
MW_{th}	:	megawatt thermal
kWh	:	kilowatt hour
MWh	:	megawatt hour
GWh	:	gigawatt hour
TWh	:	terawatt hour
GJ	:	gigajoule (10^9 joules)
TJ	:	terajoule (10^{12} joules)
EJ	:	exajoule (10^{18} joules)
m^2	:	metre squared
t	:	metric ton = tonne
kt	:	kilotonne (1000 tonnes)
1 toe	:	tonne of oil equivalent
1 ktoe	:	kilotonne of oil equivalent
1 Mtoe	:	million tonnes of oil equivalent

GDP	:	Gross domestic product
RES	:	Renewable energy Sources
TES	:	Total energy supply

0 or 0.0	:	negligible
c	:	confidential data
..	:	data not available
x	:	not applicable

IEA Publications

International Energy Agency

Website: www.iea.org

Contact information: www.iea.org/about/contact

Typeset in France by IEA – July 2023

Cover design: IEA