International Energy Agency

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PROJECTIONS: ENERGY POLICIES OF IEA COUNTRIES

DATABASE DOCUMENTATION

This document provides information regarding the 2017 edition of the Projections from Energy Policies of *IEA countries* database. This document can be found online under the *References* section at:

http://www.iea.org/statistics/topics/energybalances/

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1. DATABASE STRUCTURE

The database *Projections: Energy Policies of OECD countries* includes historical data (up to 2015) derived from the IEA database *World Energy Balances (2017 edition),* and projections data derived from country submissions, for:

- Countries: 29 IEA countries and European Union - 28 (see section 5: *Geographical coverage and country notes* for availability of projections by country);
- Years: historical: 1960, 1970, 1980, 1990, 2000, 2010, 2013, 2014, 2015; and projections: 2020, 2030, 2040 and 2050, unless otherwise specified.

The database includes the following three files:

SLTBAL.IVT **Energy balances**

Energy balances in matrix form (14 product categories; 25 flows) (Mtoe).

SLTCOAL.IVT **Coal supply**

Coal supply in matrix form (9 products and 3 flows) (Mtoe).

SLTINDIC.IVT **Economic indicators**

8 energy, economic and coupled indicators (various units).

2. FLOW DEFINITIONS

For historical years up to 2015, please refer to the documentation file of *World Energy Balances (2017 edition)* on http://data.iea.org.

Energy balance and coal supply tables		
Flow	**Short name**	**Definition**
Production	INDPROD	"Indigenous production" shows only production of primary energy, i.e. hard coal and lignite, oil shale, peat, biofuels and wastes (see product definitions), crude oil and NGL, natural gas, and electricity and heat from nuclear, hydro, tidal, wave, geothermal, wind and solar plants. Heat from heat pumps that is extracted from the ambient air is included in the heat column. (a) where synthetic liquid or gas hydrocarbons are produced directly as a result of "in place extraction" they should be regarded as primary fuels and included under production. For example, oil from tar sands and shale are shown in the oil column. (b) production of natural gas should exclude gas reinjected, vented or flared but should include gas subsequently used in the gas extraction and drying processes as well as transportation of the gas by pipeline.
Imports	IMPORTS	"Imports" (+) show trade in primary and secondary forms of energy. Imports comprise amounts having crossed the national territorial boundaries of the country whether or not customs clearance has taken place. *For oil and gas*: Note in particular that LPG traded should be placed in the "oil" column. *For nuclear:* Nuclear fuel trade is not shown in the balance. *For electricity:* Trade in electricity is counted at the same heat value as in final consumption (Data in TWh x 0.086 = Data in Mtoe). For countries trading across common borders, actual import and export figures should be given, not net trade balance.

Energy balance and coal supply tables		
Flow	**Short name**	**Definition**
Exports	EXPORTS	"Exports" (-) show trade in primary and secondary forms of energy. Exports comprise amounts having crossed the national territorial boundaries of the country whether or not customs clearance has taken place. *For oil and gas:* Note in particular that LPG traded should be placed in the "oil" column. *For nuclear:* Nuclear fuel trade is not shown in the balance. *For electricity:* Trade in electricity is counted at the same heat value as in final consumption (Data in TWh x 0.086 = Data in Mtoe). For countries trading across common borders, actual import and export figures should be given, not net trade balance.
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.
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 split should be 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.
Stock changes	STOCKCHA	"Stock changes" show additions to stocks as negative, and lowering of stock levels as positive. In energy balance projections, stock changes are conventionally zero. However, countries may report them if they wish.
Total primary energy supply (TPES)	TPES	"Total primary energy supply" (TPES) is made up of indigenous production (positive), imports (positive), exports (negative), international marine and aviation bunkers (negative) and stock changes (either positive or negative).
Transformation processes and own use	TRANENER	Shows the total of the energy transformation activities ("Electricity, CHP and heat plants" and "Other transformation") and energy used by energy-producing plants and losses ("Own use and losses").

Energy balance and coal supply tables		
Flow	**Short name**	**Definition**
Electricity CHP and heat plants	ELECHEAT	"Electricity, CHP and heat plants" should contain inputs of each fuel for the production of electricity and heat as negative entries. This row includes both main activity producers and autoproducer plants. However, for autoproducers 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. Outputs of electricity appear as a positive number under the product "Electricity" and the heat that is sold to outside users appears as a positive number under "Heat". Transformation losses are shown under "Total". Notes: 1. Gross electricity produced should contain total electricity generation in Mtoe calculated on the basis of Data in TWh x 0.086 = Data in Mtoe. Gross generation from hydro plants should not include that generated by pumped storage. The energy absorbed for pumped storage is accounted for under "own use and losses" (see "Hydro electricity" product definition). 2. If electricity is being used to produce heat in heat pumps or electric boilers, the electricity inputs are subtracted from the electricity production shown under "Electricity". 3. Main activity producers 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 does not need to take place through the public grid. 4. 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.
Other transformation	TRANOTH	"Other transformation" includes conversion losses in gas manufacture, oil refineries, coke ovens and blast furnaces, liquefaction, and other non-specified transformation.
Own use and losses	OWNUSE	"Own use and losses" contains the primary and secondary energy consumed by transformation industries for heating, pumping, traction and lighting purposes. These are shown as negative numbers. Included here are, for example, coal mines' own use of energy, power plants' own consumption (which includes net electricity consumed for pumped storage) and energy used for oil and gas extraction. "Own use and losses" also includes losses in gas distribution, electricity transmission and coal transport. Fuels used for pipeline transport are included in transport. Note that electricity generation losses appear in the electricity, CHP and heat plants.

Energy balance and coal supply tables		
Flow	**Short name**	**Definition**
Statistical differences	STATDIFF	"Statistical differences". In principle, the figure for total requirements should equal the sum of deliveries to final consumption, use for transformation and energy industry own use. However, in practice this is rarely the case and the difference is shown as statistical difference. This arises 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 difference.
Total final consumption	TFC	TFC = industry + transport + other + non-energy use, and TFC = TPES + transformation processes + own use + statistical differences. TFC is the sum of the consumption in the end-use sectors and for non-energy use. 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. Note that *international aviation bunkers* and *international marine bunkers* are not included in final consumption.
Total industry	TOTIND	"Total industry" should cover all activity in mining, manufacturing and construction except for fuel production and transformation. The industry's use of energy for transport is included in the "Total transport" flow. The use of coke oven gas and blast furnace gas by the iron and steel industry appears in the form of coal and coal products consumption. Feedstocks to the chemical/petrochemical industry should *not* be included in this category. Indeed, non-energy use in industry is excluded from industry and reported separately. Please refer to non-energy use below.
Total transport	TOTTRANS	"Transport" includes all fuels for transport regardless of sector, except international marine and aviation bunkers. Fuels used for pipeline transport should be included here. Non-energy use in transport is excluded from transport and reported separately. Please refer to non-energy use below.
of which: 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.
Other	TOTOTHER	"Other" covers residential, commerce/public services, agriculture/forestry, fishing and other sectors not elsewhere specified such as military.
of which: residential	RESIDENT	Includes consumption by households, excluding fuels used for transport.

Energy balance and coal supply tables		
Flow	**Short name**	**Definition**
Non-energy use	NONENUSE	"Non-energy use" covers those fuels that are used as raw materials in the different sectors and are not consumed as a fuel or transformed into another fuel. Non-energy use is shown separately in final consumption under the heading "non-energy use". Non-energy use of peat and biomass should not be included here (indeed, they should not figure in these tables at all unless they are used for energy purposes).
Memo: Non-energy use chemical/petrochemical	NECHEM	Fuels used for chemical feedstocks and non-energy products in the petro-chemical industry are included here and *not* in industry. *Note: this flow was called "of which: petrochemical feedstocks"*
Electricity generated (TWh)	ELOUTPUT	"Electricity generated (TWh)" shows total quantities of gross electricity generated in TWh by all electricity and CHP plants (see the notes on "Electricity, CHP and heat plants"). Electricity generated from pumped storage should not be included.
Heat generated (PJ)	HEATOUT	Heat generated (PJ)" shows quantities of heat produced for sale by CHP and heat plants. Heat produced in electric boilers is reported under "Electricity" and heat produced in heat pumps is reported under "Heat".
Total CO_2 emissions from fuel combustion (Mt of CO2)	CO2FUEL	CO_2 emissions from fuel combustion in million tonnes of CO_2. "CO2 emissions from fuel combustion" have been estimated based on the IEA energy balances and on methodologies and emission factors of the 2006 IPCC Guidelines. and from this edition exclude emissions from non-energy use of fuels. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2014 and applying this factor to projected energy supply. Projected emissions for coal are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.
Memo: CO_2 from international marine bunkers (Mt of CO2)	MARCO2	CO_2 emissions from international marine bunkers in million tonnes of CO_2. These amounts are not included in the national totals.
Memo: CO_2 from international aviation bunkers (Mt of CO2)	AVCO2	CO_2 emissions from international aviation bunkers in million tonnes of CO_2. These amounts are not included in the national totals.

Economic indicators table		
Flow	**Short name**	**Definition**
GDP (billion 2010 USD using exchange rates)	GDP	The main source of these series for 1970 to 2015 is the OECD *National Accounts Statistics* database [ISSN: 2074-3947 (online)], last published in book format as *National Accounts of OECD Countries*, *Volume 2016 Issue 2: Main Aggregates*, OECD 2017. GDP data for **Australia**, **France**, **Greece, Korea**, **Sweden** and the **United Kingdom** for 1960 to 1969 and **Denmark** for 1966 to 1969 as well as for **Netherlands** for 1969 were taken from the same source. GDP data for 1960 to 1969 for the other countries have been estimated using the growth rates from the series in the *OECD Economic Outlook* No 98 and other data previously published by the OECD. Growth rates from these sources were also used to estimate data for the **Czech Republic** (prior to 1990), **Hungary** (prior to 1991) and **Poland** (prior to 1990) and the **Slovak Republic** (prior to 1992). Data for **Chile** (prior to 1986) and **Estonia** (prior to 1992) are IEA Secretariat estimates based on GDP growth rates from the World Bank. The GDP data have been compiled for individual countries at market prices in local currency and annual rates. These data have been scaled up/down to the price levels of 2010 and then converted to US dollars using the yearly average 2010 exchange rates.
Population (millions)	POP	The main source of these series for 1970 to 2015 is the OECD *National Accounts Statistics* database [ISSN: 2074-3947 (online)], last published in book format as *National Accounts of OECD Countries, Volume 2016 Issue 2: Main Aggregates*, OECD 2017. Data for 2015 for all countries except **Germany** were estimated using the growth rates from the population series in *OECD Economic Outlook No. 95*, long-term baseline projections. Data for 1960 to 1969 have been estimated using the growth rates from the population series published in the *OECD Factbook 2015* (online database version). Growth rates from the *OECD Factbook 2015* were also used to estimate data for **Chile** (prior to 1986), **Estonia** (prior to 1993), **Israel** (prior to 1995), the **Slovak Republic** (prior to 1990) and **Slovenia** (prior to 1995).
TPES/GDP (toe per thousand 2010 USD)	TPESGDP	Expressed as toe per thousand USD (2010 prices and ex. rates). Based on national GDP.
Energy production / TPES	PRODTPES	Ratio of energy production to TPES. This is one measure of energy self-sufficiency.
TPES/population (toe per capita)	TPESCAP	Expressed as toe per capita.
Oil supply/GDP (toe per thousand 2010 USD)	TPOILGDP	Ratio of oil supply to GDP expressed as toe per thousand USD (2010 prices and ex. rates). Based on national GDP.

Economic indicators table		
Flow	**Short name**	**Definition**
TFC/GDP (toe per thousand 2010 USD)	TFCGDP	Ratio of total final consumption to GDP expressed as toe per thousand USD (2010 prices and ex. rates). Based on national GDP.
TFC/population (toe per capita)	TFCCAP	Total final consumption per capita expressed as toe per capita.

3. PRODUCT DEFINITIONS

For historical years up to 2015, please refer to the documentation file of *World Energy Balances (2017 edition)* on **http://data.iea.org**

Energy balances table		
Product	**Short name**	**Definition**
Coal	COAL	Coal includes all coal and coal products both primary and derived, such as anthracite, coking coal, other bituminous coal, sub-bituminous coal, lignite, patent fuel, coke oven coke (including semi-coke), gas coke, coal tar, brown coal briquettes as well as coke oven gas, gas works gas, blast furnace gas and other recovered gases. *Note: in this database, oil shale is aggregated with coal (however the secondary product shale oil is included under oil).*
Peat	PEAT	Peat is a combustible soft, porous or compressed, fossil sedimentary deposit of plant origin with high water content (up to 90% in the raw state), easily cut, of light to dark brown colour. Peat used for non-energy purposes should not be included. Peat includes derived peat products.
Oil	OIL	Oil includes: 1. Crude oil, refinery feedstocks, natural gas liquids, additives as well as non-crude hydrocarbons (tar sands, shale oils, etc.) and orimulsion. Imports and exports of liquefied synthetic fuels should also be shown here. 2. Oil products including liquefied petroleum gas and refinery gas. Synthesised liquid hydrocarbons from other sources (coal liquefaction, biomass, methanol, alcohol) are transferred under "Oil" from the appropriate cells. For example, liquefied coal would be shown as coal consumed (and therefore negative) under "Coal", "Other transformation" and as oil production (and therefore positive) under "Oil", "Other transformation".

Energy balances table		
Product	**Short name**	**Definition**
Natural gas	NATGAS	Natural gas comprises gases, occurring in underground deposits, whether liquefied or gaseous, consisting mainly of methane. It includes both "non-associated" gas originating from fields producing only hydrocarbons in gaseous form, and "associated" gas produced in association with crude oil as well as methane recovered from coal mines (colliery gas) or from coal seams (coal seam gas). Production represents dry marketable production within national boundaries, including offshore production and is measured after purification and extraction of NGL and sulphur. It includes gas consumed by gas processing plants and gas transported by pipeline. Quantities of gas that are re-injected, vented or flared are excluded.
Nuclear	NUCLEAR	The primary energy value ascribed to nuclear electricity is calculated from the gross generation by assuming that only 33% of the primary energy content appears as electricity. Heat sold by nuclear power plants is shown as an output under "Heat", "Electricity, CHP and heat plants" (positive number), with an identical input under "Nuclear", "Electricity, CHP and heat plants" (negative number).
Hydro	HYDRO	The primary energy value ascribed to hydro electricity is the energy content of the gross electricity generation from the natural flow of the water course. The electricity losses associated with pumped storage electricity are included in the quantities given under "Electricity", "Own use and losses".
Wind	WIND	The primary energy value ascribed to electricity produced from wind is taken to be the physical energy content of the gross generation: Gross electricity generation in TWh x 0.086 = primary energy equivalent in Mtoe.
Geothermal	GEOTHERM	If information on geothermal heat inputs to electricity generation is not available, then the primary energy value ascribed to geothermal electricity is calculated from the gross generation by assuming that only 10% of the primary energy content appears as electricity. Heat sold by geothermal plants is shown as an output under "Heat", "Electricity, CHP and heat plants", with an input under "Geothermal", "Electricity, CHP and heat plants". The default efficiency for geothermal heat is 50%.

Energy balances table		
Product	**Short name**	**Definition**
Solar/tide/wave/ocean/other	SOLARETC	The primary energy value ascribed to electricity produced from solar photovoltaic, tide, wave, ocean and other non-thermal sources is taken to be the physical energy content of the gross generation: Gross electricity generation in TWh x 0.086 = primary energy equivalent in Mtoe. The primary energy equivalent for solar thermal energy is the heat available to the heat transfer medium, i.e. the incident solar energy less the optical, collectors and other eventual losses. It should be reported as indigenous production. The quantity of heat consumed should be entered in the relevant final sectors. For solar thermal electricity, a default of 33% is used if the actual efficiency is not known. If the heat is distributed in the transformation sector, then the default efficiency is 100% for solar thermal heat.
Biofuels and waste	COMRENEW	Solid biofuels, liquid biofuels, biogases, industrial waste and municipal waste. This includes wood, vegetable waste, ethanol, animal materials/waste, sulphite lyes, the biomass fraction of biogasoline, biodiesel and other liquid biofuels, and waste produced by the industrial, residential, commercial and public service sectors.
Heat production from non-specified combustible fuels	HEATNS	Heat production from non-specified combustible fuels is used only when these amounts cannot be allocated by fuel.
Electricity	ELECTR	"Electricity" shows trade and final consumption in electricity (which is counted at the same heat value as electricity in final consumption i.e. Data in TWh x 0.086 = Data in Mtoe).
Heat	HEAT	"Heat" permits the reporting of (a) the generation and consumption of heat for sale and (b) heat extracted from ambient air and water by heat pumps. The generation of heat for sale is reported as a transformation activity. Heat consumed at the point of production, which is generated from fuels reported elsewhere in the balance, is not reported. The fuels consumed for the production of heat are included in the quantities of the fuels shown as consumed by the final sectors.
Total	TOTAL	Total is the total of all energy sources.

Coal supply table		
Product	**Short name**	**Definition**
Hard coal (if no detail)	HARDCOAL	This item is only used if the detailed breakdown is not available. It includes anthracite, coking coal and other bituminous coal.
Brown coal (if no detail)	BROWN	This item is only used if the detailed breakdown is not available. It includes lignite and sub-bituminous coal.
Anthracite	ANTCOAL	Anthracite is a high rank coal used for industrial and residential applications. It is generally less than 10% volatile matter and a high carbon content (about 90% fixed carbon). Its gross calorific value is equal to or greater than 24 000 kJ/kg on an ash-free but moist basis.
Coking coal	COKCOAL	Coking coal refers to bituminous coal with a quality that allows the production of a coke suitable to support a blast furnace charge. Its gross calorific value is equal to or greater than 24 000 kJ/kg on an ash-free but moist basis.
Other bituminous coal	BITCOAL	Other bituminous coal is used mainly for steam raising and space heating purposes and includes all bituminous coal that is not included under coking coal nor anthracite. It is characterized by higher volatile matter than anthracite (more than 10%) and lower carbon content (less than 90% fixed carbon). Its gross calorific value is equal to or greater than 24 000 kJ/kg on an ash-free but moist basis.
Sub-bituminous coal	SUBCOAL	Non-agglomerating coals with a gross calorific value between 20 000 kJ/kg and 24 000 kJ/kg containing more than 31% volatile matter on a dry mineral matter free basis.
Lignite	LIGNITE	Lignite is a non-agglomerating coal with a gross calorific value of less than 20 000 kJ/kg and greater than 31% volatile matter on a dry mineral matter free basis.
Coal products	COALPROD	Includes patent fuel, coke oven coke, gas coke, coal tar, BKB/peat briquettes, gas works gas, coke oven gas, blast furnace gas, other recovered gases.
Total coal	COAL	Sum of above products.

4. GEOGRAPHICAL COVERAGE AND COUNTRY NOTES

For historical years up to 2015, please refer to the documentation file of *World Energy Balances (2017 edition)* on **http://data.iea.org**.

Geographical coverage		
Country	**Short name**	**Definition**
Australia	AUSTRALI	Excludes the overseas territories.
Austria	AUSTRIA	
Belgium	BELGIUM	
Canada	CANADA	
Czech Republic	CZECH	Data start in 1980.
Denmark	DENMARK	Excludes Greenland and the Danish Faroes, except prior to 1990, where data on oil for Greenland were included with the Danish statistics. The Administration is planning to revise the series back to 1974 to exclude these amounts.
Estonia	ESTONIA	Data start in 1990. *Note: Estonia joined the IEA in May 2014.*
Finland	FINLAND	
France	FRANCE	Includes Monaco and excludes the following overseas departments: Guadeloupe; French Guiana; Martinique; Mayotte; and Réunion; and collectivities: New Caledonia; French Polynesia; Saint Barthélemy; Saint Martin; Saint Pierre and Miquelon; and Wallis and Futuna.
Germany	GERMANY	Includes the new federal states of Germany from 1970 onwards.
Greece	GREECE	
Hungary	HUNGARY	Data start in 1970.
Ireland	IRELAND	
Italy	ITALY	Includes San Marino and the Holy See.
Japan	JAPAN	Includes Okinawa.

Geographical coverage		
Country	**Short name**	**Definition**
Korea	KOREA	
Luxembourg	LUXEMBOU	
Netherlands	NETHLAND	Excludes Suriname, Aruba and the other former Netherland Antilles (Bonaire, Curaçao, Saba, Saint Eustatius and Sint Maarten).
New Zealand	NZ	
Norway	NORWAY	Includes the Svalbard archipelago (Spitsbergen).
Poland	POLAND	
Portugal	PORTUGAL	Includes the Azores and Madeira.
Slovak Republic	SLOVAKIA	
Spain	SPAIN	Includes the Canary Islands.
Sweden	SWEDEN	
Switzerland	SWITLAND	Includes Liechtenstein for the oil data. Data for other fuels do not include Liechtenstein.
Turkey	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.
European Union	EU28	Includes the 28 member states of the European Union.

Country notes

Country	Short name	Definition
Australia	AUSTRALI	Source: Department of the Environment and Energy. All projections data are based on the 2016/17 submission. All data refer to the fiscal year July to June. Projections are only partially available for electricity and transport consumption for 2020 and 2030.
Austria	AUSTRIA	Source: Statistics Austria. Projections are not available.
Belgium	BELGIUM	Source: FPS Economy, S.M.E.s, Self-employed and Energy. Imports represent net imports. All projections data are based on the 2016/17 submission.
Canada	CANADA	Source: Natural Resources Canada. All projections data are based on the 2016/17 submission. Projections for 2040 and 2050 are not available.
Czech Republic	CZECH	Source: Ministry of Industry and Trade of the Czech Republic. All projections data are based on the 2016/17 submission.
Denmark	DENMARK	Source: Danish Energy Agency. All projections are based on the 2016/17 submission. TPES for a given year strongly depends on the amount of net import of electricity, which may vary substantially from year to year. For 2020 and 2030, ambient heat from heat pumps may contain production from residential units which normally is not accounted for in the IEA methodology. Projections shown for 2040 actually correspond to projections for 2030, as submitted by the Danish Authorities. Projections for 2050 are not available.
Estonia	ESTONIA	Source: Ministry of Energy Affairs and Communications All projections data are based on the 2016/17 submission. Oil shale is included under Coal and shale oil under Oil. Projections for CO_2 emissions are only partially available.
Finland	FINLAND	Source: Ministry of Economic Affairs and Employment. All projections data are based on the 2016/17 submission. Projections for 2040 and 2050 are not available.

Country notes

Country	Short name	Definition
France	FRANCE	Source: Ministère de l'Ecologie, du Développement Durable et de l'Energie All projections data are based on the 2015/16 submission. For projections, electricity data is only partially available. Nuclear, hydro, wind, solar, electricity and heat are not included in 2020 and 2030 energy balances forecasts, totals are therefore also unavailable. Projections for 2040 and 2050 are not available.
Germany	GERMANY	Source: Federal Ministry for Economic Affairs and Energy. All projections data are based on the 2016/17 submission.
Greece	GREECE	Source: Ministry for Environment, Energy & Climate Change. Projections are not available.
Hungary	HUNGARY	Source: Hungarian Energy and Public Utility Regulatory Authority. Projections are not available.
Ireland	IRELAND	Source: Sustainable Energy Authority of Ireland. All projections data are based on the 2016/17 submission. Projections for 2040 and 2050 are not available.
Italy	ITALY	Source: Ministry of Economic Development. All projections data are based on the 2013/14 submission.
Japan	JAPAN	Source: Ministry of Economy, Trade and Industry, Agency for Natural Resources and Energy. All projections data are based on the 2016/17 submission. Only partial information on electricity generation by fuel is available for 2020 and 2030. Projections for 2040 and 2050 are not available.
Korea	KOREA	Source: Korea Energy Economics Institute (KEEI). All projections data are based on the 2016/17 submission. Projections are partially available only for demand and consumption for 2020, 2030 and 2040. Projections for 2050 are not available.
Luxembourg	LUXEMBOU	Projections are not available.
Netherlands	NETHLAND	Source: Ministry of Economic Affairs. All projections data are based on the 2015/16 submission. Projections for 2040 and 2050 are not available.
New Zealand	NZ	Source: Ministry of Business, Innovation & Employment. All projections data are based on the 2016/17 submission. Projections are based on the 2016 Electricity Demand and Generation Scenarios (EDGS) central scenario.

Country notes		
Country	**Short name**	**Definition**
Norway	NORWAY	Source: Statistics Norway. Projections are not available.
Poland	POLAND	Source: Ministry of Economy. All projections data are based on the 2016/17 submission. Projections for 2040 and 2050 are not available.
Portugal	PORTUGAL	Source: General Directorate of Energy and Geology. Projections based on PRIMES projections (PRIMES Baseline 2013 in annex). All projections data are based on the 2016/17 submission. Projections for 2040 and 2050 are not available.
Slovak Republic	SLOVAKIA	Source: Ministry of Economy of the Slovak Republic. All projections data are based on the 2016/17 submission.
Spain	SPAIN	Source: Ministry of Industry, Energy and Tourism. All projections data are based on the 2015/16 submission. Projections data for 2030, 2040 and 2050 are not available.
Sweden	SWEDEN	Source: Swedish Energy Agency. All projections data are based on the 2016/17 submission. Projections imports for oil are actually net imports. Projections for 2040 and 2050 are not available.
Switzerland	SWITLAND	Source: Swiss Federal Office of Energy. All projections data are based on the 2016/17 submission. Energy policies in Switzerland only account for energetic use so non-energy use is excluded.
Turkey	TURKEY	Projections are not available.
United Kingdom	UK	Source: Department for Business, Energy and Industrial Strategy (BEIS). Projections are not available.
United States	USA	Source: U.S. Energy Information Administration. All projections data are based on the 2016/17 submission.Heat generation and consumption data is not included for forecast years.

Country notes		
Country	**Short name**	**Definition**
European Union	EU28	Source: European Commission, "EU Reference Scenario 2016 - Energy, transport and GHG emissions Trends to 2050". All projections data are based on the 2016/17 submission. Export data are not available in projections years. Data reported for imports refer to net imports. Peat is included in coal in projections years. International aviation bunkers cannot be separated from transportation and is included in transportation in projections years. Inputs into blast furnaces are reported in Industry and not in transformation sector in projections years.

Projections availability for energy balances				
Country	**2020**	**2030**	**2040**	**2050**
Australia	p	p	..	..
Austria	..	..	..	..
Belgium	✔	✔	✔	✔
Canada	✔	✔	..	..
Czech Republic	✔	✔	✔	✔
Denmark	✔	✔	✔	..
Estonia	✔	✔	✔	✔
Finland	✔	✔	..	..
France	p	p	..	..
Germany	✔	✔	✔	✔
Greece	..	..	..	..
Hungary	..	..	..	..
Ireland	✔	✔	..	..
Italy	✔	✔	✔	✔
Japan	p	p	..	..
Korea	p	p	p	..
Luxembourg	..	..	..	..
Netherlands	✔	✔	..	..
New Zealand	✔	✔	✔	✔
Norway	..	..	..	..
Poland	✔	✔	..	..
Portugal	✔	✔	..	..
Slovak Republic	✔	✔	✔	✔
Spain	✔	..	..	..
Sweden	✔	✔	..	..
Switzerland	✔	✔	✔	✔
Turkey	..	..	..	..
United Kingdom	..	..	..	..
United States	✔	✔	✔	✔
European Union - 28	✔	✔	✔	✔

Note: ✔ indicates that the projections data are available; p indicates that the projections data are partially available; .. indicates that projections are not available.

Country notes for coal tables		
Country	**Short name**	**Definition**
Australia	AUSTRALI	All projections data are based on the 2016/17 submission. All data except GDP and population refer to the fiscal year July to June. Projections for 2030, 2040, and 2050 are not available.
Austria	AUSTRIA	Projections are not available.
Belgium	BELGIUM	All projections data are based on the 2016/17 submission. Import projections represent net imports.
Canada	CANADA	All projections data are based on the 2016/17 submission. Projections for 2040 and 2050 are not available.
Czech Republic	CZECH	All projections data are based on the 2016/17 submission.
Denmark	DENMARK	All projections are based on the 2016/17 submission. Projections shown for 2040 actually correspond to projections for 2030, as submitted by the Danish Authorities. Projections for 2050 are not available.
Estonia	ESTONIA	All projections data are based on the 2016/17 submission. For projections, the breakdown between the different types of coal has been estimated by the IEA to match historical data.
Finland	FINLAND	For projections, the breakdown for hard coal imports is not available. All projections data are based on the 2016/17 submission. Projections for 2040 and 2050 are not available.
France	FRANCE	All projections data are based on the 2015/16 submission. Breakdown by types of coal are not available for projections years. Projections for 2040 and 2050 are not available.
Germany	GERMANY	For projections, the breakdown between the different types of coal is not available for production. All projections data are based on the 2016/17 submission.
Greece	GREECE	Projections are not available.

Country notes for coal tables		
Country	**Short name**	**Definition**
Hungary	HUNGARY	Projections are not available.
Ireland	IRELAND	All projections data are based on the 2016/17 submission. Projections for 2040 and 2050 are not available.
Italy	ITALY	All projections data are based on the 2013/14 submission.
Japan	JAPAN	Projections are not available.
Korea	KOREA	Projections are not available.
Luxembourg	LUXEMBOU	Projections are not available.
Netherlands	NETHLAND	All projections are based on the 2015/16 submission. Projections for 2040 and 2050 are not available.
New Zealand	NZ	All projections data are based on the 2016/17 submission. Projections data refer to the fiscal year.
Norway	NORWAY	Projections are not available.
Poland	POLAND	All projections data are based on the 2016/17 submission. Projections for 2040 and 2050 are not available.
Portugal	PORTUGAL	All projections data are based on the 2016/17 submission. Projections import data represent net imports. Projections for 2040 and 2050 are not available.
Slovak Republic	SLOVAKIA	All projections data are based on the 2016/17 submission.
Spain	SPAIN	All projections data are based on the 2015/16 submission. Projections for 2030, 2040 and 2050 are not available.
Sweden	SWEDEN	All projections data are based on the 2016/17 submission. Projections for 2040 and 2050 are not available.
Switzerland	SWITLAND	All projections data are based on the 2016/17 submission. For projections, the breakdown between the different types of coal is not available for import data.
Turkey	TURKEY	Projections are not available.

Country notes for coal tables		
Country	**Short name**	**Definition**
United Kingdom	UK	Projections are not available.
United States	USA	All projections data are based on the 2016/17 submission.
European Union	EU28	All projections data are based on the 2016/17 submission. Breakdown by types of coal are not available for projections years.

Projections availability for coal supply				
Country	**2020**	**2030**	**2040**	**2050**
Australia	✔	..	..	..
Austria	..	..	..	..
Belgium	✔	✔	✔	✔
Canada	✔	✔	..	..
Czech Republic	✔	✔	✔	✔
Denmark	✔	✔	✔	..
Estonia	✔	✔	✔	✔
Finland	p	p	..	..
France	p	p	..	..
Germany	✔	✔	✔	✔
Greece	..	..	..	..
Hungary	✔	✔	✔	..
Ireland	✔	✔	..	..
Italy	✔	✔	✔	✔
Japan	..	..	..	..
Korea	..	..	..	..
Luxembourg	..	..	..	..
Netherlands	✔	✔	..	..
New Zealand	✔	✔	✔	✔
Norway	..	..	..	..
Poland	✔	✔	..	..
Portugal	✔	✔	..	..
Slovak Republic	✔	✔	✔	✔
Spain	✔	..	..	..
Sweden	✔	✔	..	..
Switzerland	p	p	p	p
Turkey	..	..	..	..
United Kingdom	..	..	..	..
United States	✔	✔	✔	✔
European Union - 28	p	p	p	p

Note: ✔ indicates projections data are available for that year; p indicates that the projections data are partially available; .. indicates that projections are not available.

5. METHODOLOGICAL NOTES

Energy balance: key concepts

Energy statistics expressed in physical units in the form of commodity balances, balances of supply and use of each energy commodity, are a simple way to assemble the main statistics so that key data are easily obtained, and that data completeness can be quickly assessed. However, because energy products are mainly bought for their heat-raising properties and can be converted into other energy products, presenting data in energy units is very powerful. The format adopted is called energy balance.

The energy balance takes the form of a matrix, where columns present all the different energy sources and rows represent all the different "flows", grouped in three main blocks: energy supply, transformation/energy use and final consumption.

To develop an energy balance from the set of energy commodity balances, the two main steps are: i) all the data are converted to a common energy unit – and also a " total" product is computed; and ii) some reformatting is performed to avoid double counting when summing products together. For example, while the production of secondary products (e.g. motor gasoline) is shown in the production row in commodity balances, it is reported as an output of the relevant transformation (e.g. oil refineries) in an energy balance, where the production row only refers to production of primary products (e.g. crude oil).

The methodological assumptions underlying energy balances discussed in the next section are particularly important to understand differences across balances formulated by different organisations starting from the same energy commodity data.

IEA energy balances methodology

The unit adopted by the IEA is the tonne of oil equivalent (toe) which is *defined* as 10^7 kilocalories (41.868 gigajoules). This quantity of energy is, within a few per cent, equal to the net heat content of 1 tonne of crude oil. Conversion of the IEA energy balances to other energy units would be straightforward.

The main methodological choices underlying energy balances that can differentiate balances across organisations are: i) "net" versus "gross" energy content; ii) calorific values; and iii) primary energy conventions.

Net versus gross energy content

The IEA energy balances are based on a "**net**" energy content, which excludes the energy lost to produce water vapour during combustion. All the elements of the energy balance are expressed on the same net basis to ensure comparability. Even elements (e.g. natural gas) that in commodity balances may be already in energy units but on a different basis (e.g. "gross") are converted (e.g. from "gross" to "net").

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, the 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.

Calorific values

Generally, the IEA adopts country-specific, time-varying, and for some products flow-dependent, net calorific values supplied by national administrations for most products; and regional default values (in conjunction with Eurostat for the European countries) for the oil products. More detailed explanations on the IEA conversion to energy units for the different energy sources are given in section 7 *Units and Conversions*.

Primary energy conventions

A very important methodological choice is the definition of the "**primary energy equivalent**" for the electricity and heat produced from non-combustible sources, such as nuclear, geothermal, solar, hydro, wind. The information collected is generally the amount of electricity and heat produced, represented in the balance as an output of transformation. Conventions are needed to compute the most appropriate corresponding primary energy, input to the transformation, both in form and in amount.

The principle adopted by the IEA is that the **primary energy form** is *the first energy form downstream in the production process for which multiple energy uses are practical*. For example, the first energy form that can be used as energy in the case of nuclear is the nuclear heat of the reactor, most of which is then transformed into electricity. The application of this principle leads to the choice of the following primary energy forms:

- **Electricity** for primary electricity (hydro, wind, tide/wave/ocean and solar photovoltaic).
- **Heat** for heat and secondary electricity (nuclear, geothermal and solar thermal).

Once the primary energy form is identified for all electricity and heat generated from non-combustible sources, the IEA adopts the **physical energy content method** to compute the corresponding primary energy equivalent amounts: the primary energy equivalent is simply the physical energy content of the corresponding primary energy form.

For primary electricity, such as hydro and solar PV, as electricity is identified as the primary energy form, the primary energy equivalent is simply the gross electricity generated in the plant.

For nuclear electricity, the primary energy equivalent is the quantity of heat generated in the reactors. In the absence of country-specific information, the IEA estimates the primary energy equivalent from the electricity generated by assuming an efficiency of 33%, derived as the average efficiency of nuclear power plants across Europe. Note that the principle of using the heat from nuclear reactors as the primary energy form for the energy statistics has an important effect on any indicators of energy supply dependence. Under the present convention, the primary nuclear heat appears as an indigenous resource. However, the majority of countries using nuclear power import their nuclear fuel, and if this fact could be taken into account, it would lead to an increase in the supply dependence on other countries.

For geothermal electricity, the primary energy equivalent is the quantity of heat and a similar back-calculation is used where the quantities of steam supplied to the plant are not measured, assuming a thermal efficiency of 10%. This figure is only approximate and reflects the fact that the steam from geothermal sources is generally of low quality. If data for the steam input to geothermal power plants are available, they are used directly as primary energy equivalent.

Similarly, for solar thermal plants the heat supply is back-calculated assuming a 33% efficiency of conversion of heat into electricity, reflecting relatively low working temperatures, although central receiver systems can reach higher temperatures and therefore higher efficiencies.

In summary, for geothermal and solar thermal, if no country-specific information is 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.

Alternative methods to the physical energy content method exist, such as the **partial substitution method**, used in the past by the IEA. In this case, the primary energy equivalent of the above sources of electricity generation would be computed as the hypothetical amount of energy necessary to generate an identical amount of electricity in conventional thermal power plants, considering an average generating effi-

ciency. The principle was abandoned by the IEA and many other international organisations because it had little meaning for countries in which hydro electricity generation was a significant supply source, and because the actual substitution values were hard to establish as they depended on the marginal electricity production efficiencies. Partial substitution also had unreal effects on the energy balance as transformation losses appeared which had no physical basis.

Since the two methods 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. To interpret shares of various energy sources in total supply, it is important to understand the underlying conventions used to calculate the primary energy supply.

6. UNITS AND CONVERSIONS

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)

Energy content

Coal

Coal has separate net calorific values for production, imports, exports, inputs to electricity/heat generation and coal used in coke ovens, blast furnaces and industry.

For electricity/heat generation, coal inputs to each type of plant (i.e. main activity electricity plant, autoproducer electricity plant, main activity CHP plant, autoproducer CHP plant, main activity heat plant, autoproducer heat plant) are converted to energy units using average factors calculated from the Annual Electricity Questionnaire. All other flows are converted using an average net calorific value.

Crude oil

Country-specific net calorific values (NCV) for production, imports and exports by country are used to calculate the balances. The average value is used to convert all the other flows to heat values.

Gases

World Energy Statistics expresses the following gases in terajoules, using their gross calorific value.

Gas data provided in joules should be converted as follows: data in TJ / 41 868 = data in Mtoe.

To calculate the net heat content of a gas from its gross heat content, multiply the gross heat content by the appropriate following factor.

Gas	Ratio from GCV to NCV
Natural gas	0.9
Gas works gas	0.9
Coke oven gas	0.9
Blast furnace gas	1.0
Other recovered gases	1.0

Biofuels and waste

The heat content of primary solid biofuels, biogases, municipal waste and industrial waste, expressed in terajoules on a net calorific value basis, is presented in *World Energy Statistics*. The Secretariat does not receive information on volumes and other characteristics of these fuels.

Data in TJ / 41 868 = data in Mtoe. Data for charcoal are converted from tonnes using the average net calorific values given in the electronic tables.

Unless country-specific information has been provided, data for biogasoline are converted from tonnes using 26 800 kJ/kg. Biodiesels and other liquid biofuels are assumed to have a net calorific value of 36 700 kJ/kg unless otherwise specified.

Oil products

For oil products, the IEA applies regional net calorific values (in conjunction with Eurostat for the European countries), except for the individual countries listed in the table below.

Electricity

Figures for electricity production, trade, and final consumption are calculated using the energy content of the electricity. Electricity is converted as follows: data in TWh x 0.086 = data in Mtoe.

Hydro-electricity production (excluding pumped storage) and electricity produced by other non-thermal means (wind, tide/wave/ocean, solar PV, etc.) are accounted for similarly. Gross electricity generation in TWh x 0.086 = primary energy equivalent in Mtoe.

The primary energy equivalent of nuclear electricity is calculated from the gross generation by assuming a 33% conversion efficiency., The calculation to be carried out is the following: Gross electricity generation in TWh x 0.086 / 0.33 = primary energy equivalent in 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%. The calculation to be carried out is the following: Gross electricity generation in TWh x 0.086 / 0.10 = primary energy equivalent in Mtoe.

For electricity produced from solar thermal heat, the primary equivalent is calculated assuming an efficiency of 33% unless the actual efficiency is known. The calculation to be carried out is the following: Gross electricity generation in TWh x 0.086 / 0.33 = primary energy equivalent in Mtoe.

Heat

Information on heat is supplied in terajoules and is converted as follows: data in TJ / 41 868 = data in 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%.

The calculation to be carried out is the following: Heat production in TJ x 0.0000238 / 0.50 = primary energy equivalent in Mtoe.

For heat produced in a solar thermal plant, the primary equivalent is equal to the heat consumed. Data in TJ / 41 868 = data in Mtoe.

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

Examples

The following examples indicate how to calculate the net calorific content (in ktoe) of the quantities expressed in original units in *World Energy Statistics*.

From original units	To Mtoe (on a NCV basis)
Coking coal production (Poland) for 2015 in thousand tonnes	divide by 41 868 and then multiply by 29.518
Natural gas in terajoules (gross)	multiply by 0.00002388 and then multiply by 0.9
Motor gasoline (Poland) in thousand tonnes	divide by 41 868 and then multiply by 44.000
Heat in terajoules (net)	multiply by 0.00002388

7. ABBREVIATIONS

Btu:	British thermal unit
GWh:	gigawatt hour
kcal:	kilocalorie
kg:	kilogramme
kJ:	kilojoule
Mt:	million tonnes
m^3:	cubic metre
t:	metric ton = tonne = 1000 kg
TJ:	terajoule
toe:	tonne of oil equivalent = 10^7 kcal
CHP:	combined heat and power
GCV:	gross calorific value
HHV:	higher heating value = GCV
LHV:	lower heating value = NCV
NCV:	net calorific value
PPP:	purchasing power parity
TPES:	total primary energy supply
EU	European Union
IEA:	International Energy Agency
IPCC:	Intergovernmental Panel on Climate Change
ISIC:	International Standard Industrial Classification
OECD:	Organisation for Economic Co-Operation and Development
OLADE:	Organización Latinoamericana de Energía
UN:	United Nations
UNIPEDE:	International Union of Producers and Distributors of Electrical Energy
c	confidential
..	not available
x	not applicable