

Conversion factors and unit abbreviations

General conversion factors for energy

To:	TJ	Gcal	Mtoe	MBtu	GWh
From:	multiply by:				
TJ	1	2.388×10^2	2.388×10^{-5}	9.478×10^2	2.778×10^{-1}
Gcal	4.187×10^{-3}	1	1.000×10^{-7}	3.968	1.163×10^{-3}
Mtoe	4.187×10^4	1.000×10^7	1	3.968×10^7	1.163×10^4
MBtu	1.055×10^{-3}	2.520×10^{-1}	2.520×10^{-8}	1	2.931×10^{-4}
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)	1	8.327×10^{-1}	2.381×10^{-2}	1.337×10^{-1}	3.785	3.785×10^{-3}
U.K. gallon (gal)	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

Conversion factors and unit abbreviations

Selected country-specific net calorific values

Steam coal

Top-ten producers in 2019	toe/tonne
People's Rep. of China	0.524
India	0.381
United States	0.555
Indonesia	0.524
Australia	0.630
Russian Federation	0.624
South Africa	0.566
Kazakhstan	0.451
Colombia	0.650
Poland	0.570

Crude oil¹

Top-ten producers in 2019	toe/tonne
United States	1.017
Russian Federation	1.005
Saudi Arabia	1.016
Canada	1.022
Iraq	1.023
People's Rep. of China	1.000
United Arab Emirates	1.018
Islamic Rep. of Iran	1.019
Brazil	1.020
Kuwait	1.016

Default net calorific values

Oil products

	OECD Europe ²	OECD Americas	OECD Asia Oceania	Non-OECD
	toe/tonne			
Refinery gas	1.182	1.149	1.149	1.149
Ethane	1.182	1.180	1.180	1.180
Liquefied petroleum gases	1.099	1.130	1.139	1.130
Motor gasoline excl. biofuels	1.051	1.070	1.065	1.070
Aviation gasoline	1.051	1.070	1.065	1.070
Gasoline type jet fuel	1.027	1.070	1.065	1.070
Kerosene type jet fuel	1.027	1.065	1.063	1.065
Kerosene	1.027	1.046	1.025	1.046
Gas/diesel oil excl. biofuels	1.017	1.017	1.017	1.034
Fuel oil	0.955	0.960	1.017	0.960
Naphtha	1.051	1.075	1.032	1.075
White spirit	1.041	1.027	1.027	1.027
Lubricants	1.003	1.003	1.025	1.003
Bitumen	0.931	0.955	0.927	0.931
Paraffin waxes	0.955	0.955	0.955	0.955
Petroleum coke	0.764	0.764	0.807	0.764
Non-specified oil products	0.955	0.955	0.955	0.955

1. Excludes NGL, feedstocks, additives and other hydrocarbons.

2. Defaults for OECD Europe were also applied to non-OECD Europe and Eurasia countries.

Conversion factors and unit abbreviations

Selected country-specific gross calorific values

Natural gas

Top-ten producers in 2019	kJ/m^3
United States	38 267
Russian Federation	38 230
Islamic Rep. of Iran	39 356
People's Rep. of China	38 931
Canada	39 386
Qatar	41 400
Australia	39 914
Norway	39 296
Saudi Arabia	38 000
Algeria	39 565

Note: To calculate the net calorific value, the gross calorific value is multiplied by 0.9.

Conventions for 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). Hydro-electricity production (excluding pumped storage) and electricity produced by other non-thermal means (wind, tide/wave/ocean, solar photovoltaic, etc.) are accounted for similarly using 1 TWh = 0.086 Mtoe. However, 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. For geothermal and solar thermal, if no country-specific information is reported, the primary energy equivalent is calculated as follows:

- 10 % for geothermal electricity
- 33 % for solar thermal electricity
- 50 % for geothermal heat
- 100 % for solar thermal heat.

Unit abbreviations

bcm	billion cubic metres	MBtu	million British thermal units
Gcal	gigacalorie	Mt	million tonnes
GCV	gross calorific value	Mtoe	million tonnes of oil equivalent
GW	gigawatt	MWh	megawatt hour
GWh	gigawatt hour	PPP	purchasing power parity
kb/cd	thousand barrels per calendar day	t	metric ton = tonne = 1 000 kg
kcal	kilocalorie	TJ	terajoule
kg	kilogramme	toe	tonne of oil equivalent = 10^7 kcal
kJ	kilojoule	TWh	terawatt hour
kWh	kilowatt hour	USD	United States dollar

Definitions

Coal

Coal includes all coal, both primary (including coking coal, steam coal and lignite) and derived fuels (including patent fuel, coke oven coke, gas coke, BKB, gas works gas, coke oven gas, blast furnace gas and other recovered gases). For presentational purposes, peat (including peat products) and oil shale are also included in this category, where applicable.

Steam coal

Steam coal comprises anthracite, other bituminous coal and sub-bituminous coal.

Crude oil

Crude oil comprises crude oil, natural gas liquids, refinery feedstocks and additives as well as other hydrocarbons.

Oil products

Oil products comprises refinery gas, ethane, LPG, aviation gasoline, motor gasoline, jet fuels, kerosene, gas/diesel oil, fuel oil, naphtha, white spirit, lubricants, bitumen, paraffin waxes, petroleum coke and other oil products.

Natural gas

Natural gas includes both "associated" and "non-associated" gas, excluding natural gas liquids.

Nuclear

Nuclear shows the primary heat equivalent of the electricity produced by a nuclear power plant with an average thermal efficiency of 33%.

Renewables

Renewables includes hydro, geothermal, solar PV, solar thermal, tide/wave/ocean, wind, municipal waste (renewable), primary solid biofuels, biogases, biogasoline, biodiesel, other liquid biofuels, non-specified primary biofuels and waste and charcoal.

Hydro

Hydro shows the energy content of the electricity produced in hydro power plants. Hydro output excludes output from pumped storage plants.

Solar photovoltaic (PV)

Solar PV electricity refers to electricity produced from solar photovoltaics, i.e. by the direct conversion of solar radiation through photovoltaic processes in semiconductor devices (solar cells), including concentrating photovoltaic systems.

Wind

Wind electricity refers to electricity produced from devices driven by wind.

Biofuels and waste

Biofuels and waste comprises solid biofuels, liquid biofuels, biogases, industrial waste and municipal waste. Biofuels are defined as any plant matter used directly as fuel or converted into fuels (e.g. charcoal) or electricity and/or heat. Included here are wood, vegetal waste (including wood waste and crops used for energy production), ethanol, animal materials/wastes and sulphite lyes. Municipal waste comprises wastes produced by residential, commercial and public services, that are collected by local authorities for disposal in a central location for the production of heat and/or power.

Definitions

Other (Energy source)

Other includes geothermal, solar, wind, tide/wave/ocean energy, electricity and heat. Unless the actual efficiency of geothermal and solar thermal is known, the quantity of geothermal and solar energy entering electricity generation is inferred from the electricity/heat production at geothermal and solar plants assuming an average thermal efficiency of:

- 10% for geothermal electricity
- 33% for solar thermal electricity
- 50% for geothermal heat
- 100% for solar thermal heat.

For solar PV, wind and tide/wave/ocean energy, the quantities entering electricity generation are equal to the electrical energy generated. Direct use of geothermal and solar heat is also included here. Electricity is accounted for at the same heat value as electricity in final consumption (i.e. 1 GWh = 0.000086 Mtoe). Heat includes heat that is produced for sale and is accounted for in the transformation sector.

Production

Production is the production of primary energy, i.e. coking coal, steam coal, lignite, peat, oil shale, crude oil, NGLs, natural gas, biofuels and waste, nuclear, hydro, geothermal, solar, wind and the heat from heat pumps that is extracted from the ambient environment. Production is calculated after removal of impurities (e.g. sulphur from natural gas).

Imports and exports

Imports and exports comprise amounts having crossed the national territorial boundaries of the country, whether or not customs clearance has taken place.

a) Oil and natural gas

Quantities of crude oil and oil products imported or exported under processing agreements (i.e. refining on account) are included. Quantities of oil in transit are excluded. Crude oil, NGL and natural gas are reported as coming from the country of origin; refinery feedstocks and oil products are reported as coming from the country of last consignment. Re-exports of oil imported for processing within bonded areas are shown as exports of product from the processing country to the final destination.

b) Coal

Imports and exports comprise the amount of fuels obtained from or supplied to other countries, whether or not there is an economic or customs union between the relevant countries. Coal in transit is not included.

c) Electricity

Amounts are considered as imported or exported when they have crossed the national territorial boundaries of the country.

International marine bunkers

International marine bunkers 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.

Definitions

International aviation bunkers

International aviation bunkers covers 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

Stock changes 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 the world total, international marine bunkers and international aviation bunkers are not subtracted from TES.

Transfers

Transfers includes both interproduct transfers, products transferred and recycled products (e.g. used lubricants which are reprocessed).

Statistical differences

Statistical differences are essentially the difference between supply and demand. They include the sum of the unexplained statistical differences for individual fuels, as they appear in the basic energy statistics. They also include the statistical differences that arise because of the variety of conversion factors in the coal and oil columns.

Electricity plants

Electricity plants 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. Both main activity producers and autoproducer plants are included here.

Oil refineries

Oil refineries shows the use of primary energy for the manufacture of finished oil products and the corresponding output. Thus, the total reflects transformation losses. In certain cases the data in the total column are positive numbers. This can be due to either problems in the primary refinery balance or to the fact that the IEA uses regional net calorific values for oil products.

Other transformation

Other transformation covers non-specified transformation not shown elsewhere, such as the transformation of primary solid biofuels into charcoal.

Energy industry own use

Energy industry own use contains the primary and secondary energy consumed by transformation industries for heating, pumping, traction and lighting purposes [ISIC 05, 06, 19 and 35, Group 091 and Classes 0892 and 0721].

Definitions

Losses

Losses include losses in energy distribution, transmission and transport.

Total final consumption (TFC)

Total final consumption (TFC) is the sum of consumption by the different end-use sectors and also includes non-energy use. Backflows from the petrochemical industry are not included in final consumption.

Industry

Industry consumption is specified by sub-sector as listed below. Energy used for transport by industry is not included here but is reported under transport. *Non-energy use* in industry is excluded from industry and reported separately:

- Mining (excluding fuels) and quarrying [ISIC Divisions 07 and 08 and Group 099]
- Construction [ISIC Divisions 41 to 43]
- Iron and steel industry [ISIC Group 241 and Class 2431]
- Chemical and petrochemical industry [ISIC Divisions 20 and 21] excluding petrochemical feedstocks
- Non-ferrous metals basic industries [ISIC Group 242 and Class 2432]
- Non-metallic minerals such as glass, ceramic, cement, etc. [ISIC Division 23]
- Transport equipment [ISIC Divisions 29 and 30]
- Machinery comprises fabricated metal products, machinery and equipment other than transport equipment [ISIC Divisions 25 to 28]
- Food and tobacco [ISIC Divisions 10 to 12]
- Paper, pulp and printing [ISIC Divisions 17 and 18]
- Wood and wood products (other than pulp and paper) [ISIC Division 16]
- Textile and leather [ISIC Divisions 13 to 15]
- Non-specified (any manufacturing industry not included above) [ISIC Divisions 22, 31 and 32].

Transport

Transport includes all fuels used for transport [ISIC Divisions 49 to 51]. It includes transport in industry and covers domestic aviation, road, rail, pipeline transport, domestic navigation and non-specified transport. Fuel used for ocean, coastal and inland fishing (included under fishing) and military consumption (included in other non-specified) are excluded from transport. Please note that international marine and international aviation bunkers are also included here for world total. *Non-energy use* in transport is excluded from transport and reported separately.

Other (Energy final consumption)

Other covers residential, commercial and public services [ISIC Divisions 33, 36-39, 45-47, 52, 53, 55, 56, 58-66, 68-75, 77-82, 84 (excluding Class 8422), 85-88, 90-99], agriculture/forestry [ISIC Divisions 01 and 02], fishing [ISIC Division 03] and non-specified consumption.

Non-energy use

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 also includes petrochemical feedstocks. Non-energy use is shown separately in final consumption under the heading non-energy use.

Geographical coverage

World

OECD¹ 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

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

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, Curaçao², 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 Rico⁹, 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 (from 1990)

Afghanistan, Armenia, Azerbaijan, Bahrain, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, the People's Republic of China, Cyprus³, Georgia, Hong Kong (China), India, Indonesia, the Islamic Republic of Iran, Iraq, Israel⁴, 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, Turkey, Turkmenistan, the United Arab Emirates, Uzbekistan, Viet Nam, and Yemen.

Europe (from 1990)

Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France⁵, Germany, Gibraltar, Greece, Hungary, Iceland, Ireland, Italy, Kosovo⁶, Latvia, Lithuania, Luxembourg, Malta, the Republic of Moldova (Moldova), Montenegro, the Netherlands, the Republic of North Macedonia, Norway, Poland, Portugal, Romania, the Russian Federation, Serbia⁷, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Ukraine, the United Kingdom.

Oceania

Australia, New Zealand, Cook Islands, Fiji, French Polynesia, Kiribati, New Caledonia, Palau, Papua New Guinea, Samoa, the Solomon Islands, Tonga, Vanuatu.

Geographical coverage

OECD¹

Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel⁴, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

OECD Americas

Canada, Chile, Mexico, the United States.

OECD Asia Oceania

Australia, Israel⁴, Japan, Korea, New Zealand.

OECD Europe

Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom.

The IEA and Accession/Association countries

IEA member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States; Accession countries: Chile and Lithuania; Association countries: Brazil, the People's Republic of China, India, Indonesia, Morocco, Singapore, South Africa, Thailand.

Middle East

Bahrain, the Islamic Republic of Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, the Syrian Arab Republic, United Arab Emirates and Yemen.

Non-OECD Europe and Eurasia

Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus³, Georgia, Gibraltar, Kazakhstan, Kosovo⁶, Kyrgyzstan, Malta, The Republic of Moldova (Moldova), Montenegro, the Republic of North Macedonia, Romania, Russian Federation, Serbia⁷, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, the Former Soviet Union and the Former Yugoslavia.

China

People's Republic of China and Hong Kong (China).

Non-OECD Asia excluding China

Bangladesh, Brunei Darussalam, Cambodia (from 1995), India, Indonesia, Democratic People's Republic of Korea, Lao People's Democratic Republic, Malaysia, Mongolia (from 1985), Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Chinese Taipei, Thailand, Viet Nam and Other non-OECD Asia.

Non-OECD Americas

Argentina, the Plurinational State of Bolivia (Bolivia), Brazil, Colombia⁸, Costa Rica, Cuba, Curaçao², 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.

Geographical coverage

1. OECD includes Estonia, Latvia, Lithuania and Slovenia starting in 1990. Prior to 1990, Estonia, Latvia and Lithuania are included in Former Soviet Union and Slovenia is included in Former Yugoslavia.

2. 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. 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.

3. Note by Turkey:

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. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of United Nations, Turkey 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 Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

4. 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.

5. Data for the overseas departments are included in Europe starting with 2011, and in other regions as appropriate (America or Africa) until 2010.

6. This designation is without prejudice to positions on status, and is in line with United Nations Security Council Resolution 1244/99 and the Advisory Opinion of the International Court of Justice on Kosovo's declaration of independence.

7. Serbia includes Montenegro until 2004 and Kosovo until 1999.

8. Data for Colombia, that joined the OECD in April 2020, are not included in the OECD aggregate in this publication.

9. Natural gas and electricity data for Puerto Rico are included under Other non-OECD Americas, except for input to and output to electricity and heat generation, included under the United States starting with 2017 data.

Note: The countries listed above are those for which the IEA Secretariat has direct statistics contacts. 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 or territory, as the case may be.