

**CO₂ EMISSIONS FROM FUEL
COMBUSTION
2019 FIRST EDITION
(OECD AND SELECTED EMERGING
ECONOMIES)**

DATABASE DOCUMENTATION

This document provides information regarding the 2019 April edition of the IEA *CO₂ Emissions from Fuel Combustion* database (for OECD and selected emerging economies – the final edition will contain global data). This document can be found online at: http://wds.iea.org/wds/pdf/OECDco2_Documentation.pdf

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www.iea.org/t&c/termsandconditions/.

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1. CHANGES FROM LAST EDITION

Geographical coverage

In an effort to enhance timeliness of data for countries beyond the OECD, the IEA is pleased to include full coverage of selected emerging economies in this release. The countries included are: Brazil, Indonesia, Morocco, Singapore and Thailand.

Old longname	New longname	Shortname	Old shortname (if changed)
	Brazil	BRAZIL	
	Indonesia	INDONESIA	
	Morocco	MOROCCO	
	Singapore	SINGAPORE	
	Thailand	THAILAND	

Lithuania became an OECD Member in July 2018. Accordingly, Lithuania appears in the list of OECD Members and is not included in the non-OECD aggregates for data from 1990, starting with the 2019 edition.

Database structure

Please note that the file OECD_CO2kwh.IVT is no longer published within *the CO₂ emissions from fuel combustion* but within a new product called *Emissions factors*. More information is available at www.iea.org/statistics.

2. DATABASE STRUCTURE

The *CO₂ Emissions from Fuel Combustion for OECD countries* database contains annual CO₂ emissions from fuel combustion and related indicators for OECD countries and regional aggregates. Emissions were calculated using IEA energy databases and the default methods and emission factors given in the *2006 GLs for National Greenhouse Gas Inventories*. This edition includes annual data for 45 countries/regions, generally from 1960-2017, unless specified differently at the country level.

The *CO₂ Emissions from Fuel Combustion for OECD countries* database includes the following six files:

OECD_BigCO ₂ .IVT	CO₂ Emissions from fuel combustion (detailed estimates) Detailed CO ₂ emissions by subsector and by product (47 products; 41 flows).
OECD_CO ₂ .IVT	CO₂ Emissions from fuel combustion (summary) Aggregated CO ₂ emissions by sector and by product category (5 product categories, 14 flow categories).
OECD_CO ₂ Indic.IVT	CO₂ Emissions indicators 30 CO ₂ -related, energy and socio-economic indicators
OECD_CO ₂ Sector.ivt	CO₂ Direct and indirect emissions by sector CO ₂ emissions split in the different sectors, before and after reallocating emissions from electricity and heat generation to final sectors. Total and per capita figures are provided. (4 allocations, 13 flow categories).
OECD_IPCC2006.ivt	IPCC Fuel combustion emissions (2006 Guidelines) CO ₂ emissions from fuel combustion, with Reference and Sectoral Approach totals, as well as detailed split between emissions across the Energy, and Industrial Processes and Product Use (IPPU) sectors, as recommended in the <i>2006 GLs</i> . (5 product categories, 13 flow categories).

Detailed definitions of each flow and product are presented in Chapter 3, *Definitions*.

3. DEFINITIONS

CO ₂ emissions from fuel combustion (MtCO ₂)		
Flow	Short name	Definition
CO ₂ Fuel combustion	CO2FCOMB	<i>CO₂ Fuel Combustion</i> presents total CO ₂ emissions from fuel combustion. This includes CO ₂ emissions from fuel combustion in IPCC Source/Sink Category 1 A Fuel Combustion Activities and those which may be reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use under the <i>2006 GLs</i> . CO2FCOMB = MAINPROD + AUTOPROD + OTHER + TOTIND +TOTTRANS + TOTOTHER
Main activity producer of electricity and heat	MAINPROD	<i>Main activity producer electricity and heat</i> contains the sum of emissions from main activity producer electricity generation, combined heat and power generation and heat plants. Main activity producers are defined as those undertakings whose primary activity is to supply the public. They may be publicly or privately owned. Emissions from own on-site use of fuel are included. This corresponds to IPCC Source/Sink Category 1 A 1 a.
Main activity 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 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.
Main activity 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 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.

CO ₂ emissions from fuel combustion (MtCO ₂)		
Flow	Short name	Definition
Main activity 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 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.
Own use in electricity, CHP and heat plants	EPOWERPLT	Emissions from own on-site use of fuel in electricity, CHP and heat plants. This includes CO ₂ emissions from fuel combustion which may be reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use under the 2006 GLs.
Unallocated autoproducers	AUTOPROD	<i>Unallocated autoproducers</i> contains the emissions from the generation of electricity and/or heat by autoproducers. Autoproducers are defined as undertakings that 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. In the 2006 GLs, these emissions would normally be distributed between industry, transport and "other" sectors. This includes CO ₂ emissions from fuel combustion which may be reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use under the 2006 GLs.
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. This includes CO ₂ emissions from fuel combustion which may be reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use under the 2006 GLs.

CO ₂ emissions from fuel combustion (MtCO ₂)		
Flow	Short name	Definition
Autoproducer CHP plants	AUTOCHP	<p>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 auto-producer'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.</p> <p>This includes CO₂ emissions from fuel combustion which may be reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use under the <i>2006 GLs</i>.</p>
Autoproducer heat plants	AUTOHEAT	<p>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.</p> <p>This includes CO₂ emissions from fuel combustion which may be reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use under the <i>2006 GLs</i>.</p>
Other energy industry own use	OTHEN	<p><i>Other energy industry own use</i> contains emissions from fuel combusted in oil refineries, for the manufacture of solid fuels, coal mining, oil and gas extraction and other energy-producing industries. This corresponds to the IPCC Source/Sink Categories 1 A 1 b and 1 A 1 c. This includes CO₂ emissions from fuel combustion which may be reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use under the <i>2006 GLs</i>.</p>

CO ₂ emissions from fuel combustion (MtCO ₂)		
Flow	Short name	Definition
Manufacturing industries and construction	TOTIND	<i>Manufacturing industries and construction</i> contains the emissions from combustion of fuels in industry. The IPCC Source/Sink Category 1 A 2 includes these emissions. However, in the 2006 GLs, the IPCC category also includes emissions from industry autoproducers that generate electricity and/or heat. The IEA data are not collected in a way that allows the energy consumption to be split by specific end-use and therefore, autoproducers are shown as a separate item (<i>unallocated autoproducers</i>). This includes CO ₂ emissions from fuel combustion which may be reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use under the 2006 GLs.
Iron and steel	IRONSTL	[ISIC Rev. 4 Group 241 and Class 2431] This includes CO ₂ emissions from fuel combustion which may be reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use under the 2006 GLs.
Chemical and petrochemical	CHEMICAL	[ISIC Rev. 4 Divisions 20 and 21]
Non-ferrous metals	NONFERR	[ISIC Rev. 4 Group 242 and Class 2432] Basic industries. This includes CO ₂ emissions from fuel combustion which may be reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use under the 2006 GLs.
Non-metallic minerals	NONMET	[ISIC Rev. 4 Division 23] Such as glass, ceramic, cement, etc.
Transport equipment	TRANSEQ	[ISIC Rev. 4 Divisions 29 and 30]
Machinery	MACHINE	[ISIC Rev. 4 Divisions 25 to 28] Fabricated metal products, machinery and equipment other than transport equipment.
Mining and quarrying	MINING	[ISIC Rev. 4 Divisions 07 and 08 and Group 099] Mining (excluding fuels) and quarrying.
Food and tobacco	FOODPRO	[ISIC Rev. 4 Divisions 10 to 12]
Paper, pulp and printing	PAPERPRO	[ISIC Rev. 4 Divisions 17 and 18]
Wood and wood Products	WOODPRO	[ISIC Rev. 4 Division 16] Wood and wood products other than pulp and paper.
Construction	CONSTRUC	[ISIC Rev. 4 Division 41 to 43]
Textile and leather	TEXTILES	[ISIC Rev. 4 Divisions 13 to 15]
Non-specified industry	INONSPEC	[ISIC Rev. 4 Divisions 22, 31 and 32] Any manufacturing industry not included above. Note: Most countries have difficulties supplying an industrial breakdown for all fuels. In these cases, the <i>non-specified</i> industry row has been used. Regional aggregates of industrial consumption should therefore be used with caution.

CO ₂ emissions from fuel combustion (MtCO ₂)		
Flow	Short name	Definition
Transport	TOTTRANS	<p><i>Transport</i> contains emissions from the combustion of fuel for all transport activity, regardless of the sector, except for <i>international marine bunkers</i> and <i>international aviation bunkers</i>, which are not included in <i>transport</i> at a national or regional level (except for World transport emissions). This includes domestic aviation, domestic navigation, road, rail and pipeline transport, and corresponds to IPCC Source/Sink Category 1 A 3. The IEA data are not collected in a way that allows the autoproducer consumption to be split by specific end-use and therefore, this publication shows autoproducers as a separate item (<i>unallocated autoproducers</i>).</p> <p>Note: Starting in the 2006 edition, military consumption previously included in <i>domestic aviation</i> and in <i>road</i> should be in <i>non-specified other</i>.</p>
Road	ROAD	<p><i>Road</i> contains the emissions arising from fuel use in road vehicles, including the use of agricultural vehicles on highways. This corresponds to the IPCC Source/Sink Category 1 A 3 b. Excludes emissions from military consumption as well as motor gasoline used in stationary engines and diesel oil for use in tractors that are not for highway use.</p>
Domestic aviation	DOMESAIR	<p><i>Domestic aviation</i> includes emissions from aviation fuels delivered to aircraft for domestic aviation – commercial, private, agriculture, 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 also incorrectly includes fuel used by domestically owned carriers for outbound international traffic.</p>
Rail	RAIL	<p>Includes emissions from rail traffic, including industrial railways.</p>
Pipeline transport	PIPELINE	<p>Includes emissions from fuels 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 coal gases, hot water or steam (ISIC Rev. 4 Division 35) from the distributor to final users is excluded and should be reported in other energy industry own use, while the energy used for the final distribution of water (ISIC Rev. 4 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 distribution losses.</p>

CO ₂ emissions from fuel combustion (MtCO ₂)		
Flow	Short name	Definition
Domestic navigation	DOMESNAV	<i>Domestic navigation</i> includes emissions from 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 emissions from transport not elsewhere specified. Note: <i>International marine bunkers</i> and <i>international aviation bunkers</i> are not included in <i>transport</i> at a country or regional level (except for World transport emissions).
Other	TOTOTHER	<i>Other</i> contains the emissions from commercial/institutional activities, residential, agriculture/forestry, fishing and other emissions not specified elsewhere that are included in the IPCC Source/Sink Categories 1 A 4 and 1 A 5. In the 2006 GLs, the category also includes emissions from autoproducers in the commercial/public services, residential and agriculture that generate electricity and/or heat. The IEA data are not collected in a way that allows the energy consumption to be split by specific end-use and therefore, autoproducers are shown as a separate item (unallocated autoproducers).
Residential	RESIDENT	<i>Residential</i> contains all emissions from fuel combustion in households. This corresponds to IPCC Source/Sink Category 1 A 4 b.
Commercial and public services	COMMPUB	<i>Commercial and public services</i> includes emissions from all activities of ISIC Rev. 4 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. This corresponds to IPCC Source/Sink Category 1 A 4 a.
Agriculture/forestry	AGRICULT	<i>Agriculture/forestry</i> 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 Rev. 4 Division 03].
Fishing	FISHING	<i>Fishing</i> includes emissions from 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 Rev.4 Division 03].

CO ₂ emissions from fuel combustion (MtCO ₂)		
Flow	Short name	Definition
Non-specified other	ONONSPEC	Includes emissions from all fuel use not elsewhere specified as well as consumption in the above-designated categories for which separate figures have not been provided. Emissions from military fuel use for all mobile and stationary consumption are 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.
Memo: International marine bunkers	MARBUNK	<i>International marine bunkers</i> contains emissions from fuels burned by 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. Emissions from international marine bunkers should be excluded from the national totals. This corresponds to IPCC Source/Sink Category 1 A 3 d i.
Memo: International aviation bunkers	AVBUNK	<i>International aviation bunkers</i> contains emissions from fuels used by 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. Emissions from international aviation bunkers should be excluded from the national totals. This corresponds to IPCC Source/Sink Category 1 A 3 a i.

Indicators		
Flow	Short name	Notes
Total primary energy supply (PJ)	TPESPJ	<p>Total primary energy supply from the <i>IEA Energy Balances</i> (converted to PJ).</p> <p>Total primary energy supply (TPES) is made up of production + imports - exports - international marine bunkers - <i>international aviation bunkers</i> ± stock changes.</p> <p>The IPCC methodology does not assign any CO₂ emissions to fuel use of biofuels <i>per se</i>, only if it is used in an unsustainable way. This is evaluated in the Agriculture, Forestry and Other Land Use module of the <i>2006 GLs</i>. So although the inclusion of biomass in the IEA energy data does not alter its CO₂ emission estimates, it gives more insight into the CO₂ intensity of national energy use.</p>
Total primary energy supply (Mtoe)	TPESMTOE	<p>Total primary energy supply from the <i>IEA Energy Balances</i>.</p> <p>Total primary energy supply (TPES) is made up of production + imports - exports - international marine bunkers - <i>international aviation bunkers</i> ± stock changes.</p> <p>The IPCC methodology does not assign any CO₂ emissions to fuel use of biofuels <i>per se</i>, only if it is used in an unsustainable way. This is evaluated in the Agriculture, Forestry and Other Land Use module of the <i>2006 GLs</i>. So although the inclusion of biomass in the IEA energy data does not alter its CO₂ emission estimates, it gives more insight into the CO₂ intensity of national energy use.</p>
Total final consumption (TFC) (PJ)	TFCPJ	<p>Total final consumption from the <i>IEA Energy Balances</i> (converted to PJ).</p> <p>The IPCC methodology does not assign any CO₂ emissions to fuel use of biofuels <i>per se</i>, only if it is used in an unsustainable way. This is evaluated in the Agriculture, Forestry and Other Land Use module of the <i>2006 GLs</i>. So although the inclusion of biomass in the IEA energy data does not alter its CO₂ emission estimates, it gives more insight into the CO₂ intensity of national energy use.</p>
Total final consumption (TFC) (Mtoe)	TFCMTOE	<p>Total final consumption from the <i>IEA Energy Balances</i>.</p> <p>The IPCC methodology does not assign any CO₂ emissions to fuel use of biofuels <i>per se</i>, only if it is used in an unsustainable way. This is evaluated in the Agriculture, Forestry and Other Land Use module of the <i>2006 GLs</i>. So although the inclusion of biomass in the IEA energy data does not alter its CO₂ emission estimates, it gives more insight into the CO₂ intensity of national energy use.</p>

Indicators		
Flow	Short name	Notes
GDP (billion 2010 US dollars)	GDP	<p>For OECD Countries:</p> <p>The main source of these series for 1970 to 2017 is the OECD <i>National Accounts Statistics</i> database [ISSN: 2074-3947 (online)], last published in book format as <i>National Accounts of OECD Countries, Volume 2018 Issue 1: Main Aggregates</i>, OECD 2018. 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 <i>OECD Economic Outlook</i> 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.</p> <p>For non-OECD countries:</p> <p>The main source of the GDP data is <i>World Development Indicators</i>, The World Bank, Washington D.C., 2018.</p> <p>The GDP data have been compiled for all individual countries at market prices in 2010 US dollars.</p>

Indicators		
Flow	Short name	Notes
GDP PPP (billion 2010 US dollars)	GDPPPP	<p>For OECD Countries:</p> <p>Purchasing power parities are the rates of currency conversion that equalise the purchasing power of different currencies. A given sum of money, when converted into different currencies at the PPP rates, buys the same basket of goods and services in all countries. In other words, PPPs are the rates of currency conversion which eliminate the differences in price levels between different countries. The PPPs selected to convert the GDP from national currencies to US dollars were aggregated using the Èltetö, Köves and Szulc (EKS) Eurostat-OECD method and rebased on the United States. For a more detailed description of the methodology please see <i>Eurostat-OECD Methodological Manual on Purchasing Power Parities</i>, 2012 edition, European Union / OECD 2012.</p> <p>The main source of these series for 1970 to 2017 is the OECD <i>National Accounts Statistics</i> database [ISSN: 2074-3947 (online)], last published in book format as <i>National Accounts of OECD Countries, Volume 2018 Issue 1: Main Aggregates</i>, OECD 2018. 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 <i>OECD Economic Outlook</i> 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), Estonia (prior to 1993) and Latvia (prior to 1994) are IEA Secretariat estimates based on GDP growth rates from the World Bank.</p> <p>For non-OECD countries:</p> <p>The main source of the GDP PPP data is <i>World Development Indicators</i>, The World Bank, Washington, D.C., 2018. However, this source is available for GDP PPP (constant 2011 US dollars scaled to the levels of 2010 using current PPP US dollars) only from 1990. Therefore, prior to 1990 GDP PPP data have been calculated based on the PPP conversion factor (GDP) to market exchange rate ratio.</p> <p>The GDP PPP reflects the changes to power purchasing parity rates based on the 2011 International Comparison Program (ICP), published in 2014. The ICP has worked for 6 years to better estimate the value of the PPP ‘basket of goods’ for all countries for which the World Bank calculates GDP PPP. For many countries, this value has significantly changed in comparison to previous ICP exercises. This leads to significant revisions to GDP PPP for many countries compared to previous publications.</p>

Indicators		
Flow	Short name	Notes
TPES / GDP (MJ per 2010 USD)	TPESGDP	This ratio is expressed in megajoules per 2010 US dollar. It has been calculated using total primary energy supply (including biofuels and other non-fossil forms of energy) and GDP calculated using exchange rates.
TPES / GDP PPP (MJ per 2010 USD PPP)	TPESGDPPP	This ratio is expressed in megajoules per 2010 US dollar. It has been calculated using total primary energy supply (including biofuels and other non-fossil forms of energy) and GDP calculated using purchasing power parities.
Population (millions)	POP	<p>For OECD Countries:</p> <p>The main source of these series for 1970 to 2017 when available is the OECD <i>National Accounts Statistics</i> database [ISSN: 2074-3947 (online)], last published in book format as <i>National Accounts of OECD Countries, Volume 2018 Issue 1: Main Aggregates</i>, OECD 2018. Data for 1960 to 1969 have been estimated using the growth rates from the population series published in the <i>OECD Factbook 2015</i> (online database version). Growth rates from the <i>OECD Factbook 2015</i> 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). Data for Latvia (prior to 1995) and Lithuania (prior to 1995) are IEA Secretariat estimates based on GDP growth rates from the World Bank.</p> <p>For non-OECD countries:</p> <p>The main source of the population data is <i>World Development Indicators</i>, The World Bank, Washington D.C., 2016.</p>
CO ₂ / TPES (tCO ₂ per TJ)	CO2TPES	This ratio is expressed in tonnes of CO ₂ per terajoule. It has been calculated using the total CO ₂ fuel combustion emissions (CO2FCOMB) and total primary energy supply (including biofuels and other non-fossil forms of energy).
CO ₂ / TFC (tCO ₂ per TJ)	CO2TFC	This ratio is expressed in tonnes of CO ₂ per terajoule. It has been calculated using the total CO ₂ fuel combustion emissions (CO2FCOMB) and total final consumption (including biofuels and other non-fossil forms of energy).
CO ₂ / GDP (kgCO ₂ per 2010 US dollar)	CO2GDP	This ratio is expressed in kilogrammes of CO ₂ per 2010 US dollar. It has been computed using the total CO ₂ fuel combustion (CO2FCOMB) emissions and GDP calculated using exchange rates.
Industry CO ₂ / GDP (kgCO ₂ per 2010 US dollar)	CO2GDP_I	This ratio is expressed in kilogrammes of CO ₂ per 2010 US dollar. It has been computed using <i>Manufacturing industries and construction</i> CO ₂ emissions (TOTIND) and total GDP calculated using exchange rates.
Transport CO ₂ / GDP (kgCO ₂ per 2010 US dollar)	CO2GDP_T	This ratio is expressed in kilogrammes of CO ₂ per 2010 US dollar. It has been computed using <i>Transport</i> CO ₂ emissions (TOTTRANS) and total GDP calculated using exchange rates.

Indicators		
Flow	Short name	Notes
Services CO ₂ / GDP (kgCO ₂ per 2010 US dollar)	CO2GDP_S	This ratio is expressed in kilogrammes of CO ₂ per 2010 US dollar. It has been computed using <i>Commercial and public services</i> CO ₂ emissions (COMMPUB) and total GDP calculated using exchange rates.
Residential CO ₂ / GDP (kgCO ₂ per 2010 US dollar)	CO2GDP_R	This ratio is expressed in kilogrammes of CO ₂ per 2010 US dollar. It has been computed using <i>Residential</i> CO ₂ emissions (RESIDENT) and total GDP calculated using exchange rates.
CO ₂ / GDP PPP (kgCO ₂ per 2010 US dollar)	CO2GDPPP	This ratio is expressed in kilogrammes of CO ₂ per 2010 US dollar. It has been calculated using CO ₂ Fuel Combustion emissions (CO2FCOMB) and GDP calculated using purchasing power parities.
Industry CO ₂ / GDP PPP (kgCO ₂ per 2010 US dollar)	CO2GDPPP_I	This ratio is expressed in kilogrammes of CO ₂ per 2010 US dollar. It has been calculated using <i>Manufacturing industries and construction</i> CO ₂ emissions (TOTIND) and total GDP calculated using purchasing power parities.
Transport CO ₂ / GDP PPP (kgCO ₂ per 2010 US dollar)	CO2GDPPP_T	This ratio is expressed in kilogrammes of CO ₂ per 2010 US dollar. It has been calculated using <i>Transport</i> CO ₂ emissions (TOTTRANS) and total GDP calculated using purchasing power parities.
Services CO ₂ / GDP PPP (kgCO ₂ per 2010 US dollar)	CO2GDPPP_S	This ratio is expressed in kilogrammes of CO ₂ per 2010 US dollar. It has been calculated using the <i>Commercial and public services</i> CO ₂ emissions (COMMPUB) and total GDP calculated using purchasing power parities.
Residential CO ₂ / GDP PPP (kgCO ₂ per 2010 US dollar)	CO2GDPPP_R	This ratio is expressed in kilogrammes of CO ₂ per 2010 US dollar. It has been calculated using <i>Residential</i> CO ₂ emissions (RESIDENT) and total GDP calculated using purchasing power parities.
CO ₂ / Population (tCO ₂ per capita)	CO2POP	This ratio is expressed in tonnes of CO ₂ per capita. It has been calculated using CO ₂ Fuel Combustion emissions (CO2FCOMB).
Industry CO ₂ / Population (tCO ₂ per capita)	CO2POP_I	This ratio is expressed in tonnes of CO ₂ per capita. It has been calculated using <i>Manufacturing industries and construction</i> CO ₂ emissions (TOTIND).
Transport CO ₂ / Population (tCO ₂ per capita)	CO2POP_T	This ratio is expressed in tonnes of CO ₂ per capita. It has been calculated using the <i>Transport</i> CO ₂ emissions (TOTTRANS).
Services CO ₂ / Population (tCO ₂ per capita)	CO2POP_S	This ratio is expressed in tonnes of CO ₂ per capita. It has been calculated using <i>Commercial and public services</i> CO ₂ emissions (COMMPUB).
Residential CO ₂ / Population (tCO ₂ per capita)	CO2POP_R	This ratio is expressed in tonnes of CO ₂ per capita. It has been calculated using <i>Residential</i> CO ₂ emissions (RESIDENT).

Indicators		
Flow	Short name	Notes
CO ₂ emissions index	ICO2EMIS	CO ₂ Fuel Combustion emissions (CO2FCOMB) expressed as an index, where the reference year = 100. Aside from the following exceptions, 1990 is used as the reference year: Hungary (average 1985-1987), Poland (1988) and Slovenia (1986).
Population index	IPOP	Population expressed as an index, where the reference year = 100. Aside from the following exceptions, 1990 is used as the reference year: Hungary (average 1985-1987), Poland (1988) and Slovenia (1986). This index can be used as one of the constituents of the Kaya identity, for more information see Chapter 5, <i>IEA emissions estimates</i> of the full publication.
GDP per population index	IGDPPOP	GDP PPP / population expressed as an index, where the reference year = 100. Aside from the following exceptions, 1990 is used as the reference year: Hungary (average 1985-1987), Poland (1988) and Slovenia (1986). This index can be used as one of the constituents of the Kaya identity, for more information see Chapter 5, <i>IEA emissions estimates</i> of the full publication.
Energy intensity index - TPES/GDP	ITPESGDP	TPES / GDP PPP expressed as an index, where the reference year = 100. Aside from the following exceptions, 1990 is used as the reference year: Hungary (average 1985-1987), Poland (1988) and Slovenia (1986). This index can be used as one of the constituents of the Kaya identity, for more information see Chapter 5, <i>IEA emissions estimates</i> of the full publication.
Carbon intensity index – ESCII: CO ₂ /TPES	ICO2TPES	CO ₂ emissions / TPES expressed as an index, where the reference year = 100. Calculated using CO ₂ Fuel Combustion emissions (CO2FCOMB). Aside from the following exceptions, 1990 is used as the reference year: Hungary (average 1985-1987), Poland (1988) and Slovenia (1986). This index can be used as one of the constituents of the Kaya identity, for more information see Chapter 5, <i>IEA emissions estimates</i> of the full publication.

Direct and indirect emissions by sector		
Flow	Allocation	Definition
Emissions by sector	NO	Expressed in million tonnes of CO ₂ . This allocation type shows emissions for the same sectors which are present in the file CO ₂ Emissions From Fuel Combustion. In particular, the emissions from electricity and heat production are shown separately and not reallocated.
Emissions with electricity and heat allocated to consuming sectors	YES	Expressed in million tonnes of CO ₂ . Emissions from electricity and heat generation have been allocated to final consuming sectors in proportion to the electricity and heat consumed.
Per capita emissions by sector	NOP	These ratios are expressed in kilogrammes of CO ₂ per capita. This allocation type shows per capita emissions for the same sectors which are present in the file CO ₂ Emissions From Fuel Combustion. In particular, the emissions from electricity and heat production are shown separately and not reallocated.
Per capita emissions with electricity and heat allocated to consuming sectors	YESP	These ratios are expressed in kilogrammes of CO ₂ per capita. Emissions from electricity and heat generation have been allocated to final consuming sectors in proportion to the electricity and heat consumed.

IPCC Fuel combustion emissions (2006 Guidelines)		
Flow	Short name	Definition
CO ₂ Fuel combustion (Energy & IPPU)	CO2FCOMB	<p><i>CO₂ Fuel Combustion (Energy & IPPU)</i> presents total CO₂ emissions from fuel combustion. This includes CO₂ emissions from fuel combustion in IPCC Source/Sink Category 1 A Fuel Combustion Activities and those which may be excluded from the Sectoral Approach and reallocated to IPCC Source/Sink Category 2 Industrial Processes and Product Use (IPPU) under the 2006 IPCC Guidelines (2006 GLs).</p> <p>CO2FCOMB = CO2SA + IPPUFCOMB</p>
CO ₂ Sectoral approach (Energy)	CO2SA	<p><i>CO₂ Sectoral Approach (Energy)</i> presents total CO₂ emissions from fuel combustion as calculated using the IPCC Tier 1 Sectoral Approach of the 2006 GLs and corresponds to IPCC Source/Sink Category 1 A.</p> <p>Under the 2006 GLs, certain fuel combustion emissions may be excluded from the Sectoral Approach and reallocated to the IPCC Source/Sink Category Industrial Processes and Product Use (IPPU). For the IEA Sectoral Approach calculations, these reallocated emissions have been excluded, and are presented separately (under <i>IPPU CO₂ Fuel combustion – Total reallocated [IPPU]</i>).</p>
IPPU CO ₂ Fuel combustion – Total reallocated (IPPU)	IPPUFCOMB	<p><i>IPPU CO₂ Fuel combustion – Total reallocated (IPPU)</i> presents the total quantity of CO₂ emissions from fuel combustion which may be excluded from the Sectoral Approach and reallocated to IPCC Source/Sink Category Industrial Processes and Product Use (IPPU) under the 2006 GLs.</p> <p>IPPUFCOMB = IPPUIRON + IPPUNFERR + IPPUAUTOP + IPPUEPOWER + IPPUEBLAST</p>
CO ₂ Reference approach (Energy)	CO2RA	<p><i>CO₂ Reference Approach (Energy)</i> contains total CO₂ emissions from fuel combustion as calculated using the Reference Approach of the 2006 GLs. The Reference Approach is based on the supply of energy in a country and as a result, all inventories calculated using this method include fugitive emissions from energy transformation (e.g. from oil refineries) which are normally included in Category 1 B. For this reason, Reference Approach estimates are likely to overestimate national CO₂ emissions from fuel combustion.</p> <p>Under the 2006 GLs, certain fuel combustion emissions are excluded from the Reference Approach as they are accounted for IPCC Source/Sink Categories other than Energy. For the purposes of these IEA Reference Approach estimates, these emissions have been excluded.</p> <p>In these tables, the difference between the Sectoral Approach and the Reference Approach includes statistical differences, product transfers, transformation losses, distribution losses. In addition, some differences between the approaches may occur due to simplifications in the Reference Approach.</p> <p>CO2RA = CO2SA + TRANDIFF + STATDIFF</p>

IPCC Fuel combustion emissions (2006 Guidelines)		
Flow	Short name	Definition
Difference due to losses and/or transformation (Energy)	TRANDIFF	<p><i>Differences due to losses and/or transformation</i> contains emissions that result from the transformation of energy from a primary fuel to a secondary or tertiary fuel. Included here are solid fuel transformation, oil refineries, gas works and other fuel transformation industries. These emissions are normally reported as fugitive emissions in the IPCC Source/Sink Category 1 B, but will be included in 1 A in inventories that are calculated using the IPCC Reference Approach. Theoretically, this category should show relatively small emissions representing the loss of carbon by other ways than combustion, such as evaporation or leakage.</p> <p>Negative emissions for one product and positive emissions for another product would imply a change in the classification of the emission source as a result of an energy transformation between coal and gas, between coal and oil, etc. In practice, however, it often proves difficult to correctly account for all inputs and outputs in energy transformation industries, and to separate energy that is transformed from energy that is combusted. Therefore, <i>differences due to losses and/or transformation</i> sometimes shows quite large positive emissions or even negative ones due to problems in the underlying energy data.</p>
Statistical differences (Energy)	STATDIFF	<p><i>Statistical differences</i> can be due to unexplained discrepancies in the underlying energy data. They can also be caused by differences between emissions calculated using the Reference Approach and the Sectoral Approach.</p>
Memo: IPPU CO ₂ Fuel combustion – Iron and steel (IPPU)	IPPUIRON	<p><i>IPPU CO₂ Fuel combustion – Iron and steel (IPPU)</i> presents the CO₂ emissions from fuel combustion which may be excluded from the iron and steel sector under the Sectoral Approach and reallocated to IPCC Source/Sink Category Industrial Processes and Product Use (IPPU) under the 2006 GLs.</p> <p>This contains emissions from coke oven coke, coke oven gas, blast furnace gas and other recovered gases reported under <i>Iron and steel</i>.</p>
Memo: IPPU CO ₂ Fuel combustion – Non-ferrous metals (IPPU)	IPPUNFERR	<p><i>IPPU CO₂ Fuel combustion – Non-ferrous metals (IPPU)</i> presents the CO₂ emissions from fuel combustion which may be excluded from the non-ferrous metals sector under the Sectoral Approach and reallocated to IPCC Source/Sink Category Industrial Processes and Product Use (IPPU) under the 2006 GLs.</p> <p>This contains emissions from coke oven coke reported under <i>Non-ferrous metals</i>.</p>

IPCC Fuel combustion emissions (2006 Guidelines)		
Flow	Short name	Definition
Memo: IPPU CO ₂ Fuel combustion – Autoproducers (IPPU)	IPPUAUTOP	<p><i>IPPU CO₂ Fuel combustion – Autoproducer (IPPU)</i> presents the CO₂ emissions from fuel combustion which may be excluded from the autoproduction sector under the Sectoral Approach and reallocated to IPCC Source/Sink Category Industrial Processes and Product Use (IPPU) under the 2006 GLs.</p> <p>This contains emissions from coke oven gas, blast furnace gas and other recovered gases reported under <i>Unallocated autoproducers</i>. For the purposes of IEA Sectoral Approach estimates, autoproducer consumption of these gases is assumed to occur within the iron and steel sector.</p>
Memo: IPPU CO ₂ Fuel combustion – Autoproducer own use (IPPU)	IPPUEPOWER	<p><i>IPPU CO₂ Fuel combustion – Autoproducer own use (IPPU)</i> presents the CO₂ emissions from fuel combustion which may be excluded from autoproducer on-site own use under the Sectoral Approach and reallocated to IPCC Source/Sink Category Industrial Processes and Product Use (IPPU) under the 2006 GLs.</p> <p>This contains emissions from coke oven gas, blast furnace gas and other recovered gases reported under <i>Own on-site use of fuel in electricity, CHP and heat plants</i>. For the purposes of IEA Sectoral Approach estimates, autoproducer consumption of these gases is assumed to occur within the iron and steel sector.</p>
Memo: IPPU CO ₂ Fuel combustion – Blast furnace energy (IPPU)	IPPUEBLAST	<p><i>IPPU CO₂ Fuel combustion – Blast furnace energy (IPPU)</i> presents the CO₂ emissions from fuel combustion which may be excluded from energy use in blast furnaces under the Sectoral Approach and reallocated to IPCC Source/Sink Category Industrial Processes and Product Use (IPPU) under the 2006 GLs.</p> <p>This contains emissions from coke oven coke, coke oven gas, blast furnace gas and other recovered gases reported under <i>Energy use in blast furnaces</i>. For the purposes of IEA Sectoral Approach estimates, energy use in blast furnaces is assumed to occur within the iron and steel sector.</p>
Memo: International marine bunkers	MARBUNK	<p><i>International marine bunkers</i> contains emissions from fuels burned by 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. Emissions from international marine bunkers should be excluded from the national totals. This corresponds to IPCC Source/Sink Category 1 A 3 d i.</p>

IPCC Fuel combustion emissions (2006 Guidelines)		
Flow	Short name	Definition
Memo: International aviation bunkers	AVBUNK	<i>International aviation bunkers</i> contains emissions from fuels used by 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. Emissions from international aviation bunkers should be excluded from the national totals. This corresponds to IPCC Source/Sink Category 1 A 3 a i.

Aggregated product categories for summary file		
Flow	Short name	Definition
Coal, peat and oil shale	COAL	Coal, peat and oil shale includes all coal, both primary (hard coal, brown coal, anthracite, coking coal, other bituminous coal, sub-bituminous coal and lignite) and derived fuels (patent fuel, coke oven coke, gas coke, coal tar, BKB, gas works gas, coke oven gas, blast furnace gas and other recovered gases). Peat, peat products and oil shale are also aggregated in this category.
Oil	OIL	Oil includes crude oil, natural gas liquids, refinery feedstocks, additives/blending components, orimulsion, other hydrocarbons, refinery gas, ethane, LPG, motor gasoline excl. biofuels, aviation gasoline, gasoline type jet fuel, kerosene type jet fuel excl. biofuels, kerosene, gas/diesel oil excl. biofuels, fuel oil, naphtha, white spirit, lubricants, bitumen, paraffin waxes, petroleum coke and non-specified oil products.
Natural gas	NATGAS	Gas represents natural gas. It excludes natural gas liquids.
Other	OTHER	Other includes industrial waste and non-renewable municipal waste.
Total	TOTAL	TOTAL = the total of all CO ₂ emissions from fuel combustion, i.e. COAL + OIL + NATGAS + OTHER.

Coal		
Flow	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, 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 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 usually more than 10% volatile matter and a relatively high carbon content (less than 90% fixed carbon). Its gross calorific value is 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.
Patent Fuel	PATFUEL	Patent fuel is a composition fuel manufactured from hard coal fines with the addition of a binding agent. The amount of patent fuel produced may, therefore, be slightly higher than the actual amount of coal consumed in the transformation process. Consumption of patent fuels during the patent fuel manufacturing process is included under <i>energy industry own use</i> .
Coke oven coke	OVENCOKE	Coke oven coke is the solid product obtained from the carbonisation of coal, principally coking coal, at high temperature. It is low in moisture content and volatile matter. Coke oven coke is used mainly in the iron and steel industry, acting as energy source and chemical agent. Also included are semi-coke (a solid product obtained from the carbonisation of coal at a low temperature), lignite coke (a semi-coke made from lignite), coke breeze and foundry coke. The heading <i>energy industry own use</i> includes the consumption at the coking plants themselves. Consumption in the <i>iron and steel industry</i> does not include coke converted into blast furnace gas. To obtain the total emissions from coke oven coke in the iron and steel industry, the quantities converted into blast furnace gas have to be added (these are aggregated under differences due to transformations and/or losses).

Coal		
Flow	Short name	Definition
Gas coke	GASCOKE	Gas coke is a by-product of hard coal used for the production of town gas in gas works. Gas coke is used for heating purposes. <i>Energy industry own use</i> includes the consumption of gas coke at gas works.
Coal tar	COALTAR	Coal tar is a result of the destructive distillation of bituminous coal. Coal tar is the liquid by-product of the distillation of coal to make coke in the coke oven process. Coal tar can be further distilled into different organic products (e.g. benzene, toluene, naphthalene), which normally would be reported as a feedstock to the petrochemical industry.
BKB	BKB	Brown coal briquettes (braunkohlebriketts) are composition fuels manufactured from lignite, produced by briquetting under high pressure with or without the addition of a binding agent. The heading <i>energy industry own use</i> includes consumption by briquetting plants.
Gas works gas	GASWKSGS	Gas works gas covers all types of gas produced in public utility or private plants, whose main purpose is the manufacture, transport and distribution of gas. It includes gas produced by carbonisation (including gas produced by coke ovens and transferred to gas works), by total gasification (with or without enrichment with oil products) and by reforming and simple mixing of gases and/or air.
Coke oven gas	COKEOVGS	Coke oven gas is obtained as a by-product of the manufacture of coke oven coke for the production of iron and steel.
Blast furnace gas	BLFURGS	Blast furnace gas is produced during the combustion of coke in blast furnaces in the iron and steel industry. It is recovered and used as a fuel, partly within the plant and partly in other steel industry processes or in power stations equipped to burn it.
Other recovered gases	OGASES	By-product of the production of steel in an oxygen furnace, recovered on leaving the furnace. The gases are also known as converter gas, LD gas or BOS gas. The quantity of recuperated fuel should be reported on a gross calorific value basis. Also covers non-specified manufactured gases not mentioned above, such as combustible gases of solid carbonaceous origin recovered from manufacturing and chemical processes not elsewhere defined.

Peat		
Flow	Short name	Definition
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 is not included here. Milled peat is included here.
Peat products	PEATPROD	Products such as peat briquettes derived directly or indirectly from sod peat and milled peat.

Oil shale		
Flow	Short name	Definition
Oil shale and oil sands	OILSHALE	Oil shale and oil sands are sedimentary rock which contains organic matter in the form of kerogen. Kerogen is a waxy hydrocarbon-rich material regarded as a precursor of petroleum. Oil shale may be burned directly or processed by heating to extract shale oil. Oil shale and tar sands used as inputs for other transformation processes are included here (this includes the portion consumed in the transformation process). Shale oil and other products derived from liquefaction are included in <i>other hydrocarbons</i> .

Oil		
Flow	Short name	Definition
Crude/NGL/ feedstocks (if no detail)	CRNGFEED	This item is only used if the detailed breakdown is not available. It includes crude oil, natural gas liquids, refinery feedstocks, additives/blending components and other hydrocarbons.
Crude oil	CRUDEOIL	Crude oil is a mineral oil consisting of a mixture of hydrocarbons of natural origin and associated impurities, such as sulphur. It exists in the liquid phase under normal surface temperatures and pressure and its physical characteristics (density, viscosity, etc.) are highly variable. It includes field or lease condensates (separator liquids) which are recovered from associated and non-associated gas where it is commingled with the commercial crude oil stream.
Natural gas liquids	NGL	NGL are the liquid or liquefied hydrocarbons recovered from natural gas in separation facilities or gas processing plants. Natural gas liquids include ethane, propane, butane (normal and iso-), (iso) pentane and pentanes plus (sometimes referred to as natural gasoline or plant condensate).
Refinery feedstocks	REFFEEDS	A refinery feedstock is a processed oil destined for further processing (e.g. straight run fuel oil or vacuum gas oil) other than blending in the refining industry. It is transformed into one or more components and/or finished products. With further processing, it will be transformed into one or more components and/or finished products. This definition also covers returns from the petrochemical industry to the refining industry (e.g. pyrolysis gasoline, C4 fractions, gasoil and fuel oil fractions).
Additives / blending components	ADDITIVE	Additives are non-hydrocarbon substances added to or blended with a product to modify its properties, for example, to improve its combustion characteristics. Alcohols and ethers (MTBE, methyl tertiary-butyl ether) and chemical alloys such as tetraethyl lead are included here. The biomass fractions of biogasoline, biodiesel and ethanol are not included here, but under liquid biofuels. This differs from the presentation of additives in the <i>Oil Information</i> publication.
Orimulsion	ORIMUL	Emulsified oil made of water and natural bitumen.
Other hydrocarbons	NONCRUDE	This category includes synthetic crude oil from tar sands, shale oil, etc., liquids from coal liquefaction, output of liquids from natural gas conversion into gasoline and hydrogen. Orimulsion and oil shale are presented separately and not included here.
Refinery gas	REFINGAS	Refinery gas is defined as non-condensable gas obtained during distillation of crude oil or treatment of oil products (e.g. cracking) in refineries. It consists mainly of hydrogen, methane, ethane and olefins. It also includes gases which are returned from the petrochemical industry.
Ethane	ETHANE	Ethane is a naturally gaseous straight-chain hydrocarbon (C ₂ H ₆). It is a colourless paraffinic gas which is extracted from natural gas and refinery gas streams.

Oil		
Flow	Short name	Definition
Liquefied petroleum gases	LPG	Liquefied petroleum gases are the light hydrocarbon fraction of the paraffin series, derived from refinery processes, crude oil stabilisation plants and natural gas processing plants, comprising propane (C ₃ H ₈) and butane (C ₄ H ₁₀) or a combination of the two. They could also include propylene, butylene, isobutene and isobutylene. LPG are normally liquefied under pressure for transportation and storage.
Motor gasoline excl. bio	NONBIOGASO	Motor gasoline is light hydrocarbon oil for use in internal combustion engines such as motor vehicles, excluding aircraft. Motor gasoline is distilled between 35°C and 215°C and is used as a fuel for land based spark ignition engines. Motor gasoline may include additives, oxygenates and octane enhancers, including lead compounds such as TEL (tetraethyl lead) and TML (tetramethyl lead). Motor gasoline excluding biofuels does not include the liquid biofuel or ethanol blended with gasoline - see liquid biofuels.
Aviation gasoline	AVGAS	Aviation gasoline is motor spirit prepared especially for aviation piston engines, with an octane number suited to the engine, a freezing point of -60°C, and a distillation range usually within the limits of 30°C and 180°C.
Gasoline type jet fuel	JETGAS	Gasoline type jet fuel includes all light hydrocarbon oils for use in aviation turbine power units, which distil between 100°C and 250°C. This fuel is obtained by blending kerosenes and gasoline or naphthas in such a way that the aromatic content does not exceed 25% in volume, and the vapour pressure is between 13.7 kPa and 20.6 kPa. Additives can be included to improve fuel stability and combustibility.
Kerosene type jet fuel excl. bio	NONBIOJETK	Kerosene type jet fuel is a medium distillate used for aviation turbine power units. It has the same distillation characteristics and flash point as kerosene (between 150°C and 300°C but not generally above 250°C). In addition, it has particular specifications (such as freezing point) which are established by the International Air Transport Association (IATA). It includes kerosene blending components. Kerosene type jet fuel excluding biofuels does not include the liquid biofuels blended with jet kerosene.
Other kerosene	OTHKERO	Kerosene (other than kerosene used for aircraft transport which is included with aviation fuels) comprises refined petroleum distillate intermediate in volatility between gasoline and gas/diesel oil. It is a medium oil distilling between 150°C and 300°C.

Oil		
Flow	Short name	Definition
Gas/diesel oil excl. bio	NONBIODIES	Gas/diesel oil includes heavy gas oils. Gas oils are obtained from the lowest fraction from atmospheric distillation of crude oil, while heavy gas oils are obtained by vacuum redistillation of the residual from atmospheric distillation. Gas/diesel oil distils between 180°C and 380°C. Several grades are available depending on uses: diesel oil for diesel compression ignition (cars, trucks, marine, etc.), light heating oil for industrial and commercial uses, and other gas oil including heavy gas oils which distil between 380°C and 540°C and which are used as petrochemical feedstocks. Gas/diesel oil excluding biofuels does not include the liquid biofuels blended with gas/diesel oil – see liquid biofuels.
Fuel oil	RESFUEL	Fuel oil defines oils that make up the distillation residue. It comprises all residual fuel oils, including those obtained by blending. Its kinematic viscosity is above 10 cSt at 80°C. The flash point is always above 50°C and the density is always higher than 0.90 kg/l.
Naphtha	NAPHTHA	Naphtha is a feedstock destined either for the petrochemical industry (e.g. ethylene manufacture or aromatics production) or for gasoline production by reforming or isomerisation within the refinery. Naphtha comprises material that distils between 30°C and 210°C.
White spirit & SBP	WHITESP	White spirit and SBP are refined distillate intermediates with a distillation in the naphtha/kerosene range. White Spirit has a flash point above 30°C and a distillation range of 135°C to 200°C. Industrial Spirit (SBP) comprises light oils distilling between 30°C and 200°C, with a temperature difference between 5% volume and 90% volume distillation points, including losses, of not more than 60°C. In other words, SBP is a light oil of narrower cut than motor spirit. There are seven or eight grades of industrial spirit, depending on the position of the cut in the distillation range defined above.
Lubricants	LUBRIC	Lubricants are hydrocarbons produced from distillate or residue; they are mainly used to reduce friction between bearing surfaces. This category includes all finished grades of lubricating oil, from spindle oil to cylinder oil, and those used in greases, including motor oils and all grades of lubricating oil base stocks.
Bitumen	BITUMEN	Bitumen is a solid, semi-solid or viscous hydrocarbon with a colloidal structure that is brown to black in colour. It is obtained by vacuum distillation of oil residues from atmospheric distillation of crude oil. Bitumen is often referred to as asphalt and is primarily used for surfacing of roads and for roofing material. This category includes fluidised and cut back bitumen.
Paraffin waxes	PARWAX	Paraffin waxes are saturated aliphatic hydrocarbons. These waxes are residues extracted when dewaxing lubricant oils, and they have a crystalline structure which is more or less fine according to the grade. Their main characteristics are that they are colourless, odourless and translucent, with a melting point above 45°C.

Oil		
Flow	Short name	Definition
Petroleum coke	PETCOKE	Petroleum coke is defined as a black solid residue, obtained mainly by cracking and carbonising of petroleum derived feedstocks, vacuum bottoms, tar and pitches in processes such as delayed coking or fluid coking. It consists mainly of carbon (90 to 95%) and has a low ash content. It is used as a feedstock in coke ovens for the steel industry, for heating purposes, for electrode manufacture and for production of chemicals. The two most important qualities are "green coke" and "calcined coke". This category also includes "catalyst coke" deposited on the catalyst during refining processes: this coke is not recoverable and is usually burned as refinery fuel.
Non-specified oil products	ONONSPEC	Other oil products not classified above (e.g. tar, sulphur and grease) are included here. This category also includes aromatics (e.g. BTX or benzene, toluene and xylene) and olefins (e.g. propylene) produced within refineries.

Gas		
Flow	Short name	Definition
Natural gas	NATGAS	<p>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).</p> <p>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.</p>

Other		
Flow	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.
Municipal waste (non-renewable)	MUNWASTEN	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. Renewable municipal waste is not included here.

4. GEOGRAPHICAL COVERAGE AND COUNTRY NOTES

Countries and regions		
<p>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.</p>		
Country/ Region	Short name	Definition
Australia	AUSTRALI	<p>Excludes the overseas territories.</p> <p>All data refer to the fiscal year (e.g. July 2015 to June 2016 for 2016).</p> <p>Starting with the 2013 edition, data for Australia were revised back to 2003 due to the adoption of the National Greenhouse and Energy reporting (NGER) as the main energy consumption data source for the Australian Energy Statistics. As a result, there are breaks in the time series for many data between 2002 and 2003. The revisions have also introduced some methodological problems. The national statistics appear to have problems identifying inputs and outputs to certain transformation processes such as gas works plants, electricity plants and CHP plants. Energy industry own use and inputs to the transformation processes are sometimes not reported separately in the correct categories. More detailed information is given in the online data documentation of <i>World Energy Balances</i>¹</p>

1. Available at www.iea.org/statistics/topics/energybalances.

Countries and regions

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Country/ Region	Short name	Definition
Austria	AUSTRIA	<p>Starting with the 2016 edition and following, widespread data revisions were received due to enhanced reporting from 2005 onwards as a consequence of improved Austrian Final Energy Consumption surveys. 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</p>
Belgium	BELGIUM	
Canada	CANADA	<p>In the 2018 edition, data for Canada were revised back to 2005 following a ten year revision of the Report on Energy Supply and Demand (RES-D), the main set of Canadian annual data. The revision standardizes the methodology used for the IEA data submission and has mainly affected the demand side. Additional details are given under each fuel.</p> <p>From the 2014 edition of this publication, the Canadian administration revised time series back to 2005, using additional data from the Annual Industrial Consumption of Energy, the Annual Survey of Secondary Distributors, the Report on Energy Supply and Demand and the Natural Resources Canada Office of Energy Efficiency. Breaks in time series also between appear 1989 and 1990, due to changes in methodology, incorporated in 2002.</p> <p>International marine bunkers are included with domestic navigation prior to 1978.</p>
Chile	CHILE	<p>Data are available starting in 1971.</p> <p>In the 2017 edition, data for 2014 and 2015 were revised to replace figures previously estimated by the Secretariat.</p> <p>From 1990, consumption in paper and pulp includes forestry and consumption in agriculture is included in <i>non-specified industry</i>. In general, a new methodology has been applied for data since 1990, leading to other breaks in time series between 1989 and 1990.</p>
Czech Republic	CZECH	<p>Due to ongoing review of energy data for 2010-2014, revisions have been made in the 2017 edition.</p> <p>Data are available starting in 1971.</p>

Countries and regions

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Country/ Region	Short name	Definition
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. In the 2004 edition, major revisions were made by the Danish administration for the 1990 to 2001 data, which may cause breaks in time series between 1989 and 1990.
Estonia	ESTONIA	Data for Estonia are available from 1990. Prior to that, they are included in the Former Soviet Union (available in the full publication).
Finland	FINLAND	In 2014, 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.
France	FRANCE	France includes Monaco and excludes the overseas collectivities: New Caledonia; French Polynesia; Saint Barthélemy; Saint Martin; Saint Pierre and Miquelon; and Wallis and Futuna. Data for the following overseas departments: Guadeloupe; French Guiana; Martinique; Mayotte; and Réunion are included for the years 2011-2017, and excluded for earlier years. Economic indicators data for France includes the aforementioned overseas departments for the whole time series. In the 2018 edition, data for France were revised back to 2011 following changes in methodology and procedures used by the energy statistics sub-department (SDSE) within the Ministry for the ecological and inclusive transition. As a result, the revisions, to bring the reporting more in line with the international standards, impacted all fuels. From 2012, the energy consumption is more detailed due to a more precise national survey.
Germany	GERMANY	Includes the new federal states of Germany from 1970 onwards. Data starts in 1960. German data include the new federal states of Germany from 1970 onwards.
Greece	GREECE	
Hungary	HUNGARY	According to the provisions of Article 4.6 of the Convention and Decisions 9/CP.2 and 11/CP.4, Hungary is allowed to use average 1985-1987 as the base year. Data are available starting in 1965. The Hungarian administration submitted questionnaires to the IEA Secretariat for the first time with 1993 data.

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Country/ Region	Short name	Definition
Iceland	ICELAND	Prior to 1970, final consumption includes inputs and outputs to heat production. The industrial classifications used by the Icelandic administration were changed in 1987.
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 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. Data are available starting in 1971. 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. Due to the unavailability of data for certain fuels, IEA estimations are also present in Israel data. In particular this is valid for oil data in 2014 and 2015, natural gas data from 2012 onwards, renewables and waste data in 2013.
Italy	ITALY	Includes San Marino and the Holy See. A change in methodology lead to breaks in time series for industry and transformation between 2003 and 2004.
Japan	JAPAN	Includes Okinawa. In the 2019 edition, data for Japan were revised back to 1990 based on new methodology. From 1990, data are reported on a fiscal year basis (e.g. April 2015 to March 2016 for 2015). Consumption data for commercial/public services may include consumption in small and medium-sized industries. The Japanese administration expects that this shortcoming will be corrected in the near future.
Korea	KOREA	Data are available starting in 1971. 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.

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Country/ Region	Short name	Definition
Latvia	LATVIA	<p>Data for Latvia are available starting in 1990. Prior to that, they are included in Former Soviet.</p> <p>Breaks in the time series appear for inputs to and outputs from electricity generation between 2016 and 2017 due to a change in methodology. This is most notable for main activity producer CHP and Heat plants. Data for 2017 onwards are reported on a unit basis, whereas data for previous years are reported on a plant basis.</p>
Lithuania	LITHUANIA	<p>Lithuania became an OECD Member in July 2018. Accordingly, Lithuania appears in the list of OECD Members and is not included in the non-OECD aggregates for data from 1990, starting with the 2019 edition.</p> <p>Data for Lithuania are available starting in 1990. Prior to that, they are included in Former Soviet Union.</p>
Luxembourg	LUXEMBOU rg	
Mexico	MEXICO	<p>Mexico became the 30th IEA Member country in February 2018. Accordingly, starting with the 2018 preliminary edition, Mexico now appears in the list of IEA Members and is included in the IEA zone aggregate for data starting in 1971 and for the entire time series.</p> <p>Data are available starting in 1971.</p> <p>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.</p> <p>In the 2016 edition, the Mexican administration completed a major work on revisions of the time series back to 1990. More revisions to historical data are pending.</p>
Netherlands	NETHLAND	<p>Excludes Suriname, Aruba and the other former the Netherlands Antilles (Bonaire, Curaçao, Saba, Saint Eustatius and Sint Maarten).</p> <p>The Netherlands Central Bureau of Statistics 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 CO₂ reporting, while the 2011 revisions were part of a harmonisation 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: http://www.cbs.nl</p>
New Zealand	NZ	<p>Prior to 1994, data refer to fiscal year (April 1993 to March 1994 for 1993). From 1994, data refer to calendar year.</p>

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Country/ Region	Short name	Definition
Norway	NORWAY	Discrepancies between Reference and Sectoral Approach estimates and the difference in the resulting growth rates arise from statistical differences between supply and consumption data for oil and natural gas. For Norway, supply of these fuels is the residual of two very large and opposite terms, production and exports. 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”.
Poland	POLAND	According to the provisions of Article 4.6 of the Convention and Decisions 9/CP.2 and 11/CP.4, Poland is allowed to use 1988 as the base year.
Portugal	PORTUGAL	Includes the Azores and Madeira.
Slovak Republic	SLOVAKIA	Data are available starting in 1971. 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.
Slovenia	SLOVENIA	Data for Slovenia are available from 1990. Prior to that, they are included in Former Yugoslavia in the full publication. According to the provisions of Article 4.6 of the Convention and Decisions 9/CP.2 and 11/CP.4, Slovenia is allowed to use 1986 as the base year. A new energy data collection system was implemented in January 2001, causing some breaks in time series between 1999 and 2000.
Spain	SPAIN	Includes the Canary Islands. Spain is currently working on improving its data collection system. Therefore breaks in time series are present in the data and historical revisions are expected in future editions.
Sweden	SWEDEN	
Switzerland	SWITZERLAND	Includes Liechtenstein for the oil data. Data for other fuels do not include Liechtenstein. From 1999, data on consumption result from a new survey and are not comparable with data for previous years.
Turkey	TURKEY	

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Country/ Region	Short name	Definition
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. Breaks occur in international marine bunkers and domestic navigation time series, as a different bunkers methodology is applied from 2008, in line with UK's National Atmospheric Emissions Inventory. Deliveries to international marine bunkers may be underestimated for previous years
United States	USA	Includes the 50 states and the District of Columbia. Oil statistics as well as coal trade statistics also include Puerto Rico ¹ , Guam, the United States Virgin Islands, American Samoa, Johnston Atoll, Midway Islands, Wake Island and the Northern Mariana Islands. Starting with 2017 data, inputs to and outputs from electricity and heat generation include Puerto Rico. End-use energy consumption data for the United States present a break in series with historical data due to a change in methodology in 2014. The break in series occurs between 2011 and 2012 for oil; and between 2001 and 2002 for electricity and natural gas. The new methodology is based on the last historical year of the most recent Annual Energy Outlook (AEO) publication. Changes occur primarily in reported end-use energy consumption in the industrial sector and its subsectors, including the non-manufacturing industries of mining, construction and agriculture. Historical revisions are pending. Due to other changes in reporting methodologies, there are numerous breaks in series for the US data, particularly in 1992, 1999, 2001, 2002 and 2013. 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.
Brazil	BRAZIL	Brazil joined the IEA as an Association country in October 2017.
Indonesia	INDONESIA	Indonesia joined the IEA as an Association country in November 2015.
Morocco	MOROCCO	Morocco joined the IEA as an Association country in November 2016.
Singapore	SINGAPORE	Singapore joined the IEA as an Association country in October 2016.
Thailand	THAILAND	Thailand joined the IEA as an Association country in November 2015.

1. Natural gas and electricity data for Puerto Rico are included under Other Non-OECD Americas in the full publication.

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Country/ Region	Short name	Definition
OECD Total	OECDTOT	Includes Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel ¹ , Italy, Japan, Korea, Latvia ² , Lithuania ³ , Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. Estonia, Latvia, Lithuania and Slovenia are included starting in 1990. Prior to 1990, data for Estonia, Latvia and Lithuania are included in Former Soviet Union and data for Slovenia in Former Yugoslavia in the publication <i>World Energy Balances</i> .
OECD Americas	OECDAM	Includes Canada, Chile, Mexico and the United States.
OECD Asia Oceania	OECDAO	Includes Australia, Israel ⁴ , Japan, Korea and New Zealand.
OECD Europe	OECDEUR	Includes Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia ² , Lithuania ³ , Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom. Estonia, Latvia, Lithuania and Slovenia are included starting in 1990. Prior to 1990, data for Estonia, Latvia and Lithuania are included in Former Soviet Union and data for Slovenia in Former Yugoslavia in the publication <i>World Energy Balances</i> .
IEA	IEATOT	Includes Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Mexico ⁵ , the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. Estonia is included starting in 1990. Prior to 1990, data for Estonia are included in Former Soviet Union.

1. 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.

2. Latvia became an OECD Member in July 2016. Accordingly, Latvia appears in the list of OECD Members and is included in the regional aggregates for data starting in 1990, starting with the 2017 edition.

3. Lithuania became an OECD Member in July 2018. Accordingly, Latvia appears in the list of OECD Members and is included in the zone aggregates for data starting in 1990, starting with the 2019 edition.

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. Mexico became the 30th IEA Member country in February 2018. Accordingly, starting with the 2018 preliminary edition, Mexico now appears in the list of IEA Members and is included in the IEA zone aggregate for data starting in 1971 and for the entire time series.

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Country/ Region	Short name	Definition
Memo: G7	MG7	Includes Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.
Memo: Annex II Parties	ANNEX2	Annex II Parties includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States. According to Decision 26/CP.7 in document FCCC/CP/2001/13/ Add.4, Turkey has been deleted from the list of Annex II countries to the Convention. This amendment entered into force on 28 June 2002.
Memo: Annex II North America	ANNEX2NA	Annex II North America includes Canada and the United States.
Memo: Annex II Europe	ANNEX2EU	Annex II Europe includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.
Memo: Annex II Asia Oceania	ANNEX2AO	Annex II Asia Oceania includes Australia, Japan and New Zealand.

5. UNDERSTANDING THE IEA CO₂ EMISSIONS ESTIMATES

The importance of estimating emissions

The ultimate objective of the UNFCCC (the Convention) is the stabilisation of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The Convention also calls for all Parties to commit themselves to the following objectives:

- to develop, update periodically, publish and make available to the Conference of the Parties (COP) their national inventories of anthropogenic emissions by sources and removals by sinks, of all greenhouse gases not controlled by the Montreal Protocol.
- to use comparable methodologies for inventories of GHG emissions and removals, to be agreed upon by the COP.

As a response to the objectives of the UNFCCC, the IEA Secretariat, together with the IPCC, the OECD and numerous international experts, has helped to develop and refine an internationally-agreed methodology for the calculation and reporting of national GHG emissions from fuel combustion. This methodology was published in 1995 in the *IPCC Guidelines for National Greenhouse Gas Inventories*. After the initial dissemination of the methodology, revisions were added to several chapters, and published as the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (1996 GLs)*. In April 2006, the IPCC approved the *2006 Guidelines* at the 25th session of the IPCC in Mauritius. Until 2015, most Parties, as well as the IEA, still calculated their inventories using the *1996 GLs*. In December 2011 in Durban, Parties adopted

Decision 15/CP.17 to update their reporting tables so as to implement the *2006 GLs*. The new reporting tables have been mandatory since 15 April 2015.

The IEA estimates of CO₂ emissions from fuel combustion

Energy is at the core of the greenhouse gas estimation. It is estimated that for Annex I Parties energy accounts for 82%¹ of total GHG emissions, while for the world the share is about 60%, although shares vary greatly by country. Within energy, CO₂ from fuel combustion accounts for the largest fraction, 92% for Annex I countries, once again varying depending on the economic structure of the country.

Given its extensive work in global energy data collection and compilation, the IEA is able to produce comparable estimates of CO₂ emissions from fuel combustion across countries and region, providing a reference database for countries with more and less advanced national systems.

The estimates of CO₂ emissions from fuel combustion presented in this publication are calculated using the IEA energy data² and the default methods and emission factors from the *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 GLs)*³.

1. Based on data reported to the UNFCCC for 2012, excluding land-use, land-use change and forestry (LULUCF).

2. Published in World Energy Statistics (preliminary), World Energy Balances (preliminary), IEA, Paris, 2017.

3. See: <http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html>.

Prior to 2015 the IEA used the methods and emission factors of the *Revised 1996 IPCC Guidelines*, in line with the UNFCCC recommendations for reporting under the Kyoto Protocol. The IEA implementation of the *2006 GLs* follows the decision of the UNFCCC Parties to update their reporting tables and to implement the *2006 GLs* starting on 15 April 2015.

The implications of changes in methods and emissions factors on the IEA emissions estimates are discussed in Chapter 3: *IEA estimates: Changes under the 2006 IPCC Guidelines*.

Data in this publication and its corresponding database may have been revised with respect to previous editions because the IEA reviews its energy databases each year. In the light of new assessments, revisions may be made to the energy data time series for any individual country.

CO₂ emissions from fuel combustion: key concepts

The IEA uses the simplest (Tier 1) methodology to estimate CO₂ emissions from fuel combustion based on the *2006 GLs*. The computation follows the concept of conservation of carbon, from the fuel combusted into CO₂. While for the complete methodology the reader should refer to the full IPCC documents, a basic description follows.

Generally, the Tier 1 estimation of CO₂ emissions from fuel combustion for a given fuel can be summarised as follows:

$$\text{CO}_2 \text{ emissions from fuel combustion} \\ \text{CO}_2 = \text{Fuel consumption} * \text{Emission factor}$$

where:

Fuel consumption = amount of fuel combusted;
Emission factor = default emission factor

Emissions are then summed across all fuels and all sectors of consumption to obtain national totals. A more detailed explanation of the step by step calculation is presented in Chapter 3: *IEA estimates: Changes under the 2006 IPCC Guidelines*.

IEA estimates vs. UNFCCC submissions

Based on the IEA globally collected energy data, the IEA estimates of CO₂ emissions from fuel combustion are a global database obtained following harmonised definitions and comparable methodologies across countries. They do not represent an official source for national submissions, as national administrations should use the best available country-specific information to complete their emissions reporting.

The IEA CO₂ estimates can be compared with those reported by countries to the UNFCCC Secretariat to highlight possible problems in methods, input data or emission factors. Still, care should be used in interpreting the results of any comparison since the IEA estimates may differ from a country's official submission for many reasons.

For most Annex II countries, the two calculations are expected to be within 5-10%, depending on the coverage of the fuel combustion sector in the national inventory. For some EIT and non-Annex I countries, differences may be larger. If the underlying energy data are different, more work is needed on the collecting and reporting of energy statistics.

In case of systematic biases in the energy data or emission factors, emission trends will usually be more reliable than the absolute emission levels. By comparing trends in the IEA estimates with trends in emissions as reported to the UNFCCC, it should be possible to identify definition problems or methodological differences.

Some of the reasons for these differences are:

- **The IEA uses a Tier 1 method to compute emissions estimates.**

For the calculation of CO₂ emissions from fuel combustion, the IEA uses a Tier 1 method. Countries may be using a more sophisticated Tier 2 or Tier 3 method that takes into account more detailed country-specific information available (*e.g.* on different technologies or processes).

- **Energy activity data based on IEA energy balances may differ from those used for the UNFCCC calculations.**

Countries often have several "official" data sources such as a Ministry, a Central Bureau of Statistics, a nationalised electricity company, etc. Data can also be

collected from the energy suppliers, the energy consumers or customs statistics. The IEA Secretariat tries to collect the most accurate data, but does not necessarily have access to the complete data set that may be available to national experts calculating emission inventories for the UNFCCC. In addition to different sources, the methodology used by the national bodies providing the data to the IEA and to the UNFCCC may differ. For example, general surveys, specific surveys, questionnaires, estimations, combined methods and classifications of data used in national statistics and in their subsequent reclassification according to international standards may result in different series.

- **The IEA uses average net calorific values for oil products.**

To transform fuel consumption data from physical units to energy units, the IEA uses an average net calorific value (NCV) for each secondary oil product. These NCVs are region-specific and constant over time. Country-specific NCVs that can vary over time are used for NGL, refinery feedstocks and additives. Crude oil NCVs are further split into production, imports, exports and average. Different coal types have specific NCVs for production, imports, exports, inputs to main activity power plants and coal used in coke ovens, blast furnaces and industry, and can vary over time for each country.

Country experts may have more detailed data on calorific values available when calculating the energy content of the fuels. This in turn could produce different values than those of the IEA.

- **The IEA uses average carbon content values.**

The IEA uses the default carbon content values given in the *2006 GLs*. Country experts may have better information available, allowing them to use country-specific values.

- **The IEA cannot allocate emissions from auto-producers into the end-use sectors.**

The *2006 GLs* recommend that emissions from auto-production should be included with emissions from other fuel use by end-consumers. At the same time, the emissions from the autoproduction of electricity and heat should be excluded from the energy transformation source category to avoid double counting. The IEA is not able to allocate the fuel use from auto-producers between industry and *other*. Therefore, this publication shows a category called “Unallocated auto-producers”. However, this should not affect the total emissions for a country.

- **Military emissions may be treated differently.**

According to the *2006 GLs*, military emissions should be reported in Source/Sink Category 1 A 5, *Non-Specified*. Previously, the IEA questionnaires requested that warships be included in international marine bunkers and that the military use of aviation fuels be included in domestic air. All other military use should have been reported in *non-specified other*.

At the IEA/Eurostat/UNECE Energy Statistics Working Group meeting (Paris, November 2004), participants decided to harmonise the definitions used to collect energy data on the joint IEA/Eurostat/UNECE questionnaires with those used by the IPCC to report GHG inventories. As a result, starting in the 2006 edition of this publication, all military consumption should be reported in *non-specified other*. Sea-going versus coastal is no longer a criterion for splitting international and domestic navigation.

However, it is not clear whether countries are reporting on the new basis, and if they are, whether they will be able to revise their historical data. The IEA has found that in practice most countries consider information on military consumption as confidential and therefore either combine it with other information or do not include it at all.

- **The IEA estimates include all CO₂ emissions from fuel combustion. Countries may have included parts of these emissions in the IPCC category industrial processes and product use.**

Although emissions totals would not differ, the allocation to the various sub-totals of a national inventory could. National GHG inventories submitted to the UNFCCC divide emissions according to source categories. Two of these IPCC Source/Sink Categories are energy, and industrial processes and product use. Care must be taken not to double count emissions from fuel combustion that occur within certain industrial processes (*e.g.* iron and steel). The IEA estimates in this publication include all the CO₂ emissions from fuel combustion, while countries are asked to report some of them within the industrial processes and product use category under the *2006 GLs*. See a more detailed discussion in Chapter 3: *IEA Estimates: Changes under the 2006 IPCC Guidelines*.

- **The units may be different.**

The *2006 GLs* ask that CO₂ emissions be reported in Gg of CO₂ (1 Gg = 1 kilotonne). A million tonnes of CO₂ is equal to 1 000 Gg of CO₂, so to compare the numbers in this publication with national inventories expressed in Gg, the IEA emissions must be multiplied by 1 000.

Macroeconomic drivers of CO₂ emissions trends

Tables and graphs for drivers refer to the decomposition of CO₂ emissions into four driving factors (Kaya identity)¹, which is generally presented in the form:

$$\text{Kaya identity} \\ C = P (G/P) (E/G) (C/E)$$

where:

C = CO₂ emissions;

P = population;

G = GDP;

E = primary energy consumption.

The identity expresses, for a given time, CO₂ emissions as the product of population, per capita economic output (G/P), energy intensity of the economy (E/G) and carbon intensity of the energy mix (C/E). Because of possible non-linear interactions between terms, the sum of the percentage changes of the four factors, e.g. $(P_y - P_x)/P_x$, will not generally add up to the percentage change of CO₂ emissions $(C_y - C_x)/C_x$. However, relative changes of CO₂ emissions in time can be obtained from relative changes of the four factors as follows:

$$\text{Kaya identity: relative changes in time} \\ C_y/C_x = P_y/P_x (G/P)_y/(G/P)_x (C/E)_y/(C/E)_x$$

where x and y represent for example two different years.

In this publication, the Kaya decomposition is presented as:

$$\text{CO}_2 \text{ emissions and drivers} \\ \text{CO}_2 = P (GDP/P) (TPES/GDP) (\text{CO}_2/TPES)$$

where:

CO₂ = CO₂ emissions;

P = population;

GDP²/P = GDP/population;

TPES/GDP = Total Primary Energy Supply per GDP;

CO₂/TPES = CO₂ emissions per unit TPES.

Indices of all terms (1990 = 100 unless otherwise specified) are shown for each country and regional aggregate in Part II of the full publication, both in the Summary tables and in the individual country/region pages (Table 1, Key indicators, and Figure 6, CO₂ emissions and drivers). Note that in its index form, CO₂/TPES corresponds to the Energy Sector Carbon Intensity Index (ESCI)³.

The Kaya identity can be used to discuss the primary driving forces of CO₂ emissions. For example, it shows that, globally, increases in population and GDP per capita have been driving upwards trends in CO₂ emissions, more than offsetting the reduction in energy intensity. In fact, the carbon intensity of the energy mix is almost unchanged, due to the continued dominance of fossil fuels - particularly coal - in the energy mix, and to the slow uptake of low-carbon technologies.

However, it should be noted that there are important caveats in the use of the Kaya identity. Most important, the four terms on the right-hand side of equation should be considered neither as fundamental driving forces in themselves, nor as generally independent from each other

1. Yamaji, K., Matsuhashi, R., Nagata, Y. Kaya, Y., *An integrated system for CO₂/Energy/GNP analysis: case studies on economic measures for CO₂ reduction in Japan*. Workshop on CO₂ reduction and removal: measures for the next century, March 19, 1991, International Institute for Applied Systems Analysis, Laxenburg, Austria.

2. GDP based on purchasing power parities (PPP).

3. See the IEA publication Tracking Clean Energy Progress 2015.

Drivers of electricity generation emissions trends

In the full publication, graphs present the change in CO₂ emissions from electricity generation over time decomposed into the respective changes of four driving factors¹:

$$\text{CO}_2 \text{ emissions from electricity generation} \\ C = (C/E) (E/ELF) (ELF/EL) (EL)$$

where:

- C** = CO₂ emissions;
- E** = fossil fuel inputs to thermal generation;
- ELF** = electricity output from fossil fuels;
- EL** = total electricity output;

This can be rewritten as:

$$\text{CO}_2 \text{ emissions from electricity generation} \\ C = (CF) (EI) (EFS) (EL)$$

where:

- C** = CO₂ emissions;
- CF** = carbon intensity of the fossil fuel mix;
- EI** = the reciprocal of fossil fuel based electricity generation efficiency;
- EFS** = share of electricity from fossil fuels;
- EL** = total electricity output.

This decomposition expresses, for a given time, CO₂ emissions from electricity generation as the product of the carbon intensity of the fossil fuel mix (CF), the reciprocal of fossil fuel based thermal electricity generation efficiency (1/EF), the share of electricity from fossil fuels (EFS) and total electricity output (EL).

However, due to non-linear interactions between terms, if a simple decomposition is used, the sum of the percentage changes of the four factors, e.g. $(C_y - C_x)/C_x$ may not perfectly match the

percentage change of total CO₂ emissions $(C_y - C_x)/C_x$. To avoid this, a more complex decomposition method is required. In this case, the logarithmic mean divisia (LMDI) method proposed by Ang (2004)² has been used.

Using this method, the change in total CO₂ emissions from electricity generation (ΔC_{TOT}) between year t and a base year θ , can be computed as the sum of the changes in each of the individual factors as follows:

$$\Delta C_{TOT} = \Delta C_{CF} + \Delta C_{EI} + \Delta C_{EFS} + \Delta C_{EL}$$

where:

$$\Delta C_{CF} = L(C^t, C^\theta) \ln \left(\frac{CF^t}{CF^\theta} \right)$$

$$\Delta C_{EI} = L(C^t, C^\theta) \ln \left(\frac{EI^t}{EI^\theta} \right)$$

$$\Delta C_{EFS} = L(C^t, C^\theta) \ln \left(\frac{EFS^t}{EFS^\theta} \right)$$

$$\Delta C_{EL} = L(C^t, C^\theta) \ln \left(\frac{EL^t}{EL^\theta} \right)$$

and:

$$L(x, y) = (y - x) / (\ln y - \ln x)$$

This decomposition can be useful when analysing the trends in CO₂ emissions from electricity generation. For instance, it shows that globally, since 1990, the main driver of increased CO₂ emissions from electricity generation has been increased electricity output, with improvements in the overall thermal efficiency, and the CO₂ intensity of the electricity generation mix being offset by an increase in the share of electricity derived from fossil fuel sources.

However, as is the case with the Kaya decomposition, it should be noted that the four terms on the right-hand side of equation should be considered neither as fundamental driving forces in themselves, nor as generally independent from each other. For instance, substituting coal with gas as a source of electricity generation would affect both the CO₂ intensity of the electricity generation mix and the thermal efficiency of generation.

1. M. Zhang, X. Liu, W. Wang, M. Zhou. *Decomposition analysis of CO₂ emissions from electricity generation in China*. Energy Policy, 52 (2013), pp. 159–165.

2. B. W. Ang. Decomposition analysis for policymaking in energy: which is the preferred method?, Energy Policy, 32 (9) (2004), pp. 1131–1139.

6. IEA ESTIMATES: CHANGES UNDER THE 2006 IPCC GUIDELINES

The 2006 IPCC Guidelines methodology: key concepts

This section briefly presents the Tier 1 methodology to estimate CO₂ emissions from fuel combustion using the *2006 GLs*, outlining the main differences with the *1996 GLs* - used prior to the 2015 edition of this publication. The focus is on the key points relevant to the IEA estimation. For the complete methodology, the reader should refer to the full IPCC documents.¹

Generally, the Tier 1 estimation of CO₂ emissions from fuel combustion for a given fuel can be summarised as follows:

$$\text{CO}_2 \text{ emissions from fuel combustion} \\ \text{CO}_2 = \text{AD} * \text{NCV} * \text{CC} * \text{COF}$$

where:

- CO₂** = CO₂ emissions from fuel combustion;
- AD** = Activity data;
- NCV** = Net calorific value;
- CC** = Carbon content;
- COF** = Carbon oxidation factor.

Emissions are then summed over all fuels.

While the basic concept of the calculation - the conservation of carbon - is unchanged, the *2006 GLs* differ from the *1996 GLs* in the:

- default **net calorific values** by product;
- default **carbon content** by product;

- default **carbon oxidation factors**;
- treatment of fuels used for **non-energy** purposes;
- **allocation** of fuel combustion emissions across the Energy and IPPU categories.

2006 Guidelines: overview of changes

This section describes the key methodological changes *2006 GLs* for a Tier 1 estimation of CO₂ emissions from fuel combustion, with a short assessment of their impact on results.

Net calorific values

Net calorific values (NCVs) are used to convert the activity data for all the different fuels from "physical" units (e.g. tonnes) to "energy" units (e.g. Joules).

In the *1996 GLs*, country-specific net calorific values were given for primary oil (crude oil and NGL), for primary coal and for a few secondary coal products. These NCVs were based on the average 1990 values of the 1993 edition of the *IEA Energy Balances*.

In the *2006 GLs*, those country-specific NCVs were removed, and one default is provided for each fuel (with upper and lower limits, as done for the carbon content). Large differences were therefore observed for products whose quality varies a lot from country to country, such as primary oil and coal products. Replacing country-specific values with one default value would significantly affect emissions calculations if the default values were used.

1. Both the *1996 GLs* and the *2006 GLs* are available from the IPCC Greenhouse Gas Inventories Programme (www.ipcc-nggip.iges.or.jp).

The IEA CO₂ emissions from fuel combustion estimates are based on the IEA energy balances, computed using time-varying country-specific NCVs. Therefore, they are not affected by changes to the default net calorific values of the 2006 GLs.

Carbon content

Carbon content is the quantity of carbon per unit of energy of a given fuel. Some of the fuel-specific default values for carbon content, called “carbon emission factors” in the 1996 GLs, were revised in the 2006 GLs. In addition, values were added for some fuels not directly mentioned in the 1996 GLs.

As the carbon content may vary considerably for some fuels, the 2006 GLs introduced ranges of values, *i.e.* providing for each fuel a default value with lower and upper limits. The IEA CO₂ emissions are calculated using the IPCC default values.

A summary of the default carbon content values in the two set of guidelines is shown in Table 1. Relative changes between the 2006 GLs and the 1996 GLs range between -13.7% (refinery gas) and + 7.3% (blast furnace gas), although for many fuels the variation is minimal, or zero. Such systematic changes are reflected in Tier 1 CO₂ emissions estimates.

Carbon oxidation factors

A small fraction of the carbon contained in fuels entering the combustion process (typically less than 1-2%) is not oxidised. Under the 1996 GLs, this amount was subtracted from emissions in the calculations by multiplying the calculated carbon content of a fuel by a “fraction of carbon oxidised”. The fraction of carbon oxidised had a value of less than 1.0, which had the effect of reducing the emissions estimate. However, in most instances, emissions inventory compilers had no “real” information as to whether this correction was actually applicable.

Therefore, in the 2006 GLs, it was decided that all carbon is assumed to be emitted by default, unless more specific information is available. Therefore, under the 2006 GLs, the default carbon oxidation factor is equal to 1 for all fuels.

A summary of the default carbon oxidation factors in the two set of guidelines is shown in Table 2. Relative changes from the 1996 GLs and the 2006 GLs are +0.5% for natural gas; +1% for oil, oil products and peat; and +2% for coal. Such changes are reflected in systematic increases in Tier 1 CO₂ emissions estimates.

Table 1. Comparison of default carbon content values*

Kilogrammes / gigajoule

Fuel Type	1996 Guidelines	2006 Guidelines**	Percent Change
Anthracite	26.8	26.8	0.0%
Coking coal	25.8	25.8	0.0%
Other bituminous coal	25.8	25.8	0.0%
Sub-bituminous coal	26.2	26.2	0.0%
Lignite	27.6	27.6	0.0%
Patent fuel	25.8	26.6	+3.1%
Coke oven coke	29.5	29.2	-1.0%
Gas coke	29.5	29.2	-1.0%
Coal tar	..	22.0	x
BKB	25.8	26.6	+3.1%
Gas works gas	..	12.1	x
Coke oven gas	13.0	12.1	-6.9%
Blast furnace gas	66.0	70.8	+7.3%
Other recovered gases	..	49.6	x
Peat	28.9	28.9	0.0%
Oil shale	29.1	29.1	0.0%
Natural gas	15.3	15.3	0.0%
Crude oil	20.0	20.0	0.0%
Natural gas liquids	17.2	17.5	+1.7%
Refinery feedstocks	20.0	20.0	0.0%
Orimulsion	22.0	21.0	-4.5%
Refinery gas	18.2	15.7	-13.7%
Ethane	16.8	16.8	0.0%
Liquefied petroleum gases (LPG)	17.2	17.2	0.0%
Motor gasoline excl. biofuels	18.9	18.9	0.0%
Aviation gasoline		19.1	+1.1%
Gasoline type jet fuel		19.1	+1.1%
Kerosene type jet fuel excl. bio	19.5	19.5	0.0%
Other kerosene	19.6	19.6	0.0%
Gas/Diesel oil excl. biofuels	20.2	20.2	0.0%
Fuel oil	21.1	21.1	0.0%
Naphtha	20.0	20.0	0.0%
Lubricants	20.0	20.0	0.0%
Bitumen	22.0	22.0	0.0%
Petroleum coke	27.5	26.6	-3.3%
Non-specified oil products	20.0	20.0	0.0%
Other hydrocarbons		20.0	0.0%
White spirit & SBP		20.0	0.0%
Paraffin waxes		20.0	0.0%
Industrial waste	..	39.0	x
Municipal waste (non-renewable)	..	25.0	x

* “Carbon content” was referred to as the “carbon emission factor” in the 1996 GLs.

** The 2006 GLs also give the lower and upper limits of the 95 percent confidence intervals, assuming lognormal distributions.

Table 2. Comparison of default carbon oxidation factors*

Fuel Type	1996 Guidelines	2006 Guidelines**	Percent Change
Coal	0.980	1.00	+2.0%
Oil and oil products	0.990	1.00	+1.0%
Natural gas	0.995	1.00	+0.5%
Peat **	0.990	1.00	+1.0%

* “Carbon oxidation factor” was referred to as “fraction of carbon oxidised” in the 1996 GLs.

** The 1996 GLs specified a carbon oxidation factor for peat used for electricity generation only.

Treatment of fuels used for non-energy purposes

Many hydrocarbons are used for non-energy purposes e.g. petrochemical feedstocks, lubricants, solvents, and bitumen. In some of these cases, the carbon in the fuel is quickly oxidised to CO₂, in other cases, it is stored (or sequestered) in the product, sometimes for as long as centuries.

In the 1996 IPCC GLs, Tier 1 Sectoral Approach emissions included emissions from fuels used for non-energy purposes. The share of carbon assumed to be stored (not emitted) was estimated based on default “fractions of carbon stored” (shown for reference in Table 3).

Table 3. Fraction of Carbon Stored in the 1996 GLs

Fuel Type	1996 Guidelines
Naphtha*	0.8
Lubricants	0.5
Bitumen	1.0
Coal oils and tars (from coking coal)	0.75
Natural gas*	0.33
Gas/Diesel oil*	0.5
LPG*	0.8
Ethane*	0.8
Other fuels for non-energy use	To be specified

* When used as feedstocks.

Note: this table is included only for reference. CO₂ emissions from fuel combustion in this publication do not include emissions from non-energy use of fuels.

In the 2006 GLs, all deliveries for non-energy purposes are excluded. Numerically, excluding all non-energy use of fuel from energy sector emissions calculations is equivalent to applying a fraction of carbon stored equal to 1 to all quantities delivered for non-energy purposes.

In the case of a complete greenhouse gas inventory covering all IPCC Source/Sink categories, any emissions associated with non-energy use of fuels would be accounted in another Source/Sink category. However, as this publication only deals with CO₂ emissions from fuel combustion, emissions associated with non-energy use of fuels are not any longer included in the IEA CO₂ emissions estimates.

Within the IEA estimates, the effect of this change is mainly noticeable for countries whose petrochemical sectors are large in comparison to the size of their economies, e.g. the Netherlands.

Allocation of fuel combustion emissions across the Energy and the IPPU sectors

To avoid possible double counting, the 2006 GLs state that combustion emissions from fuels obtained directly or indirectly from the feedstock for an Industrial Processes and Product Use (IPPU) process will be allocated to the source category in which the process occurs, unless the derived fuels are transferred for combustion in another source category.

In the case of a complete inventory, this reallocation would not affect total emissions. Still, the effect on individual source categories could be quite significant, especially in countries with large IPPU sectors (e.g. the iron and steel, and non-ferrous metals industries).

To provide continuity with previous editions of this publication and to fully account for fuel combustion emissions, the IEA CO₂ emissions from fuel combustion include all emissions from fuel combustion, irrespective of the category of reporting (Energy or IPPU) under the 2006 GLs.

To ensure comparability with submissions from Parties, an additional online database provides a summary of CO₂ emissions calculated according to the IPCC Reference and Sectoral Approaches, and a breakdown of the fuel combustion emissions which would be reallocated to IPPU under the 2006 GLs.¹

Assessing the overall impact of methodological changes on IEA estimates

Table 4 shows a comparison of IEA estimates of total CO₂ emissions from fuel combustion for the most recent year of available data (2014). Emissions are calculated using: i) the 1996 GLs Sectoral Approach methodology (used prior to the 2015 edition of this publication), and ii) the 2006 GLs² - which correspond to the data published in this edition.

1. Note that the data available to the IEA do not allow assessing whether fuels derived from IPPU processes are transferred for combustion in another source category.

2. Including the emissions which may be reallocated from Energy to IPPU under the 2006 GLs.

Table 4. Comparison of IEA CO₂ emissions estimates for OECD countries (2014)MtCO₂

Country	1996 GLs CO ₂ Sectoral Approach	2006 GLs CO ₂ Fuel Combustion ⁵	Percent Change
Australia	375.2	373.8	-0.4%
Austria	60.8	60.8	0.0%
Belgium	95.0	87.4	-8.0%
Canada	574.6	554.8	-3.4%
Chile	81.6	81.5	-0.2%
Czech Republic	98.4	96.6	-1.8%
Denmark	34.7	34.5	-0.4%
Estonia	17.5	17.5	0.3%
Finland	46.4	45.3	-2.4%
France	295.8	285.7	-3.4%
Germany	734.6	723.3	-1.5%
Greece	66.4	65.9	-0.8%
Hungary	41.3	40.3	-2.6%
Iceland	2.0	2.0	0.7%
Ireland	33.7	33.9	0.5%
Israel	66.7	65.1	-2.4%
Italy	325.7	319.7	-1.8%
Japan	1 193.3	1 188.5	-0.4%
Korea	587.9	566.2	-3.7%
Luxembourg	9.2	9.2	0.9%
Mexico	432.1	430.9	-0.3%
Netherlands	166.6	148.3	-11.0%
New Zealand	33.2	31.2	-5.9%
Norway	36.9	35.3	-4.3%
Poland	281.3	279.0	-0.8%
Portugal	43.2	42.8	-0.9%
Slovak Republic	29.9	29.3	-1.9%
Slovenia	12.6	12.8	1.1%
Spain	234.8	232.0	-1.2%
Sweden	38.7	37.4	-3.3%
Switzerland	37.7	37.7	0.1%
Turkey	304.8	307.1	0.8%
United Kingdom	409.0	407.8	-0.3%
United States	5 257.5	5 198.0	-1.1%
OECD Total	12 059.1	11 881.7	-1.5%

The overall impact of the change in methodology on the IEA estimates of CO₂ emissions from fuel combustion varies from country to country, mainly depending on the underlying fuel mix and on the relative

importance of non-energy use of fuels in the total. Most countries show a decrease in CO₂ emissions levels under the new methodology, as the reductions due to the removal of non-energy use emissions are generally larger than the systematic increase due to changes in the oxidation factor.

For the year 2014, reductions of 1% or greater are observed for seventeen OECD countries, with three showing a decrease of 5% or more. The largest relative decreases are observed in countries with high non-energy use of fuels (mainly oil products and natural gas) relative to their total energy consumption: the Netherlands (-11%) and Belgium (-8%). As emissions from non-energy use of fuels are not included in energy sector emissions under the 2006 GLs, emissions previously attributed to non-energy use of oil products and natural gas are no longer included in IEA CO₂ emissions from fuel combustion estimates for these countries. Eight countries, presented an increase in emissions of 1% or less in 2014. This occurred in countries where reported non-energy use of fuels was comparatively lower, and had a smaller influence on total emissions. As a result, impact of assuming 100% oxidation under the 2006 GLs (previously 98-99.5% under the 1996 GLs) was observed.

Within the IEA databases, these changes will also be reflected in all indicators derived from CO₂ emissions totals (*e.g.* CO₂/TPES, CO₂/GDP). Impacts on trends should be visible when the relative weight of the non-energy use of fuels changes in time.

However, as mentioned, most of the methodological changes would not have significant impact in the case of a complete inventory covering all IPCC source/sink categories; in particular, the reallocation of emissions between categories would not affect total emissions estimates, nor the overall trends.

7. UNITS AND CONVERSIONS

General conversion factors for energy

To:	TJ	Gcal	Mtoe	MBtu	GWh
<i>From:</i>	multiply by:				
terajoule (TJ)	1	2.388x10 ²	2.388x10 ⁻⁵	9.478x10 ²	2.778x10 ⁻¹
gigacalorie (Gcal)	4.187x10 ⁻³	1	1.000x10 ⁻⁷	3.968	1.163x10 ⁻³
million tonnes of oil equivalent (Mtoe)	4.187x10 ⁴	1.000x10 ⁷	1	3.968x10 ⁷	1.163x10 ⁴
million British thermal units (MBtu)	1.055x10 ⁻³	2.520x10 ⁻¹	2.520x10 ⁻⁸	1	2.931x10 ⁻⁴
gigawatt hour (GWh)	3.600	8.598x10 ²	8.598x10 ⁻⁵	3.412x10 ³	1

Conversion factors for mass

To:	kg	T	lt	st	lb
<i>From:</i>	multiply by:				
kilogramme (kg)	1	1.000x10 ⁻³	9.842x10 ⁻⁴	1.102x10 ⁻³	2.205
tonne (t)	1.000x10 ³	1	9.842x10 ⁻¹	1.102	2.205x10 ³
long ton (lt)	1.016x10 ³	1.016	1	1.120	2.240x10 ³
short ton (st)	9.072x10 ²	9.072x10 ⁻¹	8.929x10 ⁻¹	1	2.000x10 ³
pound (lb)	4.536x10 ⁻¹	4.536x10 ⁻⁴	4.464x10 ⁻⁴	5.000x10 ⁻⁴	1

Conversion factors for volume

To:	gal U.S.	gal U.K.	bbbl	ft ³	l	m ³
<i>From:</i>	multiply by:					
U.S. gallon (gal U.S.)	1	8.327x10 ⁻¹	2.381x10 ⁻²	1.337x10 ⁻¹	3.785	3.785x10 ⁻³
U.K. gallon (gal U.K.)	1.201	1	2.859x10 ⁻²	1.605x10 ⁻¹	4.546	4.546x10 ⁻³
barrel (bbbl)	4.200x10 ¹	3.497x10 ¹	1	5.615	1.590x10 ²	1.590x10 ⁻¹
cubic foot (ft ³)	7.481	6.229	1.781x10 ⁻¹	1	2.832x10 ¹	2.832x10 ⁻²
litre (l)	2.642x10 ⁻¹	2.200x10 ⁻¹	6.290x10 ⁻³	3.531x10 ⁻²	1	1.000x10 ⁻³
cubic metre (m ³)	2.642x10 ²	2.200x10 ²	6.290	3.531x10 ¹	1.000x10 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)

Tonne of CO₂

The reporting guidance in the *2006 GLs* asks that CO₂ emissions and removals generally be reported in Gg (gigagrammes) of CO₂. A million tonnes of CO₂ is equal to 1 000 Gg of CO₂, so to compare the numbers in this publication with national inventories expressed in Gg, multiply the IEA emissions by 1 000.

Other organisations may present CO₂ emissions in tonnes of carbon instead of tonnes of CO₂. To convert from tonnes of carbon, multiply by 44/12, which is the molecular weight ratio of CO₂ to C.

8. ABBREVIATIONS

Btu	British thermal unit
BKB	Brown coal briquettes (braunkohlebriketts)
Gg	gigagramme
GJ	gigajoule
GWh	gigawatt hour
J	joule
kcal	kilocalorie
kg	kilogramme
kt	thousand tonnes
ktoe	thousand tonnes of oil equivalent
kWh	kilowatt hour
MJ	megajoule
Mt	million tonnes
Mtoe	million tonnes of oil equivalent
MtCO ₂	million tonnes of carbon dioxide
m ³	cubic metre
PJ	petajoule
t	metric ton = tonne = 1 000 kg
tC	tonne of carbon
TJ	terajoule
toe	tonne of oil equivalent = 10 ⁷ kcal
CC	carbon content
CEF	carbon emission factor
COF	carbon oxidation factor
CHP	combined heat and power
GCV	gross calorific value
GDP	gross domestic product
NCV	net calorific value
PPP	purchasing power parity
TPES	total primary energy supply
Convention	United Nations Framework Convention on Climate Change
COP	Conference of the Parties to the Convention
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
OECD	Organisation for Economic Co-Operation and Development
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
e	estimated
..	not available
x	not applicable
+	growth greater than 1 000%
CO ₂	carbon dioxide