CO_2 EMISSIONS FROM FUEL COMBUSTION

DOCUMENTATION FOR BEYOND 2020 FILES

INTERNATIONAL ENERGY AGENCY

1. CHANGES FROM LAST YEAR

Country dimension

- The order of the countries and regions has been changed.
- Cambodia and Mongolia are now shown separately and not included with "Other Asia".
- European Union 25 has been replaced by European Union 27 and European Union 15 is no longer included.
- Former Yugoslavia (if no detail) (YUGOND) and Former USSR (if no detail) (USSRND) have been added. These include data for Former Yugoslavia and Former USSR respectively only when individual country information is not available.
- "Memo: Former Yugoslavia" has been added.
- The long name for "Kyoto Parties" has been changed to "Annex I Kyoto Parties".

In CO_2 from Fuel Combustion (detailed estimates) file:

- World and regional totals have been added to the detailed estimates file. These numbers should be used with caution since not all products and flows are available for all countries.

2. DEFINITIONS

CO_2 emissions from Fuel Combustion (Mt of CO_2)		
Flow	**Shortname**	**Definition**
CO_2 Sectoral Approach	CO2SA	Sectoral Approach contains total CO_2 emissions from fuel combustion as calculated using the IPCC Tier 1 Sectoral Approach and corresponds to IPCC Source/Sink Category 1 A. Emissions calculated using a Sectoral Approach include emissions only when the fuel is actually combusted.
Main activity producer of electricity and heat	MAINPROD	Main Activity Producer Electricity and Heat contains the sum of emissions from main activity producer electricity generation, combined heat and power generation and heat plants. Main activity producers (formerly known as public utilities) are defined as those undertakings whose primary activity is to supply the public. They may be publicly or privately owned. This corresponds to IPCC Source/Sink Category 1 A 1 a. For the CO_2 emissions from fuel combustion (summary) file, emissions from own on-site use of fuel in power plants (EPOWERPLT) are also included.
Main Activity Electricity Plants	MAINELEC	Electricity plants refer 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 can not be distinguished on a unit basis) then the whole plant is designated as a CHP plant. Main activity producer (formerly known as public supply undertakings) generate electricity and/or heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.
Main Activity CHP Plants	MAINCHP	Combined heat and power plants (CHP), refers to plants which are designed to produce both heat and electricity. UNIPEDE refers to these 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 is adopted. Main activity producer (formerly known as public supply undertakings) generate electricity and/or heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.

Main Activity Heat Plants	MAINHEAT	Heat plants refer to plants designed to produce heat only, which is sold to a third party under the provisions of a contract. The products show the use of primary and secondary fuels in a heating system that transmits and distributes heat from one or more energy source to, among others, residential, industrial, and commercial consumers for space heating, cooking, hot water and industrial processes. Main activity producer (formerly known as public supply undertakings) generate electricity and/or heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.
Own use in electricity, CHP and heat plants	EPOWERPLT	Emissions from own on-site use of fuel in power plants.
Unallocated Autoproducers	AUTOPROD	Unallocated Autoproducers 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 1996 IPCC Guidelines, these emissions would normally be distributed between industry, transport and "other" sectors.
Autoproducer Electricity Plants	AUTOELEC	Electricity plants refer 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 can not 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.
Autoproducer CHP Plants	AUTOCHP	Combined heat and power plants (CHP), refers to plants which are designed to produce both heat and electricity). UNIPEDE refers to these 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 is adopted. Note that for autoproducer's CHP plants, all fuel inputs to electricity production are taken into account, while only the part of fuel inputs to heat sold is shown. Fuel inputs for the production of heat consumed within the autoproducer's establishment are not included here but are included with figures for the final consumption of fuels in the appropriate consuming sector. Autoproducer undertakings generate electricity and/or heat, wholly or partly for their own use as an activity which supports their primary activity. They may be privately or publicly owned.
Autoproducer Heat Plants	AUTOHEAT	Heat plants refer to plants designed to produce heat only, which is sold to a third party under the provisions of a contract. Products coal through oil show the use of primary and secondary fuels in a heating system that transmits and distributes heat from one or more energy source to, among others, residential, industrial, and commercial consumers for space heating, cooking, hot water and industrial processes. Autoproducer undertakings generate heat, wholly or partly for their own use a;s an activity which supports their primary activity. They may be privately or publicly owned.

Other Energy Industries	OTHEN	Other Energy Industries contains emissions from fuel combusted in petroleum 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. According to the 1996 IPCC Guidelines, emissions from coke inputs to blast furnaces can either be counted here or in the Industrial Processes source/sink category. Within detailed sectoral calculations, certain non-energy processes can be distinguished. In the reduction of iron in a blast furnace through the combustion of coke, the primary purpose of the coke oxidation is to produce pig iron and the emissions can be considered as an industrial process. Care must be taken not to double count these emissions in both Energy and Industrial Processes. In the IEA estimations, these emissions have been included in this category.
Manufacturing Industries and Construction	TOTIND	Manufacturing Industries and Construction contains the emissions from combustion of fuels in industry. The IPCC Source/Sink Category 1 A 2 includes these emissions. However, in the 1996 IPCC Guidelines, 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 (Unallocated Autoproducers). Manufacturing Industries and Construction also includes emissions from coke inputs into blast furnaces, which may be reported either in the transformation sector, the industry sector or the separate IPCC Source/Sink Category 2, Industrial Processes.
Iron and Steel	IRONSTL	[ISIC Group 271 and Class 2731]
Chemical and Petrochemical	CHEMICAL	[ISIC Division 24] The petrochemical industry includes cracking and reforming processes for the purpose of producing ethylene, propylene, butylene, synthesis gas, aromatics, butadene and other hydrocarbon-based raw materials in processes such as steam cracking, aromatics plants and steam reforming [Part of ISIC Group 241]. See feedstocks under (non-energy use).
Non-Ferrous Metals	NONFERR	Non-ferrous metals basic industries [ISIC Group 272 and Class 2732]
Non-Metallic Minerals	NONMET	Non-metallic mineral products such as glass, ceramic, cement, etc. [ISIC Division 26]
Transport Equipment	TRANSEQ	[ISIC Divisions 34 and 35]
Machinery	MACHINE	Machinery comprises fabricated metal products, machinery and equipment other than transport equipment [ISIC Divisions 28, 29, 30, 31 and 32].
Mining and Quarrying	MINING	Mining (excluding fuels) and quarrying [ISIC Divisions 13 and 14]
Food and Tobacco	FOODPRO	[ISIC Divisions 15 and 16]
Paper, Pulp and Printing	PAPERPRO	[ISIC Divisions 21 and 22]

Wood and Wood Products	WOODPRO	Wood and wood products (other than pulp and paper) [ISIC Division 20]
Construction	CONSTRUC	[ISIC Division 45]
Textile and Leather	TEXTILES	[ISIC Divisions 17, 18 and 19]
Non-specified Industry	INONSPEC	Any manufacturing industry not included above. [ISIC Divisions 25, 33, 36 and 37] Most countries have difficulties supplying an industrial breakdown for all fuels. In these cases, the non-specified industry row has been used. Regional aggregates of industrial consumption should therefore be used with caution.
Non-Energy Use Ind/ Transf/Energy	NEINTREN	Non-energy use covers use of other petroleum products such as white spirit, paraffin waxes, lubricants, bitumen and other products. It also includes the non-energy use of coal (excluding peat). It is assumed that the use of these products is exclusively non-energy use. An exception to this treatment is petroleum coke, which is included as non-energy use only when there is evidence of such use; otherwise it is included as energy use in industry or in other sectors. Non-energy use of coal includes carbon blacks, graphite electrodes, etc., and is also shown separately by sector.
Transport	TOTTRANS	Transport contains emissions from the combustion of fuel for all transport activity, regardless of the sector, except for international marine bunkers and international aviation. This includes domestic aviation, domestic navigation, road, rail and pipeline transport, and corresponds to IPCC Source/Sink Category 1 A 3. In addition, the IEA data are not collected in a way that allows the autoproducer consumption to be split by specific end-use and therefore, autoproducers are shown as a separate item (Unallocated Autoproducers). Note: Starting last year (in the 2006 edition), military consumption previously included in domestic aviation and in road should be in non-specified other sectors.
Domestic Aviation	DOMESAIR	Domestic aviation includes emissions from aviation fuels delivered to aircraft for domestic aviation – commercial, private, agriculture, etc. It includes use for purpose 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.
Road	ROAD	Road 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.
Rail	RAIL	Emissions from rail traffic, including industrial railways.

Pipeline Transport	PIPELINE	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 manufactured gas, hot water or steam (ISIC Division 40) from the distributor to final users is excluded and should be reported in the energy sector, while the energy used for the final distribution of water (ISIC Division 41) 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.
Domestic Navigation	DOMESNAV	Domestic navigation 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	
Non-Energy Use in Transport	NETRANS	Non-energy use covers use of other petroleum products such as white spirit, paraffin waxes, lubricants, bitumen and other products. It also includes the non-energy use of coal (excluding peat). It is assumed that the use of these products is exclusively non-energy use.
Other Sectors	TOTOTHER	Other Sectors 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 1996 IPCC Guidelines, the category also includes emissions from autoproducers in the commercial/residential/agricultural sectors 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	Residential contains all emissions from fuel combustion in households. This corresponds to IPCC Source/Sink Category 1 A 4 b.
Commercial and Public Services	COMMPUB	Commercial and public services includes emissions from all activities of ISIC Divisions 41, 50, 51, 52, 55, 63, 64, 65, 66, 67, 70, 71, 72, 73, 74, 75, 80, 85, 90, 91, 92, 93 and 99.
Agriculture/Forestry	AGRICULT	Agriculture/Forestry includes deliveries to users classified as agriculture, hunting and forestry by the ISIC, and therefore includes energy consumed by such users whether for traction (excluding agricultural highway use), power or heating (agricultural and domestic) [ISIC Divisions 01 and 02].
Fishing	FISHING	Fishing 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 Division 05]. Previously fishing was included with agriculture/forestry and this may continue to be the case for some countries.

Non-specified Other	ONONSPEC	Includes emissions from all fuel use not elsewhere specified (e.g. military fuel consumption with the exception of transport fuels in international marine bunkers, the domestic air and road sectors and consumption in the above-designated categories for which separate figures have not been provided).
Non-Energy Use in Other Sectors	NEOTHER	Non-energy use covers emissions from use of other petroleum products such as white spirit, paraffin waxes, lubricants, bitumen and other products. It also includes the non-energy use of coal (excluding peat). These products are shown separately in final consumption under the heading non-energy use. It is assumed that the use of these products is exclusively non-energy use. An exception to this treatment is petroleum coke, which is included as non-energy use only when there is evidence of such use; otherwise it is included as energy use in industry or in other sectors. Non-energy use of coal includes carbon blacks, graphite electrodes, etc., and is also shown separately by sector.
CO_2 Reference Approach	CO2EMIS	Reference Approach contains total CO_2 emissions from fuel combustion as calculated using the IPCC Reference Approach. 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 CO_2 emissions. In these tables, the difference between the Sectoral Approach and the Reference Approach includes statistical differences, product transfers, transformation losses and distribution losses.
Diff. due to losses and/or transformation	TRANDIFF	Differences due to Losses and/or Transformation 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. 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, the row Differences due to Losses and/or Transformation sometimes shows quite large positive emissions or even negative ones due to problems in the underlying energy data.
Statistical Differences	STATDIFF	Statistical Differences can be due to unexplained discrepancies in the underlying energy data. They can also be caused by differences arising between emissions calculated using the Reference Approach and the Sectoral Approach.

Memo: International Marine Bunkers	MARBUNK	International Marine Bunkers 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	INTLAIR	International Aviation 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 should be excluded from the national totals. This corresponds to IPCC Source/Sink Category 1 A 3 a i.

Electricity and Heat Output and Emissions per kWh		
Flow	**Short name**	**Definition**
CO_2 per kWh (g CO_2 per kWh)	CO2KWHH	These ratios are expressed in grammes of CO_2 per kWh. They have been calculated using CO_2 emissions from electricity and heat ("Main Activity Producer" and "Autoproducer"). The CO_2 emissions include emissions from fossil fuels, industrial waste and non-renewable municipal waste that are consumed for electricity and heat generation in the transformation sector and the output includes electricity and heat generated from fossil fuels, nuclear, hydro (excluding pumped storage), geothermal, solar, biomass, etc. As a result, the emissions per kWh can vary from year to year depending on the generation mix. In the ratios of CO_2 emissions per kWh by fuel: •Coal includes primary and secondary coal, peat and manufactured gases (excluding gas works gas). •Oil includes petroleum products (and small amounts of crude oil for some countries). •Gas includes natural gas and gas works gas. Note: Emissions per kWh should be used with caution due to data quality problems relating to electricity efficiencies for some countries.
Electricity and Heat Output (TWh)	ELECHEAT	Total output includes electricity and heat generated in the transformation sector using fossil fuels, nuclear, hydro (excluding pumped storage), geothermal, solar, biomass, etc. Both public and autoproducer plants have been included. For electricity, data include the total number of TWh generated by power plants (including both electricity plants and CHP plants). For heat, data include the total amount of TWh generated by power plants (including both CHP plants and heat plants).
Electricity Output in (TWh)	ELOUTPUT	Electricity generated shows the total number of TWh generated by thermal power plants separated into electricity plants and CHP plants, as well as production by nuclear and hydro (excluding pumped storage production), geothermal, etc.
Electricity Output-main activity producer electricity plants (TWh)	ELMAINE	Electricity plants refer 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 can not be distinguished on a unit basis) then the whole plant is designated as a CHP plant. Main activity producer (formerly known as public supply undertakings) generate electricity and/or heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.

Electricity Output-autoproducer electricity plants (TWh)	ELAUTOE	Electricity plants refer 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 can not be distinguished on a unit basis) then the whole plant is designated as a CHP plant. 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.
Electricity Output-main activity producer CHP plants (TWh)	ELMAINC	Combined heat and power plants (CHP) refers to plants which are designed to produce both heat and electricity, sometimes referred 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 is adopted. Main activity producer (formerly known as public supply undertakings) generate electricity and/or heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.
Electricity Output-autoproducer CHP plants (TWh)	ELAUTOC	Combined heat and power plants (CHP) refers to plants which are designed to produce both heat and electricity, sometimes referred 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 is adopted. Note that for autoproducer's CHP plants, all fuel inputs to electricity production are taken into account, while only the part of fuel inputs to heat sold is shown. Fuel inputs for the production of heat consumed within the autoproducer's establishment are not included here but are included with figures for the final consumption of fuels in the appropriate consuming sector.
Heat Output in TWh	HEATOUT	Heat generated shows the total amount of TWh generated by power plants separated into CHP plants and heat plants.
Heat Output-main activity producer CHP plants (TWh)	HEMAINC	Combined heat and power plants (CHP) refers to plants which are designed to produce both heat and electricity, sometimes referred 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 is adopted. Main activity producer (formerly known as public supply undertakings) generate electricity and/or heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.

Heat Output-autoproducer CHP plants (TWh)	HEAUTOC	Combined heat and power plants (CHP) refers to plants which are designed to produce both heat and electricity, sometimes referred 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 is adopted. Note that for autoproducer's CHP plants, all fuel inputs to electricity production are taken into account, while only the part of fuel inputs to heat sold is shown. Fuel inputs for the production of heat consumed within the autoproducer's establishment are not included here but are included with figures for the final consumption of fuels in the appropriate consuming sector. Autoproducer undertakings generate electricity and/or heat, wholly or partly for their own use as an activity which supports their primary activity. They may be privately or publicly owned.
Heat Output-main activity producer heat plant (TWh)	HEMAINH	Heat plants refer to plants (including heat pumps and electric boilers) designed to produce heat only, which is sold to a third party under the provisions of a contract. Main activity producer (formerly known as public supply undertakings) generate electricity and/or heat for sale to third parties, as their primary activity. They may be privately or publicly owned. Note that the sale need not take place through the public grid.
Heat Output-autoproducer heat plants (TWh)	HEAUTOH	Heat plants refer to plants (including heat pumps and electric boilers) designed to produce heat only, which is sold to a third party under the provisions of a contract. 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.

Indicators		
Flow	**Short name**	**Notes**
Total Primary Energy Supply (PJ)	TPESPJ	Total primary energy supply from the *IEA Energy Balances* (converted into PJ). The IPCC methodology does not assign any CO_2 emissions to fuel use of biomass per se, only if it is used in an unsustainable way. This is evaluated in the Land Use Change and Forestry module of the 1996 IPCC Guidelines. So although the inclusion of biomass in the IEA energy data does not alter its CO_2 emission estimates, it gives more insight into the CO_2 intensity of national energy use.
Total Primary Energy Supply (Mtoe)	TPESMTOE	Total primary energy supply from the *IEA Energy Balances*. The IPCC methodology does not assign any CO_2 emissions to fuel use of biomass per se, only if it is used in an unsustainable way. This is evaluated in the Land Use Change and Forestry module of the IPCC Guidelines. So although the inclusion of biomass in the IEA energy data does not alter its CO_2 emission estimates, it gives more insight into the CO_2 intensity of national energy use.
GDP (billion 2000 US$ using exchange rates)	GDP	The GDP data have been compiled for individual countries at market prices in local currency and annual rates. These data have been scaled up/down to the price levels of 2000 and then converted to US dollars using the yearly average 2000 exchange rates or purchasing power parities (PPPs). The main source of the 1970 to 2005 GDP series for the OECD countries is National Accounts of OECD Countries, Volume 1, 2007. GDP data for 1960 to 1969 have been estimated using the growth rates from the series in the OECD Economic Outlook No 76 and data previously published by the OECD. Data prior to 1990 for the Czech Republic and Poland, prior to 1991 for Hungary, and prior to 1992 for the Slovak Republic are IEA Secretariat estimates based on GDP growth rates from the World Bank. Greece made very large and extensive revisions to its national accounts in the autumn of 2006 for the years 2000 to 2005 that resulted in an increase of 25.7% to GDP in the year 2000, but did not greatly affect growth rates. The revisions stem from the introduction of improved methods and the availability of more up-to-date source data. Data for years prior to 2000 have been derived by linking the previously published estimates to the revised data. The main source of the GDP series for the Non-OECD countries is *World Development Indicators*, World Bank Washington D.C., 2007. GDP figures for Brunei Darussalam, Cambodia (1995-2005), Cuba, Gibraltar, Iraq, Democratic People's Republic of Korea, Libya, Myanmar, Netherlands Antilles (1980-2005), Qatar, Chinese Taipei and the three regions Other Africa, Other Latin America and Other Asia are from the CHELEM-CEPII online database, 2007. GDP figures for Albania (1971-1979), Angola (1971-1979), Bahrain (1971-1979), Bosnia and Herzegovina (1990-1993), Bulgaria (1971-1979), Cyprus (1971-1974 and 2005), Ethiopia (1971-1980), Former USSR (1971-1989), Former Yugoslavia (1971-1989), Islamic Republic of Iran (1971-1973), Jordan (1971-1974), Kuwait (1990-1991), Lebanon

GDP (billion 2000 US$ using exchange rates) (cont.)	GDP	(1971-1987), Mozambique (1971-1979), Namibia (1971-1979), Romania (1971-1979), Serbia and Montenegro (1990-1992 and 2005), Slovenia (1992), Thailand (2005), Togo (2005), Tunisia (2005), Turkmenistan (2005), United Republic of Tanzania (1971-1987), Ukraine (2005), the United Arab Emirates (1971-1972 and 2005), Uzbekistan (2005), Vietnam (1971-1983 and 2005), Yemen (1971-1989 and 2005), Zambia (2005) and Zimbabwe (2005) have been estimated based on the growth rates of the CHELEM-CEPII online database, 2007. Due to a lack of complete series, Other Latin America does not include Anguilla and Martinique. GDP figures for Angola (1971-1979), Albania (1971-1979), Bahrain (1971-1979), Bosnia and Herzegovina (1992-1993), Bulgaria (1971-1979), Cyprus (1971-1974), Ethiopia (1971-1980), Former USSR (1971-1991), Former Yugoslavia (1971-1991), Islamic Republic of Iran (1971-1973), Jordan (1971-1974), Kuwait (1990-1991), Lebanon (1971-1987), Mozambique (1971-1979), Namibia (1971-1979), Romania (1971-1979), Serbia and Montenegro (1992), Slovenia (1992), United Republic of Tanzania (1971-1987), the United Arab Emirates (1971-1972), Vietnam (1971-1983) and Yemen (1971-1989) have been estimated based on the growth rates of the CHELEM-CEPII CD ROM, Edition 8. GDP figures for Iraq (2003 and 2004) have been estimated by the Secretariat.
GDP (billion 2000 US$ using PPPs)	GDPPPP	GDPPPP is the gross domestic product calculated using purchasing power parities. The GDP data have been compiled for individual countries at market prices in local currency and annual rates. These data have been scaled up/down to the price levels of 2000 and then converted to US dollars using the purchasing power parities (PPPs). 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. For the OECD countries, the PPPs selected to convert the GDP from national currencies to US dollars come from the OECD and were aggregated using the Geary-Khamis (GK) method and rebased on the United States. For a more detailed description of the methodology please see Purchasing Power Parities and Real Expenditures, GK Results, Volume II, 1990, OECD 1993. The PPPs for the other countries come from the World Bank and CHELEM-CEPII. The main source of the 1970 to 2005 GDP series for the OECD countries is National Accounts of OECD Countries, Volume 1, 2007. GDP data for 1960 to 1969 have been estimated using the growth rates from the series in the OECD Economic Outlook No 76 and data previously published by the OECD. Data prior to 1990 for the Czech Republic and Poland, prior to 1991 for Hungary, and prior to 1992 for the Slovak Republic are IEA Secretariat estimates based on GDP growth rates from the World Bank. The main source of the GDP series for the Non-OECD countries is World Development Indicators, World Bank Washington D.C., 2007.

GDP (billion 2000 US$ using PPPs) (cont.)	GDPPPP	GDP figures for Brunei Darussalam, Cambodia (1995-2005), Cuba, Gibraltar, Iraq, Democratic People's Republic of Korea, Libya, Myanmar, Netherlands Antilles (1980-2005), Qatar, Chinese Taipei and the three regions Other Africa, Other Latin America and Other Asia are from the CHELEM-CEPII online database, 2007. GDP figures for Albania (1971-1979), Angola (1971-1979), Bahrain (1971-1979), Bosnia and Herzegovina (1990-1993), Bulgaria (1971-1979), Cyprus (1971-1974 and 2005), Ethiopia (1971-1980), Former USSR (1971-1989), Former Yugoslavia (1971-1989), Islamic Republic of Iran (1971-1973), Jordan (1971-1974), Kuwait (1990-1991), Lebanon (1971-1987), Mozambique (1971-1979), Namibia (1971-1979), Romania (1971-1979), Serbia and Montenegro (1990-1992 and 2005), Slovenia (1992), Thailand (2005), Togo (2005), Tunisia (2005), Turkmenistan (2005), United Republic of Tanzania (1971-1987), Ukraine (2005), the United Arab Emirates (1971-1972 and 2005), Uzbekistan (2005), Vietnam (1971-1983 and 2005), Yemen (1971-1989 and 2005), Zambia (2005) and Zimbabwe (2005) have been estimated based on the growth rates of the CHELEM-CEPII online database, 2007. Due to a lack of complete series, Other Latin America does not include Anguilla and Martinique. GDP figures for Angola (1971-1979), Albania (1971-1979), Bahrain (1971-1979), Bosnia and Herzegovina (1992-1993), Bulgaria (1971-1979), Cyprus (1971-1974), Ethiopia (1971-1980), Former USSR (1971-1991), Former Yugoslavia (1971-1991), Islamic Republic of Iran (1971-1973), Jorrdan (1971-1974), Kuwait (1990-1991), Lebanon (1971-1987), Mozambique (1971-1979), Namibia (1971-1979), Romania (1971-1979), Serbia and Montenegro (1992), Slovenia (1992), United Republic of Tanzania (1971-1987), the United Arab Emirates (1971-1972), Vietnam (1971-1983) and Yemen (1971-1989) have been estimated based on the growth rates of the CHELEM-CEPII CD ROM, Edition 8. GDP figures for Iraq (2003 and 2004) have been estimated by the Secretariat.
Population (millions)	POP	The main source of the 1970 to 2005 population data for the OECD countries is National Accounts of OECD Countries, Volume 1, OECD Paris, 2007. Data for 1960 to 1969 have been estimated using the growth rates from the population series published in the OECD Economic Outlook No 76. For the Czech Republic, Hungary and Poland (1960 to 1969) and Mexico (1960 to 1962), the data are estimated using the growth rates from the population series from the World Bank published in the World Development Indicators CD-ROM. For the Slovak Republic, population data for 1960 to 1989 are from the Demographic Research Centre, Infostat, Slovak Republic. The main source of the population data for the Non-OECD countries is World Development Indicators, World Bank, Washington D.C., 2007. Population data for Cambodia, Gibraltar, Mongolia, Chinese Taipei and the three regions Other Africa, Other Latin America and Other Asia are based on the CHELEM-CEPII online database, 2007. Population data for Iraq (2000-2005) have been calculated based on the growth rates of the CHELEM-CEPII online database, 2007.

CO_2 / TPES (t CO_2 per TJ)	CO2TPES	This ratio is expressed in tonnes of CO_2 per terajoule. It has been calculated using the Sectoral Approach CO_2 emissions and total primary energy supply (including biomass and other non-fossil forms of energy).
GDP (kg CO_2 per 2000 US$)	CO2GDP	This ratio is expressed in kilogrammes of CO_2 per 2000 US dollar. It has been computed using the Sectoral Approach CO_2 emissions and the GDP calculated using exchange rates.
CO_2 / GDP (kg CO_2 per 2000 US$ PPP)	CO2GDPPP	This ratio is expressed in kilogrammes of CO_2 per 2000 US dollar. It has been calculated using the Sectoral Approach CO_2 emissions and the GDP calculated using purchasing power parities.
CO_2 / Population (t CO_2 per capita)	CO2POP	This ratio is expressed in tonnes of CO_2 per capita. It has been calculated using the Sectoral Approach CO_2 emissions.

Per capita CO_2 emissions by sector (kg CO_2 per capita)

Flow	Allocation	Definition
Per Capita Emissions by Sector	NO	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	YES	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.

Emissions of CO_2, CH_4, N_2O, HFC, PFC and SF_6 (Mt CO_2 equivalent)		
Gas	**Short name**	**Definition**
CO_2 - Fuel Combustion	CO2COMB	Fuel combustion refers to fossil fuel combustion and non-energy/feedstock use (IPCC Source/Sink Category 1A) estimated using the IPCC Sectoral Approach.
CO_2 - Fugitive	CO2FUG	Fugitive refers to flaring of associated gas in oil and gas production (IPCC Source/Sink Category 1B).
CO_2 - Industrial processes	CO2IND	Industry refers to cement production (IPCC Source/Sink Category 2).
CO_2 – Other	CO2OTHER	Other refers to the sum of direct emissions from tropical forest fires and of 10% of biofuel combustion emissions, which is the fraction assumed to be produced unsustainably (IPCC Source/Sink Category 5).
CO_2 – Total	CO2TOT	Total CO_2 Emissions.
CO_2 - Share of Energy in Total	CO2ESHARE	Share of Energy in total for CO_2 emissions (%).
CH_4 - Energy	CH4ENERGY	Energy comprises production, handling, transmission and combustion of fossil fuels and biofuels (IPCC Source/Sink Category 1).
CH_4 – Agriculture	CH4AGRI	Agriculture comprises animals, animal waste, rice production, agricultural waste burning (non-energy, on-site) and savannah burning (IPCC Source/Sink Category 4).
CH_4 – Waste	CH4WASTE	Waste comprises landfills, wastewater treatment, human wastewater disposal and waste incineration (non-energy) (IPCC Source/Sink Category 6).
CH_4 – Other	CH4OTHER	Others includes industrial process emissions and tropical and temperate forest fires and other vegetation fires (IPCC Source/ Sink Categories 2 and 5).
CH_4 – Total	CH4TOT	Total CH_4 emissions.
CH_4 - Share of Energy in Total	CH4ESHARE	Share of Energy in total for the methane (%).
N_2O – Energy	N2OENERGY	Energy comprises combustion of fossil fuels and biofuels (IPCC Source/Sink Category 1).
N_2O – Agricultura	N2OAGRI	Agriculture comprises fertiliser use (synthetic and animal manure), animal waste management, agricultural waste burning (non-energy, on-site) and savannah burning (IPCC Source/Sink Category 4).
N_2O – Industrial processes	N2OIND	Industrial Processes comprises non-combustion emissions from manufacturing of adipic acid and nitric acid (IPCC Source/Sink Category 2).

N_2O – Other	N2OOTHER	Others include N_2O usage, tropical and temperate forest fires, and human sewage discharge and waste incineration (non-energy) (IPCC Source/Sink Categories 3, 5 and 6).
N_2O – Total	N2OTOT	Total N_2O emissions.
N_2O – Share of Energy in Total	N2OESHARE	Share of energy in total for N_2O (%).
HFC - Industrial processes	HFCIND	HFC emissions comprise by-product emissions of HFC-23 from HCFC-22 manufacture and the use of HFCs (IPCC Source/Sink Categories 2E and 2F).
PFC - Industrial processes	PFCIND	PFC emissions comprise by-product emissions of CF4 and C_2F_6 from primary aluminium production and the use of PFCs, in particular for semiconductor manufacture (IPCC Source/Sink Categories 2C, 2E and 2F).
SF_6 - Industrial processes	SF6IND	SF6 emissions stem from various sources of SF_6 use, of which the largest is the use and manufacture of Gas Insulated Switchgear (GIS) used in the electricity distribution networks (IPCC Source/Sink Categories 2C and 2F).
Total	TOTAL	
Share of Energy in Total	ESHARE	Share of energy in total (%).

Aggregated Products

Flow	Short name	Definition
Coal and Coal Products	COAL	Coal includes all coal, both primary (including hard coal and lignite) and derived fuels (including patent fuel, coke oven coke, gas coke, BKB, coke oven gas, blast furnace gas, but excluding gas works gas). Peat is also included in this category.
Oil	OIL	Oil comprises crude oil, natural gas liquids, refinery feedstocks, additives, refinery gas, ethane, LPG, aviation gasoline, motor gasoline, jet fuels, kerosene, gas/diesel oil, heavy fuel oil, naphtha, white spirit, lubricants, bitumen, paraffin waxes, petroleum coke and other petroleum products.
Gas	Natural Gas	Gas includes natural gas and gas works 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.

Coal		
Flow	**Short name**	**Definition**
Hard Coal (if no detail)	HARDCOAL	This item is used prior to 1978. It includes anthracite, coking coal, other bituminous coal and (depending on the country) also may include sub-bituminous coal.
Brown Coal (if no detail)	BROWN	This item is used prior to 1978. It includes lignite and (depending on the country) also may include 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 23 865 kJ/kg (5 700 kcal/kg) on an ash-free but moist basis.
Coking Coal	COKCOAL	Coking coal refers to coal with a quality that allows the production of a coke suitable to support a blast furnace charge. Its gross calorific value is greater than 23 865 kJ/kg (5 700 kcal/kg) on an ash-free but moist basis.
Other Bituminous Coal	BITCOAL	Other bituminous coal is used for steam raising and space heating purposes and includes all bituminous coal that is not included under coking coal. 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 23 865 kJ/kg (5 700 kcal/kg) on an ash-free but moist basis.
Sub-Bituminous Coal	SUBCOAL	Non-agglomerating coals with a gross calorific value between 17 435 kJ/kg (4165 kcal/kg) and 23 865 kJ/kg (5 700 kcal/kg) containing more than 31 per cent volatile matter on a dry mineral matter free basis.
Lignite/Brown Coal	LIGNITE	Lignite is a non-agglomerating coal with a gross calorific value of less than 17 435 kJ/kg (4 165 kcal/kg), and greater than 31 per cent volatile matter on a dry mineral matter free basis.
Oil shale	OILSHALE	Oil shale is an inorganic, non-porous rock containing various amounts of solid organic material that yields hydrocarbons, along with a variety of solid products, when subject to pyrolysis (a treatment that consists of heating the rock at high temperature).
Peat	PEAT	Combustible soft, porous or compressed, fossil sedimentary deposit of plant origin with high water content (up to 90 per cent in the raw state), easily cut, of light to dark brown colour. Peat used for non-energy purposes is not included.
Patent Fuel	PATFUEL	Patent fuel is a composition fuel manufactured from coal fines with the addition of a binding agent (pitch). The amount of patent fuel produced is, therefore, 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 other energy sector.

Coke Oven Coke and Lignite 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 and semi-coke made from lignite. The heading other energy sector represents consumption at the coking plants themselves. Consumption in the iron and steel industry 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).
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. Other energy sector data represent 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/Peat Briquettes	BKB	BKB are composition fuels manufactured from brown coal, produced by briquetting under high pressure. These figures include peat briquettes, dried lignite fines and dust, and brown coal breeze.

Crude, NGL, Refinery Feedstocks		
Flow	**Short name**	**Definition**
Crude/NGL/Feedstocks (if no detail)	CRNGFEED	Series split into crude, NGL, refinery feedstocks, additives and non-crude from 1978 onward.
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	NGLs are the liquid or liquefied hydrocarbons produced in the manufacture, purification and stabilisation of natural gas. These are those portions of natural gas which are recovered as liquids in separators, field facilities, or gas processing plants. NGLs include but are not limited to ethane, propane, butane, pentane, natural gasoline and condensate. They may also include small quantities of non-hydrocarbons.
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. This definition covers those finished products imported for refinery intake and those returned from the petrochemical industry to the refining industry.
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.
Orimulsion	ORIMUL	Emulsified oil made of water and natural bitumen.
Other Hydrocarbons	NONCRUDE	Other hydrocarbons, synthetic crude oil, mineral oils extracted from bituminous minerals, bituminous sand, etc. and liquids from coal liquefaction, are included here. Orimulsion is presented separately and not included here.

Petroleum Products		
Flow	**Short name**	**Definition**
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_2H_6). It is a colourless paraffinic gas which is extracted from natural gas and refinery gas streams.
Liquefied Petroleum Gases	LPG	These are the light hydrocarbons fraction of the paraffin series, derived from refinery processes, crude oil stabilisation plants and natural gas processing plants comprising propane (C_3H_8) and butane (C_4H_{10}) or a combination of the two. They could also include propylene, butylene, isobutene and isobutylene. They are normally liquefied under pressure for transportation and storage.
Motor Gasoline	MOTORGAS	This is light hydrocarbon oil for use in internal combustion engines such as motor vehicles, excluding aircraft. Motor gasoline is distilled between 35 degrees C and 215 degrees C and is used as a fuel for land based spark ignition engines. Motor gasoline may include additives (such as ethanol), oxygenates and octane enhancers, including lead compounds such as TEL (Tetraethyl lead) and TML (tetramethyl lead).
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 degrees C, and a distillation range usually within the limits of 30 degrees C and 180 degrees C.
Gasoline Type Jet Fuel	JETGAS	This includes all light hydrocarbon oils for use in aviation turbine power un its. They distil between 100 degrees C and 250 degrees C. It is obtained by blending kerosenes and gasoline or naphthas in such a way that the aromatic content does not exceed 25 per cent 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	JETKERO	This is medium distillate used for aviation turbine power units. It has the same distillation characteristics and flash point as kerosene (between 150 degrees C and 300 degrees C but not generally above 250 degrees 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.
Other kerosene	OTHKERO	Kerosene (other than kerosene used for aircraft transport which is included with aviation fuels) Kerosene comprises refined petroleum distillate intermediate in volatility between gasoline and gas/diesel oil. It is a medium oil distilling between 150 degrees C and 300 degrees C.

Gas/Diesel Oil	GASDIES	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 degrees C and 380 degrees 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 degrees C and 540 degrees C and which are used as petrochemical feedstocks.
Heavy Fuel Oil	RESFUEL	This heading 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 degrees C. The flash point is always above 50 degrees C and the density is always more 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 in the 30 degrees C and 210 degrees C distillation range or part of this range. Naphtha imported for blending is shown as an import of naphtha, then shown in the transfers row as a negative entry for naphtha and a positive entry for the corresponding finished product (e.g. gasoline).
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^{o}C and a distillation range of 135^{o}C to 200^{o}C. Industrial Spirit (SBP) comprises light oils distilling between 30^{o}C and 200^{o}C, with a temperature difference between 5% volume and 90% volume distillation points, including losses, of not more than 60^{o}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	Solid, semi-solid or viscous hydrocarbon with a colloidal structure, being brown to black in colour, obtained as a residue in the distillation of crude oil, vacuum distillation of oil residues from atmospheric distillation. Bitumen is often referred to as asphalt and is primarily used for surfacing of roads and for roofing material. This category includes fluidized 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^{o}C.

Petroleum Coke	PETCOKE	Petroleum coke is defined as a black solid residue, obtained mainly by cracking and carbonising of residue feedstocks, tar and pitches in processes such as delayed coking or fluid coking. It consists mainly of carbon (90 to 95 per cent) 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 "calcinated 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 Petroleum Products	ONONSPEC	Includes the petroleum products not classified above, for example: tar, sulphur, and grease. This category also includes aromatics (e.g. BTX or benzene, toluene and xylene) and olefins (e.g. propylene) produced within refineries.

Gases		
Flow	**Short name**	**Definition**
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.
Oxygen Steel Furnace Gas	OXYSTGS	Oxygen steel furnace gas is obtained as a by-product of the production of steel in an oxygen furnace and is recovered on leaving the furnace. Oxygen steel furnace gas is also known as converter gas, LD gas or BOS gas.
Natural Gas	NATGAS	Natural gas comprises gases, occurring in underground deposits, whether liquefied or gaseous, consisting mainly of methane. It includes both "non-associated" gas originating from fields producing only hydrocarbons in gaseous form, and "associated" gas produced in association with crude oil as well as methane recovered from coal mines (colliery gas) or from coal seams (coal seam gas). Production represents dry marketable production within national boundaries, including offshore production and is measured after purification and extraction of NGL and sulphur. It includes gas consumed by gas processing plants and gas transported by pipeline. Quantities of gas that are re-injected, vented or flared are excluded.

Wastes		
Flow	**Short name**	**Definition**
Industrial Waste	INDWASTE	Industrial waste 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	This consists of the non-renewable part of municipal waste 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.

3. GEOGRAPHICAL COVERAGE AND COUNTRY NOTES

Countries and Regions		
Flow	**Short name**	**Definition**
World	WORLD	World = OECD Total + Non-OECD Total + International Marine Bunkers + International Aviation. World = Annex I Parties + Non-Annex I Parties + International Marine Bunkers and International Aviation. Please note that the following countries have not been considered due to lack of data: Africa: Saint Helena and Western Sahara; America: Anguilla, British Virgin Islands, Cayman Islands, Falkland Islands, Montserrat, Saint Pierre-Miquelon and Turks, and Caicos Islands; Asia and Oceania: Christmas Island, Cook Islands, Nauru, Niue and Palau. Non-OECD Europe: Liechtenstein.
OECD North America	OECDNAM	Includes Canada, Mexico and the United States.
OECD Pacific	OECDPAC	Includes Australia, Japan, Korea and New Zealand.
OECD Europe	OECDEUR	Includes Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey and the United Kingdom.
Africa	AFRICA	Algeria, Angola, Benin, Botswana, Cameroon, Congo, Democratic Republic of Congo, Côte d'Ivoire, Egypt, Eritrea, Ethiopia, Gabon, Ghana, Kenya, Libya, Morocco, Mozambique, Namibia, Nigeria, Senegal, South Africa, Sudan, United Republic of Tanzania, Togo, Tunisia, Zambia, Zimbabwe and Other Africa.

Latin America	LATAMER	Latin America includes Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay, Venezuela and Other Latin America.
Middle East	MIDEAST	Middle East includes Bahrain, Islamic Republic of Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates and Yemen.
Non-OECD Europe	NOECDEUR	Non-OECD Europe includes Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Gibraltar, Former Yugoslav Republic of Macedonia (FYROM), Malta, Romania, Serbia and Montenegro, and Slovenia. Data on Cyprus have been collected through the UN ECE questionnaires. They relate to the Southern part of the Island.
Former USSR	FSUREG	Former USSR includes Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Republic of Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. Prior to this year, data for the individual countries of the former USSR were published starting in 1992 and only a regional aggregate was given for earlier years, with the exception of estimates for total CO_2 emissions for 1990 for those countries in Annex I. This year, the IEA Secretariat used previously unpublished information to revise the data for 1990 and 1991 for all the countries of the former USSR. These revisions have affected the individual countries as well as the overall regional total for these two years. The regional total for 1990 is now 9% higher than was previously the case. The Secretariat feels that these estimates are of good quality and that the emissions had been under-estimated in earlier years.
Asia (excluding China)	ASIA	Asia includes Bangladesh, Brunei Darussalam, Cambodia, Chinese Taipei, India, Indonesia, DPR of Korea, Malaysia, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Vietnam and Other Asia. In this series, Asia excludes China and Hong Kong.
China (including Hong Kong)	CHINAREG	China includes the People's Republic of China and Hong Kong (China).
World International Aviation	WORLDAV	World Aviation Bunkers represents the sum of International Aviation from all countries
World Marine Bunkers	WORLDMAR	World Marine Bunkers represents the sum of International Marine Bunkers from all countries.
International Bunkers	BUNKERS	Used in file "Emissions of CO_2, CH_4, N_2O, HFC, PFC and SF_6". International Bunkers represents the sum of International Marine Bunkers and International Aviation from all the countries.
Albania	ALBANIA	
Algeria	ALGERIA	
Angola	ALGOLA	

Argentina	ARGENTINA	
Armenia	ARMENIA	
Australia	AUSTRALI	Excludes the overseas territories.
Austria	AUSTRIA	
Azerbaijan	AZERBAIJAN	
Bahrain	BAHRAIN	
Bangladesh	BANGLADESH	
Belarus	BELARUS	
Belgium	BELGIUM	
Benin	BENIN	
Bolivia	BOLIVIA	
Bosnia-Herzegovina	BOSNIAHERZ	
Botswana	BOTSWANA	
Brazil	BRAZIL	
Brunei Darussalam	BRUNEI	
Bulgaria	BULGARIA	According to the provisions of Article 4.6 of the Convention and Decisions 9/CP.2 and 11/CP.4, Bulgaria is allowed to use 1988 as the base year.
Cambodia	CAMBODIA	
Cameroon	CAMEROON	
Canada	CANADA	
Chile	CHILE	
People's Republic of China	CHINA	In 2006, the IEA Secretariat has revised some of the net calorific values used to convert bituminous coal to terajoules. As a result, the estimates of CO_2 emissions for 2001 to 2003 are 6 to 8% higher than those published in previous editions.
Chinese Taipei	TAIPEI	
Colombia	COLOMBIA	
Congo	CONGO	
Democratic Republic of Congo	CONGOREP	
Costa Rica	COSTARICA	
Côte d'Ivoire	COTEIVOIRE	
Croatia	CROATIA	
Cuba	CUBA	International marine bunkers for residual fuel oil in the period 1971-1983 were estimated on the basis of 1984 figures and the data reported as internal navigation in the energy balance.

Cyprus	CYPRUS	
Czech Republic	CZECH	
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.
Dominican Republic	DOMINICANR	
Ecuador	ECUADOR	
Egypt	EGYPT	
El Salvador	ELSALVADOR	
Eritrea	ERITREA	
Estonia	ESTONIA	The data reported as lignite in the energy balance have been entirely considered as oil shale for the calculation of CO_2 emissions.
Ethiopia	ETHIOPIA	
Finland	FINLAND	
France	FRANCE	France includes Monaco, and excludes the following overseas departments: Guadeloupe, Guyana, Martinique, New Caledonia, French Polynesia, Réunion and St.Pierre et Miquelon. The methodology for calculating main activity electricity and heat production from gas changed in 2000. From 2000 onwards, natural gas residential consumption includes consumption in commercial and public services. The methodology for calculating main activity electricity and heat production from gas changed in 2000.
Gabon	GABON	
Georgia	GEORGIA	
Germany	GERMANY	Germany includes the new federal states of Germany from 1970 onwards.
Ghana	GHANA	
Gibraltar	GIBRALTAR	
Greece	GREECE	
Guatemala	GUATEMALA	
Haiti	HAITI	
Honduras	HONDURAS	
Hong Kong, China	HONGKONG	
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.
Iceland	ICELAND	

India	INDIA	
Indonesia	INDONESIA	
Islamic Republic of Iran	IRAN	
Iraq	IRAQ	
Ireland	IRELAND	
Israel	ISRAEL	
Italy	ITALY	Italy includes San Marino and the Vatican. Prior to 1990, gas use in commercial/public services was included in residential.
Jamaica	JAMAICA	
Japan	JAPAN	Japan includes Okinawa. For the fourth consecutive year, the IEA has received revisions from the Japanese Administration. The first set of revisions received in 2004 increased the 1990 supply by 5% for coal, 2% for natural gas and 0.7% for oil compared to the previous data. This led to an increase of 2.5% in 1990 CO_2 emissions calculated using the Reference Approach while the Sectoral Approach remained fairly constant. For the 2006 edition, the IEA received revisions to the coal and oil data which had a significant impact on both the energy data and the CO_2 emissions. The most significant revisions occurred for coke oven coke, naphtha, blast furnace gas and petroleum coke. These revisions affected consumption rather than supply in the years concerned. As a result, the sectoral approach CO_2 emissions increased for all the years, however at different rates. For example, the sectoral approach CO_2 emissions for 1990 were 4.6% higher than those calculated for the 2005 edition while the 2003 emissions were 1.1% higher than those of the previous edition. Due to the impact these successive revisions have had on the final energy balance as well as on CO_2 emissions, the IEA is in close contact with the Japanese Administration to better understand the reasons be-hind these changes. These changes are mainly due to the Government of Japan's efforts to improve the input-output balances in the production of oil products and coal products in response to inquiries from the UNFCCC Secretariat. To cope with this issue, the Japanese Administration established a working group in March 2004. The working group completed its work in April 2006. Many of its conclusions were already incorporated prior to this year, but some further revisions to the time series (especially in industry and other sectors) were submitted this year.
Jordan	JORDAN	
Kazakhstan	KAZAKHSTAN	
Kenya	KENYA	

Democratic People's Republic of Korea	KOREADPR	
Korea	KOREA	The 6% decrease in CO_2 emissions between 2004 and 2005 is largely due to a higher percentage of fuel from navigation and aviation being allocated to the international component and therefore excluded from the national total CO_2 emissions. Between 2004 and 2005, emissions from national navigation decreased by 66% and emissions from national aviation decreased by 85%.
Kuwait	KUWAIT	
Kyrgyzstan	KYRGYZSTAN	
Latvia	LATVIA	
Lebanon	LEBANON	
Libya	LIBYA	
Lithuania	LITHUANIA	
Luxembourg	LUXEMBOU	
Former Yugoslav Rep. of Macedonia	FYROM	
Malaysia	MALAYSIA	
Malta	MALTA	
Mexico	MEXICO	
Republic of Moldova	MOLDOVA	
Mongolia	MONGOLIA	
Morocco	MOROCCO	
Mozambique	MOZAM-BIQUE	
Myanmar	MYANNMAR	
Namibia	NAMIBIA	
Nepal	NEPAL	
Netherlands	NETHLAND	Excludes Suriname and the Netherlands Antilles.
Netherlands Antilles	NANTILLES	Prior to 1992, the Reference Approach overstates emissions since data for lubricants and bitumen (which store carbon) are not available.
New Zealand	NZ	
Nicaragua	NICARAGUA	
Nigeria	NIGERIA	
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.

Oman	OMAN	
Pakistan	PAKISTAN	
Panama	PANAMA	
Paraguay	PARAGUAY	
Peru	PERU	
Philippines	PHILIPPINES	
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	Portugal includes the Azores and Madeira
Qatar	QATAR	
Romania	ROMANIA	According to the provisions of Article 4.6 of the Convention and Decisions 9/CP.2 and 11/CP.4, Romania is allowed to use 1989 as the base year.
Russia	RUSSIA	
Saudi Arabia	SAUDIARABI	
Senegal	SENEGAL	
Serbia and Montenegro	SERBMONT	Serbia and Montenegro was formerly known as the Federal Republic of Yugoslavia.
Singapore	SINGAPORE	
Slovak Republic	SLOVAKIA	
Slovenia	SLOVENIA	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.
South Africa	SOUTHAFRIC	
Spain	SPAIN	Includes the Canary Islands.
Sri Lanka	SRILANKA	
Sudan	SUDAN	
Sweden	SWEDEN	
Switzerland	SWITLAND	Does not include Liechtenstein. The sectoral breakdown for gas/diesel oil used in the residential sector before 1978 was estimated on the basis of commercial and residential consumption in 1978 and the data reported as commercial consumption in the energy balance in previous years.
Syria	SYRIA	
Tajikistan	TAJIKISTAN	
United Republic of Tanzania	TANZANIA	

Thailand	THAILAND	
Togo	TOGO	
Trinidad and Tobago	TRINIDAD	
Tunisia	TUNISIA	
Turkey	TURKEY	
Turkmenistan	TURKMENIST	
Ukraine	UKRAINE	
United Arab Emirates	UAE	
United Kingdom	UK	For reasons of confidentiality, gas for main activity electricity is included in autoproducers for 1990.
United States	USA	Includes the 50 states and the District of Columbia. Oil statistics as well as coal trade statistics also include Puerto Rico, Guam, the U.S. Virgin Islands, American Samoa, Johnston Atoll, Midway Islands, Wake Island and the Northern Mariana Islands.
Uruguay	URUGUAY	
Uzbekistan	UZBEKISTAN	
Venezuela	VENEZUELA	
Vietnam	VIETNAM	A detailed sectoral breakdown is available starting in 1980.
Yemen	YEMEN	
Zambia	ZAMBIA	
Zimbabwe	ZIMBABWE	
Former USSR (if no detail)	USSRND	Former USSR includes Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Republic of Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.
Former Yugoslavia (if no detail)	YUGOND	Includes Bosnia-Herzegovina, Croatia, Former Yugoslav Republic of Macedonia, Slovenia, Serbia and Montenegro.
Other Africa	OTHERAFRIC	Includes Burkina-Faso, Burundi, Cape Verde, Central African Republic, Chad, Comoros, Djibouti, Equatorial Guinea, Gambia, Guinea, Guinea-Bissau, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Niger, Reunion, Rwanda, Sao Tome and Principe, Seychelles, Sierra Leone, Somalia, Swaziland and Uganda.
Other Latin America	OTHERLATIN	Includes Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Dominica, French Guyana, Grenada, Guadeloupe, Guyana, Martinique, St. Kitts and Nevis, Anguilla, Saint Lucia, St. Vincent and Grenadines, and Surinam.
Other Asia	OTHERASIA	Other Asia and Oceania includes Afghanistan, Bhutan, Fiji, French Polynesia, Kiribati, Laos, Macau, Maldives, New Caledonia, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu.

Memo: OECD Total	OECDTOT	The Organisation for Economic Co-Operation and Development (OECD) includes Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.
Memo: Non-OECD Total	NOECDTOT	Africa + Latin America + Asia + Non-OECD Europe + Middle East + China Region + Former USSR.
Memo: IEA Total	IEATOT	The International Energy Agency (IEA) includes Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. Poland and the Slovak Republic are expected to become Member countries of the IEA in 2007.
Memo: European Union 27	EU27	Includes Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, the Slovak Republic, Slovenia, Spain, Sweden and the United Kingdom.
Memo: Former Yugoslavia	MYUGO	Includes Bosnia-Herzegovina, Croatia, Former Yugoslav Republic of Macedonia, Slovenia, Serbia and Montenegro. Prior to this year, only data for the former Yugoslav Republic of Macedonia and for Slovenia were available prior to 1992. An estimate for 1990 was made for Croatia since it was a member of Annex I. This year, the IEA Secretariat used previously unpublished information to revise the data for 1990 and 1991 for Bosnia/Herzegovina, Croatia and Serbia/Montenegro. These revisions have affected the overall regional total for these two years – 1990 is now 4% lower than was previously the case.
Memo: Annex I Parties	Annex 1	Annex I Parties include Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein (not included here), Lithuania, Luxembourg, Monaco (included with France), the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, the Russian Federation, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, the United Kingdom and the United States. The countries listed above are included in Annex I of the United Nations Framework Convention on Climate Change as amended on 11 December 1997 by the 12th Plenary meeting of the Third Conference of the Parties in Decision 4/CP.3. This includes the countries that were members of the OECD at the time of the signing of the Convention, the EEC, and fourteen countries in Central and Eastern Europe and the former Soviet Union that are undergoing the process of transition to market economies.

Memo: Annex II Parties	Annex 2	Annex II Parties include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Liechtenstein (not included here), Luxembourg, Monaco (included in France), 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 United States.
Memo: Annex II Europe	ANNEX2EU	Annex II Europe includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein (not included here), Luxembourg, Monaco (included in France), the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. 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 Pacific	ANNEX2PA	Annex II Pacific includes Australia, Japan and New Zealand.
Memo: Economies in Transition	ANNEX1EIT	Economies in Transition (EITs) are those countries in Annex I that are undergoing the process of transition to a market economy. This includes Belarus, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Russian Federation, the Slovak Republic, Slovenia and Ukraine.
Memo: Non Annex I Parties	NONANNEX1	
Memo: Annex I Kyoto Parties	ANNEXB	Annex I Kyoto Parties includes Austria, Belgium, Bulgaria, Canada, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein (not available in this publication), Lithuania, Luxembourg, Monaco (included with France), the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Ukraine and the United Kingdom. Membership in the Kyoto Protocol is almost identical to that of Annex I, except for Turkey and Belarus which did not agree to a target under the Protocol and the United States and Australia which have expressed their intention not to ratify the Protocol

4. IPCC METHODOLOGIES

General Notes

The ultimate objective of the UNFCCC (the Convention) is the stabilisation of greenhouse gas (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 GHGs 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, 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 IPCC Guidelines*). In April 2006, the IPCC approved the *2006 Guidelines* at the 25th session of the IPCC in Mauritius. For now, most countries (as well as the IEA) are still calculating their inventories using the *1996 IPCC Guidelines*[1].

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

Since the IPCC methodology for fuel combustion is largely based on energy balances, the IEA estimates for CO_2 from fuel combustion published in this document have been calculated using the IEA energy balances and the default IPCC methodology. However, other possibly more detailed methodologies may be used by Parties to calculate their inventories. This may lead to different estimates of emissions. See Chapter 1, IEA Emissions Estimates, for further details.

The calculation of CO_2 emissions from fuel combustion may be done at three different levels referred to as Tiers 1, 2 and 3. The Tier 1 methods estimate the emissions from the carbon content of fuels supplied to the country as a whole (the Reference Approach) or to the main fuel combustion activities (Sectoral Approach). The following chapter summarises the IPCC Tier 1 methodology from the *1996 IPCC Guidelines*.

Reference Approach

Introduction

Carbon dioxide emissions are produced when carbon-based fuels are burned. National emissions estimates are based on the amounts of fuels used and on the carbon content of fuels.

Fuel combustion is widely dispersed throughout most activities in national economies and a complete record of the quantities of each fuel type consumed in each end-use activity is a considerable task, which some countries have not undertaken. Fortunately, it is possible to obtain a relatively accurate estimate of national CO_2 emissions by accounting for the carbon in fuels supplied to the economy. The supply of fuels

is simple to record and the statistics are more likely to be available in many countries.

In accounting for fuels supplied[2] it is important to distinguish between *primary fuels* (i.e. fuels which are found in nature such as coal, crude oil, natural gas), and *secondary fuels* or fuel products, such as gasoline and lubricants, which are derived from primary fuels.

Accounting for carbon is based mainly on the supply of primary fuels and the net quantities of secondary fuels brought into the country.

To calculate supply of fuels to the country necessitates the following data for each fuel and year chosen:

- the amounts of primary fuels produced (production of secondary fuels is excluded);
- the amounts of primary and secondary fuels imported;
- the amounts of primary and secondary fuels exported;
- the amounts of fuel used for international marine bunkers and international aviation (hereafter referred to as bunkers);
- the net increases or decreases in stocks of the fuels.

For each fuel, the production (where appropriate) and imports are added together and the exports, bunkers, and stock changes are subtracted to calculate the apparent consumption of the fuels. In cases where exports of secondary fuels exceed imports or stock increases exceed net imports, negative numbers will result.

The manufacture of secondary fuels is ignored in the main calculation, as the carbon in these fuels has already been accounted for in the supply of primary fuels from which they are derived. However, information on production of some secondary fuel products is required to adjust for carbon stored in these products.

Three other important points influence the accounting methodology:

- *Stored carbon*

Not all fuel supplied to an economy is burned for heat energy. Some is used as a raw material (or feedstock) for manufacture of products such as plastics or in a non-energy use (e.g. bitumen for road construction), without oxidation (emissions) of the carbon. This is called s*tored carbon*, and is deducted from the carbon emissions calculation. Estimation of the stored carbon requires data for fuel use by activities using the fuel as raw material.

- *International bunker fuels*

The procedures given for calculating emissions ensure that emissions from the use of fuels for **international** marine and air transport are excluded from national emissions totals. However, for information purposes, the quantities and types of fuels delivered and the corresponding emissions from international marine bunkers and international aviation should be separately reported.

- *Biomass fuels*

In the IPCC methodology, biomass fuels are not included in the CO_2 emissions from fuel combustion and are only shown for informational purposes. This is because for CO_2 emissions, biomass consumption for fuel is assumed to equal its regrowth. Any departures from this hypothesis are counted within the Land Use, Land Use Change and Forestry module of the *1996 IPCC Guidelines*. For this reason, emissions from the burning of biomass for energy are not included in the CO_2 emissions from fuel combustion in this publication.

Methodology

The IPCC methodology breaks the calculation of carbon dioxide emissions from fuel combustion into six steps:

Step 1: Estimate Apparent Fuel Consumption in Original Units

Step 2: Convert to a Common Energy Unit

Step 3: Multiply by Emission Factors to Compute the Carbon Content

Step 4: Compute Carbon Stored

Step 5: Correct for Carbon Unoxidised

Step 6: Convert Carbon Oxidised to CO_2 Emissions

2. The following discussion excludes all non-carbon energy sources such as nuclear, hydro, geothermal, solar, etc.

Completing Worksheet 1

This section is from the Workbook of the *1996 IPCC Guidelines* and provides step-by-step instructions for calculating emissions at the detailed fuels and fuel products level. Worksheet 1 can be consulted at the end of this chapter.

NOTE: The main worksheet allows CO_2 emissions from biomass fuels to be calculated but it does not include them in the national total.

Step 1 Estimating Apparent Fuel Consumption

1 Apparent consumption is the basis for calculating the carbon supply for the country. To calculate apparent consumption (or total fuel supplied) for each fuel, the following data for primary fuels are entered:

- Production (Column A)
- Imports (Column B)
- Exports (Column C)
- International Bunkers (Column D)
- Stock Change (Column E)

For secondary fuels and products, the only figures entered are:

- Imports (Column B)
- Exports (Column C)
- International Bunkers (Column D)
- Stock Change (Column E)

These allow the overall calculation to account for all consumption.

Amounts of all fuels can be expressed in joules (J), megajoules (MJ), gigajoules (GJ), terajoules (TJ) or thousands of tonnes of oil equivalent (ktoe). Solid or liquid fuels can be expressed as thousands of tonnes (kt) and dry natural gas can be expressed as teracalories (Tcal) or cubic metres (m^3).

NOTE: The figure for production of natural gas, used in Worksheet 1, **does not** include quantities of gas vented, flared or re-injected into the well.

Quantities are expressed in terms of the net calorific values (NCV) of the fuels concerned. NCV is sometimes referred to as the lower heating value (LHV). NCVs are approximately 95% of the gross calorific value (GCV) for liquid fossil, solid fossil and biomass fuels, and 90% of the GCV for natural gas.

2 Apparent Consumption is calculated for each fuel using this formula:

Apparent Consumption =
Production + Imports - Exports - International Bunkers - Stock Change

The results are entered in Column F.

Particular attention is given to the algebraic sign of "stock change" as it is entered in Column E. When more fuel is added to stock than is taken from it during the year there is a net stock build and the quantity is entered in Column E with a plus sign. In the converse case (a stock draw) the quantity is entered in Column E with a minus sign.

Step 2 Converting to a Common Energy Unit (TJ)

1 The conversion factor used for each fuel is entered in Column G.

2 The Apparent Consumption is multiplied by the relevant Conversion Factor (NCV or scaling factor) to give Apparent Consumption in terajoules. The result is entered in Column H.

TABLE 1
CONVERSION FACTORS

Unit	*Conversion Factor*
J, MJ or GJ	Number is divided by the appropriate factor, 10^{12}, 10^6 or 10^3 respectively, to convert to TJ.
10^6 toe	Number is multiplied by the conversion factor, 41868 TJ/10^6 toe, to convert to TJ.
Tcal	Number is multiplied by the conversion factor, 4.1868 TJ/Tcal.
10^3 t	The Net Calorific Value of each fuel is used (see Table 2).

TABLE 2
SELECTED NET CALORIFIC VALUES

	Factors (TJ/10^3 tonnes)
Refined Petroleum Products	
Gasoline	44.80
Jet Kerosene	44.59
Other Kerosene	44.75
Shale Oil	36.00
Gas/Diesel Oil	43.33
Residual Fuel Oil	40.19
LPG	47.31
Ethane	47.49
Naphtha	45.01
Bitumen	40.19
Lubricants	40.19
Petroleum Coke	31.00
Refinery Feedstocks	44.80
Refinery Gas	48.15
Other Oil Products	40.19
Other Products	
Coal Oils and Tars derived from Coking Coals	28.00
Oil Shale	9.40
Orimulsion	27.50

NOTE: When converting from 10^3 t, for anthracite, coking coal, other bituminous coal, sub-bituminous coal and lignite, separate country specific net calorific values are used for Production (Column A), Imports (Column B), and Exports (Column C). For these fuels, Apparent Consumption is calculated by converting Production, Imports, Exports, and Stock Changes to TJ first. For International Bunkers (Column D) and Stock Change (Column E), either a weighted average net calorific value or a factor appropriate to the dominant source of supply is used.

Step 3 Multiplying by Carbon Emission Factors

1 The Carbon Emission Factor (CEF) used to convert Apparent Consumption into Carbon Content is entered in Column I.

Table 3 shows the default values used in this publication.

TABLE 3
CARBON EMISSION FACTORS (CEF)

Fuel	*Carbon Emission Factor (t C/TJ)*
LIQUID FOSSIL	
Primary fuels	
Crude oil	20.0
Orimulsion	22.0
Natural Gas Liquids	17.2
Secondary fuels/products	
Gasoline	18.9
Jet Kerosene	19.5
Other Kerosene	19.6
Shale Oil	20.0
Gas/Diesel Oil	20.2
Residual Fuel Oil	21.1
LPG	17.2
Ethane	16.8
Naphtha	(20.0) [a]
Bitumen	22.0
Lubricants	(20.0) [a]
Petroleum Coke	27.5
Refinery Feedstocks	(20.0) [a]
Refinery Gas	18.2 [b]
Other Oil	(20.0) [a]
SOLID FOSSIL	
Primary Fuels	
Anthracite	26.8
Coking Coal	25.8
Other Bituminous Coal	25.8
Sub-Bituminous Coal	26.2
Lignite	27.6
Oil Shale	29.1
Peat	28.9
Secondary Fuels/Products	
BKB & Patent Fuel	(25.8) [a]
Coke Oven / Gas Coke	29.5
Coke Oven Gas	13.0 [b]
Blast Furnace Gas	66.0 [b]
GASEOUS FOSSIL	
Natural Gas (Dry)	15.3
BIOMASS [c]	
Solid Biomass	29.9
Liquid Biomass	(20.0) [a]
Gas Biomass	(30.6) [a]

Notes to Table 3

(a) This value is a default value until a fuel specific CEF is determined. For gas biomass, the CEF is based on the assumption that 50% of the carbon in the biomass is converted to methane and 50% is emitted as CO_2. The CO_2 emissions from biogas should not be included in national inventories. If biogas is released and not combusted 50% of the carbon content should be included as methane.

(b) For use in the sectoral calculations.

(c) Emissions from the use of biomass for fuel are not shown in this publication.

2 The Apparent Consumption in TJ (in Column H) is multiplied by the Carbon Emission Factor (in Column I) to give the Carbon Content in tonnes of C. The result is entered in Column J.

3 The Carbon Content in tonnes C is divided by 10^3 to give gigagrammes of Carbon. The result is entered in Column K.

Step 4 Calculating Carbon Stored

1 **Estimating Fuel Quantities**

Bitumen and lubricants

Domestic Production for bitumen and lubricants is added to the Apparent Consumption (shown in Column F of the main Worksheet 1) for these products and the sum is entered in Column A of Auxiliary Worksheet 1.

Coal oils and tars

For coking coal, the default assumption is that 6% of the carbon in coking coal consumed is converted to oils and tars. The Apparent Consumption for coking coal (from Worksheet 1, Column F) is multiplied by 0.06.

Starting with the 2006 edition, the IEA has requested coal tar data on its annual coal questionnaire. In cases where this information has been provided, to be consistent with the *1996 IPCC Guidelines*, 75% of the part reported as non-energy was considered to be stored and the default 6% of coking coal was not applied.

Natural gas, LPG, Ethane, Naphtha and Gas/Diesel oil

The amount of these fuels used as a feedstock for non-energy purposes is entered in Column A.

2 **Converting to TJ**

The appropriate Conversion Factors are inserted in Column B of Auxiliary Worksheet 1. The Estimated Fuel Quantities (Column A) are multiplied by the relevant Conversion Factor to give the Estimated Fuel Quantities in TJ. The result is entered in Column C.

3 **Calculating Carbon Content**

The Estimated Fuel Quantities in TJ (Column C of Auxiliary Worksheet 1) are multiplied by the Emission Factor in tonnes of carbon per terajoule (Column D) to give the Carbon Content in tonnes of C (Column E). The figures are divided by 10^3 to express the amount as gigagrammes of carbon. The results are entered in Column F.

4 **Calculating Actual Carbon Stored**

The Carbon Content (Column F of Auxiliary Worksheet 1) is multiplied by the Fraction of Carbon Stored (Column G) to give the Carbon Stored. The result is entered in Column H.

When Auxiliary Worksheet 1 is completed

5 The values for Carbon Stored for the relevant fuels/products are entered in Column L of the main Worksheet 1.

6 The values for Carbon Stored (Column L) are subtracted from Carbon Content (Column K) to give Net Carbon Emissions. The results are entered in Column M.

Step 5 Correcting for Carbon Unoxidised

1 The values for Fraction of Carbon Oxidised are entered in Column N of Worksheet 1. Table 4 provides information on typical values measured from various facilities and suggests global default values for solid, liquid and gaseous fuels.

2 Net Carbon Emissions (Column M) are multiplied by Fraction of Carbon Oxidised (Column N) and the results are entered in Column O, Actual Carbon Emissions.

TABLE 4
FRACTION OF CARBON OXIDISED

Coal[1]	0.98
Oil and Oil products	0.99
Gas	0.995
Peat for electricity generation[2]	0.99

1 This figure is a global average but varies for different types of coal, and can be as low as 0.91.
2 The fraction for peat used in households may be much lower.

Step 6 Converting to CO_2 Emissions

1 Actual Carbon Emissions (Column O) are multiplied by 44/12 (which is the molecular weight ratio of CO_2 to C) to find Total Carbon Dioxide (CO_2) emitted from fuel combustion. The results are entered in Column P.

2 The sum is total national emissions of carbon dioxide from fuel combustion. These are the numbers shown for total CO_2 emissions from fuel combustion in this publication.

Sectoral Approach

Introduction

A sectoral breakdown of national CO_2 emissions using the defined IPCC Source/Sink Categories is needed for monitoring and abatement policy discussions. The IPCC Reference Approach provides a rapid estimate of the total CO_2 emissions from fuels supplied to the country but it does not break down the emissions by sector.

The more detailed calculations used for the Sectoral Approach are essentially similar in content to those used for the Reference Approach.

Completing Worksheet 2

This section is from the Workbook of the *1996 IPCC Guidelines* and provides step-by-step instructions for calculating emissions by fuels for each of the main source categories using the IPCC Tier 1 Sectoral Approach. A sample sheet of Worksheet 2 can be consulted at the end of this chapter.

Step 1 Estimating Sectoral Fuel Consumption

The amount of each fuel consumed by sector is entered in Column A.

Energy and Transformation Sector

Special care needs to be taken when considering the fuel use of the Energy and Transformation sector so that double counting is avoided.

Fuel use in the Energy and Transformation Sector can be divided into three groups:

Transformation Sector

1 Fuels transformed into secondary fuels by physical or chemical processes not involving combustion (e.g. crude oil to petroleum products in refineries, coal to coke and coke oven gas in coke ovens);

2 Fuels combusted to generate electricity and/or heat (excluding fuels used for autoproduction of electricity and heat, which are reported in the sector where they are used);

Energy Sector

3 Fuels combusted by the energy (energy extraction and transformation) industries for heating, pumping, traction and lighting purposes (e.g. refinery gas for heating distillation columns, use of colliery methane at mines for heating purposes).

In this worksheet, only fuel use by Groups 2 and 3 (fuels that are combusted) is included. However, see Step 4 for the reporting of lubricants used by the energy industries. For emissions resulting from fuel use by Group 1, no worksheets are available. They should be reported under the IPCC Source/Sink Category 1B: Fugitive Emissions from Fuels. It is most important that this distinction be appreciated. The quantities of ***primary*** fuels reported in Column A will understate the quantities used for Group 1 activities. The reported quantities cover only the combustion needs of these industries.

Step 2 Converting to a Common Energy Unit (TJ)

1 The conversion factor (NCV or scaling factor) to convert to terajoules is entered in Column B.

2 The Consumption is multiplied by the relevant Conversion Factor to give Consumption in terajoules. The result is entered in Column C.

Step 3 Multiplying By Carbon Emission Factors

1 The Carbon Emission Factor used to convert Consumption into Carbon Content is entered in Column D.

2 The Consumption in TJ (in Column C) is multiplied by the Carbon Emission Factor (in Column D) to give the Carbon Content in tonnes of Carbon. The result is entered in Column E.

3 The Carbon Content in tonnes of Carbon is divided by 10^3 to be expressed as gigagrammes of Carbon. The result is entered in Column F.

Step 4 Calculating Carbon Stored

For the calculation of carbon stored, fuels are distinguished into four groups:

- Fuels used as feedstocks, such as naphtha, natural gas, gas/diesel oil, LPG or ethane;
- Lubricants;
- Bitumen and coal tars;
- Fuels for which no carbon is stored.

Fuels used as feedstocks, such as naphtha, natural gas, gas/diesel oil, LPG or ethane:

This subsection on feedstocks applies only to the Industry Source Category.

1 **Estimating Fuel Quantities**

The amount of fuel used as a feedstock for non-energy purposes is entered in Column A of Auxiliary Worksheet 2.

2 **Converting to TJ**

The appropriate Conversion Factor is inserted in Column B. Feedstock Use (Column A) is multiplied by the relevant Conversion Factor to give the Feedstock Use in TJ. The result is entered in Column C of Auxiliary Worksheet 2.

3 **Calculating Carbon Content**

The Feedstock Use in TJ (Column C) is multiplied by the Emission Factor in tonnes of carbon per terajoule (Column D) to give the Carbon Content in tonnes C (Column E). The figures are divided by 10^3 to express the amount as gigagrammes of carbon. The results are entered in Column F of Auxiliary Worksheet 2.

4 **Calculating Actual Carbon Stored**

The Carbon Content (Column F) is multiplied by the Fraction of Carbon Stored (Column G) to give the Carbon Stored. The result is entered in Column H of Auxiliary Worksheet 2.

After completion of Auxiliary Worksheet 2

5 The amount of Carbon Stored for the relevant fuel/product is entered in Column H of Worksheet 2 for the Industry Source Category.

6 The amount of Carbon Stored (Column H) is subtracted from the Carbon Content (Column F) to give Net Carbon Emissions. The results are entered in Column I.

Lubricants:

It has been estimated that during the first use, recycling and final disappearance of lubricants, approximately half of the production is oxidised as CO_2.

1 For each sector where lubricants are used, the Fraction of Carbon Stored for lubricants is entered in Column G. The default value of 0.5 is used for this publication.

2 The Carbon Content (Column F) is multiplied by the Fraction of Carbon Stored (Column G) to obtain the amount of Carbon Stored. The result is entered in Column H.

3 The amount of Carbon Stored (Column H) is subtracted from the Carbon Content (Column F) to obtain the Net Carbon Emissions. The result is entered in Column I.

Bitumen and Coal Tars:

Bitumen and coal tars are usually not combusted but used in a manner that stores almost all of the carbon. Emissions of Non-methane volatile organic compounds (NMVOCs) from the use of bitumen for road paving are estimated in the Industrial Processes Chapter.

Fuels for which no carbon is stored:

Step 4 is skipped and the values from Column F are entered in Column I before continuing with Step 5.

Step 5 Correcting for Carbon Unoxidised

1 Values for Fraction of Carbon Oxidised are entered in Column J of Worksheet 2. Table 4 provides information on typical values measured from coal facilities and suggests global default values for solid, liquid and gaseous fuels.

2 Net Carbon Emissions (Column I) are multiplied by Fraction of Carbon Oxidised (Column J) and the results are entered in Column K, Actual Carbon Emissions.

Step 6 Converting to CO_2 Emissions

1 Actual Carbon Emissions (Column K) are multiplied by 44/12 (which is the molecular weight ratio of CO_2 to C) to find Actual Carbon Dioxide (CO_2) Emissions. The results are entered in Column L and correspond to the sectoral emissions included in the present publication.

Module			**ENERGY**					
		SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**					
		WORKSHEET	**1**					
		SHEET	**1 OF 5**					
			STEP 1					
			A Production	B Imports	C Exports	D International Bunkers	E Stock Change	F Apparent Consumption
FUEL TYPES								F=(A+B -C-D-E)
Liquid Fossil	Primary Fuels	Crude Oil						
		Orimulsion						
		Natural Gas Liquids						
	Secondary Fuels	Gasoline						
		Jet Kerosene						
		Other Kerosene						
		Shale Oil						
		Gas / Diesel Oil						
		Residual Fuel Oil						
		LPG						
		Ethane						
		Naphtha						
		Bitumen						
		Lubricants						
		Petroleum Coke						
		Refinery Feedstocks						
		Other Oil						
Liquid Fossil Totals								
Solid Fossil	Primary Fuels	Anthracite[(a)]						
		Coking Coal						
		Other Bit. Coal						
		Sub-Bit. Coal						
		Lignite						
		Oil Shale						
		Peat						
	Secondary Fuels	BKB & Patent Fuel						
		Coke Oven/Gas Coke						
Solid Fossil Totals								
Gaseous Fossil		Natural Gas (Dry)						
Total								
Biomass Total								
		Solid biomass						
		Liquid biomass						
		Gas biomass						

(a) If anthracite is not separately available, include with Other Bituminous Coal.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**
WORKSHEET	**1**
SHEET	**2 OF 5**

			STEP 2		STEP 3		
			G[a] Conversion Factor (TJ/Unit)	H Apparent Consumption (TJ)	I Carbon Emission Factor (t C/TJ)	J Carbon Content (t C)	K Carbon Content (Gg C)
FUEL TYPES				H=(FxG)		J=(HxI)	K=(Jx10^{-3})
Liquid Fossil	Primary Fuels	Crude Oil					
		Orimulsion					
		Natural Gas Liquids					
	Secondary Fuels	Gasoline					
		Jet Kerosene					
		Other Kerosene					
		Shale Oil					
		Gas / Diesel Oil					
		Residual Fuel Oil					
		LPG					
		Ethane					
		Naphtha					
		Bitumen					
		Lubricants					
		Petroleum Coke					
		Refinery Feedstocks					
		Other Oil					
Liquid Fossil Totals							
Solid Fossil	Primary Fuels	Anthracite[b]					
		Coking Coal					
		Other Bit. Coal					
		Sub-Bit. Coal					
		Lignite					
		Oil Shale					
		Peat					
	Secondary Fuels	BKB & Patent Fuel					
		Coke Oven/Gas Coke					
Solid Fossil Totals							
Gaseous Fossil		Natural Gas (Dry)					
Total							
Biomass Total							
		Solid biomass					
		Liquid biomass					
		Gas biomass					

(a) Please specify units.
(b) If anthracite is not separately available, include with Other Bituminous Coal.

MODULE			**ENERGY**				
SUBMODULE			**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**				
WORKSHEET			**1**				
SHEET			**3 OF 5**				
			STEP 4		**STEP 5**		**STEP 6**
			L Carbon Stored (Gg C)	M Net Carbon Emissions (Gg C)	N Fraction of Carbon Oxidised	O Actual Carbon Emissions (Gg C)	P Actual CO_2 Emissions (Gg CO_2)
FUEL TYPES				M=(K-L)		O=(MxN)	P=(Ox[44/12])
Liquid Fossil	Primary Fuels	Crude Oil					
		Orimulsion					
		Natural Gas Liquids					
	Secondary Fuels	Gasoline					
		Jet Kerosene					
		Other Kerosene					
		Shale Oil					
		Gas / Diesel Oil					
		Residual Fuel Oil					
		LPG					
		Ethane					
		Naphtha					
		Bitumen					
		Lubricants					
		Petroleum Coke					
		Refinery Feedstocks					
		Other Oil					
Liquid Fossil Totals							
Solid Fossil	Primary Fuels	Anthracite[(a)]					
		Coking Coal					
		Other Bit. Coal					
		Sub-Bit. Coal					
		Lignite					
		Oil Shale					
		Peat					
	Secondary Fuels	BKB & Patent Fuel					
		Coke Oven/Gas Coke					
Solid Fossil Totals							
Gaseous Fossil		Natural Gas (Dry)					
Total							
Biomass Total							
		Solid biomass					
		Liquid biomass					
		Gas biomass					

(a) If anthracite is not separately available, include with Other Bituminous Coal.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**
WORKSHEET	**1**
SHEET	**4 OF 5 EMISSIONS FROM INTERNATIONAL BUNKERS (INTERNATIONAL MARINE AND AIR TRANSPORT)**

		STEP 1	STEP 2		STEP 3		
		A Quantities Delivered[(a)]	B Conversion Factor (TJ/unit)	C Quantities Delivered (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
FUEL TYPES				C=(AxB)		E=(CxD)	F=(E x 10^{-3})
Solid Fossil	Other Bituminous Coal						
	Sub-Bituminous Coal						
Liquid Fossil	Gasoline						
	Jet Kerosene						
	Gas/Diesel Oil						
	Residual Fuel Oil						
	Lubricants						
			Total				

(a) Enter the quantities from Worksheet 1, Sheet 1, Column D: "International Bunkers".

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**
WORKSHEET	**1**
SHEET	**5 OF 5 EMISSIONS FROM INTERNATIONAL BUNKERS (INTERNATIONAL MARINE AND AIR TRANSPORT)**

		STEP 4			STEP 5		STEP 6
		G Fraction of Carbon Stored	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions (Gg CO_2)
FUEL TYPES			H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx44/12)
Solid Fossil	Other Bituminous Coal	0	0				
	Sub-Bituminous Coal	0	0				
Liquid Fossil	Gasoline	0	0				
	Jet Kerosene	0	0				
	Gas/Diesel Oil	0	0				
	Residual Fuel Oil	0	0				
	Lubricants	0.5					
						Total[(a)]	

(a) The bunker emissions are not to be added to national totals.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM ENERGY**
WORKSHEET	**AUXILIARY WORKSHEET 1: ESTIMATING CARBON STORED IN PRODUCTS**
SHEET	**1 OF 1**

	A	B	C	D	E	F	G	H
	Estimated Fuel Quantities	Conversion Factor (TJ/Units)	Estimated Fuel Quantities (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Fraction of Carbon Stored	Carbon Stored (Gg C)
FUEL TYPES			C=(AxB)		E=(CxD)	F=(Ex10^{-3})		H=(FxG)
Naphtha[(a)]							0.80	
Lubricants							0.50	
Bitumen							1.0	
Coal Oils and Tars (from Coking Coal)							0.75	
Natural Gas[(a)]							0.33	
Gas/Diesel Oil[(a)]							0.50	
LPG[(a)]							0.80	
Ethane[(a)]							0.80	
Other fuels[(b)]								

(a) Enter these fuels when they are used as feedstocks.
(b) Use the Other fuels rows to enter any other products in which carbon may be stored.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION (TIER I SECTORAL APPROACH)**
WORKSHEET	**2 STEP BY STEP CALCULATIONS**
SHEET	***SAMPLE SHEET - FILLED OUT FOR EACH SECTOR***

Energy Industries	A Consumption	B Conversion Factor (TJ/unit)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
specific fuels listed for each sector (a)			C=(AxB)		E=(CxD)	F=(E x 10^{-3})
		Total				
***Memo items**:*						
Wood/Wood Waste						
Charcoal						
Other Solid Biomass						
Liquid Biomass						
Gaseous Biomass						
		Total Biomass				

(a) Certain sectors have specific calculations for some products. See the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* for further details.

Module	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION (TIER I SECTORAL APPROACH)**
WORKSHEET	**2 STEP BY STEP CALCULATIONS**
SHEET	***SAMPLE SHEET - FILLED OUT FOR EACH SECTOR***

Energy Industries	G Fraction of Carbon Stored	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions (Gg CO_2)
specific fuels listed for each sector (a)		H=(FxG)	I=(F-H)		K=(IxJ)	L=(K x [44/12])
					Total	
Memo items:						
Wood/Wood Waste						
Charcoal						
Other Solid Biomass						
Liquid Biomass						
Gaseous Biomass						
					Total Biomass	

(a) Certain sectors have specific calculations for some products. See the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* for further details.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY (TIER I SECTORAL APPROACH)**
WORKSHEET	**AUXILIARY WORKSHEET 2: ESTIMATING CARBON STORED IN PRODUCTS**
SHEET	**1**

	A Feedstock Use	B Conversion Factor (TJ/Units)	C Feedstock Use (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)	G Fraction of Carbon Stored	H Carbon Stored[a] (Gg C)
FUEL TYPES			C=(AxB)		E=(CxD)	F=(Ex10^{-3})		H=(FxG)
Gas/Diesel Oil							0.5	
LPG							0.8	
Ethane							0.8	
Naphtha							0.8	
Natural Gas							0.33	
Other Fuels[b]								

(a) Enter the result of this calculation in Worksheet 2 Step by Step Calculation, in the *Manufacturing Industries and Construction* sector.
(b) Please specify.

Key Sources

In May 2000, the IPCC Plenary, at its 16th session held in Montreal, accepted the report on *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*[3]. The report provides good practice guidance to assist countries in producing inventories that are neither over nor underestimates so far as can be judged, and in which uncertainties are reduced as far as practicable. It supports the development of inventories that are transparent, documented, consistent over time, complete, comparable, assessed for uncertainties, subject to quality control and quality assurance, and efficient in the use of resources. The report does not revise or replace the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, but provides a reference that complements and is consistent with those guidelines.

Methodological choice for individual source categories is important in managing overall inventory uncertainty. Generally, inventory uncertainty is lower when emissions are estimated using the most rigorous methods, but due to finite resources, this may not be feasible for every source category. To make the most efficient use of available resources, it is good practice to identify those source categories that have the greatest contribution to overall inventory uncertainty. By identifying these key source categories in the national inventory, inventory agencies can prioritise their efforts and improve their overall estimates. Such a process will lead to improved inventory quality, as well as greater confidence in the resulting emissions estimates. It is good practice for each inventory agency to identify its national key source categories in a systematic and objective manner.

A key source category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both.

Any inventory agency that has prepared an emissions inventory will be able to identify key source categories in terms of their contribution to the absolute level of national emissions. For those inventory agencies that have prepared a time series, the quantitative determination of key source categories should include evaluation of both the absolute level and the trend in emissions. Evaluating only the influence of a source category on the overall level of emissions provides limited information about why the source category is key. Some key source categories may not be identified if the influence of their trend is not taken into account.

The *Good Practice Guidance* describes both a basic Tier 1 approach and a Tier 2 approach. The basic difference between the two approaches is that the Tier 2 approach accounts for uncertainty.

In each country's national inventory, certain source categories are particularly significant in terms of their contribution to the overall uncertainty of the inventory. It is important to identify these key source categories so that the resources available for inventory preparation may be prioritised and the best possible estimates prepared for the most significant source categories.

The results of the key source category determination will be most useful if the analysis is done at the appropriate level of detail. The *Good Practice Guidance* suggests at which levels of details the various IPCC Source Categories should be analysed. For example, the combustion of fossil fuels is a large emission source category that can be broken down into subsource categories, and even to the level of individual plants or boilers. The following guidance describes good practice in determining the appropriate level of analysis to identify key source categories:

- The analysis should be performed at the level of IPCC source categories (i.e. at the level at which the IPCC methods are described). The analysis should be performed using CO_2-equivalent emissions calculated using the global warming potentials (GWPs) specified for the preparation of national greenhouse gas inventories by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories (UNFCCC Guidelines).
- Each greenhouse gas emitted from a single source category should be considered separately, unless there are specific methodological reasons for treating gases collectively. For example, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are

3. The report on *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* is available from the IPCC Greenhouse Gas Inventories Programme (http://www.ipcc-nggip.iges.or.jp).

emitted from mobile sources. The key source category evaluation should be performed for each of these gases separately because methods, emission factors and related uncertainties differ for each gas. In contrast, a collective evaluation of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) may be appropriate for some source categories, such as emissions from substitutes for Ozone Depleting Substances (ODS substitutes).

- Source categories that use the same emission factors based on common assumptions should be aggregated before analysis. This approach can also help deal with cross-correlations between source categories in the uncertainty analysis. The same pattern of aggregation should be used both to quantify uncertainties and to identify key source categories unless the associated activity data uncertainties are very different.

Quantitative approaches to identify key source categories

It is good practice for each inventory agency to identify its national key source categories in a systematic and objective manner, by performing a quantitative analysis of the relationships between the level and the trend of each source category's emissions and total national emissions.

Any inventory agency that has developed an emissions inventory will be able to perform the Tier 1 Level Assessment and identify the source categories whose level has a significant effect on total national emissions. Those inventory agencies that have developed emissions inventories for more than one year will also be able to perform the Tier 1 Trend Assessment and identify sources that are key because of their contribution to the total trend of national emissions. Both assessments are described in detail in the *Good Practice Guidance*.

For CO_2 emissions from stationary combustion, the *Good Practice Guidance* suggests that the emissions be disaggregated to the level where emission factors are distinguished. In most inventories, this will be the main fuel types. If emission factors are determined independently for some sub-source categories, these should be distinguished in the analysis.

When using the Tier 1 approach, key source categories are identified using a pre-determined cumulative emissions threshold. The pre-determined threshold is based on an evaluation of several inventories, and is aimed at establishing a general level where 90% of inventory uncertainty will be covered by key source categories.

The Tier 1 method to identify key source categories of the national emissions inventory assesses the impacts of various source categories on the level and, if possible, on the trend. When national inventory estimates are available for several years, it is good practice to assess the contribution of each source category to both the level and trend of the national inventory. If only a single year's inventory is available, only a Level Assessment can be performed.

For the **Tier 1 Level Assessment**, the contribution of each source category to the total national inventory level is calculated according to Equation 1:

EQUATION 1

Source Category Level Assessment = Source Category Estimate / Total Estimate

$$L_{x,t} = E_{x,t} / E_t$$

Where:

$\mathbf{L_{x,t}}$ is the Level Assessment for source x in year t

Source Category Estimate ($E_{x,t}$) is the emission estimate of source category x in year t

Total Estimate (E_t) is the total inventory estimate in year t

The value of the source category Level Assessment should be calculated separately for each source category, and the cumulative sum of all the entries is calculated. Key source categories are those that, when summed together in descending order of magnitude, add up to over 95% of the total. Any source category that meets the 95% threshold in any year should be identified as a key source category.

The **Tier 1 Trend Assessment** calculates the contribution of each source category trend to the trend in the total national inventory. This assessment will identify source categories that have a different trend to the trend of the overall inventory. As differences in trend are more significant to the overall inventory level for larger source categories, the result of the trend difference (i.e. the source category trend minus total trend)

is multiplied by the result of the level assessment ($L_{x,t}$ from Equation 1) to provide appropriate weighting. Thus, key source categories will be those where the source category trend diverges significantly from the total trend, weighted by the emission level of the source category.

If nationally derived source-level uncertainties are available, inventory agencies can use **Tier 2** to identify key source categories. The Tier 2 approach is a more detailed analysis that builds on the Tier 1 approach, and it is likely to reduce the number of key source categories. Under Tier 2, the results of the Tier 1 analysis are multiplied by the relative uncertainty of each source category. In this case, the pre-determined threshold applies to the cumulative uncertainty and not to the cumulative emissions. Key source categories are those that together represent 90% of total uncertainty.

5. UNITS AND CONVERSIONS

GENERAL CONVERSION FACTORS FOR ENERGY

To:	TJ	Gcal	Mtoe	MBtu	GWh
From:	multiply by:				
TJ	1	238.8	2.388×10^{-5}	947.8	0.2778
Gcal	4.1868×10^{-3}	1	10^{-7}	3.968	1.163×10^{-3}
Mtoe	4.1868×10^{4}	10^{7}	1	3.968×10^{7}	11630
MBtu	1.0551×10^{-3}	0.252	2.52×10^{-8}	1	2.931×10^{-4}
GWh	3.6	860	8.6×10^{-5}	3412	1

Conversion Factors for Mass

To:	kg	T	lt	st	lb
From:	multiply by:				
kilogramme (kg)	1	0.001	9.84×10^{-4}	1.102×10^{-3}	2.2046
tonne (t)	1000	1	0.984	1.1023	2204.6
long ton (lt)	1016	1.016	1	1.120	2240.0
short ton (st)	907.2	0.9072	0.893	1	2000.0
pound (lb)	0.454	4.54×10^{-4}	4.46×10^{-4}	5.0×10^{-4}	1

Conversion Factors for Volume

To:	gal U.S.	gal U.K.	bbl	ft^3	l	m^3
From:	multiply by:					
U.S. gallon (gal)	1	0.8327	0.02381	0.1337	3.785	0.0038
U.K. gallon (gal)	1.201	1	0.02859	0.1605	4.546	0.0045
Barrel (bbl)	42.0	34.97	1	5.615	159.0	0.159
Cubic foot (ft^3)	7.48	6.229	0.1781	1	28.3	0.0283
Litre (l)	0.2642	0.220	0.0063	0.0353	1	0.001
Cubic metre (m^3)	264.2	220.0	6.289	35.3147	1000.0	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 CO_2

The *1996 IPCC Guidelines* and the UNFCCC *Reporting Guidelines on Annual Inventories* both ask that CO_2 emissions be reported in Gg of CO_2. A million tonnes of CO_2 is equal to 1 000 Gg of CO_2, 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 CO_2 emissions in tonnes of carbon instead of tonnes of CO_2. To convert from tonnes of carbon, multiply by 44/12, which is the molecular weight ratio of CO_2 to C.

ABBREVIATIONS

Btu:	British thermal unit
GJ:	gigajoule
Gt C:	gigatonnes of carbon
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
m^3:	cubic metre
PJ:	petajoule
t:	metric ton = tonne = 1 000 kg
t C:	tonne of carbon
Tcal:	teracalorie
TJ:	terajoule
toe:	tonne of oil equivalent = 10^7 kcal
CEF:	carbon emission factor
CHP:	combined heat and power
GCV:	gross calorific value
GDP:	gross domestic product
HHV:	higher heating value = GCV
LHV:	lower heating value = NCV
NCV:	net calorific value
PPP:	purchasing power parity
TPES:	total primary energy supply
AGBM	Ad Hoc Group on the Berlin Mandate under the UNFCCC
AIJ:	Activities Implemented Jointly under the United Nations Framework Convention on Climate Change
Annex I:	See Chapter 4, Geographical Coverage
Annex II:	See Chapter 4, Geographical Coverage
CDM:	Clean Development Mechanism
Convention:	United Nations Framework Convention on Climate Change
COP:	Conference of the Parties to the Convention
EITs:	Economies in Transition (see Chapter 4, Geographical Coverage)
IEA:	International Energy Agency
IPCC:	Intergovernmental Panel on Climate Change
OECD:	Organisation for Economic Co-Operation and Development
OLADE:	Organización Latino Americana De Energía
SBI:	Subsidiary Body for Implementation
SBSTA:	Subsidiary Body for Scientific and Technological Advice
TCA:	Technology Co-operation Agreement
UN:	United Nations
UNECE:	United Nations Economic Commission for Europe
UNFCCC:	United Nations Framework Convention on Climate Change
..	not available
-	nil
x	not applicable
+	growth greater than 1 000%