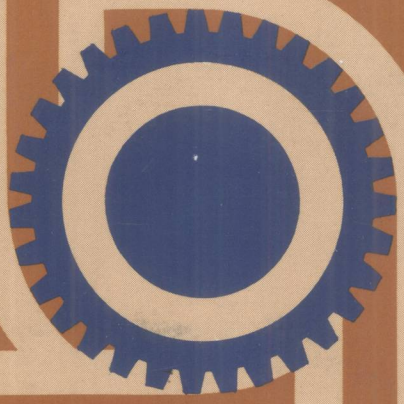
WORLD ENERGY SUPPLIES 1973-1978



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World Energy Supplies

1973-1978

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ABBREVIATIONS, COUNTRY NOMENCLATURE AND SYMBOLS

The requirements of computer tabulation necessitate abbreviations. Clarification of these abbreviations and of country nomenclature is given below:

ANGOLA	Includes the enclave of Cabinda.
ANTARCFS	This heading identifies bunkers delivered by tankers to vessels on the Antarctic fishing grounds; fuels delivered to Antarctic research stations are not included.
C.AF.EMP	Central African Empire.
CAM DVLG	Caribbean America, Developing.
CHRIS.IS	Christmas Island (Indian Ocean); territory of Australia.
CT P ASA	Centrally Planned Asia: comprises China, Democratic People's Republic of Korea (KORE DPR), Mongolia and Viet Nam.
CT P EUR	Centrally Planned Europe: comprises Albania, Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania and USSR.
CTPLD EC	Centrally Planned Economies: comprises the sum of Centrally Planned Asia and Centrally Planned Europe. 1/
DJIBOUTI	Formerly French territory of the Afars and Issas.
DVELOPED	Comprises Developed Market Economies of Australia, Canada, Israel, Japan, New Zealand, South Africa, United States of America and Western Europe. 1/
DVELOPING	Comprises Developing Market Economies of Africa, Caribbean America, North America, Other America, Middle East (including Turkey), Far East and Oceania. 1/
DM YEMEN	Democratic Yemen.
EEC	European Economic Community.
EFTA	European Free Trade Association: comprises Austria, Finland, Sweden, Iceland, Norway, Portugal, Switzerland and Faeroe Islands. 2/
EQ.GUIN	Equatorial Guinea; comprises Macías Nguema Biyogo and Rio Muni.

1/ All tables except 8, 11, 20, 23 and 26 are summarized into the categories Developed Market, Developing Market and Centrally Planned Economies.

2/ Included in this grouping for statistical convenience.

FRANCE	Includes Monaco.
FR.POLYN	French Polynesia.
GRMN.DR	German Democratic Republic.
GRMNY.FR	Germany, Federal Republic of; includes Saar.
GRENADA	Includes Carriacou and other dependencies in the Grenadines.
HONG KNG	Hong Kong; comprises Hong Kong Island, Kowloon and the New (leased) Territories.
INDIA	Includes the Andaman, Nicobar, Laccadive, Minicoy and Amindivi Islands; also includes Jammu and Kashmir, the final status of which has not yet been determined, and Sikkim (for purposes of statistical convenience).
INDONSIA	Indonesia; includes West Irian.
ITALY	Includes San Marino.
KIRIBATI	Formerly Gilbert Islands; includes data for Tuvalu.
KUWAIT	Includes Kuwait portion of the Neutral Zone.
LIBY A J	Libyan Arab Jamahiriya; formerly Libyan Arab Republic.
MACAU	Comprises Macau City and the islands of Taipa and Coloane.
MALTA	Includes Gozo and Comino Islands.
NETH.ANT	Netherlands Antilles: comprises Aruba, Bonaire, Curaçao, Sabah, St. Eustatius and the Dutch part of St. Martin.
NEW CALD	New Caledonia.
NEW HEBR	New Hebrides.
NORWAY	Includes Svalbard (Norwegian operated coal mines only).
NOT SPEC	Not specified.
OAM DVLP	Other America, Developing.
OTH EUR	Other Europe; comprises Gilbraltar, Greece, Malta, Spain and Yugoslavia.
PACF ISL	Pacific Islands (Trust Territory); comprises the Caroline, Mariana and Marshall Islands, except Guam, shown separately.

PANM.C.Z.	Panama Canal Zone.
PAP.N.GN.	Papua New Guinea.
PORTUGAL	Includes the Azores and Madeira.
SAF.CSUN	Customs Union of South Africa; includes Botswana, Lesotho, Namibia and Swaziland.
SAUD.ARB.	Saudi Arabia; includes Saudia Arabia portion of the Neutral Zone.
SPAIN	Includes the Balearic and Canary Islands, Alhucemas, Ceuta, Peñon de Velez de la Gomera, Chafarinas and Melilla.
S.TM.PRN.	São Tomé and Príncipe.
ST.KITTS	Comprises St. Kitts-Nevis-Anguilla.
ST.P.MIQ	St. Pierre and Miquelon.
ST.VINCT	St. Vincent; includes Bequia and other dependencies in the Grenadines.
U.AR.EMR	United Arab Emirates; comprises the seven emirates of the former Trucial Oman - Abu Dhabi, Ajman, Dubai, Fujairah, Ras al Khaimah, Sharjah and Umm al Qaiwain.
U.RP.CAM	United Republic of Cameroon.
U.RP.TNZ	United Republic of Tanzania; formerly shown separately as Tanganyika and Zanzibar.
U.S.V.IS.	United States Virgin Islands.
VIET NAM	Viet Nam; formerly Socialist Republic of Viet-Nam.
W EUROPE	Western Europe total; comprises the sum of EEC, EFTA and OTH EUR.
WORLD	World total; comprises the sum of Developed Market, Developing Market and Centrally Planned Economies.

Separate data are <u>not</u> available for the following countries and areas: Andorra, Antarctic Research Stations and Antarctic Territories, Bhutan, Bouvet Island, British Indian Ocean Territory, Canton and Enderbury Islands, Cocos (Keeling) Islands, Heard and McDonald Islands, Holy See, Johnston Island, Liechtenstein, Midway Islands, Monaco, Norfolk Island, Pitcairn Island, San Marino, Tokelau, Turks and Caicos Islands, and Wallis and Futuna Islands.

Separate data for Maldives has been introduced in this issue.

Data relating to the People's Republic of China generally include those for Taiwan Province in the field of statistics relating to population, area, natural resources and natural conditions such as climate etc. In other fields of statistics, they do not include Taiwan Province unless otherwise stated. Therefore, in this publication the data published under the heading "China" exclude those for Taiwan Province.

The territory of Okinawa Prefecture, which was formerly under the jurisdiction of the United States of America, reverted to Japan on 15 May 1972, and the data are now included with those for Japan.

The data which relate to the Federal Republic of Germany and the German Democratic Republic include the relevant data relating to Berlin for which separate data have not been supplied. This is without prejudice to any question of status which may be involved.

Unless specifically footnoted, the data for the former Democratic Republic of Viet-Nam and the former Republic of South Viet-Nam have been combined under the heading "Viet Nam".

Data for Sabah, Sarawak and Peninsular Malaysia have been combined under the heading "Malaysia".

Coverage in this issue has been changed as follows:

Tables 2, 3, 5 and 6 - are new.

Table 11 - Mexico is included as an exporter.

Table 20 - OAM Developing is included as an exporting region; Indonesia, United Arab Emirates and Norway are included as exporters; Netherlands is included as an importer.

Table 21 - Data on refinery gas production for "external use" and for "own use" have been combined under the single heading "Production - Refinery Gas".

The following symbols have been used:

* Statistical Office estimate.

** Identifies regional totals; the individual countries comprising each total are listed in table 2 after the total.

... Not available.

Footnotes appear at the end of the appropriate table. Footnotes to detailed tables apply also to summary tables.

INTRODUCTION

Coverage in this study has been increased by the inclusion of preliminary data for 1978. This additional coverage has increased the timeliness of the publication by 10 months. Data is provided for the 6-year period 1973-1978, covering the principal elements of production, import, export, bunkers, stock change and apparent consumption of commercial energy for 193 countries and areas with a combined population of 4,222 million people in 1978. It updates the statistical series shown in previous volumes of World Energy Supplies 1/ on a consistent and internally comparable time series. Supplementary series of monthly and quarterly data on production of energy may be found in the Monthly Bulletin of Statistics.

By virtue of the paucity of reliable or detailed information on non-commercial fuels, the data mainly treat commercial forms of energy; supplementary data are presented on the production of fuelwood and charcoal. Data for each type of fuel and aggregate data for the total mix of commercial fuels are shown for individual countries and territories, as well as being summarized into regional and world totals. The data are primarily compiled from annual questionnaires distributed by the Statistical Office of the United Nations, supplemented by official national statistical publications. Where official data are not available or are inconsistent, estimates are made by the Statistical Office - indicated in the text by an asterisk (*) - based on governmental, professional or commercial materials.

The principal objective of the series is to provide a global framework of comparable data on long-term trends and recent developments in the supply of all commercial forms of energy, as a basis for the examination of the characteristics of energy supply and demand. Data are provided on both primary and secondary forms of energy in the interests of coverage as comprehensive as possible of the total availability of energy commodities. The data on production refer to the first stage of production: accordingly, for hard coal the data refer to mine production; for briquettes to the output of briquetting plants; for crude petroleum and natural gas to production of oil and gas wells; for natural gas liquids to production at wells and processing plants; for refined petroleum products to gross refinery output; for cokes and coke-oven gas to the output of ovens; for other manufactured gas to production of gas works or refineries; and for electricity to the gross production of generating plants.

As far as the international trade of energy commodities is concerned, bunkers have been isolated from export data where possible. Bunker data refer to fuels supplied to ships and aircraft in international transportation, irrespective of the flag of the carrier. Thus, it is necessary to include in imports the movement of fuels into entrepôt for bunkering purposes, and, to include in exports, re-exports of imported fuels. Accordingly, trade data are presented on the "general trade" system.

1/ Statistical Papers, Series J, World Energy Supplies, Nos. 19 and 21 (United Nations publications Sales Nos. E.76.XVII.5 and E.78.XVII.7), covering the years 1950-1974 and 1972-1976 respectively.

In general, data on additions to stocks refer to changes in stocks at producers, importers and consumers at the beginning and end of each year. In some cases, however, stock series have been derived on the basis of the difference between gross availabilities for transformation or consumption and official or published data on actual consumption.

Data on consumption refer to "apparent inland" consumption, and are derived from the formula "production + imports - exports - bunkers ± additions to stocks" (transfers of liquids/gases for blending or mixing are also included in the equation but are not detailed in the respective tables.) Accordingly, the series on apparent consumption may occasionally represent only an indication of the magnitude of actual (i.e., "measured") gross inland availability. This statement is particularly apposite either when stock data are unavailable or unreliable, or when apparent consumption is a small residual element derived from calculations between large aggregate series and thus is sensitive to small variations in these series. This latter point is also appropriate with respect to the per capita consumption calculations presented in some tables. Where the quantities involved are small, the series tend to exaggerate the effects of such elements as stock additions or withdrawals. Also, where relatively small populations are involved, large fluctuations in per capita consumption series may accrue, in fact, to only small quantitative variations.

Four tables in matrix form present international trade flows in hard coal, in crude petroleum, in natural gas and in electricity between principal exporter and importer countries and between regions. These matrices represent a reconciliation of exporter and importer data on direction of trade in these energy commodities. For the hard coal, crude petroleum and natural gas matrices, the total volume of trade is keyed into the exporter totals, the reconciliation being conducted among importer partners. Minor inconsistencies accrue to the fact that, owing to the length of elapsed time in voyage between export origin and import destination, export data may be recorded in one calendar year while the corresponding import data may not be revealed until the following year. Exact correlation is further complicated by inadequate data on losses or spillage at terminal facilities or on the high seas. In the case of the electricity matrix, the total volume of trade is keyed into the importer totals, for the reason that this procedure takes into account that losses occur during transmission of this commodity, thereby complicating any reconciliation based on exporter totals.

The definition of commodities is taken from the International Standard Industrial Classification of All Economic Activities (ISIC) 2/ at the production stage, and from the Standard International Trade Classification (SITC) 3/ at the trade stage.

Coal comprises all grades of anthracite and bituminous coal with a gross calorific value over 5,700 calories/gram on an ash-free and moist basis, including fresh produced breeze, fines, middlings and slurries. Production comprises the sum of sales, mine consumption, issues to miners and issues to coking, briquetting and

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2/ United Nations publication, Sales No. E.68.XVII.8.

3/ United Nations publication, Sales No. E.75.XVII.6.

other ancillary plants at mines. Production data relate to quantities extracted from surface and underground workings, and normally exclude wastes removed at mines or associated preparation plants. Lignite and Brown Coal comprise coal of gross calorific value under 5,700 calories/gram on an ash-free and moist basis. Peat used as a commercial fuel, where quantities are significant and can be isolated from agricultural or domestic usage, has been included in the data for lignite in the tables. 4/ Production of lignite and brown coal includes quantities used by producers and quantities issued to miners and excludes wastes removed at mines or associated preparation plants.

For the purposes of comparison, all primary solid fuels are reduced from a ton-ton basis to a common coal equivalent. Thus, for low-grade coal, recovered slurries, lignite and brown coal, and for peat used as fuel, national conversion factors are applied, as indicated in figure I. It should be noted that the base used for coal equivalency comprises 7,000 calories/gram.

Coke comprises the solid residue obtained in the distillation of coal, brown coal or lignite in the absence of air (carbonization) at high temperature. Semi-coke comprises the solid residue so obtained, at low temperature. Coke oven coke comprises coke produced at coke ovens, including coke oven semi-coke and gas works coke breeze. Different conversion factors are applied to coke according to its origin from anthracite and bituminous coal or from brown coal and lignite, in the reduction to coal equivalent, as indicated in figure I.

Coal briquettes comprise briquettes, ovoids and similar secondary solid fuels manufactured from hard coal by agglomeration of coal particles with pitch; solid, smokeless patent fuels are included. Brown coal and peat briquettes comprise the secondary solid fuels manufactured from brown coal and peat respectively by a process in which the brown coal or peat is partly dried, warmed to expel excess moisture and then compressed into briquettes, usually without the use of a binding substance. In the reduction of briquettes to coal equivalent, as indicated in figure I, different conversion factors are applied according to their origin from anthracite and bituminous coal or from brown coal and lignite or from peat.

Crude petroleum comprises the liquid product obtained from oil wells consisting predominantly of non-aromatic hydrocarbons (paraffinic, cyclanic, etc.) provided that they have not been subjected to any further processes other than those of decantation, dehydration or stabilization (removal of certain dissolved hydrocarbon gases for convenience of transport) or to which have been added only hydrocarbons previously recovered by physical methods during the course of the above processes. Data for crude petroleum include shale oil and field or lease condensate but exclude natural gas liquids and oils obtained from the distillation of solid fuels. Since accurate data on year-to-year variations in the density of crude petroleum produced are not available on a comprehensive basis, original figures of capacity or volume are converted to metric tons on the basis of the specific gravities shown in figure II. Data in thousands of cubic metres can be derived by dividing the figures presented in table 6 by the appropriate national average specific gravity. These

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4/ Notably in the case of Burundi, Finland, Ireland and the USSR.

volume data, in turn, can be converted into thousands of barrels by multiplication by a factor of 6.2898.

Natural gas liquids comprise natural gasolene, liquefied petroleum gases from special plants (as distinct from refineries) and plant condensate and other finished products; that is, liquid hydrocarbon mixtures which are recovered through the processing of wet natural gas by condensation and/or absorption, being separated from the natural gas stream at natural gas processing plants. Natural gasolene comprises a light spirit extracted from wet natural gas, often in association with crude petroleum; it is used as petroleum refinery and petroleum plant input and is also used directly from blending with motor spirit without further processing. Liquefied petroleum gases comprise light hydrocarbon fractions of the paraffin or methane series, produced in natural gas processing plants and consisting mainly of propane, butane, iso-butane and ethane or mixtures of them. They are liquefied by compression or absorption to facilitate storage, handling and transport; they are used as petroleum refinery and petro-chemical plant input and as final energy product without further processing. They exclude data for liquefied petroleum gas derived from crude petroleum. Plant condensate comprises a liquid hydrocarbon condensed from wet natural gas in natural gas processing plants; it is used as a petroleum refinery input.

Crude petroleum and natural gas liquids are treated as primary energy commodities. For the conversion of natural gasolene, liquefied petroleum gases (plant) and plant condensate from a volume to weight basis, the factors 0.63, 0.54 and 0.7 are applied respectively. Different coefficients of conversion to coal equivalent are used for crude petroleum and the different categories of natural gas liquids, as indicated in figure I. It should be noted that the production series for natural gas liquids presented in table 10 represent an aggregate of the three components indicated above, to which individual coefficients of conversion have been applied. For convenience, a weighted average coefficient has been included in figure I for application to natural gas liquids in aggregate, in order to facilitate direct comparison with their coal equivalency in table 4.

The series on refinery capacity refer to petroleum refinery distillation capacity, the theoretical maximum capability of all crude distillation plants available for operation at the end of the year stated. Reserve plants are included, whether or not they are in actual operation or available to operate on the reported date. The actual capacity may be subject to variation depending on the density of the crude petroleum processed and the number of stream days per year. Owing to lack of uniformity in the volume data, converted values in table 10 may be in excess of actual capacity by 2-3 per cent on the average. Volume data are converted into weight using a global average specific gravity of 0.86 for crude petroleum throughout.

Petroleum Products comprise the liquid fuels, lubricant oils and solid and semi-solid products obtained by distillation and cracking of crude petroleum, shale oil, or semi-refined and unfinished petroleum products. As far as possible the series include fuels consumed in refining, but exclude oil products obtained from natural gas, coal, lignite and their derivatives. Petroleum products are subdivided into two types: energy and non-energy petroleum products, i.e. those which are put to further energetical use and those which are removed from the energy stream as raw materials.

Aviation gasolene consititutes any of the specially blended grades of gasolene with high anti-knock value, high stability, a high volatility and low freezing

point, intended for use in aviation piston-engined power units only. Natural gasolene, motor gasolene and jet fuels are excluded.

Motor gasolene comprises a mixture of relatively volatile hydrocarbons with or without small quantities of additives, which have been blended to form a fuel suitable for use in spark-ignition internal combustion engines. Natural gasolene, aviation gasolene and naphthas are excluded.

Kerosene comprises mixtures of hydrocarbons with a flash point above 21° C, distilling less than 90 per cent in volume at 210°C, including losses: it is a refined crude petroleum fuel, in volatility between motor gasolene and gas oil, free of gasolenes and heavy hydrocarbons such as gas oil and lubricating oil. It is used as an illuminant and as a fuel in certain types of spark-ignition engines such as those used for agricultural tractors and stationary engines. The data include those products commonly termed burning oil, vaporizing oil, power kerosene and illuminating oil. Jet fuel, white spirit, naphthas and special boiling-point products are excluded.

Jet fuel comprises fuel meeting the required properties for use in jet engines and aircraft-turbine engines, mainly refined from kerosene; gasolene-type jet fuel (light hydrocarbons, also naphtha type, intended for use in aviation gas-turbine units as opposed to piston power units) is included.

Distillate fuel oil comprises gas oils (with a flash point in a closed vessel of at least 55° C and distilling 90 per cent or more in volume at 360°C), fuel oils (with a flash point in a closed vessel of between 55°C and 190°C and a needle penetration at 25°C of 400 or more), domestic fuel oil (with a viscosity of less than 12 centistokes at 20°C and an asphalt content of not less than 0.5 per cent). It is used as a fuel for internal combustion in diesel engines, as a burner fuel in heating installations such as furnaces and for enriching water gas to increase its luminosity. The data refer to those products commonly called diesel fuel, diesel oil, gas oil, solar oil etc.

Residual fuel oil comprises mixtures of hydrocarbons with a viscosity of at least 49 centistokes at 20°C and an asphalt content of at least 1 per cent. It is crude petroleum residues, such as viscous residuum, obtained by the refinery operations of crude petroleum after gasolene, kerosene and sometimes heavier distillates (such as gas oil or diesel oil) have been removed. It is commonly used by ships and industrial large-scale heating installations as a fuel in furnaces or boilers firing to produce heat and power; it is also known as mazout.

Liquefied petroleum gas (LPG) is a hydrocarbon fraction of the paraffin series, lighter than gasolene, derived from the distillation of crude petroleum only (excluding LPG from natural gas plants or liquefied natural gas and liquefied gases). It is presented in the liquid state by compression or absorption processes to facilitate storage, handling and transport. It mainly consists of butanes (normal butane and isobutane) and propane or a mixture of them and is used in domestic heating, as fuel and as solvent. Data for liquefied petroleum gas from natural gas plants are presented under natural gas liquids.

Lubricating oils are mixtures of hydrocarbons distilling less than 30 per cent in volume at 300°C and with a flow point lower than 30°C; they are heavy liquid distillates obtained by refining crude petroleum, and are used for lubricating purposes. They may be produced either from petroleum distillates or residues at refineries. Solid lubricants (e.g. grease) are excluded.

Bitumen (asphalt) comprises the brown to black solid or semi-solid material obtained as a residue in the distillation of crude petroleum; it is used mainly in road construction. Natural asphalt is excluded.

Paraffin wax includes paraffin wax (a translucent white or yellow crystalline hydrocarbon material of low oil content normally obtained as a residue by the distillation of wax-bearing petroleum), paraffin scale, slack wax and wax emulsions used for candle manufacture, polishes and water-proofing of containers, wrappings etc.

Petroleum coke is a solid residue consisting of carbon obtained by the distillation of heavier petroleum oils and used mainly in metallurgical processes. Solid residues obtained from carbonization of coal are excluded.

White spirit is a highly refined distillate with a boiling point range about 150-200°C; it is used as a paint solvent and for dry-cleaning purposes.

Naphthas are refined or partly refined light distillates derived from crude petroleum with an approximate boiling point range of 27-221°C; blended further or mixed with other materials they make high-grade motor gasolene or jet fuel. They are also used as raw materials for town gas or feedstocks to make various types of chemical products, or are used as various solvents, depending on the character of the naphthas derived and the demands of various industries. In the few cases (e.g. the Libyan Arab Jamahiriya and the United States of America) where naphthas are derived from the natural gas stream, they have been considered as plant condensates. Chemical feedstocks originating from other than crude petroleum are excluded.

Average specific gravity factors are applied to each petroleum product in order to convert original data expressed in units of capacity or volume to a weight basis, as follows:

Energy petroleum products		Non-energy petroleum products	
Liquefied petroleum gas	0.54	Naphthas	0.72
Aviation gasolene	0.73	White spirit	0.81
Motor gasolene	0.74	Paraffin wax	0.80
Kerosene	0.81	Lubricating oils	0.90
Jet fuel	0.81	Bitumen	1.04
Distillate fuel oil	0.87	Petroleum coke	1.14
Residual fuel oil	0.95		
Fuel oils (undifferentiated)	0.91		

Different conversion factors are applied to the energy petroleum products in their reduction to coal equivalent, as indicated in figure I. It should be noted that in some countries i.e. Japan and the United States, crude petroleum is used directly as fuel in thermal electric power plants.

Natural gas comprises any combustible gas of natural origin from underground

sources, consisting primarily of hydrocarbons (whether or not in association with crude petroleum). The data for production cover, to the extent possible, gas obtained from gas fields, petroleum fields or coal mines actually collected and utilized as a fuel or raw material, measured at 15°C and 760 mm/hg. Data thus exclude gas used for repressuring and reinjection, as well as gas flared, vented or otherwise wasted, and shrinkage accruing to processing for the extraction of natural gas liquids.

Manufactured gases comprise gas works and coke-oven gas; blast furnace gas is excluded.

Gas-works gas comprises gas made by establishments belonging to undertakings, whatever their legal form, whose main purpose is the production of manufactured gas, measured at 15°C and 760 mm/hg. It includes gas manufactured in coke ovens situated at gas works and municipal gas plants. Wherever possible, production data include gas consumed for heating furnaces and for other internal uses by the producing establishment.

Coke-oven gas comprises gas made in coke ovens or plants for the gasification of coal owned by industrial groups not dependent on gas undertakings proper, measured at 15°C and 760 mm/hg. Wherever possible, production data include gas consumed for heating furnaces and for other internal uses by the producing establishment.

In this edition, data for all gases are presented on a teracalorie basis, in order to more accurately reflect their heating value. To provide a method of comparison with earlier editions, a table of average gross conversion factors from kilocalories to cubic metres is provided in figure IV; these factors apply to production of gases only.

Net installed capacity of electric generating plants comprises the sum of the rated capacities of the main and auxiliary generators in all groups, including stand-by groups. In principle, data refer to the situation at the end of each year although in a few cases, data reflect fiscal years. Where available, data are subdivided by enterprises generating primarily for their own use, as well as by type of capacity (hydro, thermal, nuclear and geothermal).

Production of electric generating plants comprises the total gross production of electricity generated by public utilities (i.e., publicly or privately owned enterprises generating primarily for use in the public sector) and by industrial establishments generating for their own use or for sale. Output is measured at generating centres and therefore usually includes station use and transmission losses. Data are subdivided by type of production (hydro, thermal, nuclear and geothermal).

The conversion factor applied to primary electricity in its reduction to coal equivalent is indicated in figure I.

The production data for Uranium (U) are taken from series reported jointly by the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development and the International Atomic Energy Agency; they comprise the U content of uranium ores and concentrates intended for treatment for uranium recovery.

In most cases the data for Fuelwood and Charcoal are taken from series reported by the Food and Agriculture Organization of the United Nations. They comprise data

on production and trade of fuelwood and on trade of charcoal.

Metric units of measurement are used throughout the study in the interests of international uniformity and comparability. A selected series of average conversion factors for petroleum products from metric tons into other units of measurement is indicated in figure III.

The comparison between different fuels is presented in metric tons of coal equivalent, on the basis of the heat energy which may be obtained from each of them under ideal conditions. In the case of solid fuels, liquid fuels and gases, this is represented by the heat energy obtained by burning an average grade of the fuel in a bomb calorimeter. In the case of electricity, however, the ideal condition is taken to be 3,412 British Thermal Units (BTU) per kilowatt-hour, which results in a coal equivalency of 0.123 metric tons per 1,000 kilowatt-hours. Experience indicates that, for thermal electric generating plants of average efficiency, only one quarter to one third of the energy in the coal burned is transformed into electrical output. Thus, on average, approximately 0.6 metric tons of coal are required to produce 1,000 kilowatt-hours of electrical output. The majority of the energy loss which is represented by the difference between 0.6 and 0.123 accrues to the conversion of heat energy into mechanical energy to turn dynamos. Of this energy loss, the greater part is inherent in the process, by the second law of thermodynamics, and could only be eliminated by the suppression of the mechanical stage. A unit of primary electricity (hydro, nuclear or geothermal) may be equated theoretically with the amount of coal required to produce an equivalent unit of thermal electricity, again under average conditions, a procedure which may be viewed as a comparison of sources of energy by virtue of their average capacity to produce electrical energy. However, not all fuels are used to produce only electrical or mechanical energy. A large proportion are normally used to produce heat energy, the actual amount varying widely from installation to installation. Furthermore, all sources of energy other than electricity normally produce heat energy as an integral part of processes for the production of electrical or mechanical energy. For these reasons, the different sources of energy presented in this study, including hydro, nuclear and geothermal electricity, are compared on the basis of the heat energy that they would produce under ideal conditions.

Data from the tables on individual fuel commodities are reduced to coal equivalent for the summary presentation in tables 1 and 4, oil equivalent in tables 2 and 5, and terajoules in tables 3 and 6. To derive the total energy production, only the primary sources of energy are considered, namely, coal, lignite and brown coal (including peat used as fuel in the case of Burundi, Finland, Ireland and the USSR), crude petroleum and natural gas liquids, natural gas and hydro, nuclear and geothermal electricity. Figure V indicates schematically the relationship of these elements to the summary series. In the case of low-grade coals, conversion factors listed in figure I are applied for all years in reduction to coal equivalent. Individual factors of conversion are applied to the component elements of natural gas liquids. The secondary or derived sources of energy (cokes, briquettes, refined oil products, manufactured gases and thermal electricity) are excluded from the calculation of total primary energy production, as are fuelwood and charcoal.

To derive the total import, export and bunker series presented in tables 1 and 4, the conversion factors indicated in figure VI are applied. Trade in electricity cannot be identified as being of hydro or thermal origin, and so for the purposes of statistical convenience it is converted into coal equivalent as though it

constituted hydro electricity. Negative consumption may occur due to exports exceeding the total of primary electricity production and imports. Data on import and export of gases, derived from table 21, include that proportion of liquefied natural gas converted into gaseous form.

To derive the total energy consumption presented in tables 1, 2, 3, 4, 5 and 6 see figure VII which indicates the conversion factors applied to the component elements. The minor incomparability between data in coal equivalent for total production and for total consumption of all energy commodities accrues to the fact that liquid fuels consumption excludes the non-energy petroleum products. In the case of gases and electricity, production and net trade enter the calculation of consumption. Production of refinery gas is treated as an element of liquid fuel rather than gas consumption. It should be noted that, although a factor of 0.1429 is used for conversion into coal equivalent, a factor of 0.0952 is applied for conversion of refinery gas in original units into liquid fuel equivalent (tables 12 and 14).

A United Nations Expert Group on Classification and Measurement in the Field of Energy Statistics recommended that the United Nations Statistical Office present additional data, for world and regional totals in tons oil equivalent and joules, in the 1979 issue of World Energy Supplies, 1973-1978. Tables 2 and 3 show data for world and regions in fuel oil equivalency and terajoules respectively. In addition, tables 5 and 6 show country data in fuel oil equivalency and terajoules respectively.

To convert from coal equivalency to terajoules, multiply coal equivalent (C.E.) by 29.3076. The conversion factor (C.F.) 29.3076 was derived as follows:

1 Kilojoule (KJ) = 0.238845 Kilocalories
1 Kilocalorie (Kcal) = 4.1868 Kilojoules
7 Kilocalories/gram = C. E. base

Therefore, $\frac{4.1868 \text{ KJ}}{1 \text{ Kcal}} \times \frac{7 \text{ Kcal}}{1 \text{ gram}} = 29.3076 \text{ Kilojoules/gram.}$

To convert from coal equivalency to oil equivalent, multiply coal equivalent (C.E.) by 0.680272. The conversion factor 0.680272 was derived as follows:

1 TCE (metric ton coal equivalent) = 7000×10^3 Kcal
1 TOE (metric ton oil equivalent) = 1.47×7000 Kcal/gram
= $10,290 \times 10^3$ Kcal

Therefore, $\frac{7000 \times 10^3 \text{ Kcal}}{10,290 \times 10^3 \text{ Kcal}} = 0.680272.$

Figure I. Summary of coefficients used to convert other fuels into coal equivalent.

Fuel and country	Coal equivalent (metric tons unless otherwise indicated)
Coal, anthracite and bituminous	1.0
Coal, low grade	
Norway	0.957
United Kingdom	0.879-0.897
Czechoslovakia	0.86
New Zealand	0.84
USSR	0.81-0.84
India	0.71
Pakistan	0.7
German Democratic Republic	0.6
Hungary	0.529-0.587
Recovered slurries	
France, Spain	0.7
Belgium, Czechoslovakia	0.6
United Kingdom	0.52
Hungary	0.515
Turkey	0.5
Coal briquettes	1.0
Cokes of anthracite or bituminous coal	0.9
Cokes of brown coal or lignite	0.67
Lignite briquettes	0.67
Lignite and brown coal	
Czechoslovakia, France, Democratic People's Republic of Korea	0.6
Chile	0.59
Canada	0.52
Albania, Austria, Bulgaria, New Zealand, Spain, USSR	0.5
United States of America	0.47-0.57
Yugoslavia	0.407-0.427
Hungary	0.4
Italy	0.36
Australia, India, Japan, Mongolia, Romania, Thailand, Turkey	0.33