

World primary energy consumption in 2002

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In this brief overview, the world consumption of primary energy -- oil, gas, coal, hydro and nuclear -- is summarized in a Table based on the 2002 data of British Petrol, which provides basic data on a year-by-year basis. The Table comprises the above-cited commercially traded fuels only, excluding other fuel sources such as solar, wind, wood, peat or animal waste, which are important fuel sources in many countries, but are unreliably documented in terms of consumption statistics. The most recent developments are mentioned in the application of the challenging fuel of the future - hydrogen.

In the Figure the "energy units" - eV, Joules, kilocalories, Watt-hours, tons of TNT, and mass of matter converted to energy by $E=MC^2$ - are displayed in logarithmic scale and the most important conversion factors are also illustrated.

2002 in review

World consumption of primary energy increased by 2.6% in 2002, well ahead of the 10-year growth trend of 1.4% per annum. Reported growth in energy demand of almost 20% in China was behind much of this relative strength: energy consumption in the world, excluding China, grew by less than 1% during the year, reflecting a second year of below-trend economic growth.

Oil

Brent oil prices averaged \$25.19 per barrel in 2002, up slightly on the 2001 average price of \$24.77 and well above the post-1986 annual average of \$19.40. Prices were relatively weak at the start of the year in the wake of the 11 September 2001 terrorist attacks, but trended upwards over the course of 2002 on the back of OPEC production restraint and supply disruptions involving Iraq and Venezuela. The low point in prices of around \$18 per barrel was recorded in mid-January, whereas the peak of almost \$32 was registered just before the end of the year. OPEC oil production fell substantially in 2002 for the second year running. Average production for the year was down by more than 1.8 million barrels per day (b/d) or 6.4%, following an 870,000 b/d or 2.8% decrease in 2001. The steep drop in OPEC output was the result of output restraint and a number of unplanned disruptions to production. As in 2001, the largest fall in percentage terms was 14.4% in Iraq, which was affected by a month-long suspension of exports from April to May and the imposition of 'retroactive pricing' under the UN's 'Oil for Food' program. OPEC output restraint in 2002 was a response to the sharp drop in the demand for its oil in the face of weak global oil demand growth and the rapid expansion of oil production outside OPEC. Oil demand in 2002 was exceptionally weak for the third consecutive year, with consumption growing by

only 290,000 b/d. Oil production outside OPEC increased by 1.45 million b/d. The countries of the Former Soviet Union (FSU) accounted for over half of this increase, with Russia and Kazakhstan, up by 640,000 b/d and 150,000 b/d respectively, accounting for nearly all the FSU's gains. Other large output increases came from Canada, Angola and Brazil, up by 170,000 b/d, 160,000 b/d and 160,000 b/d respectively.

The oil consumption is the largest in the USA (19.7 and will be 31.8 million barrels per day in 2002 and 2025 respectively according to EIA), but the second position of China (5.4 and 12.9 million barrels per day) is not so evident and not so widely known in Europe. Presumably the reason is that vehicle (including SUV) ownership in the USA was 779 vehicle per 1000 person in 2001 and 13 vehicle per 1000 person as compared to China with strong growth of automobile use in the future.

Natural gas

World consumption of natural gas grew by a relatively strong 2.8% in 2002 on the back of a 3.9% US consumption increase and robust growth in Non-OECD Asia Pacific of more than 7%. The US increase followed a fall of similar magnitude the year before, as natural gas prices moderated from 2001 levels. On the gas production side, North America was the only region to see a decline. A price-driven drop in drilling activity following the boom in 2001 explains some of the decrease, but the maturity of the USA and Canada from a resource perspective also seems a contributing factor. Another notable feature of 2002 was the first increase in Russian production for several years, as the super-giant Zapolyarnoye field was brought on stream. Within Europe, Norwegian output expanded strongly by 21.4% as production from the UK and the Netherlands, down 2.6% and 3.2% respectively, contracted.

Other fuels

Coal

World coal consumption increased by 6.9% in 2002. However, this was almost entirely a Chinese phenomenon: reported consumption in China rose by an extraordinary 27.9%. Excluding China, world coal consumption grew by just 0.6%, with strong growth of 3.7% in Asia (excluding China), and modest growth in North America of 1.5%, offset by declines of 1% in Europe and 7.8% in the FSU.

Nuclear Power

At the end of 2002, 362 nuclear power units were connected to grid in OECD countries, providing approximately 24% of total electricity supply in the OECD area. Three new nuclear units were brought into operation: one in the Czech Republic and two in Korea; two units were retired in the UK. Seven units were

under construction: three in Japan, two in Korea, and two in the Slovak Republic. Consumption of nuclear power rose modestly in 2002, expanding by 1.5% globally. Nuclear power (historically started 60 year ago with the Manhattan Project, May 5, 1943) now is represent a shrinking share of electricity consumption despite the new constructions in Asia (India, China, etc.) and life extensions (mainly in the USA) of the commercial reactors. In the US approach the NRC has approved renewal of operating licenses for 18 nuclear units and has applications under review for 12 more. US plants are initially licensed for a period of 40 years, instead 30 years for example in Hungary. (see also Nuclear Energy Data to 2020 in OECD Countries, Paris, June 6 2003.

US nuclear operators report their 2002 operations and maintenance (O&M) spending continued gains in generating efficiency, producing a kilowatt-hour (kWh) for a record low median of 1.59 cents, according to an exclusive analysis by Platts' Nucleonics Week. The most efficient nuclear generator reporting in 2002 was Duke Power's Catawba at 1.13 cents/kWh. Other top-ranked plants were Tennessee Valley Authority's Sequoyah, Progress Energy's Harris, and Dominion Energy's North Anna and Surry, all producing in the 1.1-1.2 cent/kWh range. Only hydroelectric and some mine-mouth coal plants produce power for less.

Forecast for electricity consumption for 2025:

Electricity consumption (Billion Kilowatt-hours)	1990	2001	2025	%
Industrialized Countries	6368	8016	11994	1.7
United States	2827	3602	5252	1.6
EE/FSU	1906	1528	2642	2.3
China	551	1312	3596	4.3
India	257	492	1104	3.4
Total World	10546	13934	24673	2.4

(%) Average Annual Percent Change, 2001-2025

Hydro electricity

Hydroelectric generation recovered only partially from a very weak 2001. Strong rebounds of 10.4% in North America and 4.6% in Latin America were counteracted by weakness in Europe, which declined by 9.9%.

Hydrogen

The 50 million tons of hydrogen produced worldwide each year is mostly used in fertilizer production, petroleum refining and other industrial uses, though it's also used as rocket fuel for space programs said Moe Khaleel, director of Pacific Northwest National Laboratory's Hydrogen and Transportation programs. But its most promising future use will be in fuel cells, he said. A future world with cars, trucks, homes and businesses running smoothly and emissions-free on the fuel of the future -- hydrogen.

The United States and the European Union in June 16, 2003 in Brussels, Belgium signed a cooperation agreement to develop fuel cell technology. The seven point plan, brokered by European Research Commissioner Philippe Busquin and the U.S. Energy Secretary Spencer Abraham, aims to strengthen research by bringing together European and U.S. researchers from public and private sectors. Key challenges for fuel cells to become commercially competitive are cost reduction, improved performance and durability.

The agreement details the development of joint initiatives in seven fuel cell related areas.

- Transportation vehicle demonstrations, including fueling infrastructure
- Fuel cells as auxiliary power units that boost the onboard power of gasoline vehicles
- Codes and standards for fuel infrastructure, vehicles and auxiliary power units
- Fuel choice studies and socio-economic assessment of critical materials availability for low temperature fuel cells
- Support studies, including assessment of critical rare earth materials for high temperature fuel cells
- Direct methanol and polymer electrolyte membrane fuel cells for transportation and stationary applications
- Solid oxide fuel cells and high temperature fuel cell turbine hybrid systems

Table - Primary energy consumption in 2002, by selected countries and by fuel

(in million tonnes oil equivalent)

in 2002	Oil	Gas	Coal	Nuclear	Hydro	Total	[in 1991]
USA	894,3	600,7	553,8	185,8	58,2	2293,0	1949,8
North-America	1064,9	711,2	591,5	205,0	142,4	2715,4	2300,7
France	92,8	38,5	12,7	98,9	15,0	258,0	231,1
Germany	127,2	74,3	84,6	37,3	5,9	329,4	340,6
UK.	77,2	85,1	36,5	19,9	1,7	220,3	215,9
EU 15	634,4	347,2	216,8	201,7	69,2	1468,9	1345,6
Russian Fed.	122,9	349,6	98,5	32,0	37,2	640,2	-
FSU	168,3	511,9	160,5	53,4	52,0	946,1	1375,3
Europe & Eurasia	925,2	939,5	506,1	280,0	178,9	2829,5	-
Middle East	207,4	185,1	8,4	-	1,9	403,1	264,3
Africa	118,6	60,7	90,6	2,9	18,5	291,0	220,2
China	245,7	27,0	663,4	5,9	55,8	997,8	694,5
Japan	242,6	69,7	105,3	71,3	20,5	509,4	451,1
India	97,7	25,4	180,8	4,4	16,9	325,1	205,8
Asia	991,6	297,3	1183,5	118,0	127,7	2717,8	1886,2
Australia	38,0	21,6	49,5	-	3,8	112,9	88,0
OECD	2181,9	1235,6	1116,3	522,7	289,5	5346,1	4606,7
World	3522,5	2282,0	2397,9	610,5	592,1	9405,0	8147,2

[Total primary energy consumption in 2002 and Total primary energy consumption in 1991]

Figure: Energy Units (see separate sheet)

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July 29, 2003

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US: The Massachusetts Institute of Technology (MIT) has published an interdisciplinary study that examines the prospects and challenges faced by the nuclear power industry, focused on the USA. The report says that nuclear energy has an important role in meeting future global electricity needs without emitting carbon dioxide (CO₂) and other air pollutants. The study states that the nuclear option must be retained 'precisely because it is an important CO₂-free source of power'. The authors urge the US to focus its attention over the next decade on building nuclear reactors that use existing technology and a 'once-through' fuel cycle. The study postulated a 'grow scenario' by 2050 of about 700 new reactors worldwide, each of approximately 1000 MWe of capacity, to keep nuclear's share of the electricity market constant. However, for a large expansion of nuclear energy to take place, four critical areas must be addressed: better economics; continued high security; waste management; and, proliferation issues. The report - 'The Future of Nuclear Power' - is available at <http://web.mit.edu/nuclearpower/>.

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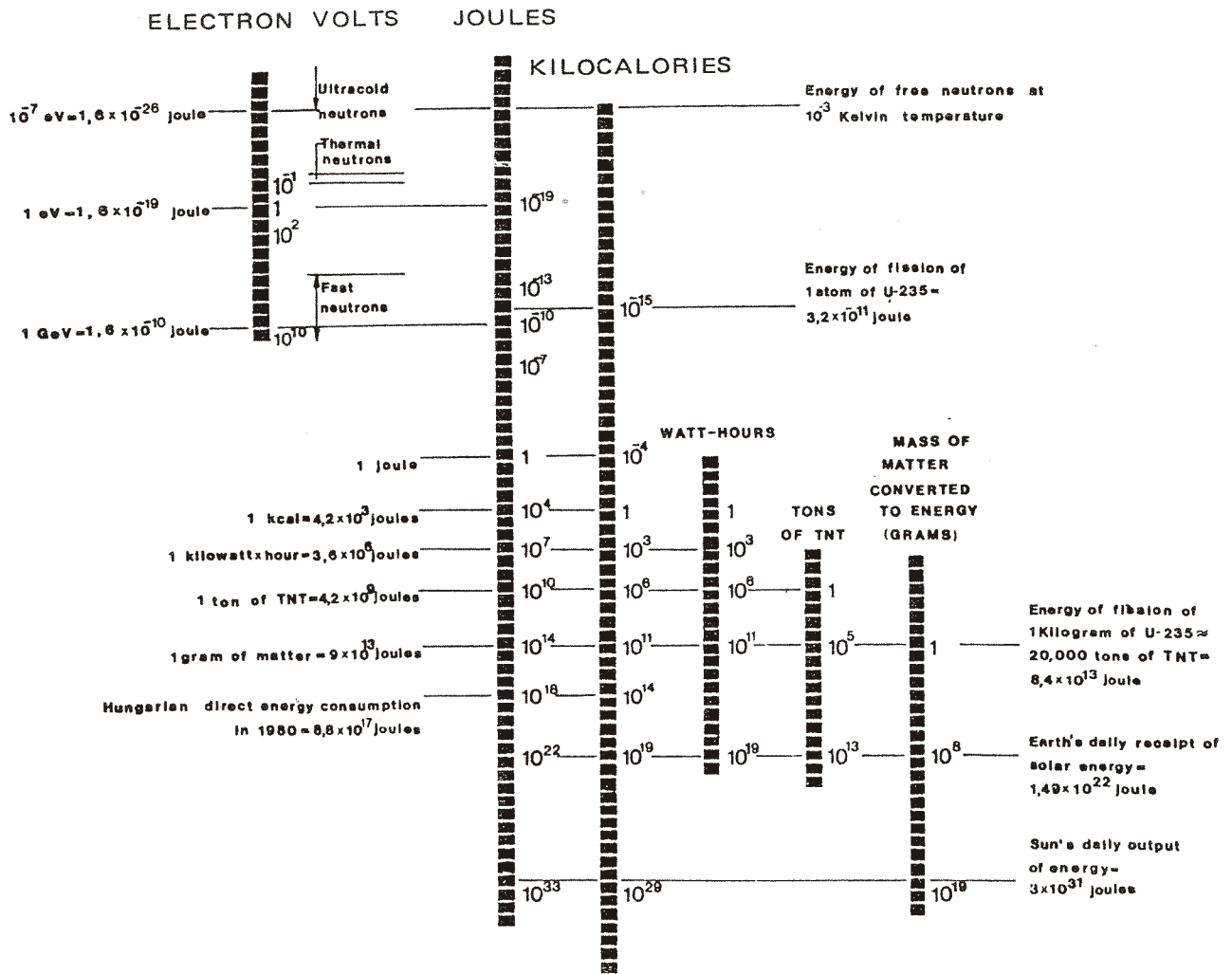
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Energy Units:



Source: Kiss, D., Nagy, A.Z., Neményi, M. (eds): The Neutron and its Applications in Science and Technology (in Hungarian): Akadémiai Kiadó, Budapest, 1985.