Energy

THE TAMING of fire was one of humankind's earliest technological achievements. It provided energy for heat and light on demand. But today the environmental impacts of the world's power plants, internal combustion engines and boilers have serious implications for the future health and well-being of the planet.

Energy is one of the most basic of human needs, not as an end in itself but as a means to numerous ends. We need energy to heat and air-condition our living spaces, to cook food and forge steel, to power engines and for transportation, and most of all to generate electricity for myriad purposes from boiling a kettle to running computer systems.

During the past 50 years, global consumption of commercial energy has risen more than fourfold, far outpacing the rise in population. One way or another, all this energy comes from natural resources – whether fossil fuels such as coal and oil, living resources such as timber and biomass, nuclear fuel such as uranium, or "renewable" resources such as flowing water and wind and the power of the sun.

A generation ago, there was concern that fossil fuels would run out, plunging the world into an energy crisis. Today the fear is that their continued use might be wrecking the global climate by emitting carbon dioxide (CO_2) as we burn carbon-containing fuels. This anxiety is substantially increased in view of the considerable unmet demand for energy in the developing world.

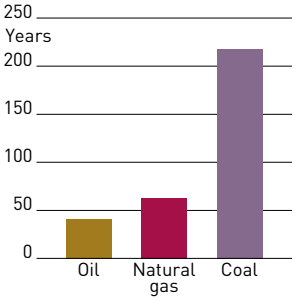
Energy use is closely tied to health and well-being – low energy users have high infant mortality rates, low literacy rates and low life expectancies. Worldwide, 2 billion people do not have access to electricity and use fuelwood or dung for cooking and heating – often destroying their local environments in the process. The challenge for the 21st century is to develop methods of generating and using energy that meet the needs of the poor while protecting the planet.

There are three global energy trends in relation to demographics. First and most obviously, as populations grow, energy use increases. Secondly, as wealth grows, energy use per capita also increases. In the early stages of industrialization, this is typically accompanied by a decline in the efficiency with which energy supplies are used, resulting in more pollution per dollar of output. India's emissions of CO_2 per dollar of GDP rose by 29 percent between 1980 and 1995; Malaysia's rose by 58 percent[1].

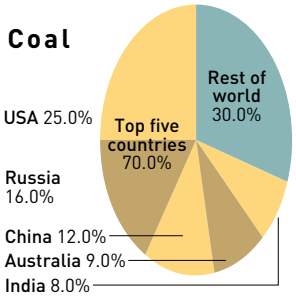
But the third stage is more optimistic[2]. Beyond a certain threshold of wealth, which may vary widely between countries, energy efficiency begins to improve. Thereafter, countries with expanding economies and growing personal wealth can, with sensible energy policies, dramatically reduce growth in energy use. They may begin to show sharp reductions in emissions of polluting gases, including greenhouse gases, particularly by shifting to cleaner sources of energy, such as natural gas and renewables.

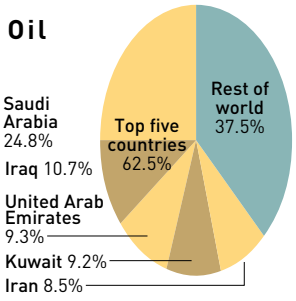
The world is already slowly starting to wean itself from the most polluting energy source – coal. During the past 50 years, global coal use has only doubled, while oil use has risen sevenfold and

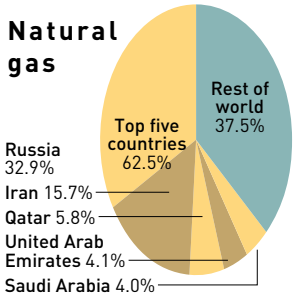
FOSSIL FUEL RESERVES, 1998
Estimated years of use at current exploitation levels



Reserves by location

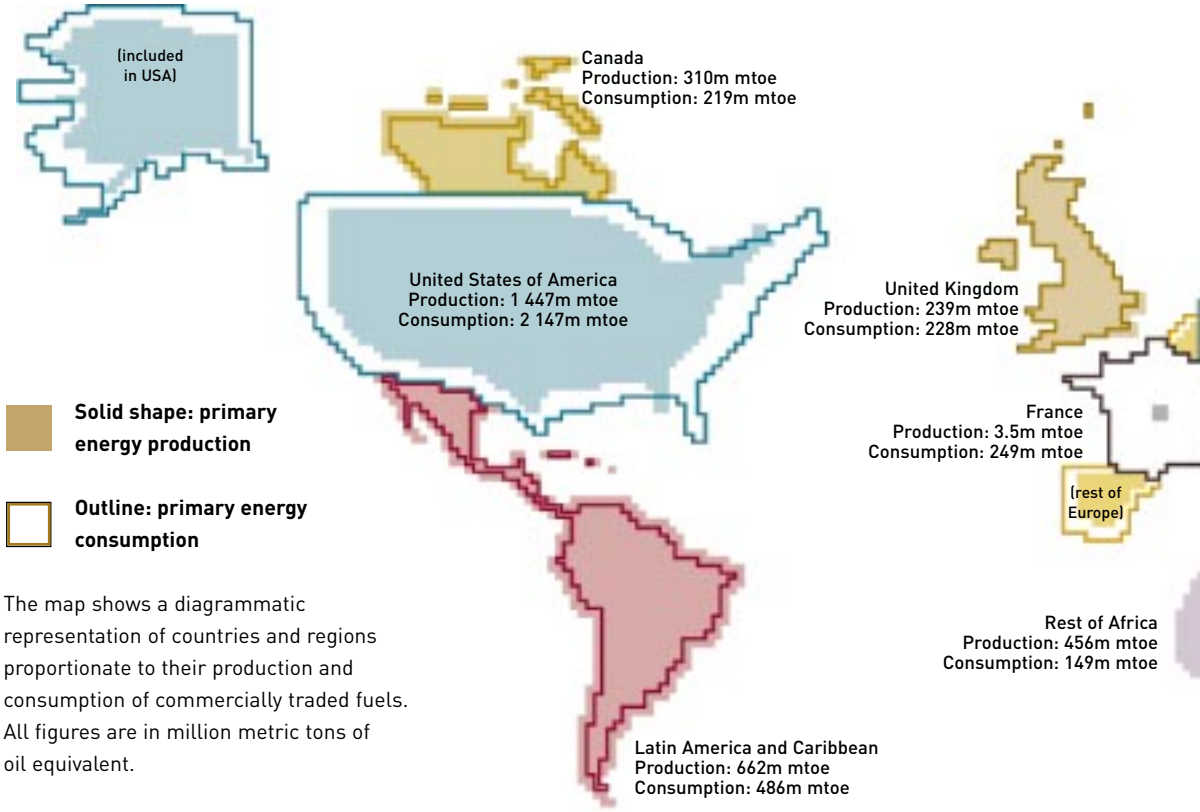






Source: BP.

PRIMARY ENERGY CONSUMPTION AND PRODUCTION, 1998



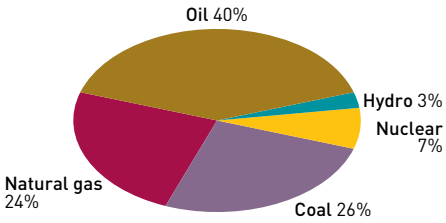
The map shows a diagrammatic representation of countries and regions proportionate to their production and consumption of commercially traded fuels. All figures are in million metric tons of oil equivalent.

TOP ENERGY CONSUMERS, 1998

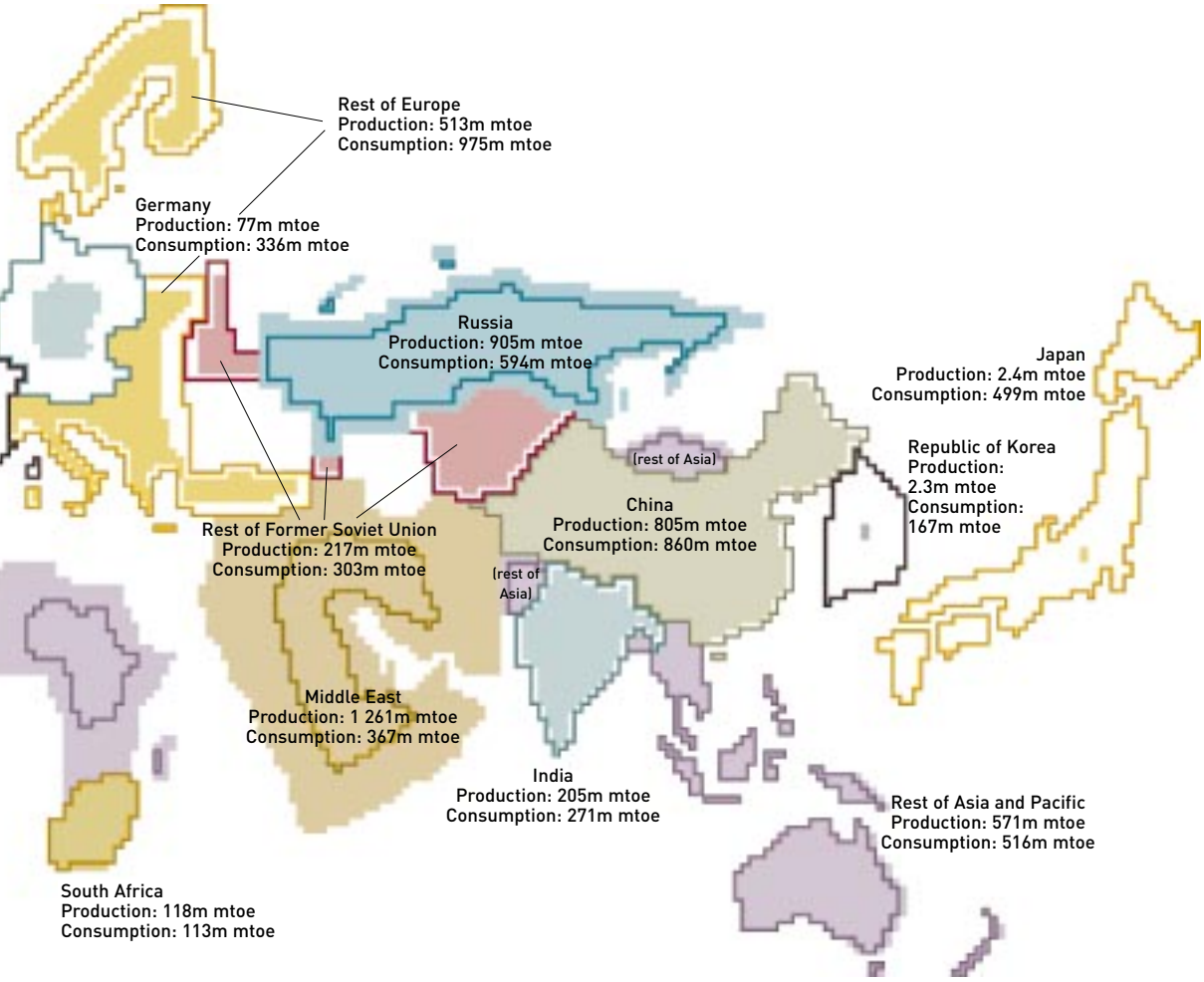
	Consumption as % of world	Population as % of world
USA	25.32	4.64
China	9.96	21.28
Russia	7.00	2.50
Japan	5.89	2.14
Germany	3.97	1.39
India	3.19	16.64
France	2.94	0.99
UK	2.68	1.00
Canada	2.59	0.52
Korea, Rep.	1.97	0.78
Italy	1.91	0.97
Ukraine	1.58	0.86
Brazil	1.49	2.81
Mexico	1.48	1.62
Spain	1.35	0.67
South Africa	1.33	0.67
Iran	1.25	1.11
Australia	1.21	0.31
Saudi Arabia	1.19	0.34
Poland	1.05	0.66

Source: BP; UNPD.

ENERGY CONSUMPTION, 1998
By source



Source: BP.



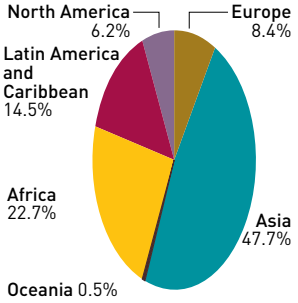
Source: BP.

FUELWOOD CONSUMPTION, 1988-98

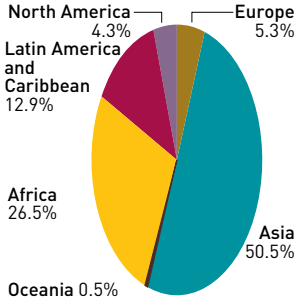
	Million cubic meters 1998	Change in volume 1988-98 %	Population change %
North America	75.5	-24	10
Latin America and Caribbean	226.1	-3	19
Europe	92.8	-31	2
Africa	463.9	27	29
Asia	883.5	16	17
Oceania	8.5	-1	16
World	**1 750.3**	**9**	**16**

Source: FAO.

FUELWOOD CONSUMPTION, 1988 AND 1998 By region



Total consumption, 1988:
1 604 million cubic meters



Total consumption, 1998:
1 750 million cubic meters

Source: FAO.

OECD AND NON-OECD ENERGY CONSUMPTION

	OECD		Non-OECD	
	Consumption 1998 Million mtoe*	% change in consumption 1988-98	Consumption 1998 Million mtoe	% change in consumption 1988-98
Oil	2 131.3	14	1 257.7	8
Gas	1 101.0	31	915.4	11
Coal	1 056.2	-6	1 163.2	4
Nuclear	543.2	33	83.4	4
Hydro	116.4	13	110.0	36
Total	**4 948.1**	**14**	**3 529.7**	**8**

* Metric tons of oil equivalent
Note: During the period 1988-98, the population increased by 9% in OECD countries and by 18% in non-OECD countries.

Source: BP.

natural gas use more than tenfold[3]. China, the world's largest user of coal, has recently begun to cut its consumption despite continued fast economic growth. With similar declines in many industrialized countries, global coal use may be close to or past its peak – with positive effects on urban air pollution, acid deposition and the greenhouse effect[4].

Gains in the use of non-fossil fuels have been inconsistent. Alternative technologies that require large initial capital outlays did well until around 1990, but have since stalled. World civil nuclear reactor construction is now just a tenth of 1970s levels both because Western civil society has turned against nuclear power and because former Soviet bloc nations cannot afford the investment. Large-scale hydroelectric power has suffered from a shortage of sites and a growing awareness of its environmental downside. But smaller-scale renewable energy sources, notably wind and solar power, have seen double-digit annual growth – albeit from a lower starting point[5].

The fast-growing demand for energy in developing countries offers the opportunity for them to avoid the high-energy and pollution-intensive development paths of already industrialized countries and "leapfrog" to sustainable energy sources. There are many examples of moves around the world to more sustainable energy policies. Solar power is making inroads in many parts of rural Africa where urban electricity grids are unlikely to reach. Wind turbines are whirring on the plains of India, the steppes of Mongolia, the shores of the North Sea and among the sheep of Patagonia. Brazil fuels half its vehicles on ethanol made from fermented sugarcane juice, reducing the country's CO_2 emissions by 18 percent[6].

Many leading figures in the oil business believe that by the middle of the century the world's vehicle fleet will run on hydrogen fuel cells, probably extracted from water using electricity generated from renewable sources[7]. Iceland has plans to complete the task of creating the first "hydrogen economy" within its own shores by 2020, using its domestic geothermal and hydroelectric energy sources to convert its small self-contained vehicle fleet[8].

Most analysts still anticipate fast global rises in the use of oil and natural gas, and expect CO_2 emissions to continue to rise for many decades yet, as developing countries' economies grow. But the increases may be much less than once feared. In 1997 and 1998, the global economy grew by 6.8 percent, but CO_2 emissions held steady. The explanation appeared to lie in a combination of reduced coal use and the rise of economic growth based on new information technologies, which have lower energy requirements than traditional industries[9].

CHINA

China, the world's most populous country, mines a third of all the coal cut from the Earth, providing three quarters of the country's energy requirements. It has made Chinese cities the most polluted on Earth[10] and the country the world's second largest source of CO_2. But China is also engaged in a massive effort to clean up both its own backyard and the planet.

China is switching to natural gas, cutting coal subsidies and investing heavily in improved energy efficiency. A National Improved Stove Programme has upgraded 160 million domestic stoves. Since 1996, China has shut down 60 000 smoky and inefficient industrial boilers, while hundreds of small inefficient power stations over 25 years old are also to be closed.

Overall since the early 1980s, China has improved its energy efficiency by 47 percent, doubling economic output while raising CO_2 emissions by only 50 percent. In 1998, while increasing its economic output by more than 7.2 percent, it actually reduced its emissions of CO_2 by 3.7 percent – thanks mainly to continuing declines in coal burning[11].