

2

CHAPTER 2

Context and current situation

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The current situation of energy is one of ever-increasing demand and an energy supply which is still capable of meeting requirements, though it seems to be having difficulty in keeping up with this growing pace. The outlook is not an encouraging one, with the prospect of consumption levels which cannot be met at present energy output.

Energy consumption continues to rise at unsustainable rates as a result of the continuous growth of the global economy and population. The availability of cheap and plentiful primary energy from fossil fuels has helped foster this growth, but the present scarcity of profitable energy supplies has led to a new situation which may put a brake on this growth.

This chapter describes the current energy situation, which is largely based on fossil fuels-although other alternative energy sources now being promoted should not be ignored.

2.1. Overview of the current situation

Definition and Background

Energy is defined as the capacity to perform work. From an economic point of view, the term also refers to energy as a natural resource and the associated technology used to harness it and utilise it for industrial and economic purposes.

Little over a century ago, the main sources of energy were the animal power and man power, together with the heat obtained from burning wood. Human ingenuity had also developed a number of machines which used water power to mill cereals or make iron in forges, and the force of the wind to drive ships and windmills. However, the great revolution came with the steam engine; since then, the large scale development of industry and technology has drastically changed the energy sources that drive modern society.

Table 1 shows the leading technological innovations related to energy development and their impact on energy sources throughout human history.

Notes

Years ago	Technological innovation	Impact
2.000.000	Hunting	Meat as food
400.000	Preserving fire	Extension of hunting grounds
10.000	Making fire	Ditto
6.000	Arable and livestock farming	Production of foodstuffs
2.000	Water wheel	Water power
1.000	Water-powered smithy / Windmill	New agriculture, based on extensive use of iron
500	Seafaring	Enlargement of the farmed area
200	Coke / Steam engines	Mass access to fossil resources
130	Kerosene distilling	Incorporation of oil
50	Controlled fission	Nuclear energy
25	Transcontinental gas pipelines	Incorporation of gas

Table 1: Technological innovations and their impact on the history of energy sources.
Source: "*Energía e Historia: pocos recursos y muchos residuos*".
José Eduardo Mohedano Córdoba.

The history of energy can be described, simply, if roughly, as a series of stationary states, separated by transitory crises, which evolved as a result of energy needs.

Growth in the useful extracted part of resources therefore appears to be inevitably accompanied by greater growth in the consumption of resources. Two aspects should always be borne in mind with regard to energy: supply and demand. These are the two sides of the same coin, always linked, although each one has its own economic, political, social, environmental and technological implications.

Over the last 25 years, global energy consumption has grown steadily, as Illustration 1 shows. In 2005, consumption grew by 2.7%, less than the previous year's increase of 4.4%, but still above the average for the previous ten years. China accounts for over half of the annual growth in the world's primary energy consumption.

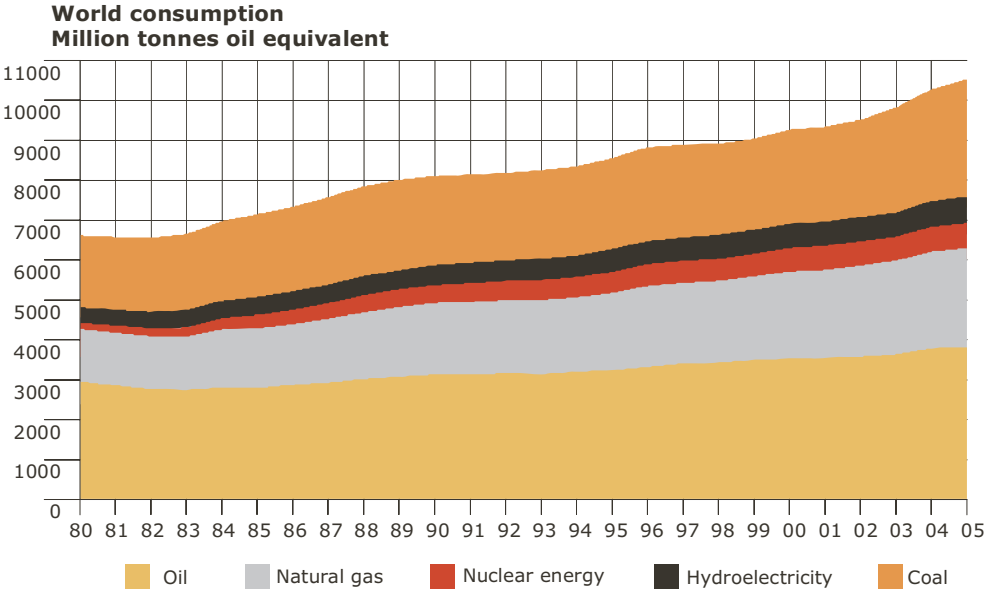


Illustration 1: Global consumption of the leading energy sources
 Source: BP Statistical Review of World Energy June 2006.

This demand, which appears not only to be rising, but to be rising ever more sharply, has resulted in major increases in energy output in recent years. Naturally, there are regional variations, depending on the level of development achieved or pursued.

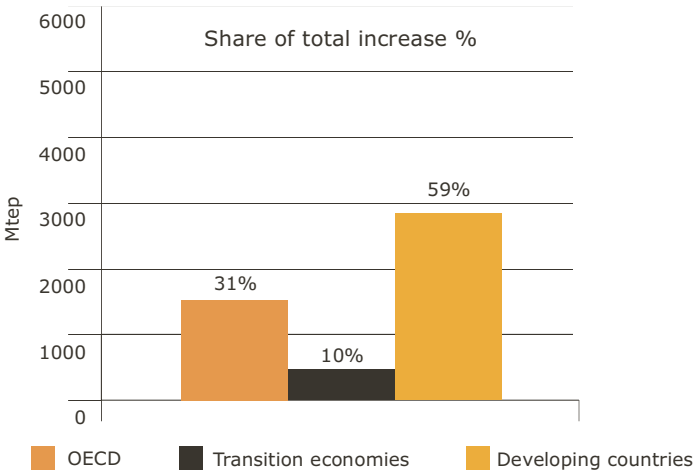


Illustration 2: Global increase in primary energy production by regions.
 Source: World Energy Outlook 2004. International Energy Agency.

Let us now look in greater detail at the current situation of energy demand, and the supply that is available to meet these energy needs.

The leading source in satisfying energy demand is clearly fossil fuels

One of the features of today's energy demand is that petroleum clearly outstrips all other energy sources. Our lifestyle centres on this energy source. Transport and the many industrial applications that use petroleum derivatives make a continuous supply of oil essential, but this situation must change, since it is a limited resource with serious consequences for the environment.

Other fossil fuels-natural gas and coal-continue to be the main sources used for power production, so necessary in any industry.

Illustration 3 shows that fossil fuels account for around 80% of total world energy demand, with nuclear energy making up only about 7% and biomass slightly over 9%.

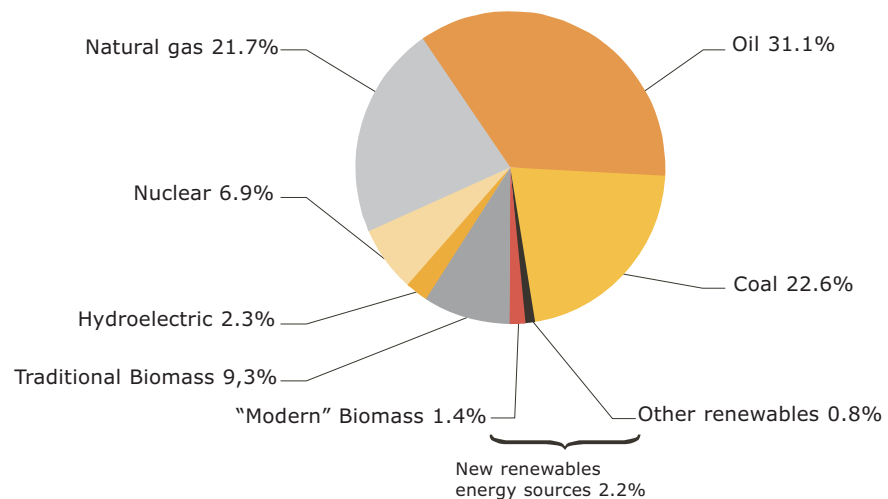


Illustration 3: Global consumption by energy sources.
Source: *World Energy Assessment: Overview: 2004 update.*

Notes

Over the last forty years, global energy consumption has doubled. However, not all regions consume the same. Illustration 4 show that industrialised countries generally have higher per capita consumption rates.

**Consumption per capita
Tonnes oil equivalent (toe)**

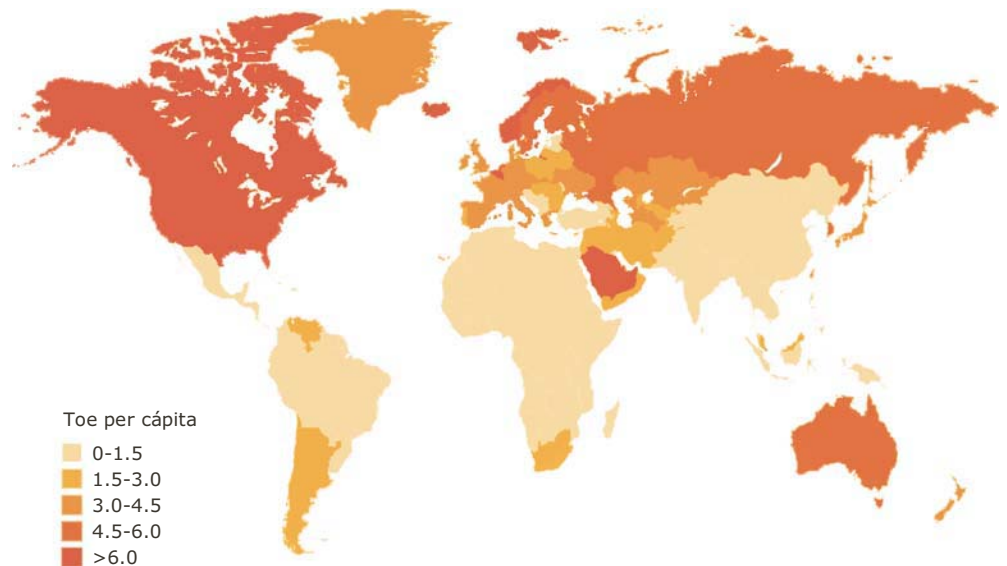


Illustration 4: Global consumption per capita.
Source: BP Statistical Review of World Energy, June 2006.

However, we also need to analyse total consumption figures by region, since much of the increase over recent years has occurred in developing countries, particularly in Asia. Asia's economic recovery in 1999 resulted in greater energy demand, especially in South Korea, Thailand, Malaysia, Singapore and Taiwan, which have sustained exports of electronic apparatuses. Energy consumption in China, since it joined the WTO, has grown spectacularly and the Russian economy has also experienced a major increase in energy consumption.

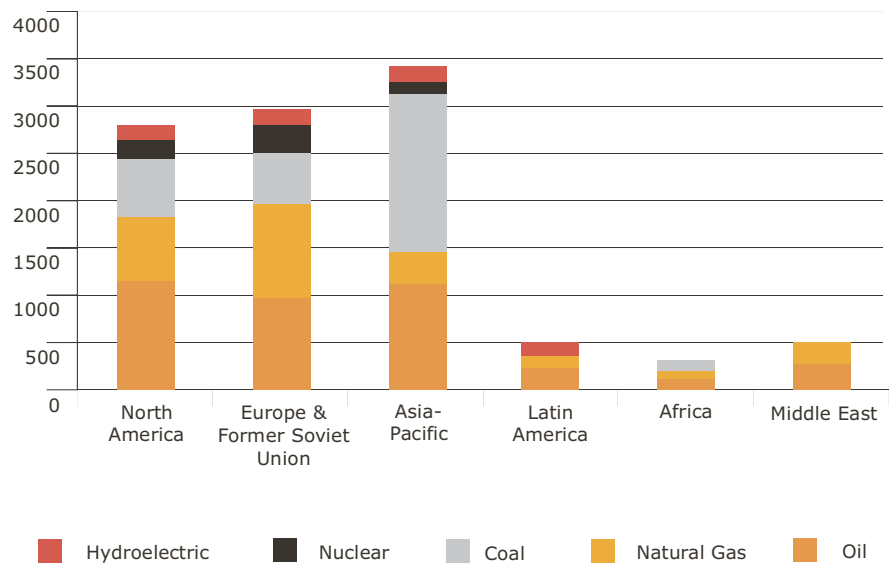
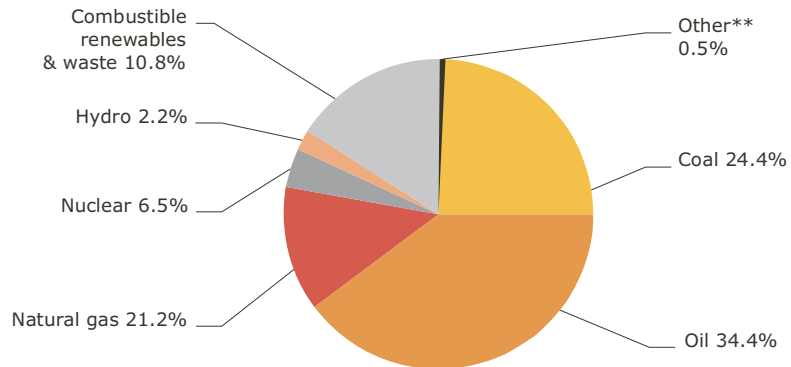


Illustration 5: Consumption of different energy sources by region.
Source: BP Statistical Review of World Energy June 2005.

In addition, industrialised economies, such as the United States and the European countries, account for over 40% of global consumption.

The other side of the coin is supply

Obviously, energy supply is tied to demand. Dependence on fossil fuels in different industries means that most energy production concentrates on extracting these fuels, leaving less room for renewable energy sources and other forms of production.



**Other includes: geothermal, solar, wind, heat, etc.

Illustration 6: Global energy production by source.
Source: *Key World Energy Statistics 2005. International Energy Agency.*

With the reduced margin separating it from demand, energy production from fossil fuels is increasingly coming up against the ropes. Hubbert peak theory states that world oil production will reach a peak and then decline as quickly as it grew. The factor limiting oil extraction is not the economic cost, but the energy required in the process¹.

The debate is not whether an oil peak will happen, but when it will happen, since it is evident that oil is a finite and not a renewable resource in the short run. The answer will depend on discoveries of new reserves, an increase in the efficiency of existing deposits, deep drilling and the use of new unconventional types of oil.

The same theory can be applied to natural gas and coal, although the peak in these cases seems to be somewhat further off.

Illustration 7 shows that the ratio of fossil fuel reserves to production is not uniform in all regions of the world, meaning that import-export flows may play a decisive role in the world economy.

1. See
http://en.wikipedia.org/wiki/Peak_oil

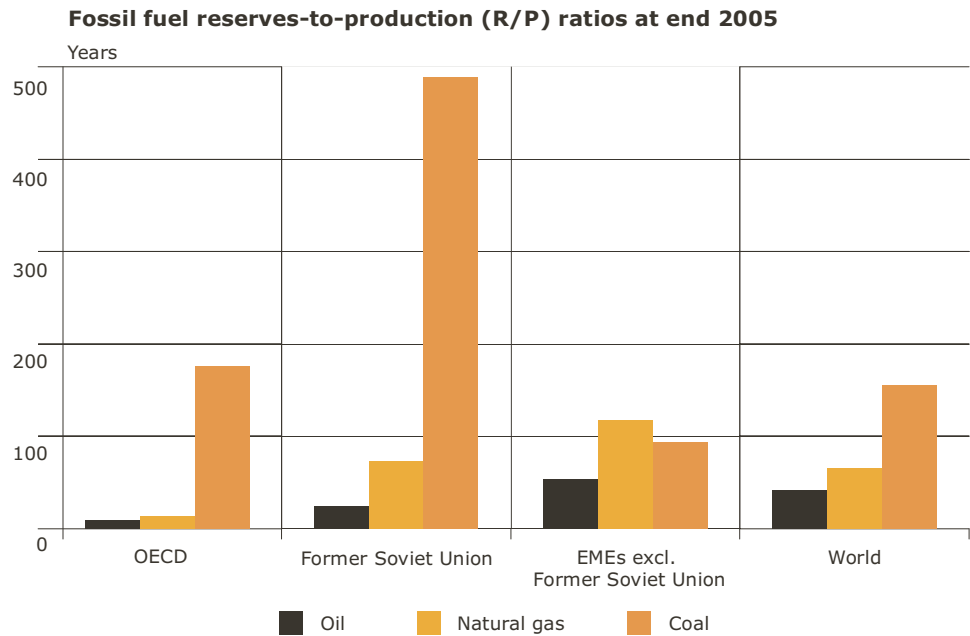


Illustration 7: Ratio fossil fuel of reserves to production.
Source: BP Statistical Review of World Energy June 2006.

The Middle East continues to be the largest producer and exporter of oil, thanks to Saudi Arabia. Nonetheless, oil production is more diversified than natural gas and coal, whose largest producers are Russia and China, respectively.

Illustration 8 shows these differences, and the different regions' share in total production of fossil fuels.

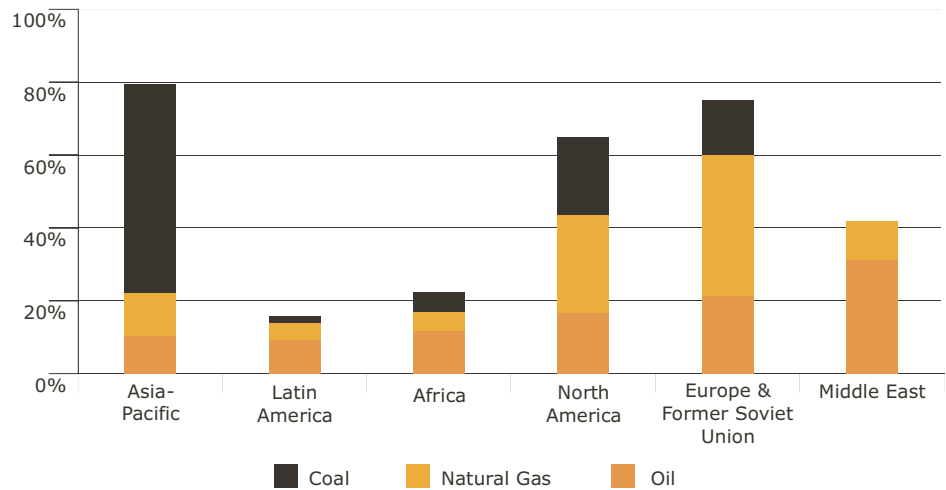


Illustration 8: Production of fossil fuels by region (2005).
Source: BP Statistical Review of World Energy June 2005.

In order to gain a better overview of the energy situation and its potential consequences for global economy and society in coming decades, we will now look in greater detail at the key features and the relative advantages and disadvantages of existing energy sources (fossil fuels and alternative sources).

Notes

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2.2. Main energy sources: fossil fuels

Fossil fuels have been the protagonists of the industrial drive since the invention of the steam engine. Most industry and transport now depends on this energy source. The three account for around 80% of all commercial energy used in the world.

The undisputed **advantages** these fuels offer are their high efficiency and relatively low cost. Thanks to fossil fuels we have achieved progress at a level unprecedented in human history, but they are non renewable sources of energy. This means that quantities that have taken thousands of years to form are burnt up in a few minutes.

They also hold out other **disadvantages**. The energy is obtained from them through burning, a process in which large quantities of carbon dioxide (CO₂) and other pollutants gases are formed and emitted into the air. In strategic terms, they lead to external reliance, since there is only a limited number of countries with these natural resources, and they do not favour innovation, since the technology used is mostly imported².

Let us now look at each of the three fossil fuels individually: oil, natural gas and coal. we will examine trends in demand and supply, and the reserves available to meet future demand. In particular, we will study the current differences between countries or regions in each of the areas.

2.2.1. Oil

Petroleum oil is a liquid produced from a mixture of hydrocarbons-compounds made up of hydrogen and carbon. The various components of the oil are separated in refineries. These include petrol, diesel, fuel oil and asphalt, which are used as fuels. Other products are also separated and used to make plastics, fertilisers, paint, pesticides, medicine and synthetic fibres.

Oil is currently the world's leading energy source and any shortage could have a vast impact on society, given our constant use of it. At present, total production capacity and consumption needs are very close to each other, meaning that the slightest change in supply or demand can result in major price fluctuations.

Market prices of oil grew from a monthly average of \$10.87 per barrel of Brent crude in 1998 to \$70.95 dollars in May 2006-an increase of over sixty dollars a barrel. We will later be analysing the main causes for this price rise, and the real price of oil at any given time, taking inflation into account.

2. Asociación de productores de energías renovables. See <http://www.appa.es>.

The particular features of oil supply and demand are set out below.

Demand

Global oil consumption has increased steadily over the last twenty years, from 60 million barrels a day in 1985 to 83.6 million barrels a day in 2005³. Average annual growth rate over the last ten years came to approximately 1.7%. In 2004, however, oil consumption rose by 3.6%. In 2005 the trend was reined in, and the increase fell to 1.3%.

Obviously, this increase was not the same in all countries; oil consumption in absolute terms need to be compared to the increase in each region. Although Africa and Middle East are the two regions with the greatest increase in 2005 (4.4%), they do not account for a major proportion of global oil consumption (3% and 7% respectively). On the other hand, the entire Asia-Pacific region saw an average increase in consumption over the last two years of 3.5%, making it the second highest oil-consuming region, ahead of Europe and Eurasia⁴.

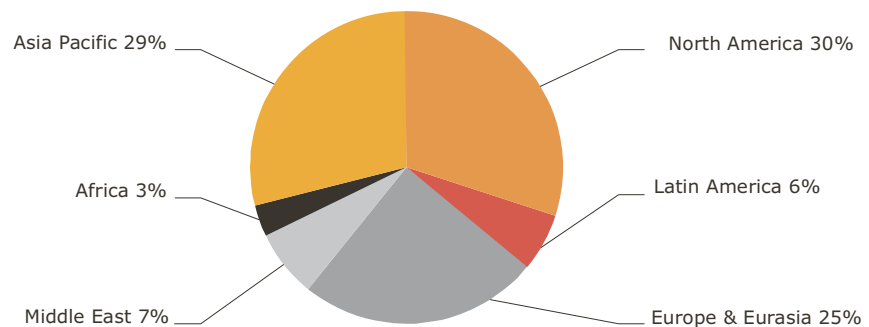


Illustration 9: Global oil consumption by region (2005).
Source: BP Statistical Review of World Energy June 2006.

In 2005, three of the world's six largest oil consumers managed to cut consumption (the United States, Germany and India) thus helping to contain the total increase in demand. So far in 2006, Chinese demand for energy continues to grow at a rate of over 5%⁵, offset only by close-to-zero growth in Europe and Pacific OECD (Organisation for Economic Cooperation and Development) countries, as Illustration 10 shows.

3. International Energy Agency. Oil Market Report. 13 de junio de 2006. Véase www.oilmarketreport.org.

4. BP Statistical Review of World Energy June 2006.

5. International Energy Agency. Oil Market Report. 13 de junio de 2006.

Global Demand Growth 2004/2005/2006

thousand barrels per day

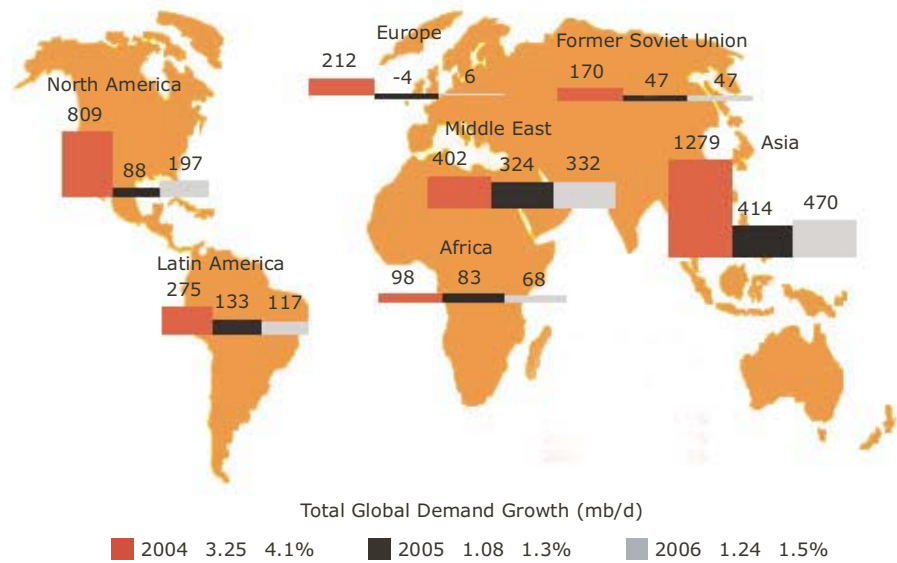


Illustration 10: Growth in global oil demand by region.
 Source: International Energy Agency. Oil Market Report. 13 June 2006.

By sector, oil is used particularly in transport and as a source of energy and heat in industrial processes. In industrialised countries, most of the increase in oil use is in transport, where there are still few economically viable alternatives. In the area of power generation, oil is being displaced by natural gas, which is cleaner and more efficient to burn.

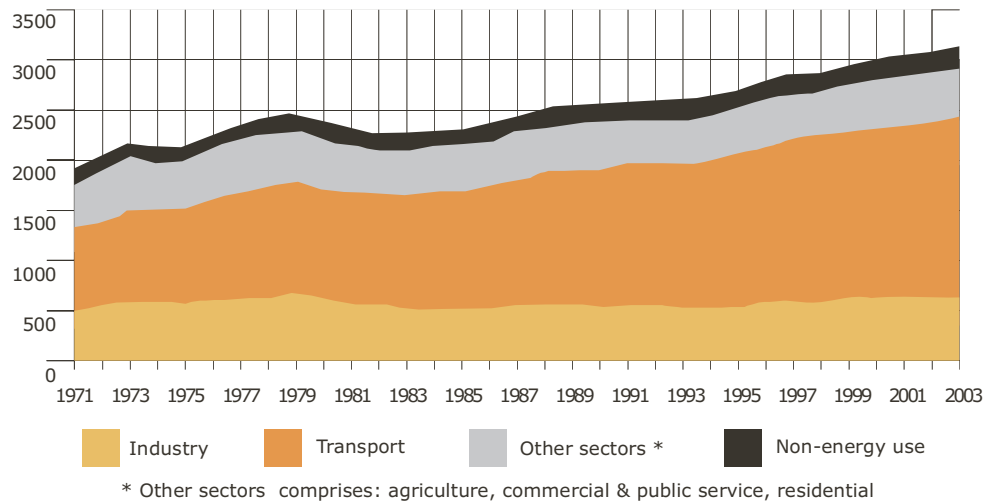


Illustration 11: Global oil consumption by sector.
Source: Key World Energy Statistics 2005. International Energy Agency.

In developing countries, transport is also the sector which contributes most to growth in oil consumption. However, unlike industrialised countries, the overall increase in demand is also caused by the replacement of other fuels -such as firewood for cooking and heating- with petroleum derivatives.

Supply

In examining the oil supply-as already mentioned in the section on fossil fuels-we need to bear in mind existing production and reserves, since both aspects are essential to ensuring energy supply.

Notes

Not all countries or regions in the world have their own oil reserves. The main oil producers (see Table 2) have an impact on the energy market and a global influence.

Producers	% for the World
Saudi Arabia	12.7
Rusia	1.7
United States	8.7
Iran	5.2
Mexico	4.9
China	4.5
Venezuela	3.9
Norway	3.9
Canada	3.8
Nigeria	3.3
Rest of the World	37.4
World	100.0

Table 2: Oil producing countries
Source: Key World Energy Statistics 2005. International Energy Agency.

The purpose of the international economic organisation OPEC (Organisation of Petroleum Exporting Countries) is to unify and coordinate the oil policies of member countries to defend their interests as oil-producing nations. Founded in Baghdad in 1960 and initially comprised of five countries (Saudi Arabia, Iraq, Iran, Kuwait and Venezuela). Subsequent enlargements added a further six members: Qatar, Indonesia, Libya, the United Arab Emirates, Algeria and Nigeria. The organisation was set up to respond to a unilateral lowering of the official price of oil by the major distribution companies in August 1960.

OPEC countries now produce over 29 million barrels a day, nearly 40% of all world production. The largest producer in the organisation is Saudi Arabia.

Within Europe and the countries of the former Soviet Union, Russia leads the way in oil production, followed a long way behind by Norway and the United Kingdom. Altogether, the region accounts for 22% of global production.

Oil output from the Asia-Pacific region has grown to 10% of world production, nearly half of which comes from China. Significantly, current domestic consumption in the area has increased faster than production. The new economic powers, particularly China and India, are demanding ever greater volumes of energy resources to sustain their economic boom.

Some countries which previously played a less significant role on the world stage are now gaining more importance as they open up to foreign investment. In Africa, for example, in addition to the countries that already belong to OPEC, Angola has increased production by 26% in a single year.

Latin American countries have seen substantial growth in crude oil output over recent years thanks to privatisation of the state oil companies and opening up to foreign investment. Venezuela (an OPEC member) is the regional leader with Brazil also seeing a major growth in output (11% last year).

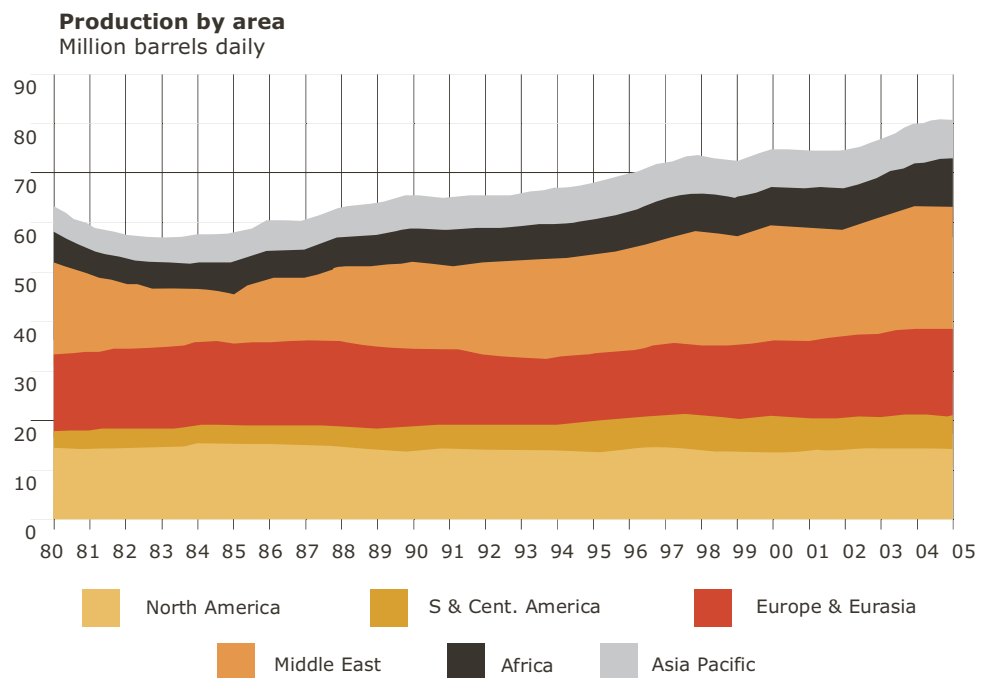


Illustration 12: World oil production by region (2005).
Source: BP Statistical Review of World Energy June 2006.

Specifically, in 2005, global oil output grew by over 81 million barrels a day, a 1% increase on the previous year. Nearly all of the net increase was due to production increase among OPEC countries. The growth in Russian production slowed, while in the United States it fell, largely as a result of the consequences of hurricane damage. At the same time, growth in Angola, Brazil and China offset a fall in production from the United Kingdom and Norway⁶.

6. BP Statistical Review of World Energy June 2006.

Production figures show trends in oil supply as seen from the past, but to look ahead, we need to take into account existing reserves, which guarantee supply for coming years.

As Illustration 13 shows, the Middle East possesses over 60% of total proven oil reserves. For its part, Saudi Arabia alone possesses 22% of global reserves. In this region, oil reserves have increased considerably over the last two decades.

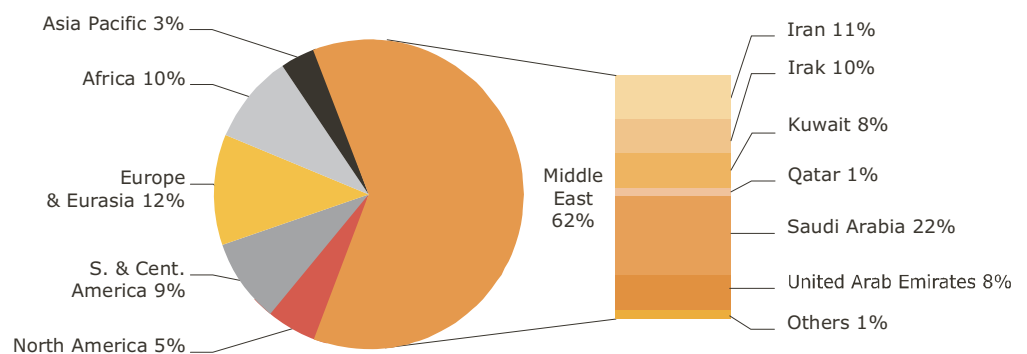


Illustration 13: Distribution of global oil reserves by country.
Source: BP Statistical Review of World Energy June 2006.

In contrast, it should be noted that the oil reserves of the US and Mexico are falling sharply, from 92,000 million barrels in 1985 to 43,000 million barrels in 2005. This represents a fall in North America's relative weight in total world reserves from 13.2% to 5% over the period.

The final significant issue regarding global oil supply is that the ratio of reserves to production (i.e. how long the oil will last at current production rates) seems to be remaining steady at a figure of over forty years. This means that growth in oil reserves is keeping abreast of a continuous increase in output, thanks to new discoveries and technological innovations that allow more oil to be pumped out of already identified reserves.

2.2.2. Natural gas

Natural gas is a mixture of gases found in nature in what are known as "gas pockets"⁷, found alone or alongside oil or coal deposits. Although its composition varies depending on the deposit from which it is taken, it is mainly comprised of methane.

Natural gas has been the fastest-growing source of primary energy over recent years and the greatest increase has been seen in power generation. Combined-cycle gas turbines in power plants offer some of the highest levels of economic efficiency available. In addition, natural gas is also more environmentally friendly, releasing less sulphur dioxide and carbon dioxide than oil and coal.

Demand

At present, natural gas consumption continues to grow, although the growth rate appears to be stabilising at around 2.5% per year.

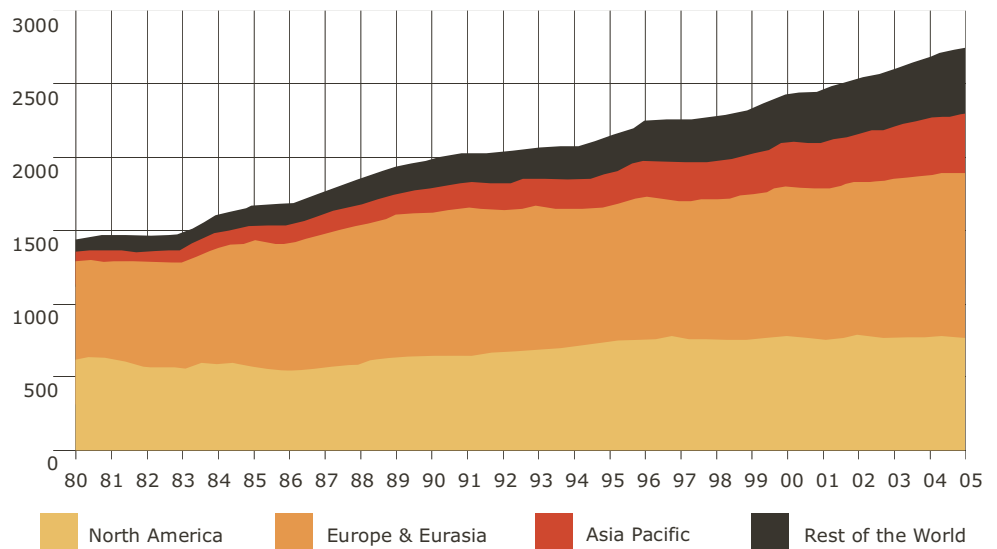


Illustration 14: Global gas consumption by region.
Source: BP Statistical Review of World Energy June 2006.

The regions that consume most natural gas are Europe and countries in the former Soviet Union. Russia, in particular, accounts for nearly 15% of total world demand.

7. Underground geological structures covered by impermeable layers which prevent it from getting out.

For its part, the European Union is promoting the enlargement and upgrading of Europe's natural gas pipeline network. Projects are being carried out to increase the transport capacity between the various networks and thus increase security of supply in Northern Europe; Gas pipelines are being built between North Africa and Spain and France and Italy, with networks of gas pipelines from new sources in Turkey to Greece and Austria⁸.

The US and Canada are the two countries with the highest per capita consumption. Given its size, this means that for example, natural gas consumption in the United States accounted for 23% of global consumption in 2005 (despite the fact that the year saw a 1.5% fall, caused by the effects of hurricane damage).

Between 1995 and 2005, natural gas consumption in the Asia-Pacific region grew by 217.6 billion cubic metres to 406.9 billion cubic metres. The largest consumer was Japan, especially after the nuclear accident of September 1999⁹, which has led Japan to make greater use of natural gas in generating electricity.

Among developing countries, the most important are the two largest, China and India, which respectively account for 1.7% and 1.3% of global consumption.

Supply

World production of natural gas is largely concentrated in two areas, led mainly by Russia and the United States, which produce 21.6% and 19% of the total respectively. Despite this concentration, as Illustration 15 shows, over the last fifteen years there has been greater diversification in natural gas output with a presence in more countries.

8. A European initiative for growth: Investing in networks and knowledge for growth and employment. Communication from the European Commission of 11 November 2003.

9. The accident at the uranium fuel process plant in Tokaimura (Japan) occurred on 30 September 1999, in the plant's conversion facility.

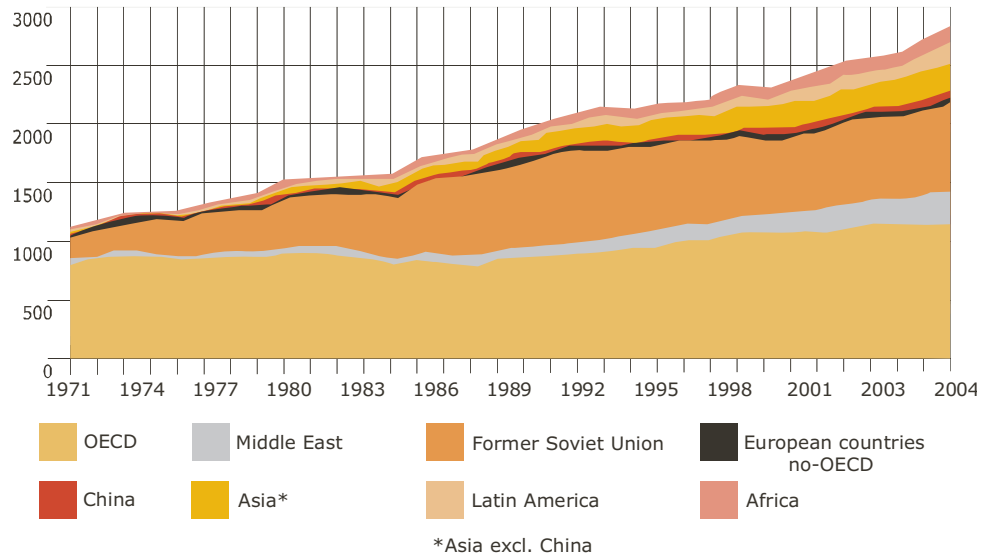


Illustration 15: Global production of natural gas by region.

Source: *Key World Energy Statistics 2005*. International Energy Agency.

China's gas production has grown by over 22%, but it is not the only country in Asia enjoying this growth rate: Malaysia, Myanmar (Burma), Vietnam and Pakistan have all shown consistently high rates of growth over the last ten years, giving the Asia-Pacific region as a whole a 13% share of total global output.

Countries in Africa (especially Egypt and Libya) and the Middle East are also increasing their production to very high rates, of over 25%. In the case of Middle East countries, the capacity to increase gas production, if the necessary infrastructures are developed, is very high, since nearly 40% of the world's natural gas reserves are concentrated in this region (especially in Iran and Qatar, which possess 30% of the world's proven reserves¹⁰).

Russia, with nearly 27% of global reserves, is the largest supplier in the Europe and Eurasia region, and also leads the way in terms of natural gas reserves.

10. Proven reserves of natural gas are the quantities of gas which, with reasonable certainty, can be recovered from known reservoirs under existing economic and operating conditions.

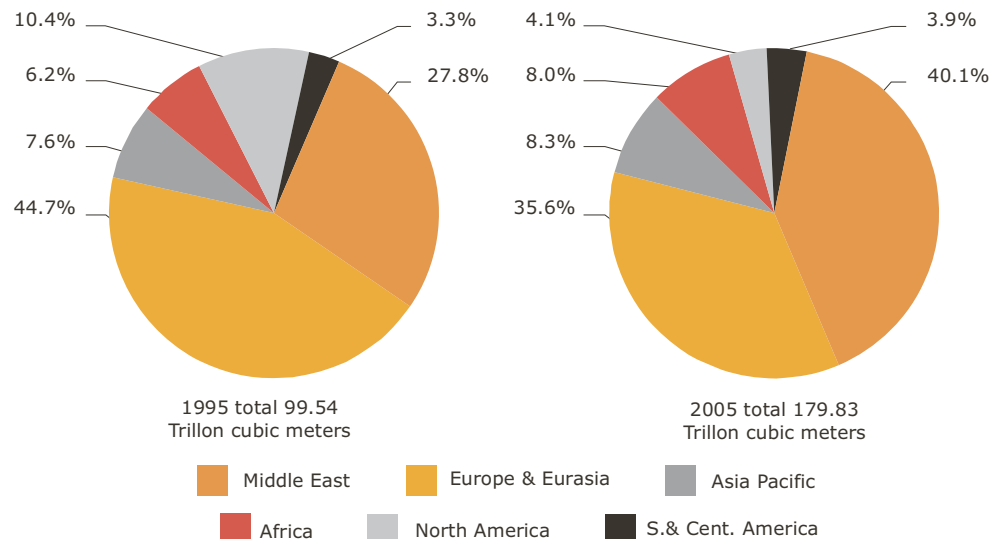


Illustration 16: Proven reserves of natural gas by region.
Source: BP Statistical Review of World Energy June 2006.

Over the last twenty years, thanks to geological discoveries and technological developments, the total volume of natural gas reserves has doubled and the ratio of reserves to production¹¹ has remained constant at over 65 years.

2.2.3. Coal

Coal is the result of the decomposition of onshore vegetable matter, leaves, wood, bark, spores, etc., which accumulate in shallow areas of marshland, lagoons or the sea. The result of the action of the anaerobic bacteria is that the organic matter gradually gains in carbon and loses oxygen and hydrogen. This process, together with increases in pressure and temperature caused by the passing of time, causes physical and chemical changes in the organic remains, turning them into what we know today as coal.

From an economic point of view and in terms of energy supply, coal is a fundamental energy source. There are abundant reserves and market competition keeps prices low and stable. Nonetheless, coal is no longer used in homes (due to legislation as part of the fight against atmospheric pollution) and, more recently, it is being used less for generating electricity, where gas is now preferred.

11. Ratio of Reserves to production: If the reserves remain constant at the end of a year and are divided by the output for that year, the result is the time that those reserves will last if production continues at the same rate.

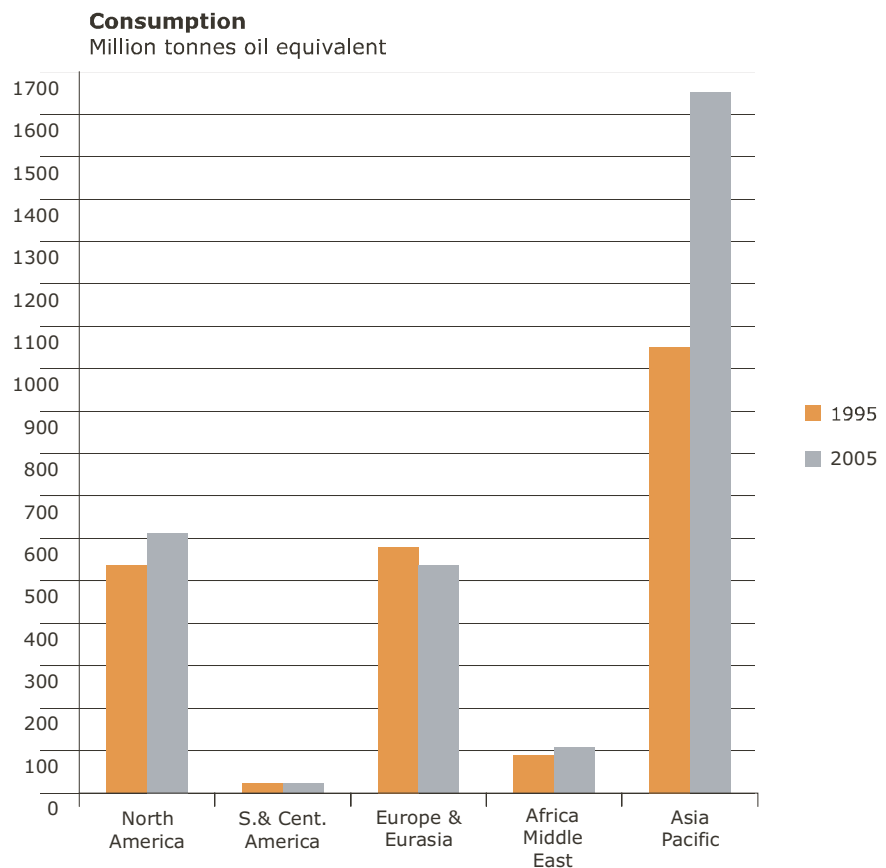


Illustration 17: Global coal consumption by region (1995-2005).
Source: BP Statistical Review of World Energy June 2006.

Of all the coal produced in the world, 64% is used for generating electricity and 30% for industrial purposes. In the industrial sector, the development of the iron and steel industry has always been associated with the use of coal as an energy source.

Supply

Coal production has also rallied very considerably over the last few years. As is the case with consumption, China leads this market both in rates of growth (nearly 11%) and in absolute terms, accounting for 38% of global coal production.

The reserves, however, are more evenly distributed among the different regions and the energy supply powered by this source appears to be guaranteed for at least the next 150 years.

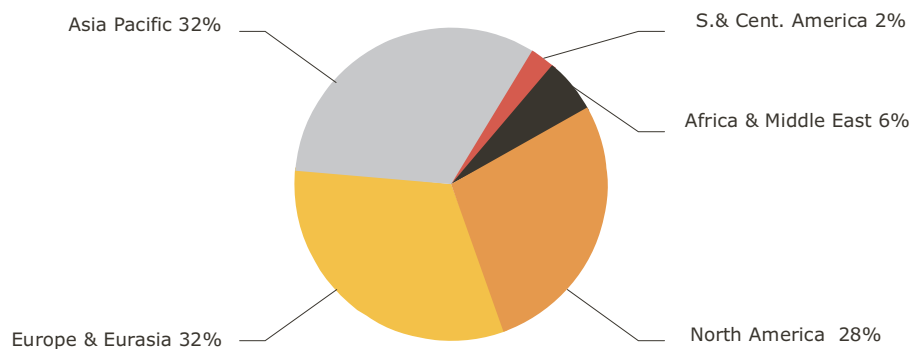


Illustration 18: Proven world coal reserves by region.
Source: BP Statistical Review of World Energy June 2006.

It is important to stress, however that it is not enough to guarantee supply; it is also necessary to curb the environmentally-harmful emissions of coal-burning. There is still a long way to go, both in terms of research and in the application of existing developments.

Chapter 3 will analyse in greater detail the repercussions of fossil fuel concentration in certain areas and the way in which the production capacity of each country does not always match its reserves or its consumption requirements. We will examine different economic, political, social, environmental and technological aspects.

However, let us first examine the other existing sources of energy. Although they do not account for a major share of total energy supply and demand, they should not be ignored, given the inevitable trend towards diversification of energy sources, especially towards less environmentally harmful ones.

2.3. Other alternative energy sources

Although, as was clear from the previous section, the current energy supply is dominated by fossil fuels, there is a range of other energy types which also play a part in the energy mix.

Nuclear energy and other renewable energy sources have to be an alternative for absorbing the increase in demand without increasing the production of fossil fuels, or even reducing their share in total world supply.

Let us now take a look at the current position of nuclear energy and other alternative energy sources throughout the world.

2.3.1. Nuclear energy

Nuclear energy is produced by splitting atoms, thus releasing vast quantities of energy which is used to generate electricity.

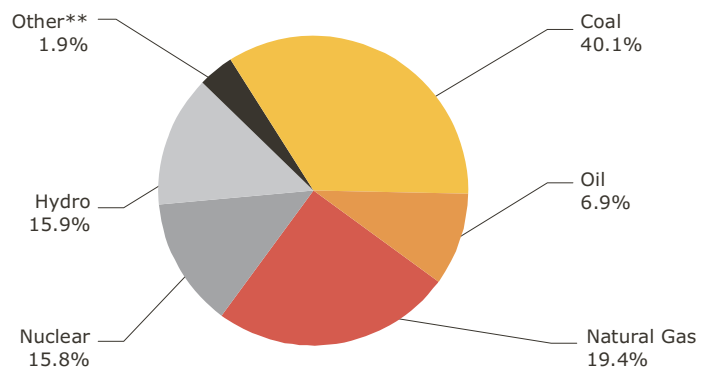
The first commercial nuclear power station was commissioned in Britain in 1956. In 1990 there were 420 commercial nuclear reactors in 25 countries, producing 17% of the world's electricity.

In the 1950s and 60s, this new means of generating power was greeted with enthusiasm, given the small amounts of fuel consumed (just one kilogram of uranium could produce as much energy as 1,000 tonnes of coal). However, in the 1970s and particularly in the 1980s, an increasing number of voices were raised warning of the dangers of radiation, especially in the event of an accident.

The risk of a serious accident in a well-built and well-run nuclear power station is small, but it is true that accidents have happened. The accident at Chernobyl in 1986 made a particularly strong impact, and in many countries majority public opinion turned against the continuation or enlargement of nuclear programmes.

As a result, in recent years the increase in world demand for nuclear energy has remained largely unchanged, with annual average growth standing at around 1.8%. This type of energy is also largely concentrated in a small number of countries: the US (29.6%), France (16.3%) and Japan (10.6%) consume more than half of all nuclear energy generated.

Nuclear energy is essentially used to generate electricity. Illustration 19 shows that it makes a nearly 16% contribution to the world's power generation.



**Others includes geothermal, solar, wind, combustible renewables & waste

Illustration 19: Global power generation by energy source.
Source: Key World Energy Statistics 2005. International Energy Agency.

442 power stations throughout the world currently cover 24% of the electricity production of OECD Countries.

Over recent months, moves appear to be afoot to promote a change in favour of nuclear energy. At the meeting of the G8¹² in mid-July 2006, the main issue on the agenda was security of the energy supply. The meeting concluded that the impetus of nuclear energy might be a possible solution, provided that certain conditions could be met which would guarantee the non proliferation of nuclear weapons.

While these countries are considering the possibility of reassessing the nuclear option, Asia appears to have come out more decidedly in favour of this type of energy production. Thirty-two plants are currently under construction throughout the world, 19 of which are in Asian countries. This region is experiencing strong economic growth and has a high rate of external energy dependency, and as a result it is turning to nuclear energy as a means of diversification.

China, the country in which energy demand is most on the increase, has made a definite commitment to nuclear power and has plans to build 40 new nuclear plants over the next 15 years.

12. The members of G8 are Great Britain, Canada, France, Germany, Italy, Japan, Russia and the United States.



However, the weak points of nuclear power are well known. In addition to the oft-mentioned risk of accident, a nuclear power stations has to two other major drawbacks. On the one hand, money: very large-scale investment is needed to build and maintain nuclear power stations at high levels of efficiency; at the same time, the problem of handling nuclear waste has not been technologically resolved.

This energy source is not, therefore, the final solution for ensuring the energy supply, but might perhaps be a "transition energy", which would help meet electricity demand while renewable energy sources are being developed or until a more definitive technological advance is found.

2.3.2. Renewable energy

"Renewable energy" sources are those which are produced continuously, and which will not be exhausted by human consumption. They are also environmentally sound. This does not mean that they have no negative impact on their surroundings, but that such affects are infinitely less than the environmental impact of non renewable energy.

Table 3 shows the main advantages and disadvantages of renewable energy sources.

Advantages	Disadvantages
<ul style="list-style-type: none"> • They are produced continuously and are inexhaustible. • They do not produce greenhouse gases or other emissions. • They do not generate difficult-to-treat hazardous waste (such as radioactive waste). • They contribute to territorial balance, since they can be installed in rural and isolated areas, and to a reduction in reliance on external supplies, since renewable energy sources are local. • The impact of these energy types is less and more localised, and thus more correctable or controllable. 	<ul style="list-style-type: none"> • Availability of the resource is variable and not always predictable. • Lower energy efficiency. • They have their own particular ecological problems. • Due to their high cost, a small autonomous system is rarely economic, except in isolated situations, when a connection to the power grid would involve higher costs. • The equipment requires a certain degree of maintenance. • Ignorance among consumers and insufficient official promotion.

Table 3: Advantages and disadvantages of renewable energy sources.
Source: Drawn from conclusions within the Future Trends Forum.

Notes

There seems to be global consensus on the need to increase the share of renewable energy sources in the energy mix.

The global supply of renewable energy comes to around 13% of total energy output¹³, and traditional biomass¹⁴ accounts for over 80% of that share. It should be noted that use of this fuel is greater in non-OECD countries. Only 0.5% of the world's total energy is produced by other renewable forms of energy, such as wind, solar power and geothermal power¹⁵. These alternative energy sources are being promoted primarily in OECD countries (66.5% of total production).

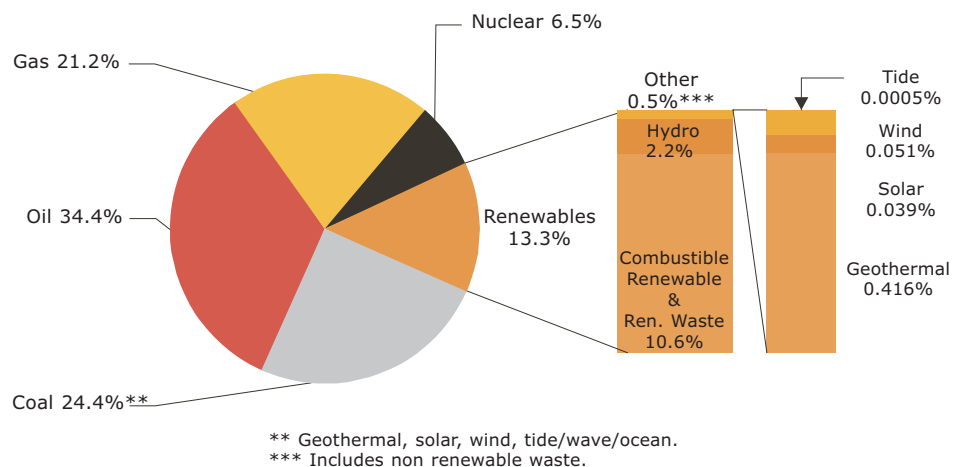


Illustration 20: Global supply of primary energy.

Source: *Renewables in Global Energy Supply*. International Energy Agency.

13. See Key World Energy Statistics 2005. International Energy Agency.

14. Biomass: any available organic substance which can be renewed, such as arable crops and arable waste and residue, wood and timber waste and residue, animal waste, municipal waste and aquatic plants.

15. For more detailed information on renewable energy sources, see the glossary at the end of this publication.

Despite the relatively small share of new renewables as a percentage of the total, it is significant that the growth rate in this area is four times higher than the average increase in the production of the other energy sources mentioned here.

If we make an **analysis by sectors**, renewable energy sources are seen to be most important in the *residential* sector; this is because biomass is the main fuel for heating and cooking in regions such as Africa, Asia and Latin America.

Secondly, renewable energy sources are used for generating electricity: it is here where their contribution is essential and where they may have the greatest scope for development, especially if technological advances occur in the area of geothermal, wind and solar energy. Illustration 21 shows how renewable energy sources are the third source of power generation, ahead of even nuclear energy (thanks to output from hydroelectric stations).

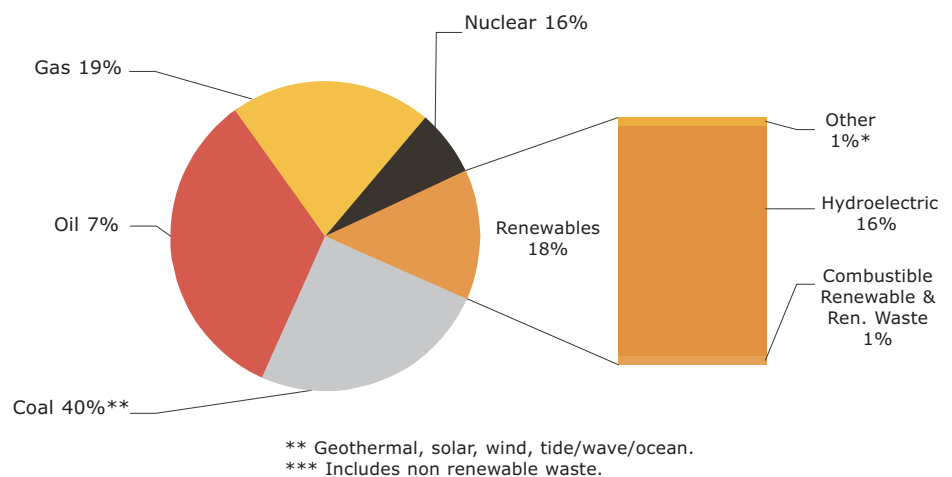


Illustration 21: Renewable energy in power production.
Source: *Renewables in Global Energy Supply*. International Energy Agency.

Although the *transport* industry is not one of the leaders in using alternative energy sources, it deserves a mention, in view of the thousands of column inches newspapers are now beginning to devote to biofuels.

Recent research into the production of biofuels is being carried out as a consequence of various factors, including the development of more efficient conversion technologies, the impetus of government policies and, above all, the rise in oil prices.

The two main biofuels that can be used in vehicles existing are ethanol and biodiesel. Ethanol is mixed with petrol, whereas biodiesel is combined with diesel. Ethanol currently represents 90% of total production of biofuels¹⁶.

Unlike oil refining, which is carried out on a large scale, biofuels are produced in smaller volumes. In addition, output centres more on specific geographical areas. At present, the United States (with corn) and Brazil (with sugar cane) are the two pioneers in the area of biofuels.

16. Biofuels for Transportation. Prepared by the Worldwatch Institute for the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), in cooperation with the Agency for Technical Cooperation (GTZ) and the Agency of Renewable Resources (FNR). June 2006.

These new fuels hold out great hope for coming years, since they could help improve security of the energy supply for some countries and create new economic opportunities for the rural world, while at the same time contributing to the conservation of the environment. They may not offer a definitive solution, but they could help make the transition from fossil fuels to another new technology for powering existing means of transport.