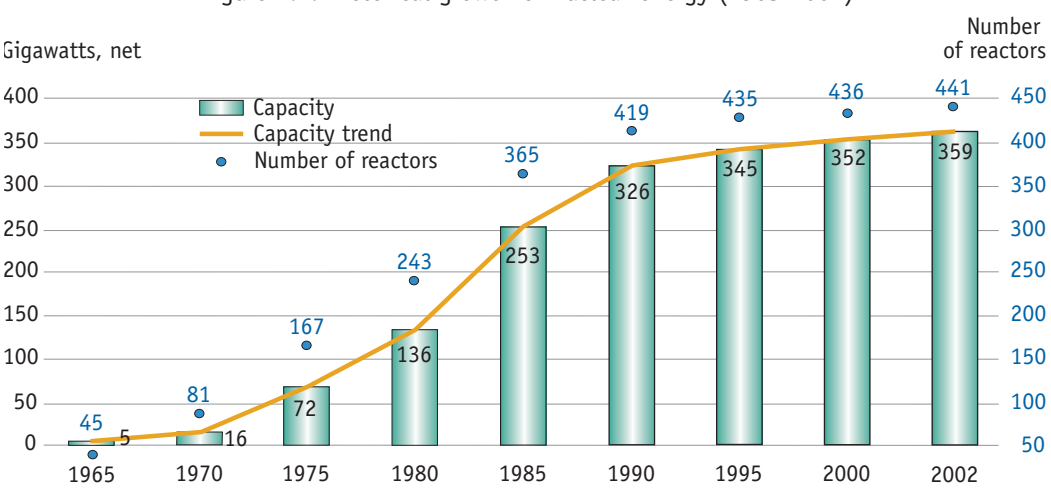
Overview of Nuclear Energy Today

Nuclear energy has grown continuously since its inception – demonstrating increased performance and efficiency – and today is a major source of energy, supplying about 17% of the world's electricity.

Stimulated by the urgency of the Second World War, nuclear science progressed rapidly from the discovery of the neutron by Sir James Chadwick in 1932. Out of this basic knowledge came the discovery in 1939 that when atoms fission (i.e. are split), energy is released. This led in turn to the first controlled chain reaction (1943), the first atomic weapon (1945), and the first production of electricity using nuclear energy (1951). Thus, within a span of twenty years, nuclear energy developed from first principles to practical demonstration.

Following its first application for generating electricity in the United States, nuclear energy began to be applied to the production of electricity in the United Kingdom (1953), Russia (1954), France (1956), and Germany (1961) – five countries within the first decade. Ten more countries began nuclear-based generation in the 1960s followed by another ten in the 1970s. The oil crisis of the early seventies provoked a surge in nuclear power plant orders and construction. Later that decade, the world economic slowdown combined with the declining price of fossil fuels curtailed the growth of nuclear energy demand. As this took effect, two accidents, at Three Mile Island in the United States (1979) and at Chernobyl in the former Soviet Union (1986), raised serious questions in the public mind about nuclear safety. The overall effect was a significant slowing of nuclear energy's growth in the nineties. Nevertheless, some countries continued to push ahead strongly with reactor construction, thus contributing to small increases in nuclear electricity production (see Figure 1.1).

Figure 1.1: Historical growth of nuclear energy (1965-2002)



Source: IAEA.

Sir James Chadwick discovered the neutron in 1932.

Altogether, 32 countries have so far produced electricity from nuclear reactors, amounting to over 10 000 reactor-years of operating experience and generating by the end of the first "nuclear century" over 40 000 Terawatt-hours (TWh) net of electricity. As of 1 January 2003, there were 441 commercially operating nuclear reactors (see Table 1.1) representing an installed generating capacity of about 357 Gigawatts (GWe) net supplying about 7% of the world's total energy and about 17% of the world's electricity (see Figures 1.2 and 1.3). Within the OECD area there were 356 nuclear reactors in commercial operation in 17 countries, representing an installed capacity of some 306 GWe net and producing about 11% of the energy supply (about 24% of the electricity supply). Additionally, 34 reactors were under construction worldwide that will add a further 27 GWe of net capacity.

Figures 1.2 and 1.3 show the high worldwide reliance on fossil fuels in supplying primary energy and producing electricity. The consequent production of greenhouse gases, which cause changes in the world's climate, is a main cause of the growing emphasis on "decarbonising" the world's economies. Concern for the security of energy supply arising from the concentration of oil and natural gas resources among relatively few suppliers is also an element of reflection in national energy policies. Nuclear energy's lack of carbon emissions and the relatively uniform availability of fuel resources worldwide are focusing attention on its ability to meet these energy policy objectives.

Table 1.1
Operable reactors by country
(as of 1 January 2003)

Country	Number of reactors
United States	104
France	59
Japan	54
United Kingdom	33
Russian Federation	30
Germany	19
Republic of Korea	18
Canada	14
India	14
Ukraine	13
Rest of World	83
Total	441

Source: IAEA.

Figure 1.2: World primary energy supply by fuel, 2000
(in percentage)

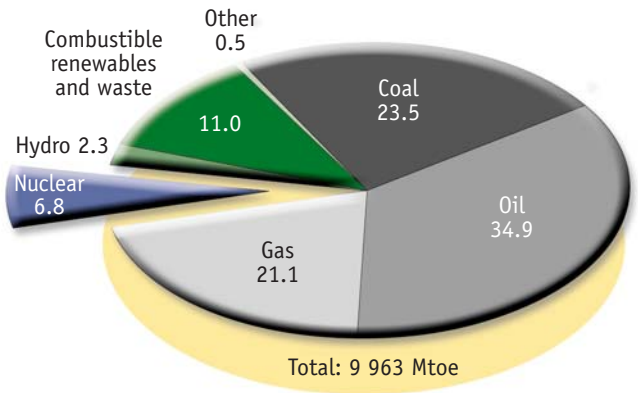
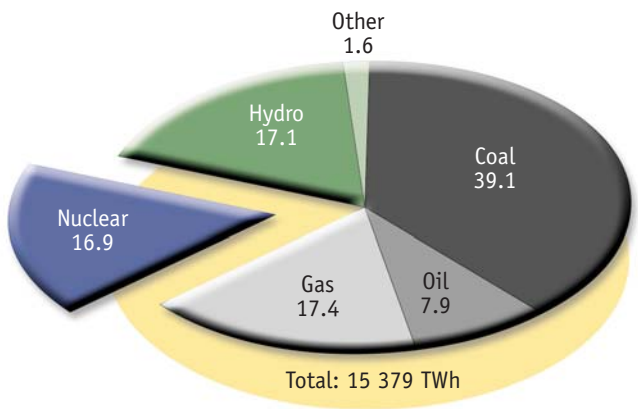


Figure 1.3: World electricity generation by fuel, 2000
(in percentage)



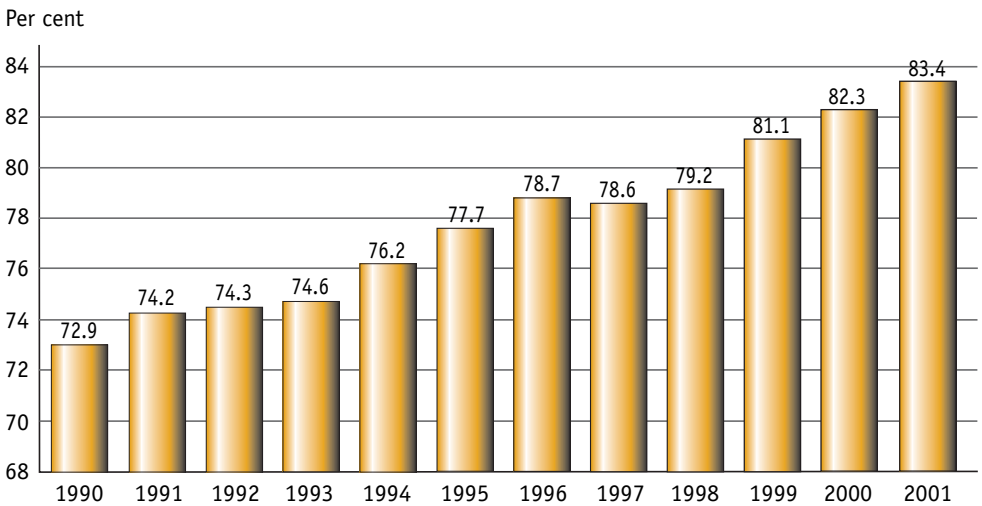
Source: International Energy Agency.

Over the last decade, there has been a trend of improving nuclear plant performance measured by energy availability. This has led, in recent years, to many countries generating record amounts of electricity (see Figure 1.4). For example, the countries experiencing record generation performance during 2001 include Argentina, Brazil, Bulgaria, Finland, France, Germany, India, the Republic of Korea, Russia, Spain, Switzerland and the United States.

Yet despite its maturity, widespread usage and steady progress, compared with other energy sources, nuclear energy has a level of governmental involvement and public concern that makes it unique among energy sources. Many factors contribute to this, including its military origins and potential to be applied to weapons purposes, technical complexity, the long-term implications of nuclear waste, its complicated safety, legal and insurance requirements, the consequences associated with potential accidents, the health effects of exposure to ionising radiation and the large-scale investments required for its exploitation. Understanding these issues is important, then, to understanding nuclear energy today.

The first sustained atomic chain reaction occurred on 2 December 1942 in Chicago, Illinois, under the direction of **Dr. Enrico Fermi**.

Figure 1.4: Worldwide nuclear power plant energy availability factor (1990-2001)



Source: IAEA, Power Reactor Information System.

The energy availability factor is the percentage of maximum energy generation that a nuclear power plant is capable of supplying to the electricity grid and is a measure of operational performance.

For further information

See the references listed below provided in the "For Further Information" section for more in-depth information on:

- The numbers and types of reactors worldwide along with related information, updated annually, see 1.1 and 1.2.
- Estimates of energy supply and demand by region and fuel type, see 1.3, including projections of the near future, see 1.4.
- A general discussion of nuclear energy's role and related issues within the OECD, see 1.5.