

ENERGY



Steady supplies of energy are essential for modern life. Developed countries use large amounts but waste much through poor insulation and inefficient equipment. Stable supplies are vital for information technology, transport and manufacturing so vulnerability to interruptions increases. All methods of producing energy have environmental impacts. As demand increases, reduction of waste and security of supply become important.

The World economy depends largely on oil and natural gas. Significant reserves remain. More are being found. But that will not continue indefinitely and increasing demand depletes reserves more quickly. Most is extracted through boreholes from natural accumulations deep underground. Oil is also distilled from oil-shales but surface quarrying causes local environmental impacts. Oil and gas are transported by sea and through long-distance pipelines. Disruption can cause serious pollution or accidents. Large-scale underground storage facilities can provide security against disruptions of supply.

Coal seams are geologically and geographically widespread. Buried plant materials subjected to increased pressure and temperature break down to carbon. Some form nearby pure carbon (anthracite) but significant amounts of impurities remain in most. These include sulphur which causes polluting emissions when burnt. Methane trapped within coal seams can also be tapped for energy. Peat (remains of marsh vegetation preserved in acidic waters) is sometimes abundant enough to supply power stations. Because of its association with wetland habitats, there is opposition to peat extraction on nature conservation grounds.

Methane gas under great pressure in the deep ocean floor combines with water to form solid gas hydrates. Brought to the surface, these form usable gas. The extent and environmental sensitivity of these resources are being explored.

Combustion of oil, natural gas, coal, coal gases and peat produces carbon dioxide emissions that affect global climate. Research to produce hydrogen from fossil fuels may provide cleaner power from fossil fuels. Carbon dioxide can be pumped deep into the ground and stored, but that is at the experimental stage. Other emissions, such as sulphur dioxide, can be removed by chemical treatment of fumes.

Nuclear energy is reliable, without carbon emissions, but widely opposed because of accidents at some plants and problems of dealing with radioactive wastes. Even when properly stored, these remain a long-term hazard. High decommissioning costs and dealing with wastes make nuclear power relatively expensive. Mining and processing of uranium ores, and reprocessing of spent fuel, also cause environmental hazards.

Heat from the Earth's interior flows towards the surface. The rate is highest in volcanic areas. Geothermal energy is tapped by extracting natural hot water, or by pumping cold water into the ground to heat up. It is a steady, cheap source where heat flow is strong but marginally economic where heat flow is moderate. Extracted water contains dissolved minerals and is often acidic and must be recycled.

Strongly flowing water is a good source of clean power. Dams confine large lakes. Controlled release of water through turbines generates hydroelectricity. However important wildlife and cultural area may be flooded and long-established communities displaced. Lakes may silt up, reducing capacity, and requiring expensive dredging. Flooding can be caused down-stream by poor design, maintenance and management. Small hydroelectric facilities can contribute usefully to local electricity supplies.

Energy from waves and tides is tapped through submerged turbines. These must be carefully located to exploit the source efficiently without being navigational hazards.

Wind turbines can provide clean energy but the rate fluctuates with the weather. Large arrays are needed to replace a single conventional power station. Facilities may damage bird populations and can be navigational hazards at sea or through disturbing radar systems. Marine facilities may also affect water and sediment circulation.

Solar cells are a good clean source in sunny areas but less reliable elsewhere. Small facilities such as panels on houses providing internal heating are particularly useful.



There is growing interest in cultivating crops for energy production but even a modest power station needs large cultivated areas, with implications for land use and biodiversity. Burning produces emissions of carbon dioxide but these cancel out because new crops use equivalent amounts of this gas. In some countries, alcohol has long been produced from sugar to power vehicles. A wider range of crops, including palm oil and soya are now grown for energy and in some areas this has led to a local decline in food crop production. Wood is commonly used as fuel in developing countries but increasing population leads to widespread loss of woodland and consequent erosion of the ground.

Where commercial and domestic waste is incinerated it is sensible to use the resulting heat. However incineration needs careful management since, at certain temperatures, emissions of harmful dioxins can occur. Also gas from landfill sites can be collected and used.

If fossil fuels remain cheap and readily available, incentives to use alternatives are limited. A carbon emissions trading scheme has been developed to encourage industry to reduce consumption. Renewable sources will only meet part of total demand for some time to come. Many of these cannot supply continuously, therefore storage is an important issue. Energy can be stored at times of low daily or seasonal use and used when demand rises. Storage can be in the form of hot water in the ground, or by pumping water to higher levels and then running it down through turbines when the need arises. However local circumstances may give specific advantages to solar or small-scale hydroelectric power especially where it is difficult to supply by cable. In general, a mix of facilities will be needed. But if supplies are inadequate it is likely to be necessary to use nuclear power despite public concerns.



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