Nuclear power

A nuclear reactor is a machine in which nuclear fission reactions take place, producing energy. The **fuel** of a nuclear reactor is typically uranium-235.

The reaction is self-sustaining, therefore it is a **chain reaction**. The neutrons produced can collide with other nuclei of uranium-235, producing more fission, more energy and more neutrons.

For the chain reaction to get going, a **critical mass** of uranium-235 must be present (about 15kg for uranium-235). The neutrons produced in the fission reactions are much too fast, and so they must be slowed down before they can initiate further reactions.

Neutrons slow down through collisions with the atoms of the **moderator**, the material surrounding the **fuel rods** (the tubes containing uranium). As the neurons collide with moderator atoms, they transfer energy to the moderator, increasing its temperature.

A **heat exchanger** is therefore needed to extract the heat from the moderator. This is done with cold water that circulates in pipes throughout the moderator. The water is turned into steam at high temperature and pressure, which produces electricity by turning the turbines of the generator.

Control rods absorb neutrons when too many are present thus decreasing the rate of reactions. If the rate of reactions needs to be increased, the control rods are removed.

The greenhouse effect

The **greenhouse effect** may be described as the warming of the Earth caused by infrared radiation, emitted by the Earth's surface, which is absorbed by various gases in the Earth's atmosphere and is then partly re-radiated towards the surface. The gases primarily responsible for this absorption (the **greenhouse gases**) are water vapour, carbon dioxide, methane and nitrous oxide. The result is that the atmosphere traps heat and causes the temperature of the planet to rise. The **resonance** allows the gas to heat up.

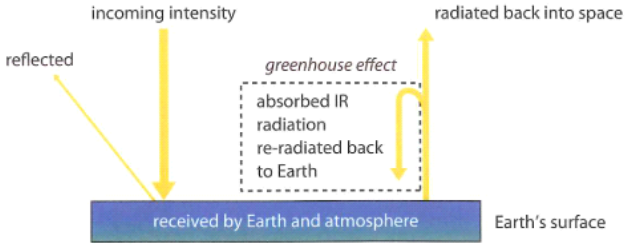

Figure 8.21 A simplified energy flow diagram to illustrate the greenhouse effect.

The greenhouse effect is thus a *natural* consequence of the presence of the atmosphere. The *enhanced* greenhouse effect refers to the additional warming due to *increased quantities* of the greenhouse gases in the atmosphere. The increases in the gas concentrations are due to human activity.

Greenhouse gases in the atmosphere can be natural as well as man-made (anthropogenic). There are 'sinks', which are mechanisms that reduce these concentrations.

Greenhouse gas	Natural sources	Anthropogenic sources
H_2O	evaporation of water from oceans, rivers and lakes	irrigation
O_2	forest fires, volcanic eruptions, evaporation of water from oceans	burning fossil fuels in power plants and cars, burning forests
CH_4	wetlands, oceans, lakes and rivers, termites	flooded rice fields, farm animals, processing of coal, natural gas and oil, burning biomass
N_2O	forests, oceans, soil and grasslands	burning fossil fuels, manufacture of cement, fertilisers, deforestation (reduction of nitrogen fixation in plants)