

# NUCLEAR

## WHAT IS NUCLEAR ENERGY?

Nuclear energy is the energy that binds the protons and neutrons together in the nucleus (core) of an atom. Sometimes, a big nucleus splits into two smaller ones, releasing energy in the process. This process is called nuclear fission. The energy released is converted into heat, which can be used to drive a turbine and generate electricity. In other situations, two small nuclei may join together to make a bigger one. This is the process of nuclear fusion. Nuclear fusion takes place inside the sun, releasing the energy we know as solar radiation (ultraviolet light, daylight and infra-red radiation).

## HOW IS ELECTRICITY GENERATED FROM NUCLEAR ENERGY?

The essential parts of a nuclear power station are the reactor, which contains fuel rods, coolant, control rods and shielding; a heat exchanger; a turbine; and a generator.

All nuclear power stations currently operating in the world use the process of nuclear fission, and most use uranium as their main fuel. Uranium is quite a common metal found in rocks around the world. Natural uranium is made up of two kinds of atoms, U-235 and U-238, but only U-235 is used in nuclear power plants. When the nucleus of a U-235 atom is hit by a neutron, it splits into two smaller nuclei, and in the process releases a large amount of energy and more neutrons. The energy is absorbed as heat by the coolant, and then produces steam that drives a turbine and electrical generator. Some of the neutrons hit more U-235 nuclei and so keep the fission process going; the others are absorbed by the control rods.

The fuel is usually uranium oxide in the form of pellets that are packed into tubes to be loaded into the reactor. The pellets are about the size of your fingertip, but each one produces the same amount of energy as 567 kg of coal.

## WHAT ARE THE ADVANTAGES OF NUCLEAR ENERGY?

A nuclear power station uses a steam turbine and generator to produce electricity in exactly the same way as any other thermal power station. However, the heat needed to create the high-pressure steam is produced much more efficiently and without the emission of carbon dioxide or other pollutants that are formed when things are burnt. In this respect, nuclear energy is cleaner and more environmentally friendly than coal-, oil- or gas-fired power stations.



THE GUNDEMMINGEN NUCLEAR POWER PLANT IN GERMANY.  
SOURCE: ENCARTAMSN.COM



## WHAT ARE THE DISADVANTAGES OF NUCLEAR ENERGY?

The process of nuclear fission creates materials that are still radioactive and that will remain harmful to humans and to the environment for thousands or even millions of years. Currently, the only safe way to store such waste is to bury it very deep underground in places that are unlikely to ever be populated.

Accidents at nuclear power stations are very rare, but when they do occur, they can be catastrophic. The best known and most deadly accident occurred at the Chernobyl power plant in the USSR (now Ukraine) in 1986, when a reactor exploded and sent a huge cloud of radioactive material into the atmosphere. The immediate area remains unpopulated to this day, and much of northern Europe was affected by this event. It is impossible to estimate the final damage from such an accident.

Steam coming out of the turbine is also still hot, and so adds heat to the environment.

## HOW IS NUCLEAR ENERGY USED IN NEW ZEALAND?

Because of the dangers posed by nuclear waste and the risk of large-scale nuclear accidents, New Zealand has a nuclear-free policy and so we have no nuclear power stations. However, they are common in many other countries, including Great Britain; France, which generates 80% of its electricity from nuclear energy; and the

United States, which produces the most nuclear energy in the world.

## ACTIVITIES

### ACTIVITY ONE

Debate

Divide the class into groups. Each group selects the advantages or the disadvantages of using nuclear energy. Using classroom resources, the library, and the Internet, groups research their topic and prepare a five minute presentation. Each group delivers their presentation to the class and answers questions afterwards.

### ACTIVITY TWO

Students write down ten key words that they came across in the study of nuclear energy. Create a glossary with the key words and definitions.

## SUPPORTING RESOURCES

- Andy Darvill's Science Site: [www.darvill.clara.net](http://www.darvill.clara.net)
- World Nuclear Association: [www.world-nuclear.org](http://www.world-nuclear.org)
- Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency: [www.oecd-nea.org](http://www.oecd-nea.org)