THE UK NUCLEAR INDUSTRY

HOW IT WORKS AND HOW *YOU* CAN BE A PART OF IT...

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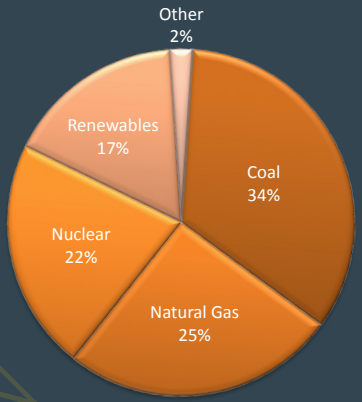
WHY NUCLEAR POWER?

- Nuclear power supplies around 11% of the world's electricity, with an average of around **20%** in the UK
- There are currently over **437** commercial nuclear power stations operating in **30** countries and an additional **67** are under construction.
- In comparison to traditional fossil fuels, nuclear fuel generates millions of times more power, saves billions of tonnes of CO_2 emissions, and causes no air pollution. Unlike fossil fuels, uranium has a much greater shelf-life.
- Uranium is sourced from a range of countries, including many which are not major suppliers of other fuels such as oil and gas. These include Canada and Australia, which account for about a half of the world's known reserves of useable uranium.
- In the UK, we currently have **16** nuclear reactors generating about **20%** of its overall electricity and all but one of these will be retired by the late 2020s. The spent fuel from the current generation of nuclear reactors is recycled for re-use.
- The UK nuclear industry currently employs over **60,000** people involved in a range of activities from power generation to clean-up and construction. This is likely to increase in the years to come as we build new power stations.

UK National Average Fuel Mix 2013-2014



Source: DECC, 2014 Digest of UK Energy Statistics

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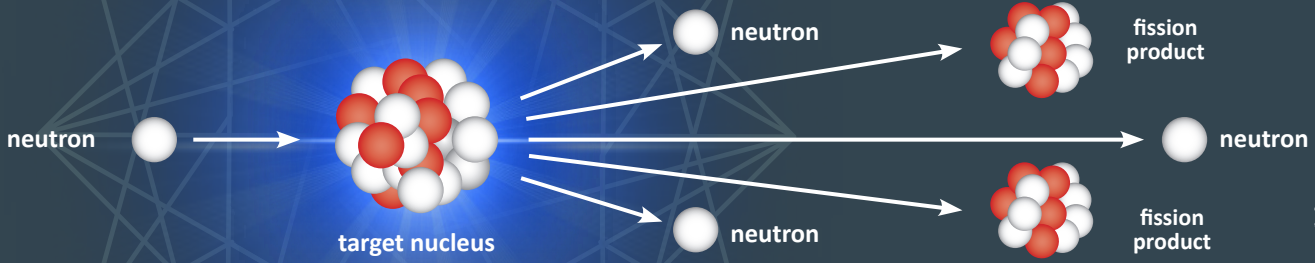
HOW DOES NUCLEAR ENERGY WORK?

- Nuclear energy is the energy that is stored in the nucleus of an atom. This energy can be used by releasing it, either by fusion or, fission. Nuclear Power Plants use fission to make electricity.
- Power plants use the heat given off during fission as fuel to make electricity.
- Atoms of uranium, a common element that can be mined from the Earth, are used in nuclear reactions. It is a cheap and plentiful fuel source.
- In the process called nuclear fission, a tiny particle called a neutron hits a uranium atom; splitting it and releasing two or three neutrons and generating a chain reaction. A huge amount of energy is released during this process as heat. Each of the neutrons which are produced could then hit another uranium atom and cause another fission, thus creating a chain reaction.
- This energy can boil water to create steam, which in turn causes turbines to spin, generating electricity in a power plant.

DID YOU KNOW...?

Nuclear power plants can generate electricity continuously for many months at a time, without interruption.

RELEASE OF SIGNIFICANT ENERGY AS HEAT



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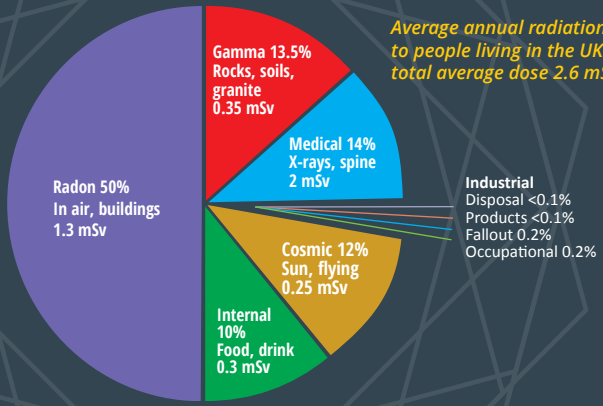
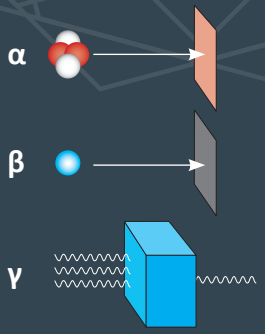
RADIATION... IT'S ALL AROUND US



Average annual radiation doses to people living in the UK: total average dose 2.6 mSv

Ionising Radiation



alpha: fast-moving helium nucleus, stopped by skin or paper

beta: high energy electron, stopped by aluminium plate

gamma high energy: photons, stopped by dense material

- Radiation is the energy that emanates from a source and travels through some material or space. Light, heat and sound are all types of radiation.
- Our bodies are exposed to natural radiation every day – from soil and underground gases to cosmic radiation from the sun and outer space. We're also exposed to radiation from our own inventions – medical procedures, televisions, mobile phones and microwave ovens.
- The ionising radiation is called so as it can produce charged particles, known as 'ions' in matter. Ionisation causes chemical changes in materials, and can affect our bodies and other things around us.
- There are several types of ionising radiation with varying penetrative powers, of which the most important are alpha, beta and gamma (and X-ray). The radioactivity of a substance, or the rate at which decay is taking place, is measured in bequerels (Bq), and the unit which estimates the effect a dose of background radiation has on living matter is the millisievert (mSv).

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HOW DO NUCLEAR POWER STATIONS WORK?

- A nuclear reactor is the centre of a power station where nuclear fission takes place. Pieces of uranium about the size of your fingertip get stacked up in 12-foot-long metal tubes, called rods. These rods form the core of the reactor and ensure that enough neutrons are captured by the uranium to establish a fission chain reaction.
- The neutrons released during fission move so quickly that they tend to bounce off other uranium atoms, so the fuel rods are surrounded by a 'moderator' to slow them down. This is usually water or graphite.
- The amount of energy released inside a nuclear reactor can be controlled by using 'control rods'. These are made from substances such as boron steel and fit between the fuel rods, and can be lowered or raised. The control rods absorb neutrons and lowering them reduces the number of neutrons available to cause fission of uranium. If they are lowered completely, the reactor will shut down.
- The heat energy released by the nuclear fission process is continually removed from the reactor core by a 'coolant'. The coolant flows at a high temperature from the core to a heat exchanger (or 'boiler'), where it converts water into steam, which drives a steam turbine converting the rotation into electricity.

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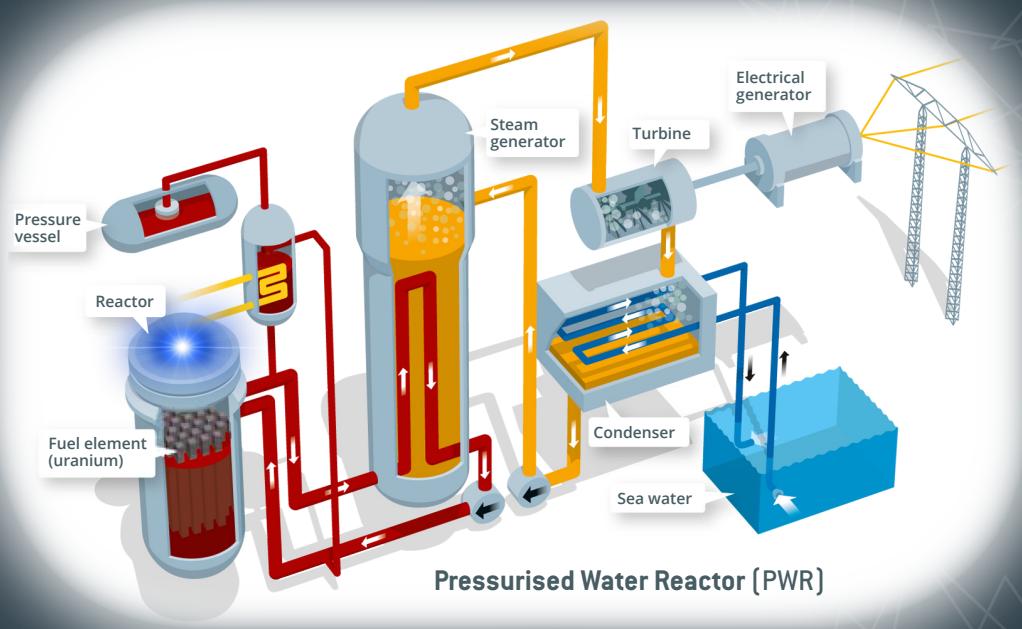
The existing generation of nuclear power stations in the UK are gas cooled with carbon dioxide except the most modern one built at Sizewell B in Suffolk, which is a pressurised water reactor (PWR). The next generation of power stations to be built in the UK will be light water cooled, either pressurised water reactors (PWR) or boiling water reactors (BWR).



Pressurised Water Reactor (PWR)

DID YOU KNOW...?

1 gram of Uranium when undergoing fission in a nuclear reactor gives energy equivalent to burning around 3 tonnes of coal or 2 tonnes of oil

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AN EXCITING TIME FOR NUCLEAR

NEW POWER STATIONS!

- UK Government policy is to support the building of a series of new nuclear power stations in the UK, with the first at Hinkley Point in Somerset.
- Hinkley Point is expected to be online by 2024 and will have two reactors on site. A further nine or ten reactors are planned to be built across another four sites, giving a total of 16GW of new nuclear electricity production by 2030.
- The UK has implemented a very thorough assessment process for its new reactor designs and location, overseen by independent regulators, the Office of Nuclear Regulation (ONR) and the Environment Agency (EA).
- The investment to build these power stations is coming from private utilities and is estimated at more than £70 billion.
- The developers are all using different forms of light water moderated reactors. Some are using a form of Pressurised Water Reactor whereas some have chosen a form of boiling water reactor

DID YOU KNOW...?

Hinkley Point power station is expected to provide up to 25,000 jobs during the lifetime of the project and once built will provide about 900 full-time jobs.

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CAREERS IN NUCLEAR...

Does this sound exciting?
Do you want to get involved?

This is an exciting time for the sector with the creation of many new jobs and opportunities. There is a need for scientists, engineers and many other types of professionals who can;

- design and build nuclear power plants
- help maintain nuclear power stations during their operating lives and
- support the operations of the fuel cycle including 'enriching' uranium to create reactor fuel, turning the fuel into pellets and assemblies for use in the power stations, transporting fuel safely and dealing with used fuel.
- take the power stations apart at the end of their lives, which is called decommissioning. This involves developing underground waste disposal facilities and, in due course, operating these facilities.

There is also a need for specialists who can undertake assurance and ensure regulatory compliance including Quality Assurance, Safety, Environmental and Health Physicists (radiation experts).

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ABOUT THE NUCLEAR INSTITUTE

The Nuclear Institute is the UK membership organisation and professional body for all who work in the nuclear industry. We maintain the standards of professionalismand help the careers of our members through continued learning, networking and professional registration.

Our work in education and training involves offering a variety of services, events and resources for everyone from young people in schools and universities, to professionals, the government and the general public. These events and resources provide information on a range of subjects, such as advice on career pathways; the discussion of technical issues which can advance nuclear science, engineering and technology; and basic information to help public understanding of nuclear sciences and their impact on society and the environment. Some of these activities include STEM outreach to Secondary Education, attendance at engineering/ science fairs such as the Big Bang Fair and a successful Speaking Competition for young people.

The Nuclear Institute offers great networking and professional development opportunities. Holding licences from both the Engineering Council and Science Council, the Nuclear Institute registers Chartered Engineers, Incorporated Engineers, Engineering Technicians and Chartered Scientists.

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USEFUL LINKS

FOR MORE INFORMATION ON NUCLEAR ENERGY AND CAREERS

ORGANISATION	WEBSITE
Nuclear Institute	www.nuclearinst.com
Nuclear Institute Young Generation Network	www.nuclearinst.com/YGN
Nuclear Industry Association	www.niauk.org
World Nuclear Association	www.world-nuclear.org
World Nuclear University	www.world-nuclear-university.org
European Nuclear Society	www.euronuclear.org
NSA Nuclear	www.nuclear.nsacademy.co.uk
Engineering Construction Industry Training Board	www.ecitb.org.uk
Women in Nuclear	www.womeninnuclear.org.uk
Nuclear Graduates	www.nucleargraduates.com
Cogent SSC	www.cogent-ssc.com
Nuclear Careers	www.sciencecareerpathways.com/nuclear-careers
Office for Nuclear Regulation	www.onr.org.uk
UK Nuclear University Network	www.uknuclear.net

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