Nuclear Energy Factsheet

The issues around the generation of electricity through nuclear energy are many and varied, this factsheet is intended to focus on the environmentally-related concerns. It does not cover other, non-environmental issues such as proliferation and energy security. This factsheet is intended to be informative only and the IES expresses no preference for nuclear energy generation or otherwise.

Nuclear energy: a history

Nuclear power has been contributing to the UK energy since 1956[26], when the worlds first commercial nuclear reactor opened at Calder Hall. Although not communicated to the public in that way at the time, it has subsequently been recongnised that nuclear power generation was motivated by the perceived need to provide a nuclear deterrent[1]. Currently there is no formal public subsidy for nuclear energy generation projects[26], although there is much debate about what constitutes a subsidy.

Nuclear power is regulated by the UK Government and the Secretary of State for Energy and Climate Change is accountable to Parliament for nuclear safety at civil sites around the UK. The Health and Safety Executive is responsible for making sure there is adequate health and safety regulation for the nuclear industry. The Office for Nuclear Regulation is responsible for regulating safety at nuclear sites in the UK. The disposal of radioactive waste is regulated by the Environment Agency.

				
The issue	**What the Government says**	**What the nuclear industry says**	**What the campaigners say**	**What the scientists say**
Waste	The UK has a range of laws and regulations to make sure the UK meets its obligations under the Euratom Treaty and other international obligations and standards. As a member state of the International Atomic Energy Agency, the UK also observes internationally agreed protocols on nuclear safeguards and safety standards[2]. Any disposal of radioactive waste requires an environmental permit from the relevant national environment agency.	Nuclear power is the only energy-producing industry which takes full responsibility for all its wastes and costs this into the product[3].	In 2000 the global nuclear industry produced 220,000 tonnes of spent fuel waste. Internationally there is yet to be a feasible, sustainable and safe solution to growing energy demands[4]. The UK has enough radioactive waste to fill the Royal Albert Hall five times over. There's still no safe way to deal with it. The government plans to bury it deep underground - out of sight, out of mind, for now at least. But no one can guarantee that this highly radioactive waste won't leak back into the environment, contaminating water supplies and the food chain[5].	Due to the imprecise nature of long-term climate modelling, facilities for storing nuclear waste must be tested against a range of possible climate scenarios to ensure their integrity in the long term (100,000 – 1 million years)[6].

<table>
<tr><td>Water use</td><td></td><td>When comparing the water demands of nuclear energy generation versus coal-fired plants consideration needs to be given to water use apart from cooling. Often a lot of water is used in coal cleaning and handling in ash removal[22].</td><td></td><td></td></tr>
<tr><td>Accidents / safety</td><td>The Secretary of State for Energy and Climate Change is accountable to Parliament for nuclear safety at nuclear power stations and other licensed civil nuclear sites in the UK. The Health and Safety Executive (HSE) has statutory responsibility for making sure there is adequate health and safety regulation for the UK nuclear industry. The Office for Nuclear Regulation (ONR) is responsible for regulating safety at nuclear sites in the UK. The ONR's licence conditions cover all safety arrangements, including emergency planning and responding to accidents, leaks and spillages of radioactive materials at individual civil nuclear sites[7].</td><td>Nuclear energy has been demonstrated to be safe. The only serious incident in over 30 years was the Fukushima disaster, caused by "an unprecedented tsunami". Even then, and despite massive inconvenience due to evacuation, the lack of human casualties from the accident contrasted with the 25,000 killed by the actual tsunami. There is probably no other large-scale energy generation technology used worldwide with a comparable safety record[8]."</td><td>Climate change threatens the safety of nuclear power stations; many reactors are built on coastal sites vulnerable to the impacts of sea level rise, including flooding and erosion[5].</td><td><table><tr><th></th><th>Accidents</th></tr><tr><td>Coal</td><td>1737</td></tr><tr><td>Oil</td><td>594</td></tr><tr><td>Natural Gas</td><td>224</td></tr><tr><td>LPG</td><td>151</td></tr><tr><td>Wind</td><td>84</td></tr><tr><td>Hydro</td><td>14</td></tr><tr><td>Biogas</td><td>2</td></tr><tr><td>Nuclear</td><td>1</td></tr><tr><td>Geothermal</td><td>1</td></tr></table>
Above is the number of accidents and fatalities for different energy sources between 1970 and 2008[9].

NOTE: This does not include accidents after 2008 including the Fukushima disaster (2011). There were no deaths as a direct result of radiation from Fukushima[10].</td></tr>
<tr><td>Cost</td><td></td><td>Electricity generated from nuclear energy can be competitive with other newer sources of power such as solar PV or wind[11].</td><td>Building enough nuclear power stations to meaningfully reduce global greenhouse gas emissions would cost trillions of dollars[12].

The construction and generating costs of nuclear power are greater than most renewable energy and energy efficiency technologies. Added to these are costs associated with</td><td>Coal remains a cheaper option than gas for generating electricity in many regions, but policy interventions to improve efficiency, curtail local air pollution and mitigate climate change will be critical in determining its longer-term prospects[14]. The future of nuclear will depend in part on carbon taxes implemented at a political level.</td></tr>
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			dismantling nuclear stations and waste disposal. The clean-up costs for the UK's existing nuclear industry and its waste have alone been estimated at up to £100bn. That's £100bn of public money[13].	
Decommissioning	As regulated by the Energy Act 2008, operators of nuclear power stations must be able to meet the full costs of decommissioning a plant[26].	The responsibility for the decommissioning of nuclear plants remains with the operator, including management of associated wastes[15].	After a cooling-off period that could be up to 50 years or longer, nuclear reactors must be decommissioned as do uranium enrichment facilities. The decommissioning period may be twice as long as the reactor's operating life. Nuclear plants typically have a design life of 40-60 years, whereas it might be more than 100 years after closure before decommissioning is complete. Decommissioning costs are difficult to forecast, mainly because the processes have not been proven on a commercial scale. Estimates for decommissioning costs range from an average of $300 million (US dollars) in the US to £1 billion in the UK per 1,000 MW reactor.[16]	Recent studies of a plant in Italy have shown no appreciable increase in radioactivity as a result of the decommissioning process[17].
Climate change	The Government believes that new nuclear power can help the UK secure energy supply and meet its climate change targets[18]. Nuclear energy is unlikely to help provide energy security in the short term as there are constraints on how rapidly replacement nuclear capacity could be built[25].	Nuclear energy is a vital component of a clean energy strategy. Currently nuclear generation avoids the emission of over two billion tonnes of carbon dioxide each year. Nuclear energy can address the competing needs for greenhouse gas emissions reduction, economic development and energy security. A wider deployment of nuclear power will reduce the cost of achieving emissions reductions, and increase the chances of meeting our climate change objectives[19].	New nuclear power stations would not stop climate change. Even at the most optimistic build rate - 10 new reactors by 2024 - our carbon emissions would only be cut by four per cent: far too little, far too late[5].	Any study of emissions must take into account the full lifecycle analysis of the plant as most of emissions are caused in the upstream and down-stream processing stages[20].

Ecosystem health		Scientific studies have shown that aquatic life mortality at the water intake point are not significant because it represents only a small proportion of the overall population (roughly one per cent)[21]. Technical solutions (such as fish screens) can effectively mitigate many of these impacts[22]. In a nuclear plant the water used for cooling is not polluted ("beyond some minor chlorination")[22].	'Clean up' of nuclear projects is projected to cost more than US$300 billion through the year 2070, and even then the contaminated sites will require monitoring and stewardship into the far future. Some plutonium isotopes have very long half-lives. The burial of radioactive materials is presently being touted as the 'solution' to radioactive waste 'disposal'. The burial of these materials must not be confused with their safe containment and isolation from the environment. Currently there is no solution to the problem of radioactive waste; there are no technologies that can clean up radiation[23].	The temperature increase in bodies of water, caused by the outflow of cooling fluid, can have serious adverse effects on aquatic life. Warmer water carries less oxygen than cold water therefore discharge can cause a 'temperature squeeze' that elevates the metabolic rate of fish[24].
Low carbon emissions	The emissions associated with nuclear energy generation are relatively low with an average value of 4.4tC/GWh compared to 243tC/GWh for coal and 97tC/GWh for gas[25]. Nuclear power is "low-carbon, affordable, dependable, and safe"[26]	The life cycle emissions from nuclear energy generation are comparable to other non-emitting sources of electricity such as wind, solar and hydropower[27]. Nuclear energy has "one of the lowest impacts on the environment of any energy source because it does not emit air pollution, it isolates its waste from the environment and requires a relatively small amount of land"[27]. Nuclear power plants do not emit any carbon dioxide, nor any sulphur dioxide or nitrogen oxides. Their wastes end up as solids that, though requiring careful handling, are very much less than the wastes from burning coal and are easily managed[3].		From a GHG emission perspective nuclear power plants (i.e. LWR) are very attractive since they have a huge GHG life-cycle reduction potential when displacing fossil fuel fired power plants, as well as the ability to provide electricity generation services similar to most fossil fuel based energy technologies[28].

Annex: Plans for more nuclear generation in the UK

A spanner in the works?

The European Commission published a critique suggesting that the EDF deal agreed for a new nuclear power station constitutes illegal state aid.

In particular the commission has two objections:

1. The UK could reduce emissions to the same extent, and at the same rate in other ways; and
2. It is concerned that by subsidising Hinkley Point, alternative energy technologies that could help the UK reduce emissions – such as wind and solar – could be unfairly crowded out[29].

	What the UK Government says	Why the European Commission objects
	The Hinkley Point nuclear plant will help the UK, and the EU, reduce their greenhouse gas emissions.	It's not clear that the UK needs more nuclear power to do this – renewable energy could do the same job
Security of supply	The Hinkley Point nuclear plant will help secure energy supply for the UK and EU.	The Hinkley Point power plant won't come online until 2023, so the UK must be making other plans to help supply. The UK has underestimated the extent to which the European interconnection will help secure supply.
Competition	As the new nuclear plant will help the EU achieve its broader goals, it should be allowed to receive state aid.	Nuclear is not an 'immature' technology, so doesn't qualify for state aid. Other Government policies make nuclear power an attractive investment, so Hinkley Point could be built without additional state aid. New nuclear plants have been built in other EU countries – such as France and Finland – without state aid, and it's unclear why the UK market is any different.

Global attitudes towards nuclear power post-fukushima

Global attitudes to nuclear energy changed after the Fukushima disaster. The world had been heading towards 'nuclear rennaissance' but countries are now much more cautious about expanding their nuclear programmes. For example Germany is intending to phase nuclear out completely by 2022. Similarly, the Swiss parliament has decided that currently-operational reactors will be allowed to remain open until they are due to be decommissioned but no new reactors will be built[30]. Having said that, many countries are now turning to nuclear power - such as Vietnam and Jordan - and stills others are expanding their programmes - such as Russia, China and Argentina.

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