Is it in the interest of the United Kingdom to develop a new generation of nuclear power stations?

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Introduction

Background

The global situation not only confronts us with deep social and environmental challenges, but we have also reached a junction, from which choices made this decade, could take us to very different destinations, with outcomes that could range from being a success, to being catastrophic. The question of whether, or not, the UK develops a new generation of nuclear power stations, is one such choice that is soon to be made.

Increasingly, it is acknowledged that climate change is one of the greatest threats facing humanity and the UK government recognises the urgent need for action. Nonetheless, whilst the government has a domestic target of a 60% reduction in carbon dioxide emissions by 2050, it concedes that it is not even on track in meeting it's earlier target of a 20% reduction by 2010 (a target that is in addition to it's Kyoto target of a smaller 12.5% reduction by the same year). (DTI/DEFRA, 2005)

Coupled with this is the fact that whilst nuclear power is viewed as being a low-carbon means of generating electricity, there are only thirteen nuclear power stations still operating in the UK, with two of these scheduled to close in 2006, and with just one still expected to be in operation after 2023 (New Economics Foundation, 2005, p.27). Given that in 2004 nuclear power contributed 19.4% of the UK's electricity supply (Nuclear Technology Review – Update 2005, p.5), the question faced is, what will substitute the energy currently supplied by these thirteen existing stations as they reach the end of their lifetime, whilst assisting the government with meeting its domestic targets for carbon dioxide emissions reduction.

Thus, there are three tightly connected issues. Firstly, there is the threat of climate change; secondly there is the task of meeting domestic reduction targets for carbon dioxide emissions; and thirdly there is the gradual disappearance of nearly all of the existing nuclear power input over the next 18 years, representing an energy gap equivalent to just under 20% of the UK's electricity.

It is thus unlikely to be coincidental that the nuclear debate is currently intensifying in the UK. Strong feelings associated with this debate were demonstrated in November 2005, when activists disrupted a speech given by Tony Blair in which he launched an energy review, demanding a ten-minute slot in which to add their perspective on nuclear power (BBC News, 2005). Also, at numerous climate meetings in the UK, shortly before a national climate demonstration in December 2005, audiences repeatedly raised the nuclear question.

With strong feelings, a public keen to find answers, the great challenge of climate change, and a public consultation likely soon, it is vital that the issue of nuclear energy is better understood and this is the motivation for producing this paper.

Overview

In attempting to answer the question raised, this paper firstly examines the potential value of nuclear energy to reduce carbon dioxide emissions. Uncertainties over uranium reserves are then discussed which leads to a look at the time needed to develop a new generation of power stations. Following this, the cost-efficiency of nuclear energy is explored. This leads to an examination of nuclear waste disposal and the risks associated with it. National and global security is also considered in this paper to be an essential part of UK interest and hence the threat of terrorism and nuclear weapons proliferation is brought into the discussion. Finally, the different parts of the paper are brought together to reach a final conclusion.

The Question of Greenhouse Gas Emissions

Greenhouse Gas Emissions from the Nuclear Chain

Although the process of electricity generation from nuclear power stations is widely agreed to be carbon-free, it is becoming common knowledge that there are, however, emissions associated with energy from other parts of the nuclear chain. This subsection draws on estimates of these emissions relating the figures to those from other energy technologies. Whilst additional factors would also need accounting for (see next subsection), as will be seen, evidence drawn out here places nuclear as a currently 'low-carbon' technology competitive with wind.

As pointed out by Green (2005, p.22) of Friends of the Earth, Australia, processes in the nuclear chain associated with greenhouse gas emissions include: uranium mining, milling the ore, conversion and enrichment, reactor construction, reactor refurbishment and decommissioning, waste management, and the transport of materials, including between continents.

There is however considerable variation in estimates of what the emissions from these other processes are. Green points out that estimates range from 2 to 60g of CO2 (equivalent) averaged out over each kWh of electricity generated.

A 1997 study (cited in Ward, 2005, p.9), carried out by the Oko Institute in Germany, puts the figure for nuclear power at 35g CO2 equivalent/kWh, much lower than the figure provided for gas (400g) and coal (1, 000g), only slightly more than for hydroelectric power (33g) and almost double that of electricity from wind energy (20g).

Another study, (Spadaro et al, 2000), estimates nuclear energy to produce emissions ranging between 9.2 to 20.9g CO2eq/kWh. The study estimates emissions from wind energy from the UK (and Belgium) coast to be at the low end of the nuclear range (9.2g CO2eq/kWh). A higher value is estimated for wind turbines inland in Belgium at 27.9g CO2eq/kWh, and no estimate given for those inland in the UK. In comparison, emissions from fossil fuels, as in the previous study, are much higher than for nuclear energy.

Depending on the local conditions considered, it is inevitable that predictions of carbon dioxide emissions from different energy sources will vary in different studies. Nonetheless, the above evidence suggests relatively low carbon emissions from nuclear power, especially relative to fossil fuels and at least in the second study, competitive with wind energy, even in the UK, the windiest country in Europe. This being said, there are wider issues that also come into play, and these will now be discussed.

When ores become poor

Whilst greenhouse gas emissions arising from nuclear energy production may be relatively low now, it appears that the issue of ore quality will enter strongly into the equation in the future. As good quality uranium ore becomes depleted over time, this will mean the necessary use of poorer quality ore, (assuming lack of an alternative viable nuclear fuel), if nuclear power is still to play a role in generating electricity. Unfortunately evidence suggests that poorer quality ores will require greater energy input during processing and that this could lead to higher emissions.

The above issue was raised by Leeuwen and Smith (2005a), who point out that CO2 emissions from the milling of uranium ore can vary tremendously. In fact, as a consequence of a variation in the richness of the ore, the difference in carbon dioxide production can be remarkable. Based on a 24 year full-load life for a nuclear plant (the longest operating time expected from current reactors), the minimum level of carbon dioxide emissions averages out to be about one-fifth that of a gas plant per unit energy. At worst, and especially as the percentage of uranium in the ore decreases to approach 0.1%, emissions from the nuclear chain begin to rapidly increase. At about 0.01% richness, emissions begin to reach and exceed that of a gas powered plant.

Thus in order to reduce greenhouse gas emissions, nuclear power whilst viable in the short term, in the long-term may hinder rather than help. Indeed, as will be discussed later when discussing uranium reserves, other obstacles in sustaining nuclear energy may also arise, possibly again in relation to uranium ores.

The socio-economic context

In the New Economics Foundation's (NEF) report (2005, p.31) reference is made to the UN's IAEA's 2004 review of the nuclear sector. In this review (IAEA, 2004, p.8) a 'low' and a high' projection scenario is described for nuclear power expansion (in nation states that are members of the IAEA). The low projection scenario assumes the closing down of old nuclear power plants as scheduled, and the building of no new ones other than those already being built or *firmly* planned to be built. The high projection, assumes that as well as those *firmly* planned, *reasonably* planned and proposed builds will also go ahead.

In the low projection, starting from 2002 as the baseline year, electricity generation from nuclear rises until 2020, and then by 2030, falls to a level just slightly higher than in 2002 as a consequence of old power stations closing faster than new ones being built. In the high projection scenario, there is a steady rise and no fall. However, a highly relevant point picked up by the NEF analysis of this paper, which also opens up a whole new perspective on the nuclear debate is that whilst electricity generated in the high nuclear projection is unsurprisingly greater than in the low (by 50%), the actual proportion of *total* electricity generated by nuclear is in fact less, by 1% (i.e. 11% in the high projection and 12% in the low). The NEF points out that ‘nuclear powers potential relative contribution to reducing greenhouse emissions is even worse under the IAEA’s more optimistic high-growth scenario’, and explains this to be ‘because the model takes account of the fact that in order to pay for a major nuclear building programme there would have to be high economic growth, which would still largely be powered by even faster growth of fossil-fuel use.’

Elaborating further, it would be of additional value to gain a picture of energy supplied in both scenarios through all means, as energy supplied through means other than electricity would undoubtedly also be affected. If, this too followed the same pattern, this might indicate an additional increase in greenhouse gases through other avenues such as transport, for example.

Thus, whilst nuclear energy is accepted to be a low-carbon means of generating electricity, the conclusion that increasing nuclear energy output in a given country will mean lower greenhouse gas emissions would be an over-simplification given that the socio-economic environment in which nuclear is most supported to expand, might also feed other forms of activity, that are potentially associated with a greater reliance on fossil fuels.

Further evidence of the importance of taking into account the wider socio-economic context can be seen when comparing greenhouse gas emissions between nations. If having a larger nuclear sector meant lower greenhouse gas emissions, then countries that generate the most nuclear power would have the lowest emissions. However, this is not the case and in fact there is some evidence to the contrary reported in a World Wildlife Fund briefing (2000), that where nuclear electricity production is high, carbon emissions per person, also tends to be high. Whilst France is noted to be an exception, the same briefing draws on a study carried out by the French National planning commission looking at different scenarios in France itself, the results of which showed that the most nuclear scenario for France was not in fact the one with the lowest emissions.

The literature examined thus suggest that the expansion of nuclear power might lead to increased *total* electricity generation, and to an extent, this is likely to be drawn from fossil fuels. As it would not be incorrect to assume that increased energy generated is often associated with increased production, nuclear expansion also might also raise questions over resource depletion and conflict, as well as waste issues arising from the increased production.

Uranium Reserves: How long will they last?

A factor that could severely limit the viability of nuclear power over a medium to long-term period is that of uranium reserves. In the absence of necessary technological advances ((e.g. viable fast-breed or fusion reactors), nuclear power could have a life span of at most several decades. Humankind would then find itself in a scenario in which there would be an urgent need to find a substitute to the nuclear energy contribution to global energy supplies. If economic systems and human needs have in the meantime become overly-dependant on this supply, then both could dramatically suffer.

The New Economics Foundation (2005, p.30) quotes IAEA literature estimating known conventional and recoverable uranium resources to last 85 years at a rate of usage in 2002. The NEF also quotes the World Council for Renewable Energy's estimate, which suggests depletion of uranium reserves in around four decades.

Ward (2005) draws on several sources (WISE, 2003; NEA-IAEA, 2004; WNA, 2004) and concludes that there are 3.5 million tonnes of global known recoverable reserves 'which can be extracted at a cost of less than $80/kg', and that this would last about 50 years at the current rate of use. More recently the IAEA's Nuclear Technology Review Update (2005, p.1) draws home the issue of limits in revealing that uranium prices, whilst having remained low and stable for approximately fifteen years, have increased three-fold between 2002 and 2005, from $25/kg to $75/kg. The IAEA explains that production was 'well below consumption for about 15 years' and attributes the recent price increase to 'the growing perception that secondary sources, which have covered the difference are becoming exhausted.'

Leeuwen and Smith (2005b p.21) note once again the influence of ore richness and assert, that with poorer quality ores the increased energy consumption (associated with mining and milling) can become counter-productive. They state that 'at ore grades of 0.02% and lower, the specific energy consumption rapidly becomes prohibitive.' In terms of time period, 'even if the useful uranium resources were found to be much larger than now estimated, the maximal contribution to the electrical energy supply would only satisfy the global demand for several decades.' (p.18) However they also point out that over the last 30 years, they know of no reports of rich and large discoveries of uranium in the open literature, concluding thus that whilst future discoveries cannot be excluded, they are unlikely (p.20-21).

The literature reviewed and described above illustrates the scenario in which humankind now finds itself - that unless technological developments allow a fundamental shift in the type of fuel used for nuclear reactors, dependence on nuclear power for energy will lead to a corresponding vacuum in energy supply within the next few decades, with nothing left to fill it. The faster the expansion of nuclear power, the sooner we will reach this point in time.

The time needed for nuclear development

It is widely agreed that there would be no chance of any new nuclear power stations being operational in the UK for at least about fifteen years. As the Sustainable Development Commission (2005, p.40) points out, 'any decision would need to allow for public consultation, public enquiries for potential sites, and then the long process of plant construction.'

The New Economics Foundation (2005, p.27) makes mention of a 2002 government review stating that the AP1000 (Westinghouse Advanced Passive 1000), viewed as the most likely development would take a minimum of 20 years to develop.

Thus it appears that a total time period of at least 15 to 20 years from the start of a public consultation would be needed before any new nuclear reactors could be built and functioning. Clearly thus, such a time delay in the UK means that new nuclear power stations could not contribute to the government target of a 20% reduction in carbon emissions by 2010. A further concern is that whilst they could theoretically be operational by 2050 and potentially contribute to the 60% target reduction, there is uncertainty as raised earlier, as to whether enough viable uranium will still be available at this time, firstly, in terms of producing a significant net energy output, and secondly, in terms of remaining a low-carbon energy source.

The cost of electricity from nuclear power

In order for nuclear energy to be viable a further factor is cost. This would need to be relatively competitive with other technologies, and in the context of climate change, especially with low-carbon renewable energies such as wind power. With considerable developments taking place, their cost is expected to decrease significantly over time and as it would take at least 15 to 20 years for new nuclear power stations to begin generating any electricity, the comparison between nuclear and other energy sources would need to be projected into the future. This section examines projected cost for electricity generated from nuclear energy, along with some other technologies.

A useful starting point for an initial cost comparison is found in the Cabinet Office's Energy Review (2002). This review includes a projected cost of various energy generating technologies (as well as energy efficiency programs) for 2020. As 2020 is likely to be about the earliest that any new nuclear power station might be functioning in the UK, this projection has a unique advantage for cost-comparison. Much of the above-mentioned information from the Energy Review is compiled within Table 1, below, with an attempt to place the different technologies in order of cost per kWh.

Although large CHP gas comes out 2nd, the cost of gas, as pointed out by the Sustainable Development Commission (2005, p. 40), has increased significantly, and hence the projected figure in the table would need to be correspondingly revised.

As it stands, in table 1, nuclear comes out in eight place, at 3 to 4p/kWh, behind offshore and onshore wind (first place), but in front of wave and solar photovoltaics, the latter predicted to be the most expensive (10 to 16p/kWh).

However, there is controversy as to the authenticity of the figure for nuclear and as the New Economic Foundation (2005, p. 34) point out, the Cabinet Office's figure was an adaptation of figures received from the industry, which proposed an original cost that was slightly lower (2.5 to 3p), and based on very fast learning rates, which the Cabinet Office believed may not be achieved, hence their slightly higher proposed figure of 3p to 4p as in Table 1.

Nonetheless whilst the NEF recognise the validity of the lower limit, they argue that the upper limit for nuclear should be contested further as there is even greater risk. Thus included in their report a stream of variables such as variability in construction time (e.g. the Dungeness B nuclear power station took 23 years to complete instead of 5 years), the higher cost of early reactors and a lower than expected achieved performance, the NEF place the higher limit at 8.3p/kWh.

Table 1: Fuel type and projected cost in 2020 (Cabinet Office, 2002, p.199)

Technology	Cost in 2020 (p/kWh)	Confidence in Estimate	Cost Estimate to 2050	Basis for Assessment
Onshore wind	1.5 - 2p	High	Limited Decrease	Learning Rate and Market Growth Rate
Large CHP (gas)	Under 2p	Moderate	Limited Decrease	Engineering Assessment
Gas (CCGT)	2 – 2.3p	High	Limited Decrease	Engineering Assessment and Learning Rate
Offshore wind	2 – 3p	Moderate	Decrease	Engineering Assessment and Onshore Learning Rate
Micro CHP (gas)	2.5 – 3.5p	Moderate	Sustained Decrease	Engineering Assessment
Coal (IGCC)	3 – 3.5p	Moderate	Decrease	Engineering Assessment
Energy crops	2.5 to 4p	Moderate	Decrease	Engineering Assessment and Learning Rate
Nuclear	3 – 4p	Moderate	Decrease	Engineering Assessment
Fossil generation + CO2 Capture & Sequestration	3 – 4.5p	Moderate	Uncertain	Engineering Assessment
Wave	3 – 6p	Low	Uncertain	Engineering Assessment
Solar Photovoltaics	10 – 16p	High	Sustained decrease	Learning Rate and Market Growth rate

If this figure were used instead, then nuclear would drop from 8th to 10th place, with only solar photovoltaics being more costly. However, the NEF point out that wider risks are not factored into even their calculations such as the cost of terrorism, (which will be touched on later), insurance and accidents.

To summarise, there is dispute over the maximum cost of electricity from potential new nuclear builds in 2020 in the UK, with the NEF raising variables that could lead to a substantially higher cost than the 4p/kWh given by the Cabinet Office. In either case, nuclear energy in 2020 would likely be significantly more expensive than wind, which comes out cheapest of all low-carbon technologies. However, placed in the context of climate change along with a potential lack of low-carbon energy, a contribution from another source would no doubt be welcomed, even at a slightly higher financial cost. Simultaneously, however, there are numerous other issues raised regarding the building of a new generation of nuclear power stations, as this paper as a whole, attempts to address.

Radioactive waste: Still no certainty of a solution

An almost certain but unwanted consequence of developing a new series of nuclear power stations will be the simultaneous production of radioactive waste. Indeed, no solution has yet been found to effectively manage all waste already produced from existing and old nuclear power stations. Unfortunately, neither does there appear to be any likelihood of a viable solution in the near-term. Consequently, radioactive discharges into the air and ocean are likely to continue, potentially affecting human and non-human life, and risks and economic costs of managing solid waste could continue for tens of thousands of years.

Radioactive waste is graded into low-level waste (LLW), Intermediate-level waste (ILW) and high-level waste (HLW). There has also been a recent addition of very low-level waste (VLLW), (IAEA, 2005 p.1) in some countries referring to certain wastes arising out of decommissioning.

Health, radiological exposure and Sellafield

As explained by a DTI briefing (2002), low-level liquid and gaseous waste is treated and discharged under authorisation granted under the Radioactive Substances Act 1993 (RSA 93). Yet, commenting on a report based on research from 2003, the Food Standards Agency (FSA, no date) reveals that the people with the highest estimated radiological exposure in the UK (620 microsieverts) are those living near Sellafield in Cumbria. Whilst Sellafield is also where nuclear reprocessing occurs in the UK, the FSA points out that the level of exposure is below the EU dose limit of 1,000 microsievert. However, the World Wildlife Fund-UK (2002, p.5) refers to a 2001 report called the STOA report, which exposes a link between childhood leukaemia and Sellafield residents, and concludes that radiation exposure from Sellafield cannot be excluded as a cause of this. This would imply that the assumed safe level of exposure might actually require revision.

Worryingly, as pointed out in the same WWF-UK paper (2002, p. 7), there has also been a major accident at Sellafield in 1957, and a series of serious radioactive leaks between 1975 and 1981, whilst in 1999 it was discovered that data had been falsified regarding a shipment of MOX fuel to Japan.

Solid waste

Whilst Greenpeace state that high-level waste (HLW) remains dangerously radioactive for 240, 000 years or more years (cited in Ward 2005, p.15), there is still no guaranteed means to deal with it adequately. Ward (2005, p.15) reports of a technology, which, over the last few decades has been researched to reduce the radioactivity of nuclear waste. Named the ‘transmutation process’ according to Ward, there is still however no guarantee of success although if so, would require billions of dollars and many decades before it could be utilised.

Attempts at developing a deep underground disposal facility for certain solid wastes have failed (DTI, 2002) and currently stored solid waste is kept above ground in specialised storage facilities according to the type of waste.

The evidence to support the probable development of a viable complete solution to managing nuclear waste, whilst possible appears weak. It thus remains an unfortunate aspect of nuclear power that there will most certainly be ongoing costs to ensure safekeeping of waste produced, which would be further exacerbated by a new generation of power stations.

Major Accidents

There have been a number of incidents of nuclear accidents over the years (Ward, 2005, p. 16), the best known being, Three Mile Island, in 1979, and Chernobyl, in 1986, which carried the biggest impact. This section gives an overview of the Chernobyl accident and then looks at the implications of accident risk in decision-making.

The Chernobyl accident occurred twenty years ago resulting in tonnes of nuclear material being released, hundreds of thousands of people evacuated, thousands of deaths and higher levels of mental and emotional disorders in children. In addition radionucleotides released are still measurable in all countries of the Northern Hemisphere, with restrictions in sheep farming in parts of Cumbria, Wales and Scotland. Economically Chernobyl was the most expensive industrial accident in the world. (Energy Choices, "The Chernobyl Accident"; Ma'anit, 2005, p.6).

Fortunately, lessons have been learnt and local and international safety measures taken. For instance, the IAEA Convention on Nuclear Safety, a binding agreement setting international benchmarks and to which the UK is a signatory, was adopted in 1994. (Energy Choices "Could it Happen Again?")

Past accidents can lead to additional safety measures and there has been progress within the nuclear industry and international framework. Equally, however, future accidents cannot be excluded and when they occur can be catastrophic. In addition, new reactor designs also carry new unforeseen risks that are higher with greater nuclear expansion. Hence building a new generation of nuclear stations in the UK increases the likelihood of such a major accident occurring. However, the level of the risk cannot be accurately predicted.

The threat of terrorism and weapons proliferation

Especially following 9/11 and the 7th July London bombings, both the UK and the US governments especially, have been frequently voicing the issue of terrorism and their commitment to dealing with it. This voiced commitment has been a factor in justifying the war in Afghanistan and also, though to a lesser extent, the recent war in Iraq. The UK government has also been keen to bring in domestic policies in countering terrorism such as an extension of the period of detention without trial, and has demonstrated a strong intention to introduce in ID cards. Whilst an objective of this paper is not to examine these measures in terms of their effectiveness, nor to examine the level of threat posed by terrorism, it would only be logical for national security risks to be factored into policy-decision making in other areas and this includes the question of nuclear power.

Whilst this paper addresses the question of nuclear power in the UK, decisions cannot be removed from climate change as a global problem. As noted by Ward (2005, p.16) plutonium-239, a by-product of most nuclear reactors, can be used in nuclear weapons. Following on from this, it thus seems that the presence of nuclear reactors in a country could assist it in covert nuclear weapons production programs. Iran's claim that it's nuclear development program is for energy purposes is disputed and whilst friction between it and the UK/EU is not in the context of climate change, such a scenario with a nation could occur, especially if more countries are bound by climate treaties in future. The question arises as to whether the UK, if having developed a new generation of nuclear power stations, would in such an instance have the moral authority to attempt to deny another country the same means of meeting its CO_2 emission reduction targets. If so, then who should be made to reduce greenhouse gas emissions that this country would now be emitting (if any) as a consequence of this restriction?

A second issue is the risk that a nuclear power station could, like the World Trade Centre, become a terrorist target, the results of which could be catastrophic in terms of life and economic costs.

Thus, building new nuclear reactors in the UK has international implications and presents additional complexities and risks associated with national and global security. Such risks are unique to nuclear power.

Summary and Conclusion

The question of whether or not the UK should build a new generation of nuclear power stations is likely to continue to raise emotive debate. This paper raises a number of issues regarding timeframe, sustainability, emissions reduction, uncertainties, risk of accidents and risks to national security. These issues will now be summarised and concluded on.

Firstly, regarding time-frame, no new nuclear power station is likely to be functioning until about 2020 at the earliest, and hence would provide no contribution in helping the government achieve its target reduction of CO_2 emissions by 2010. Additionally, as action on climate change must be taken urgently, there is a strong argument for giving priority to solutions that can come in place sooner.

The issue of sustainability is unresolved. As better quality uranium ore becomes depleted over time, the poorer ore left, firstly, may need such high-energy inputs for milling that there is no net energy produced, and secondly, given that the energy input may originate from fossil fuels, could exacerbate the climate problem. The longer any delay in developing new nuclear power stations, the greater the depletion.

Evidence examined in this paper demonstrates that there is in actuality no clear link between expansion of nuclear power and reduced greenhouse gas emissions. In fact, future projections and cross-country comparisons show that nuclear expansion can, on the contrary, be associated with higher total electricity output from non-nuclear sources, and thus potentially higher greenhouse gas emissions. This highlights a probable connection between the wider socio-economic system and nuclear expansion. A serious examination and understanding of these dynamics would be crucial in the context of the nuclear question so as not to compound the problem, whilst having the intention of solving it.

An additional issue raised regarding greenhouse gas emissions is that the only contribution nuclear power can supply to energy needs is through electricity, which is only a proportion of total energy supply. Hence even whilst nuclear power was contributing to reduced CO2 emissions it would only be for a limited energy sector. Transport, for instance would be excluded.

With regards uncertainties, depletion of uranium reserves could be overcome with new technologies. The development of new reactors that can utilise an alternative fuel could lead to an extension of the lifetime for nuclear power. However, in the literature reviewed, no clear evidence was found demonstrating that such a technology will exist in a viable form in the future.

There is also uncertainty over whether radioactive waste will be fully dealt with. At present some waste is stored for potentially more than 240 000 thousand years, whilst other types of waste is released into the environment and cannot be excluded as a cause of childhood leukaemia. Unless technological advances are successful (e.g. the transmutation process), a new generation of power stations will exacerbate this ongoing problem.

Regarding accident risk, safety measures have been implemented and the risk of accidents may now be smaller for any given nuclear power station. However, a greater expansion of nuclear power would increase the risk of accidents and new models have a 'first of a kind' risk. In addition the threat of a terrorist strike is an additional factor that is of greater concern in the current climate.

To conclude with, firstly there are risks that are difficult to quantify, for instance risk concerning waste disposal, the risk of accidents, as well as risk of a terrorist strike on a nuclear power station. These risks relate to health and the environment as well as financial costs and to national security. Whilst difficult to quantify, any potential damage stemming from these risks could be catastrophic.

There are in addition more quantifiable problems. For example new nuclear power stations cannot be in place til at least 2020 whilst the climate problem requires urgent action, and there is evidence demonstrating that nuclear power would only be viable (in terms of producing net energy) for a few more decades for the electricity sector alone. Also evidence illustrates that a significant rise in CO2 emissions would be expected from the nuclear chain as good quality ores become depleted in a few decades.

Unless these obstacles can be overcome, a new generation of nuclear power stations will not only fail in contributing to urgent climate change action but would exacerbate it firstly, by not contributing to energy supply until around 2020 whilst directing research funds away from more immediately available solutions and secondly by leaving an energy gap in a few decades time coupled with the problem we are left with of finding something to fill it. Hence at present developing a new generation of nuclear power stations would be against the interest of the United Kingdom.

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