Climate Change and Energy Security

Why Nuclear Power is Not the Answer to the problems of Climate Change and Energy Security

A briefing for the government from
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"Nuclear power needs climate change more than climate change needs nuclear power."

**Walt Patterson, Associate Fellow,
Energy, Environment and Development Programme,
Chatham House, March 2011**

The Headlines

Climate change

1. The opportunity cost of nuclear The massive cost of nuclear power inevitably crowds out investment in alternatives. This is not just an issue of financial opportunity cost: as a 'tunnel vision' on nuclear power takes over, the amount of political space and leadership capital available for promoting energy efficiency and renewables diminishes proportionately.

2. The technical debate: can nuclear and renewables co-exist? Technical issues suggest that renewables and nuclear either compete for the role of base load providers, or require different kinds of grids to operate at their optimum level of efficiency.

3. Is nuclear power really low-carbon? Credible academic analysis of the full Life Cycle shows that nuclear emits many more times the amount of greenhouse gases (GHG) than renewables. Some analysts argue that within the lifespan of the proposed UK programme, uranium will be so rare that mining it will release as much GHGs as efficient gas-burning. There are huge uncertainties in calculating nuclear power's GHG emissions. Any claims that nuclear is 'very low-carbon' should be treated with scepticism – let alone the PR hype that nuclear is a 'zero-carbon' source of electricity. Analysis of the GHG impacts of nuclear disasters (particularly regarding Fukushima) has not yet been done.

Energy Security

4. Peak Uranium? The relatively low concentration of uranium in its ores means that it is energy-intensive to mine and refine. In addition, 40% of global production is in politically and economically unstable countries, making availability (and hence prices) highly unpredictable.

5. Nuclear is not 'ever-ready' Nuclear plants suffer unplanned outages (as do all forms of electricity generation). But the scale of nuclear makes the consequences of these outages much worse and reduces energy security. Meanwhile, distributed grids that are optimised for renewable energy are probably capable of being no more 'intermittent' than conventional generation.

6. Nuclear's 'nightmare scenario' in the UK; there are real fears in the UK that a new nuclear programme might fall apart under the weight of its own contradictions. But whilst it remains the officially preferred option (through planning, build and preliminary operations), the UK Government will have failed to develop any viable alternatives, leaving the UK unable to meet its GHG commitments and even more dependent on imported energy.

1. The opportunity cost of nuclear

"My overriding concern about nuclear power for decades has been its opportunity cost".

Walt Patterson, Associate Fellow, Energy, Environment and Development Programme, Chatham House.[1]

The costs of nuclear new build are extremely high. UK governments, both Labour and the Coalition Government, have made it clear that money for new nuclear must come from the private sector, and yet, despite promising not to, have then gone on to attract private sector investment, thus committing large amounts of public money not available for other energy supply or demand management options.

The scale of both the financial and the political investment required are such that they will crowd out equivalent investment in renewables and energy efficiency. The cost of the new nuclear build that Coalition Governments hopes for is in the region of £50 billion. Since private investors money is to be channelled through energy utilities (either as equity borrowing or simple bank lending), it will come from the same funding pools that other types of energy generation investment would access; part of the opportunity cost of nuclear power is that it will inevitably draw investment away from alternatives.

But it's not just the scale of the investment needed that undermines other possibilities. The massive timescales for bringing nuclear power online are also important - once investment has begun in nuclear, the entirety of the investment must remain in nuclear or be lost. Renewables are much nimbler – if problems occur, the project can be scaled down and still provide some generated energy.

Lastly, there is a substantial political opportunity cost. When governments throw their weight behind a particular course of action, they divert resources from all others. In the past decade, UK governments of both parties have established over three dozen taxpayer-funded quangos and agencies to support the nuclear industry. It is inevitable that the pro-nuclear perspective of these bodies will pervade the thinking of the Civil Service, and of politicians and business investors too. Speaking about Finland's experience with the disastrous Olkiluoto reactor, Oras Tynkynnen, a former climate policy advisor to the Office of the Finnish Prime Minister, said:

"We concentrated so much on nuclear that we lost sight of everything else ... And nuclear has failed to deliver. It has turned out to be a costly gamble for Finland, and for the planet".[2]

The Finnish Environment Minister, Satu Hassi, who resigned over the decision to build Olkiluoto, spoke later of how that choice had undermined energy efficiency policies: "the government said we would invest in renewable energy. It didn't happen".[3] The data show that Finnish greenhouse gas emissions (GHG) were on average over 7% higher in the 8 years following the decision in 2000 to commission Olkiluoto than in the decade before that decision.[4] This is in contrast to a clear majority of EU member states that saw falls in GHG emissions over the same period, including states such as Sweden and Denmark with directly comparable economies and climates. In the words of Greenpeace Nordic Chair, Harri Lammi: *"Finland did not implement energy efficiency measures, for example using heat pumps in heating of houses, like Sweden did".*[5]

But if the Finnish example shows that the 'business as usual' mindset that lies behind the nuclear option distracts attention from energy conservation and renewables, it also shows how the nuclear industry's appalling construction record undermines the claims made for its usefulness in addressing

[1] Changing the way the world works. Walt Patterson. Accessed 10 April 2012 at: www.waltpatterson.org/barca.pdf

[2] Bad Reactors: Rethinking your opposition to nuclear power? Rethink again. Washington Monthly Jan/Feb 2009. Accessed on 10 April 2012 at: http://www.washingtonmonthly.com/features/2009/0901.blake.html

[3] Caught between global warming and an energy crisis: Blair looks north for answers. The Guardian 14 April 2006. Accessed on 11 April 2012 at: http://politics.guardian.co.uk/green/story/0,,1753914,00.html

[4] Finland Carbon Dioxide Emissions. Accessed on 11 April 2012 at: http://emissions.findthedata.org/d/d/Finland

[5] Nuclear energy in Finland - A heated debate. Ovi Magazine, Feb 2008. Accessed on 11 April 2012 at: http://www.ovimagazine.com/art/2683

climate change. As long ago as 2004, the International Energy Agency (IEA) issued a warning to Finland that relying on power from Olkiluoto to meet its obligations under the Kyoto Treaty was a risky strategy.[6] It pointed out that Olkiluoto was scheduled to start reducing Finnish emissions by 7 – 10 million tonnes (Mt) of GHGs annually in 2009 (enabling an average annual reduction of 5-7 Mt in the 2008 -2012 period, as called for by Kyoto), and that any delays would make Finland unable to hit those targets. Since Olkiluoto is not presently scheduled to start producing electricity until 2014 at the earliest, the IEA's warning was prescient.

Forensic academic analysis of the UK nuclear programme has produced similar findings. Professor Steven Thomas argues that:

'However, the main outcome of [the UK nuclear programme of the 1960s] is the huge opportunity cost of these largely fruitless programs. They consumed the vast majority of government and electricity industry research and development budgets, they dominated the attention of civil servants involved with the electricity industry, and they influenced UK industry to try to develop nuclear capabilities instead of more productive and profitable capabilities in renewable energy sources and energy efficient technologies'.[7]

This conclusion is shared by Catherine Mitchell, Professor of Energy Policy at Exeter University.[8]

Meanwhile, the UK Government's Sustainable Development Commission (SDC),[9] Warwick Business School[10] and the Environment Agency[11] have all warned that a decision to proceed with new reactors could seriously undermine the development of a low-carbon energy system. Warwick Business School argues that, far from complementing the necessary shift to a low-carbon economy, the scale of the financial and institutional arrangements needed for new nuclear stations means that they would fatally undermine the implementation of low-carbon technologies and measures such as demand management, and therefore the shift to a true low-carbon economy.

For an example of how this pro-nuclear bias can undermine alternative forms of electricity generation, one need look no further than news reports in March 2012 that the Coalition Government has begun lobbying the European Commission to give nuclear power full parity with renewables.[12] At present, member states are obliged to source at least 20% of their energy from renewables by 2020. But the Coalition Government is arguing that instead of increasing this figure for the next target date, 2030, the obligation should be for 'low-carbon' electricity generation, a move that clearly sets nuclear and renewables in competition with each other for subsidy-led investment.

This demonstrates that the Coalition Government's obsession with the nuclear option has already begun to undermine a critically important Europe-wide renewables policy, with potentially huge consequences for extra GHG emissions in a large number of countries. Moreover, the implications of the policy do not end in Europe - they are inevitably global. Vijay Vaitheeswaran, The Economist's environment and energy correspondent until 2006, says:

'Decisions taken in the next few years about energy in rich countries like Britain and the United States will shape investments made in energy infrastructure around the world for a generation or more. After all, nuclear and coal plants and oil refineries last for decades – and that sunk investment displaces or discourages nimbler, cleaner, and more distributed options like micropower. If we want to shift to a clean, secure, low-carbon energy system during this century, the time to start is now'.[13]

[6] International Energy Agency, Energy Policies of IEA Countries, Finland 2003 review, IEA, 2004. Accessed on 11 April 2012 at: http://www.iea.org/textbase/nppdf/ free/2000/finland2003.pdf

[7] What will be required of the British government to build the next nuclear power plant? Professor Stephen Thomas In, Nuclear Power's Global Expansion: Weighing Its Costs and Risks Edited by Henry D. Sokolski. 2010.

[8] New Nuclear Power: implications for a sustainable energy system. Mitchell, C. and Woodman, B., Warwick Business School 2006.

[9] The role of nuclear power in a low carbon economy, UK Sustainable Development Commission, March 2006.

[10] New Nuclear Power: Implications For A Sustainable Energy System, Warwick Business School for Green Alliance, April 2005.

[11] Environment Agency, Response to the DTI Consultation: The Energy Review, 2006.

[12] UK opposes a 2030 renewable energy target. The Guardian 11 March 2012. Accessed on 11 April 2012 at: http://www.guardian.co.uk/environment/2012/mar/11/uk-renewable-energy-target-nuclear-power

[13] Power to the People, Vaitheeswaren, V. Earthscan, 2005.

2. The Technical Debate: can nuclear and renewables co-exist?

The idea of a diversified energy portfolio is attractive; politicians enjoy talking of the UK's 'energy mix'. This briefing does not intend to give a detailed synopsis of the technical debate on this issue, but seeks rather to highlight some of the problems that nuclear power imposes on a generation and transmission system, and to show that different types of electricity generation do not necessarily complement each other but can come into serious conflict. In particular, the issue of 'base loading' poses a problem for balancing renewables and nuclear.

Since electricity cannot easily be stored, and since demand varies widely over short timescales, arranging a constantly available supply is a complex task. That part of the demand for electricity that is constant (i.e. always present) is known as 'the base load'. This is supplemented by 'top up' supply that meets more regular increases in demand (usually known as 'the mid load') and demand spikes ('peak loads').

This variability leads to some important consequences. One is cost. Whichever source of generation provides base load will be able to run constantly at its maximum efficiency, i.e. at its lowest cost per unit of generation. By contrast, mid and peak loads need to be produced as and when required, and therefore incur all sorts of extra costs, not least the general cost of having plant standing idle for extended periods of time. Therefore, the choice of what generates base load has critical consequences for making proper comparison of the costs of different methods of generation.

Even more importantly, while some generation methods can be used for all kinds of loading (gas and hydro are good examples of highly flexible methods), some cannot – and nuclear is a good example of this. It is presented as an ideal base load generator, but it is crucial to understand that this is not because it is uniquely good at this role – it is not – but rather because it cannot realistically fulfill any other role due to its inherent inflexibility. One consequence of this, as mentioned above, is cost: nuclear's generating cost is always calculated at its most beneficial level, in effect artificially increasing the price of any competing method. But it also leads to crowding out of rivals for the task of providing base load – and, of course one of those rivals is renewables. Historically, renewables have suffered over the issue of intermittency – i.e. unreliability of supply – but the increasing levels of investment in renewables appear to demonstrate that it will be possible to overcome this problem.[14]

[14] The Base Load Fallacy and other Fallacies disseminated by Renewable Energy Deniers. Briefing paper 16 revised March 2010. Dr Mark Diesendorf, Energy Science Coalition. Accessed 10 April 2011 at: www.energyscience.org.au

3. Is nuclear power really low-carbon?

"A factor driving the renewed interest in nuclear power is that it emits almost no greenhouse gases."

Annual Report 2007, The International Atomic Energy Authority.

Nuclear power is usually presented as 'a low-carbon' or 'very low-carbon' form of electricity generation. But this claim is highly debatable, and often (as in the IAEA report quoted above) refers to the carbon costs of generation alone – which are indeed low. But nuclear power has a long and complex lifecycle, with CO¬2 emissions spread very unevenly throughout.

There are five basic stages in generating electricity from nuclear power (figures in brackets are the percentage of CO¬2 emitted by each operation): plant construction (12%); fuel extraction and processing (38%); operation (17%); spent fuel storage (14%); and decommissioning (18%).[15] It is only by including all these emissions, and then comparing that total footprint with the electricity produced over a plant's lifetime that a figure for the 'gCO2e/kWh' (grammes of carbon dioxide equivalent per kilowatt-hour of electricity generated) can be calculated.

Inevitably, the process of calculating this figure is controversial: and the conclusions reached can vary widely. The Oxford Research Group (ORG)[16] compiled the following list of estimates:

Coal	755
Natural Gas	385
Biomass	29 - 62
Wind	11 - 37
Nuclear (OECD)	11 - 22
Nuclear (Storm and Smith)	84 - 122
Nuclear (ISA, Uni. of Sydney)	10 - 130
Nuclear (Extern-E UK)*	11.5

(*construction only)

The ORG makes it clear that, by some measures, nuclear power emits 10 or 11 times more greenhouse gases than, for example, wind. And they are not the only researchers to have questioned the 'zero/low' GHG credentials of nuclear power. Sovacool conducted a meta-analysis of the academic research into nuclear's GHG emissions, and found that the range of estimates extended from as low as 1.4 to as high as 288 gCO2e/kWh, concluding that a figure of 66 gCO2e/kWh is a reasonable estimate.[17] As Sovacool points out:

'A number in the 60s puts it [i.e. nuclear power] well below natural gas, oil, coal and even clean-coal technologies. On the other hand, things like energy efficiency, and some of the cheaper renewables, are a factor of six better. So for every dollar you spend on nuclear, you could have saved five or six times as much carbon with efficiency, or wind farms'.[18]

Meanwhile, researchers at Stanford University have calculated that nuclear power emits between 9 and 25 times more GHG than windpower.

There are therefore many expert doubts over nuclear's claimed status as a low-carbon form of generation, even if the actual scale of GHG emissions for nuclear are hard to compute accurately. It is important to understand that the scale of the uncertainties is very large indeed, and that any claims that hard-and-fast figures for emissions over a nuclear plant's lifetime can be calculated accurately should be treated with scepticism. Moreover, there are still too many unknowns, not least because no nuclear facility has ever been fully decommissioned.[19]

However, it is not just the full life-cycle carbon costs discussed above that are unreliable. As was seen above, a full 38% of the greenhouse gases emitted by a nuclear plant are from the extraction, processing and transport of uranium. Because nuclear lifecycle emissions depend so heavily on the quality and concentration of the

[15] Valuing the greenhouse gas emissions from nuclear power: A critical survey, Sovacool, B., Energy Governance Program, Centre on Asia and Globalisation, Lee Kuan Yew School of Public Policy, National University of Singapore

[16] Secure Energy? Civil Nuclear Power, Security and Global Warming. Eds. Barnaby, F. and Kemp, J., Oxford Research Group, May 2007.

[17] Sovacool, B.K., "Valuing the greenhouse gas emissions from nuclear power: A critical survey" Energy Policy 36 (2008): 2950-2963.

[18] Nuclear energy: assessing the emissions, Nature Reports, Vol II, October 2008. Accessed on 8 April 2012 at: www.nature.com/reports/climatechange

[19] Greenhouse Gas Emissions from Nuclear Power in 2030, Tudiver, S., Yale Journal of International Affairs, Spring/Summer 2009

uranium ore used, some researchers have found that, under certain conditions, the nuclear lifecycle could emit more greenhouse gases than a natural gas-fired plant.[20]

The issue here is what level of demand there will be for uranium. Uranium is a relatively rare mineral; it is even rarer at concentrations that make mining economic, and even in these places concentrations are low – 10% is considered to be a very rich ore. At relatively low levels of demand (as is the case today), mining operations will generally be confined to the richest ores that can be extracted relatively easily, with correspondingly low use of fossil fuels. However, because of its scarcity, uranium can be mined at concentrations as low as 0.02%[21] (i.e. 200gms per tonne of ore mined). As the richest ores are mined out, the carbon cost gradually builds.

According to the Oxford Research Group: '…new nuclear build in the UK cannot make a significant contribution to reducing UK or global CO2 emissions. Within the lifetime of new nuclear build, sufficiently high-grade uranium resources will become severely depleted. The use of lower grade uranium would increase nuclear CO2 emissions to the level of a gas-fired power station by 2070. (It is worth pointing out that this figure only holds if nuclear generation is kept at present levels; if nuclear takes its share of a **growing** electricity market, the balance point between gas and nuclear in terms of greenhouse gas emissions will come in 2050).[22]

When uranium concentrations are lower than 0.01 percent (i.e. 100 grams of uranium for every tonne of ore), the energy required to mine and process it releases more GHG than are saved. At this point, 'the nuclear system in effect becomes a complex and expensive gas burner'.[23] The future availability of uranium in high quality deposits is thus crucial for maintaining the efficiency of the nuclear lifecycle.

The question of the future availability of uranium will be examined in more depth below (under Energy Security), but the critical point in terms of calculating nuclear's gCO2e/kWh is that since the lifecycle of a plant's operation can be as high as 60 years, it is **impossible** to predict what the carbon footprint of the uranium extraction will be. Since that footprint is totally dependent on the global level of demand for uranium, which will depend on the number of operating plants and a multitude of other highly unpredictable variables, it is quite literally unknowable. It is also important to remember that there are **no equivalent carbon costs or uncertainties for renewable energies;** the lifetime costs of wind, solar and other renewables can be quantified at the point of construction.

Lastly, the lengthy lead time required to bring nuclear online means that there is still the carbon cost of generating electricity with fossil fuels in the mean-time. Stanford Professor of Civil Engineering, Mark Jacobson, who has argued that nuclear's carbon footprint has been significantly under-estimated, has included these costs in his figure for nuclear's true carbon cost which he rates as up to 25 times higher than wind.[24]

The Carbon Cost of Clean Ups

Another uncertainty in the final carbon cost of nuclear is the emissions-cost of any post-disaster clean-up. Because of the relative infrequency of nuclear disasters and the huge scale of their impact, these costs are hard to quantify and, to date, there appears to have been no serious academic attempt to do so. However, when that potential translates into reality (as will be the case with the disaster at Fukushima), the carbon costs will be huge. They include the actual clean-up costs themselves – which might involve moving hundreds of millions of tons of contaminated materials over large distances – and the forced switch to fossil fuels for replacement energy.

[20] Nuclear Power: the Energy Balance; van Leeuwen, J.& Smith, P., August 2005. Accessed on 14 April 2012 at: http://www.stormsmith.nl/

[21] Sovacool, B.K., "Valuing the greenhouse gas emissions from nuclear power: A critical survey." Energy Policy 36 (2008): 2950-2963.

[22] Secure Energy? Civil Nuclear Power, Security and Global Warming. James Kemp Frank Barnaby Oxford Research Group 2007

[23] Energy from Uranium. Storm van Leeuwen, J.W., Oxford: Oxford Research Group, 2006

[24] Review of Solutions to Global Warming, Air Pollution, and Energy Security. Stanford University, Mark Jacobson, Professor of Civil & Environmental Engineering 2008

Energy Security

Energy security has grown in significance as a strategic concern for the UK as we have depleted our own fossil fuel reserves and become a net energy importer. A key argument used in favour of nuclear power is that it delivers energy security. As mentioned above, this is a questionable claim on many grounds, not least because a replacement nuclear programme will only supply 4% of the total energy used by the UK – and it will only deliver this much if the whole 10 reactor nuclear programme envisaged by the government is built. Since the pull-out by E.ON UK and RWE npower in March 2012, it is reasonable to assume that much of that programme will not be built, so this figure will be even lower. However, there are sound reasons for arguing that the promise of energy security will not be delivered by nuclear power even with a much larger programme.

4. Peak Uranium?

This issue was discussed in the section above relating to nuclear's ability to contribute usefully to GHG reduction. The point was made that as global supplies of uranium are depleted, the CO2 cost of extracting that uranium increases markedly, and severely undermines the 'low carbon' claims made by advocates of nuclear power.

But it is also clear that as uranium becomes less easily available, nuclear's ability to deliver 'energy security' also diminishes. The Oxford Research Group (ORG) comments:

'Nor would nuclear energy increase the UK's energy security over the coming decades. There are no indigenous uranium supplies, and dwindling known resources of high grade uranium will lead to future price rises and fluctuations, and resource competition'.[25]

It is important to note that there is considerable controversy over exactly when global uranium supplies will start to run out. The International Atomic Energy Agency (IAEA) has declared that there are accessible reserves of about 4.7 million tonnes, which would supply present demand (ie as of 2005) for 85 years.[26] The OECD Nuclear Energy Agency (OECD-NEA) says there are an estimated 10 million tonnes of 'undiscovered resources', and 22 million tonnes of unconventional resources (associated, for example, with phosphates) which can be extracted for around the same price as the conventional resources - less than $130/kg. At current rates of consumption, this would mean we have enough uranium to last over 600 years, or 350 years at the projected rate of consumption in 2025.[27]

However, neither the IAEA nor the OECD-NEA reports address the problem of ore quality. As discussed above, reductions in ore quality have a big impact on nuclear's ability to be a low-carbon form of generation, and it is important to understand that reductions in ore quality ultimately destroy nuclear power's ability to yield meaningful energy at all. In the words of the ORG:

'If the world nuclear generating capacity stays at the current levels, nuclear power will fall off the 'energy

[25] Secure energy: options for a safer world, Energy Security and Uranium Reserves. Oxford Research Group 2006

[26] World uranium resources ample for projected nuclear energy needs - UN study. UN News Centre. Accessed on April 17 2012 at: http://www.un.org/apps/news/story.asp?NewsID=18741&Cr=uranium&Cr1=

[27] Uranium 2005, Resources Production and Demand, ["The Red Book"] IAEA and OECD-NEA, 2006. Accessed on 17 April 2012 at: http://www.iaea.org/NewsCenter/News/2006/uranium_resources.html

cliff' by around 2070 – within the lifetime of new UK nuclear build. Nuclear power then consumes as much energy as it puts into the grid'.[28]

If, as expected, nuclear generation increases significantly, that threshold will come correspondingly sooner.

Lastly, although some of the major uranium producers can be considered politically and economically stable (for example, Australia and Canada), other key producers cannot. These include Kazakhstan, Niger, Namibia and Uzbekistan, who between them supply 40% of current global production. Since the price of commodities is set at the margins, disruption to supply from any of these countries has the potential to cause serious price fluctuations.

[28] Secure energy: options for a safer world, Energy Security and Uranium Reserves Oxford Research Group 2006

5. Nuclear Plants are not 'ever-ready'

Unscheduled outages are an unavoidable feature of all kinds of electricity generation. Of the 132 US nuclear plants built to date, 21% were permanently and prematurely closed due to reliability or cost problems, while another 27% have completely failed for a year or more at least once.[29] Nuclear plants are built large to achieve economies of scale, so when they go wrong, a huge amount of generating power disappears at once, which in fact makes them potentially more disruptive of energy supply than other apparently more intermittent suppliers. Moreover:

'Nuclear plants have an additional disadvantage: for safety, they must instantly shut down in a power failure, but for nuclear-physics reasons, they can't then be quickly restarted. During the August 2003 Northeast blackout, nine perfectly operating U.S. nuclear units had to shut down. Twelve days of painfully slow restart later, their average capacity loss had exceeded 50%. For the first three days, just when they were most needed, their output was below 3% of normal.[30]

By contrast, a portfolio of many smaller units is unlikely to fail all at once; its diversity makes it more reliable even if its individual units are not. It is for the same reason that distributed power networks are financially more attractive to investors; the Economist Book of the Year 2002 was titled Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size.[31]

This is a finding corroborated by a University of Sussex study conducted by the Science and Technology Policy Research Unit who concluded that despite some 'possible' security benefits:

'… overall we are not convinced that there is a strong security case for new nuclear, especially if the costs and risks of strategies that include new nuclear are considered alongside those of strategies that do not… the energy security case for nuclear power has not yet been made.[32]

And while there is no particular reason to expect nuclear's reliability to improve drastically, no one questions that technological innovation is radically improving the reliability of nuclear's competitors (particularly renewables), for which the issue of 'intermittency' has

[29] Nuclear Power: Climate Fix or Folly? Amory B. Lovins, Imran Sheikh, and Alex Markevich April 2008 RMI Solutions article "Forget Nuclear," updated and expanded by ABL 31 Dec 2008

[30] Nuclear Power: Climate Fix or Folly? Amory B. Lovins, Imran Sheikh, and Alex Markevich April 2008 RMI Solutions article "Forget Nuclear," updated and expanded by ABL 31 Dec 2008

[31] A.B. Lovins, E.K. Datta, T. Feiler, K.R. Rábago, J.N. Swisher, A. Lehmann, & K. Wicker, Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size, 2002, Rocky Mountain Institute (Snowmass CO), www.smallisprofitable.org

[32] New nuclear power in the UK: A strategy for energy security? Watson, J. & Scott, A. Sussex Energy Group, SPRU, The Freeman Centre, University of Sussex, 2009.

always been salient. German renewables operators are already running smart 'combined' plants:

Combined Power Plant links and controls 36 wind, solar, biomass and hydropower installations spread throughout Germany. It is just as reliable and powerful as a conventional large-scale power station… [and] optimally combines the advantages of various renewable energy sources. Wind turbines and solar modules help generate electricity in accordance with how much wind and sun is available. Biogas and hydropower are used to make up the difference: they are converted into electricity as needed in order to balance out short-term fluctuations, or are temporarily stored. Technically, there is nothing preventing us from 100 per cent provision with renewables.[33]

Meanwhile, the construction of a European supergrid allowing the transmission of electricity across the continent is increasingly enabling the much more efficient use of renewables – as well as bringing previously unusable resources (such as Iceland's huge geothermal supply of energy) to high-use economies such as the UK.[34] The Independent has described the 'floodgates opening' on international grid connections.[35] No fewer than nine new interconnectors from Britain to neighbouring countries are currently planned, which will further guarantee the reliable supply of electricity from a range of affordable renewable energy sources.

[33] Press release: The Combined Power Plant – the first stage in providing 100% power from renewable energy. Berlin, 9 October 2007. Accessed on 17 April 2012 at: http://www.kombikraftwerk.de/index.php?id=27

[34] Iceland's volcanoes may power UK. Guardian 11th April 2012. Accessed on 17 April 2012 at: http://www.guardian.co.uk/environment/2012/apr/11/iceland-volcano-green-power?newsfeed=true

[35] How the supergrid could help keep the lights on. The Independent 13th April 2012. Accessed on 17 April 2012 at: http://www.independent.co.uk/environment/climate-change/how-the-supergrid-could-help-keep-the-lights-on-7640771.html

6. Nuclear's 'nightmare scenario' in the UK

The 'normal' nightmare scenario for nuclear is the unlikely but devastating disaster/accident. But with any analysis of opportunity costs, there is another much more likely nightmare.

Whatever views one may have about nuclear, the proposed programme for the UK faces a massive uphill struggle. As we have seen in our four earlier Briefings, nuclear is a very expensive generation option, and very high-risk one for private investors. The Coalition Government clearly doesn't have the money or the political will to inaugurate any taxpayer-funded programme; the construction time scales are huge; there is significant public and political opposition; and major European partners of the UK, who will help frame energy policy over the coming decades, have either closed down their domestic nuclear industries or are discussing doing so for the first time. There is therefore a significant chance that no nuclear power stations will be built in the UK.

The nightmare scenario is therefore as follows: that the Coalition Government wastes 10 or more years desperately trying to push through a nuclear programme, but ultimately fails, having at the same time diverted crucial time, money and political impetus from viable alternatives such as renewables and energy efficiency, leaving the UK with neither nuclear nor much of anything else except relatively high-carbon gas-fired power stations. The result would be a certain increase in GHG emissions, and would leave the UK at the mercy of the vagaries of the international energy markets for its power. A former Chair of the Committee on Radioactive Waste Management (CoRWM), Gordon MacKerron, has publically described this as the "worst-case scenario" for the UK.[36]

If that outcome seems just too improbable, students of history may recall that it is exactly what took place when the last Conservative Government came to power in 1979. Promising to build 10 new nuclear plants, Margaret Thatcher's government eventually managed just one at Sizewell – and that took nearly 15 years to commission. All sorts of more secure alternatives (including energy efficiency) were completely neglected during that time.

[36] Who Puts Up The Cash?, Observer, December 4, 2005. Accessed on 24 April 2012 at http://observer.guardian.co.uk/business/story/0,,1657015,00.html

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