

**The future of nuclear power: the role of nuclear power in a low carbon UK economy
Energy Institute response to DBERR consultation – October 2007**

Introduction

The Energy Institute (EI) is the leading professional body and learned society dedicated to supporting the advancement of the science of energy and fuels. It has a membership of over 13,500 individuals and 300 organisations and provides an independent focal point for the energy community, bringing together industry, NGOs and academia with governments to develop and facilitate the dissemination of energy-related knowledge. The EI's purpose is to promote the safe, environmentally responsible and efficient supply and use of energy in all its forms and applications. In fulfilling its purpose the EI can address a wide range of topics in detail, from upstream and downstream hydrocarbons and other primary fuels and renewables, through power generation, transmission and distribution to sustainable development, demand side management and energy efficiency.

As a charitable body incorporated by Royal Charter and with membership across the full range of energy sectors, it is not appropriate for the EI to promote specific technologies or options. Instead we seek to inform the policy process by helping clarify the key issues and by improving the evidence base on which policy decisions will be made. The views expressed by members in their contributions have of course varied widely. In this submission, we reflect widely shared views and where useful we note divergence of opinion – this distillation is, we hope, a useful contribution in itself, as we therefore identify views held largely in common across the range of sometimes polarised positions. The EI's submission is structured around the questions posed in the consultation document.

(Q1) To what extent do you believe that tackling climate change and ensuring the security of energy supplies are critical challenges for the UK that require significant action in the near term and a sustained strategy between now and 2050?

On the basis of the scientific consensus concerning the impacts of climate change and society's reliance on the energy system to function, any responsible energy policy must set a framework to reduce greenhouse emissions and ensure security of energy supplies, as fundamental and constant objectives.

The EI has previously recommended, together with other learned bodies, an Energy Hierarchy approach as shown below, offering an integrated approach to the management of energy demand and supply, which recognises the need for effective use of energy as a valuable resource to manage our response to climate change. We would encourage Government in adhering to the hierarchy to be mindful of the relative cost effectiveness of the various options.

Sustainable



Energy conservation (reducing total energy demand)
Energy efficiency
Exploitation of renewable, sustainable resources
Exploitation of non-sustainable resources using low/no-carbon technologies
Exploitation of conventional resources

Unsustainable

Both policy objectives are critical immediately and between now and 2050. By tackling each successive stage of the Energy Hierarchy with vigour we automatically design a sustainable strategy to utilise resources effectively and mitigate the impacts of climate change in both near and long term. The balance of evidence today suggests such a strategy is overdue for implementation which in turn suggests a need for measures to be implemented in parallel, not on a linear basis as the diagram might imply. In addition any such strategy should appreciate total energy needs but should also distinguish where appropriate between the demand and management of heat and power. Equally, the strategy should encourage the arrival of new technology to the marketplace, such as carbon capture and storage and early-stage renewables, whilst recognising there are limited, but not open-ended, opportunities to extend the useful lives of some existing technologies. It is well documented that we are at a pivotal point in terms of investment in infrastructure of the energy system in the UK.

Essentially the balance of evidence suggests urgent implementation of a strategy which delivers a low carbon economic environment. The scale and timetable of the challenge should mean that all technologies that can contribute to this aim are likely to have a role to play without trading one technology against another in the policy making process.

The overriding challenge is whether by showing leadership in the UK, this will result in worldwide initiative to achieve the same and by showing leadership, the UK does not become uncompetitive.

(Q2) Do you agree or disagree with the Government's views on carbon emissions from new nuclear power stations? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

There was consensus agreement with the Government's view about the comparison of nuclear energy versus gas powered generating plant.

The statement in the consultation that emissions of carbon dioxide from nuclear generation and wind power generation are about the same also gathers broad agreement. It was noted that reference to UKERC's Intermittency report that there is some misconception by informed publics about the degree of need for 'back up' capacity for short periods of peak demand coinciding with the times of low wind generated output. This has been shown to be a rare occurrence and the energy, and thus carbon emissions implications of using a fossil source as back up, is very small.

There was a view that some existing policy instruments do not adequately reflect the range of low carbon energy options equitably and efforts should be made to ensure a balanced approach to all low carbon energy options in the future.

(Q3) Do you agree or disagree with the Government's views on the security of supply impact of new nuclear power stations? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

The Government's role must be to set the right framework for industry to develop and provide an energy supply, which is reliable at all times, affordable and internationally competitive - a very high priority of any energy policy.

Security of supply has a number of dimensions. Amongst these, geo-political concerns about the stability of major supply and transmission access regions typically gain the headlines. However there is evidence to demonstrate that the larger risk to reliability of energy and power systems specifically is from problems with the transmission and distribution infrastructures in place in the UK.

Regarding geo-politics, the ever increasing international demand, political problems in the Middle East and increasing difficulties in extraction lead to greater long term uncertainty of the supply of oil and gas to such countries as UK. International demand for oil is now predicted to exceed supply between 2010 and 2020. Nuclear fuel requirements are sourced from more politically stable countries widely dispersed like Australia and Canada. The quantity of imported fuel is also minimised as uranium has a very high calorific value – small quantities give off a huge amount of energy. Thus the risk of disruption to the supply chain is limited, although given its nature, this small supply chain could attract particular attention from those seeking to disrupt the energy supply. Unlike fossil fuel plant, even if uranium stockpiles in the UK are running low, nuclear reactors can continue to provide electricity albeit with degraded reactor efficiency for short periods, approximately one month, beyond a scheduled refuelling.

With regard to UK transmission reliability, EI members have commented that nuclear power is traditionally associated with a centralised configuration of the network, with long distance transmission and remote location of nuclear power in relation to conurbations. Decentralised energy systems can offer greater resilience to disruption as well as lower transmission losses and potential to receive heat to meet local thermal loads.

(Q4) Do you agree or disagree with the Government's views on the economics of new nuclear power stations? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

Companies and professional service organisations to the energy sector advise that nuclear power can operate on a different basis to that in the UK previously, i.e. without government subsidy to invest in the building and operation of nuclear plant.

Within the EU, wholesale electricity prices tend to be cheaper in countries which have a strong nuclear sector and prices are dearest where there is less nuclear generation. All major industrial competitors except Italy have significant nuclear sectors. The USA, has over 100 reactors, which operate very profitably and are extending lives from 20 to 40 and now to 60 years.

However, some concerns have been expressed about some aspects of the economic case e.g. the discount rates used are thought by some to be low compared to the risk for the private sector in investing in new nuclear build. This may be due to a lack of clear distinction between analysis from a societal perspective of the merits of nuclear power and that from an investor perspective.

The treatment of insurance and cost of liabilities is thought by some to be unclear, including where ultimate liabilities rest and who pays in any situation where the need should arise. This will also lead to public unease if the situation is not clear. A solely private sector solution gave rise to some unease in relation to the longevity of private sector organisations in comparison to the state. Therefore whilst direct subsidy is not desirable, some level of commitment from the state, probably around the issue of liabilities, will be necessary.

There should be provision for plant decommissioning and clean-up which may add a small amount to the cost of power. Experience has shown that the costs of many current industrial projects are significantly under-estimated. Hence, the cost-benefit analysis of new nuclear power stations will have to be periodically updated with the latest data and a substantial risk premium is appropriate.

In addition to a long term strategic energy policy, a stable fiscal and regulatory regime will be required to stimulate private sector investment in new nuclear generation. The same can be said for many energy technologies and in particular to stimulate deployment of as yet unproven technologies which will be required to meet policy objectives.

A factor that is thought to be missing in the overall analysis and review process to date is a proper assessment of security of supply issues for the heat and electricity sector and the country's vulnerability to supply disruptions and blackouts that have a cost. Some felt the White Paper was

criticised for not considering that consumers are interested in secure heat and power supplies and the least cost route for achieving that objective. To date the Government has analysed the sectors as separate entities and we encourage it to analyse them as a single entity.

(Q5) Do you agree or disagree with the Government's views on the value of having nuclear power as an option? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

The key word here is options. Sound security of supply is underpinned by a diverse energy mix and on balance the view is that the nuclear option should be included in that mix as an option for investment alongside all other low carbon emitting technologies. It is not seen as a technology to invest in instead of others as the view is all options are likely to be required to achieve the strategic objectives to 2050.

This answer is also given in the context of promoting the Energy Hierarchy concept explained in the response to Q1. To offer one example of many, for all types of power generation the use of the reject heat through piped hot water heat supplies to buildings should be evaluated as such systems can triple the useful energy obtained from the fuel.

(Q6) Do you agree or disagree with the Government's views on the safety, security, health and non-proliferation issues? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

Safety, security and health aspects as they apply to this technology have been given rigorous and continuous attention and much in the way of process and procedure under these headings is understood to be information which is not in the public domain. Whilst respecting security requirements it is suggested that better information could be provided independently by government or regulator on this issue to educate and inform interested publics. Various sectors within the energy industry and some processes carry risks to personnel and the public but there is clear accountability within the companies concerned where the civil nuclear sector could learn by example. Nuclear facilities are not uniquely or overtly vulnerable to those who wish to disrupt them.

(Q7) Do you agree or disagree with the Government's views on the transport of nuclear materials? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

The transport of nuclear fuel has a good safety record over the last 50 years. Transport flasks have to withstand 100mph impact testing which should give confidence as can other measures adopted around the regulation of transportation of nuclear fuel. As in response to question 6, the public could be better informed about the management of risk without compromising security.

(Q8) Do you agree or disagree with the Government's views on waste and decommissioning? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

Without causing any harm to the public, waste has been well managed for the past 50 years and decommissioning of nuclear facilities for the past 20 years within the relevant statutory system. Both are well understood disciplines. Waste from any new build will also be of significantly less quantity proportional to that generated in the past and to energy it provides.

Some would argue there is greater risk from carbon storage in reservoirs where any fault in the structure could release CO₂ into the atmosphere as 'waste' which does not decay.

The responsibility and costs for legacy waste belong to the Government. EU legislation does not allow Government to pay for disposing of new waste, as this would effectively represent a subsidy to the industry. Apart from this there is no scientific or technological reason to treat new waste any differently than legacy waste. New nuclear operators should be made to put aside the correct best-assessed costs for nuclear waste and decommissioning liabilities with an appropriate risk premium.

Whether legacy or new nuclear waste there are three timescales of concern: the time on site at the power station (tens of years), the time at the intermediate depository (hundreds of years) and the time in the final repository (thousands of years). By the time that the intermediate depository is set-up the differentiation between existing legacy waste and "new" waste will be indistinguishable. Furthermore, the discipline of waste management continues to progress internationally.

The Committee on Radioactive Waste Management (CoRWM) has concluded the best solution for existing waste is deep geological disposal with initial secure interim storage. CoRWM has also recommended actively pursuing community involvement through the principle of volunteerism, adopting a partnership approach, with the understanding that the wellbeing of the host community would be enhanced. As the CoRWM approach is to be followed, it will go a long way in addressing public concern.

As for decommissioning the sector's techniques are continuously developing, getting better and safer as experience develops leaving change required in relation to how costs are managed and who is responsible for them. As the owner should be responsible here, equally new nuclear build designs will present far less of a decommissioning challenge as they are designed to be, unlike the older ones.

(Q9) What are the implications for the management of existing nuclear waste of taking a decision to allow energy companies to build new nuclear power stations?

The figure of 10% increase on existing nuclear waste has been widely reported from various sources. Existing waste must be dealt with, whether or not there is new nuclear build.

Managing nuclear waste can never be a short-term strategy and new build nuclear power stations would not change this fact. The composition of the new build waste will depend on the timing of any reprocessing, which can be taken as separate decision. There is no fundamental difference between handling nuclear waste or any other hazardous substance. It has to be controlled and monitored and should be done through monitored establishments using approved and well established practices.

Having said this, it is extremely important that for new nuclear build to be a consensual option, real identifiable progress is made on existing waste disposal, as recommended by CoRWM.

(Q10) What do you think are the ethical considerations related to a decision to allow new nuclear power stations to be built? And how should these be balanced against the need to address climate change?

In their submission to CoRWM, Churches Together in Cumbria said: "Each generation receives a legacy from the past of both good and ill, benefit and burden. The present generation must do its utmost to solve the problem but not by compromising long-term safety. We must be able to demonstrate that we acted in good faith, on the best possible information and resources open to us and that we acted from a genuine concern for the well-being of future generations"

The majority of responses to the consultation that EI received would fit within the spirit and content of this quote recognising that the majority view of an informed public will draw conclusions from a scientific consensus and the ethical considerations would need to significantly undermine the technical evidence to change opinion generally. That said, this has been the most controversial

consultation to provide a response to because of its emotive nature. This has been manifested in basic objections to the way in which consultation questions were posed to a much deeper objection to pursuing new nuclear build on ethical grounds.

Should new nuclear build become an investment option these objections must not be dismissed, but faced up to and understood in a way they have not been previously, based on whatever grounds and whether they are perception or reality. Usually the former are more difficult to address and there is a legacy of not communicating openly in the past to overcome.

A selection of the ethical grounds giving cause for concern include:

- Exposing the human population and surrounding biosphere to ionising radiation within groundwater and seawater. That the repository is well below ground water is not widely understood;
- Still no safe means of safely disposing of highly radioactive waste is irresponsible to future generations. The issues are poorly projected to the public;
- Ionising radiation affects our genetic make-up and also that of future generations. COMARE type information needs to be disseminated more widely. COMARE is an independent expert advisory committee and part of the UK Health Protection Agency whose remit is to protect the health and well-being of the population, and other such organisations need to be brought closer into the consciousness of the public when such issues are being discussed;
- Creating a hazard which will endure for far longer than any human civilisation;
- If the UK embarks on a programme of nuclear new build then it will be very poorly positioned to discourage other countries from pursuing similar programmes;
- A waste programme must be put forward before new power stations are constructed. This is a perceptual issue and the Government needs to take heed of this by demonstrating its ability to competently deal with nuclear waste as it is not possible to finish the waste programme before embarking on new build. A clear demonstration with visibility of dealing with some diverse part of the waste issue might be helpful;
- There is no proven link between the development of nuclear power and favourable climate change. This show that emissions from nuclear power are not understood;
- Considering the rapidly increasing photovoltaic capacity, energy efficiency where each dollar spent delivers 10 dollars worth of nuclear generation, city wide and smaller heat supply option via CHP for all types of power generation, decentralised and micro-generation, there is no need for for nuclear energy;
- If you consider the full life cycle cost of nuclear power it is not as low carbon as promoted;
- If increased global temperatures result from the sun's activities and part of the natural cycle, it is completely outside human control.

(Q11) Do you agree or disagree with the Government's views on environmental issues? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

There was a consensus of agreement with the Government's views on environmental issues for the reasons that are contained in the consultation document. Further reasons include:

- Any environmental issues should be manageable in line with UK and European requirements.
- The issues are not very different from those associated with existing facilities.
- Progressive improvements to the environment are necessary, commensurate with maintaining the security of power supplies. Nuclear power represents a compromise, with negligible pollution of the environment and small physical intrusion.

But there is more to be done to change our practices. For example, we have started to get a grip on solid and liquid discharges but there is a significant amount of work to do to manage gaseous waste i.e. reduce the amount of CO₂ emitted.

(Q12) Do you agree or disagree with the Government's views on the supply of nuclear fuel? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

There was consensus agreement with the assessment and predictions in the consultation concerning the availability and cost of reactor fuel in the coming decades.

The presently available known, not speculative, conventional uranium resources exist amounting to 3.5Mt, which is about 50 years supplies economically available at present rates of consumption. The OECD's NEA 2005 "Red Book" increases the range of known recoverable resources to 4.7Mt Uranium, about 72 years, and of total conventional resources and phosphates to about 27Mt Uranium - about 400 years. The March 2006 Sustainable Development Commission report has also supported the view that there are no major concerns over the long-term availability of uranium. Their evidence also points out that in the past uranium reserves have been consistently underestimated and in the context of new build, fast reactors will utilise uranium stockpiles better than previously by a factor of at least 50.

Those who disagreed with the Government had concerns that the calculations were unrealistic as they are based on 2004 global nuclear generation figures and fail to take into account prospective increases in global nuclear generation. With growth in generation some considered the reserves may last another 30-40 years, i.e. barely until 2050 with a confident response not being extended beyond the next 40-60 years without reprocessing.

(Q13) Do you agree or disagree with the Government's views on the supply chain and skills capacity? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

Largely there was agreement, with the caution that the situation could easily balance on a knife-edge if skills challenges in particular are not addressed with priority to attract the skills and knowledge required in the timescale available.

Both the supply chain and skills capacity will be drawn from worldwide and UK sources. The latter has been identified in the 2006 NIA study. As the technology types used for new build may differ, a consistent level of quality and skills will be necessary, both within the industry and more so for the regulator. The regulator should be a single body with all necessary skills within it or available to it.

Bodies such as the EI can assist on two levels. Firstly EI exists to set standards of competence in partnership with educators which are required in industry and to support people to reach these standards and maintain a successful career with appropriate recognition. It does this in the nuclear sector through its own activities and in partnership on some initiatives with Cogent – Sector Skills Council e.g. the national skills academy for the nuclear industry. At present the nuclear industry, employs 50,000 people and also creates additional secondary jobs. New build would add to this capacity in the UK.

Secondly the EI is respected by industry and regulators as an independent honest broker able to drive industry good practice forward by working with partners to produce industry guidance which addresses key technical aspects of operations under the health, safety and environment themes. There may be a role in the future, should new build proceed or not, for the EI to broker similar good practice guidance to address some of the current or future unregulated aspects of operations.

(Q14) Do you agree or disagree with the Government's views on reprocessing? What are your reasons? Are there any significant considerations that you believe are missing? If so, what are they?

There was some disagreement with the Government's views on reprocessing. However it was recognised that it is possible to proceed on the basis that spent fuel will not be reprocessed. It might also be appropriate to later review this decision in the light of changing overall circumstances particularly given that the UK has a reprocessing plant. In addition, given the view of some that there will be likely worldwide growth in demand for uranium, which has implications for the competitiveness of fuel reprocessing, it may even prove to be profligate in the long term to treat spent fuel as waste.

(Q15) Are there any other issues or information that you believe need to be considered before taking a decision on giving energy companies the option of investing in nuclear power stations? And why?

The Government's analysis is very comprehensive and it is expected to generate a wealth of material to review in the responses to the questions posed. It is then necessary to maintain momentum, make informed decisions and then communicate these clearly to the interested publics, followed by timely actions that result as 'next steps'. Time for continued review of energy policy frameworks is limited given the self determined timetable for implementation of a coherent UK energy policy.

Other aspects to address not covered elsewhere in this document include:

- Resolving the well documented problems in the planning process via classification and management of applications for large infrastructure projects, such as new energy generation capacity via a central agency or similar system so as to deal with planning issues only once.
- Addressing design certification and other regulatory aspects recognising the international nature of the sector and accepting the approval methods of regulators and licensing bodies
- Identifying fiscal arrangements to encourage longer term price signals for carbon, enabling the investment appraisal process to be effective and equitable. Government may need to reframe the market to turn around long term, capital intensive low carbon investment if a stable long term cost of carbon does not emerge as a result of the EU Emissions Trading Scheme. However we encourage a clearer distinction between policy instruments that are intended to internalise the cost of carbon dioxide emissions (e.g. EU ETS) for investments in commercial low carbon options and those incentivising the creation/deployment of emerging low carbon options through innovation policy (e.g. ROCs). Clearer communication about the aims of, and differentiation between, such policy would be a valuable contribution to the debate.
- If investors proceed with new build if determined to be an option, ensuring any such build on existing sites includes a review of present transmission capability to see it is matched to the output capacity of the new facilities that are likely to be different to, and larger than, the existing capacity.
- If new nuclear build proceeds, to determine the impact of severe climate events given sites are likely to be coastal or estuarial in location.
- Demonstrate to the public their areas of concern are understood and remedied or at least mitigated.
- As a point of information, building to the same design in clusters or fleets will clearly be most economical if new build is to proceed. Investors understand this of course, and policy/planning/regulation should not unnecessarily impede sensible decisions by investors, for example the formation of consortia.
- The energy generation gap will start to appear from next year onwards during phase II of EUETS when emission allowances will be tighter and the introduction of the Large Combustion Plant Directive under which generators will have to decide whether to opt in or out and those that opt out will have to shut down by 2015 at the latest, setting the near time horizon for action.

(Q16) In the context of tackling climate change and ensuring energy security, do you agree or disagree that it would be in the public interest to give energy companies the option of investing in new nuclear power stations?

The overall consensus is that all low carbon generation options should be available as investment options for the private sector to assess and make appropriate investment decisions, including new nuclear build. In doing so, public concern over the use of various technologies must also be addressed.

However, amongst EI members there is a significant minority who believe that new nuclear build is not necessary. If strong action to reduce consumption combined with other low carbon supply options (i.e. those higher up the Energy Hierarchy mentioned earlier) can achieve policy objectives, the real and/or perceived risks of nuclear power and the controversy it will entail could be avoided. A decision on this issue requires both wide ranging analysis of the alternative technical and policy options (as has been undertaken by government and been submitted to it through the various energy reviews) and a vision of the possibilities for a reinvigorated and creative energy policy programme going forwards.

If the decision to allow new build is taken, there are concerns that the take up of nuclear investments by the private sector will require greater confidence in electricity and carbon price stability than will be exist in the near term. Close attention should be given to the variety of options to underpin the EU ETS carbon price mechanism through action in the UK, for example setting a price floor or developing carbon contracts. Such measures could be valuable for all low carbon investment options and should be applied without discrimination.

There must be transparency, accountability and financial viability of participating companies. One of the main public concerns about private enterprise and nuclear power is the potential for 'short-cutting' and risks to the public with impact on safety. The regulator must be skilled and effective in all parts of the life cycle and the responsibilities of the Government made clear.

One question the Government has not posed but we expect it must be considering is what happens if subsequent to making a decision to permit this option, it is not taken up by investors?

(Q17) Are there other conditions that you believe should be put in place before giving energy companies the option of investing in new nuclear power stations? (for example, restricting build to the vicinity of existing sites, or restricting build to approximately replacing the existing capacity?)

If the investment is to be a private sector one then an element of 'natural selection' will prevail to support what makes a good investment as opposed to what makes for a bad one. i.e. the economics of investing in new build on an existing site over a new one for example. New sites might be less attractive given the development and feasibility work that would be required by an investor. The danger of being overly prescriptive when encouraging private sector investment is that you have the opposite effect. Equally current conditions do not permit free reign of large infrastructure development without due consideration.

Government should stimulate an effectively functioning carbon market that benefits low carbon generation and encourages investors to make informed, long-term investment decisions. Government should then monitor market delivery of the strategic objectives and be prepared to intervene in the national interest if markets fail to deliver.

(Q18) Do you think these are the right facilitative actions to reduce the regulatory and planning risks associated with such investments? Are there any other measures that you think the Government should consider?

No other industry is so regulated, but a unification of the regulators is required.

The UK Government should consider whether in delivery of its strategic energy policy objectives there are actions for devolved administrations or whether development of the UK energy system is in the national interest of Great Britain. And, in doing so what the implications of either approach are in reality as the energy industry operates across boundaries and is likely to respond most favourably to a streamlined policy framework.

Acknowledgements

This response has been collated from views expressed by EI members and colleagues at a stakeholder event organised by the Energy Institute, and through active engagement via the EI's website. On behalf of the Energy Institute, this submission was prepared by Dr Feroze Duggan, and was peer-reviewed by eminent EI members and the staff team. If you would like further information or detail on the content of this submission, please contact:

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