UK Government Nuclear Consultation Response : by Stephen J. Stretton on behalf of EFN-UK (with Zero Carbon Society input)

Consultation Questions

This document sets out a summary of the key challenges of tackling climate
change and ensuring energy security that the UK faces:

1. 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?

The document also sets out the evidence and information that we have considered and the preliminary conclusions that we have reached following our assessment of this evidence. We invite respondents to consider the evidence we have presented, and to comment on the following questions:

2. 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?
3. 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?
4. 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?
5. 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?
6. 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?
7. 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?
8. 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?
9. 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?
10. 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?
11. 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?
12. 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?
13. 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?
14. 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?

The purpose of this major consultation exercise is to provide interested parties
with information on nuclear power, and to assist parties to reach an informed
view on the future of nuclear power in the UK. Based on the responses and evidence gathered during this consultation, we will consider whether it is appropriate to confirm our preliminary view as Government policy, and to allow
energy companies to invest in new nuclear power stations.

15. 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?

In their responses to the consultation, we encourage parties to include the reasoning behind their conclusions and any evidence that supports their views. In
reaching a conclusion on the future of nuclear power, we will assess the responses
to this consultation and the evidence and information that it brings forward.

16. 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?
17. 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)

Alongside this in-principle consultation, there is a linked technical consultation
on the details of running a Justification process and a Strategic Siting Assessment. Respondents to this consultation may wish to consider the information brought forward in these consultations61.

18. 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?

UK Government Nuclear Consultation Response : by Stephen J. Stretton on behalf of EFN-UK (with Zero Carbon Society input)

Response to the UK Government's Nuclear Consultation

1) Tackling Climate Change is a critical challenge.

Tackling climate change is a critical challenge for the UK and for the world.

Global temperatures have already risen by 0.7C since 1900. With the time lag due to oceans heat capacity, the *committed* global temperature rise at current GHG concentrations is approx 1.5C. If we pass around 2C, the Amazon rainforest and the West Antarctic and Greenland Ice sheets are likely to collapse.

By the end of the century, on the A1F1 trajectory ("a return to coal" currently seen around the world) by 2100 we will have committed to about 9W/m2 of radiative forcing (IPCC 2001), corresponding to *6 to 9 degrees* of committed climate change (double that at the poles). This would likely be enough to destabilise methane clathrates stored on the (shallow) Arctic ocean sea bed.

The warming is equivalent to that experienced at the Permian-Triassic boundary, the greatest of all mass extinctions.

As countries across the world develop, they will tend to converge on similar technical/economic model with similar energy use, secondary energy infrastructure and per-capita emissions.
The sustainable level of global CO2 emissions is about 7 billion tCO2 per annum (2GtC/y)* or 1 tonne of CO2 pa per capita. Current UK emissions stand at 10 tonnes CO2 pa pc.

To achieve GHG stabilisation a 90% reduction in UK emissions is needed; to avoid 2C we must achieve this in 20-30 years. It took humanity only 10 years to put a man on the moon; the average life of energy infrastructure is of the order of 20-30 years.

To avoid the most serious consequences of climate change the UK needs to:
1) Reduce emissions to sustainable level (1 tonne CO2 per year) over 2-3 decades.
2) Do it in a way that has positive economic value for Britain. so that others might follow our example

Electricity supply is crucial in reaching this target:
a) because the needed reductions are so great, they cannot be achieved realistically by reductions in consumption or efficiencies
b) electricity consumption is rising more rapidly than overall energy consumption across the world and 'business as usual' is a return to coal
c) carbon-free electricity seems to be the main alternative vector for all sectors, not just the sector which is currently electricity

UK Government Nuclear Consultation Response : by Stephen J. Stretton on behalf of EFN-UK (with Zero Carbon Society input)

2). Yes, I agree with the conclusions regarding carbon emissions, as they are consistent with most published papers and with scientific common sense. Fluorinated gases emissions from US enrichment plants need to be considered as part of life cycle assessments, but I am confident that they are small and non-material.

3) Security of supply is also an important issue. There is no certainty over the future price of gas and leaks are an issue.
Much of the UK's electricity generation is retiring soon. There is a danger that policy and price uncertainty will preclude investment on the scale that is required even to keep the lights on.

To achieve a 90% reduction in CO2 emissions, we may need in the region of *150GW* of carbon-free electricity capacity. This could be split perhaps 20GW CCS, 30GW Renewable, 100GW Nuclear. France achieved a build rate of 4.5GW/year for nuclear in 1980s; and with streamlined planning, international designs and market incentives such as electricity & carbon price floors (see later) the same could be achieved here.

Nuclear is essential when you combine security of supply concerns with the need for large low-carbon energy supplies for economically successful very-low or net-zero carbon economy.

To have a timely impact on both issues, planning needs to be streamlined in advance, unadjusted international designs must be used, and pre-licensing of sites all need to happen in parallel. In addition, for *both* security of supply and carbon reduction reasons, a stable long-term minimum price of electricity (and possibly carbon) can be guaranteed by means of financial instruments, (such as one sided contracts for difference). Additional higher-price contracts for the first generators to produce carbon-free electricity would be effective at encouraging investment rapidly.

4.1) There is a strong social benefit for investing in nuclear energy. In fact from a social perspective, and using appropriate long-term social discounting (Stern) and long-term damage cost of Carbon ($85/tCO2, Stern), the social benefit is likely to be much greater than that estimated in the Energy Review. Policy outlined in this submission would reduce the financing rate, making it closer to the appropriate social discount factor.

4.2) However, the private advantages for an investor constructing nuclear power plants are less than these social benefits. The levelised cost of electricity production (and standard Net Present Value approach) does not properly account for the risk/reward profile of private investors investing in new electricity generating capacity. An appropriate analysis might use the Real Options approach (Dixit and Pindyck), which captures the interaction between uncertainty and irreversibility in investment.

UK Government Nuclear Consultation Response : by Stephen J. Stretton on behalf of EFN-UK (with Zero Carbon Society input)

According to Dixit and Pindyck, market uncertainty extremely important in investment. This is highly relevant since:

a) Investment is *highly irreversible* (with nuclear, the capital cost is even greater than the cost of construction since it could be argued that the decommissioning liabilities are incurred when fuel is added to the reactor)

b) The price of electricity is *highly uncertain*

c) Policy over future carbon prices is *highly uncertain* (ETS volatility and unknown future)

d) The costs of nuclear after construction are largely fixed and not well matched to the revenue stream (compare gas, where gas and electricity prices move together and capital costs are high; overall financial risk is very low).

4.3) There is a clear social benefit from fuel diversification. Nuclear provides a social hedge against higher gas prices. Nuclear gives little price volatility, the gas and carbon prices are unknown. In this author's opinion the potential costs of volatility are not yet accounted for.

4.4) Nuclear has strong learning effects (experience-based cost reductions) but only when reactors are constructed of a consistent design. Experience suggests that the first reactor is likely to have teething problems and cost and time overruns, but nth of series will be much more timely and economic.

4.5) There are strong social benefits of information revelation created by the constructors of the first-of-kind reactors in demonstrating the cost of the technology. Since the first may be most expensive, there may be justification for preferential help for these constructors.

4.6) To take account of all of these proposals, the author has developed policy proposals for this consultations which would enable and ensure large-scale investment at very low or zero cost to the government, using a long-term price floor (a one sided contract for difference).
The paper is available online here: http://zcarb.net/?p=69

5) Nuclear energy is essential if moving to very-low or net-zero carbon economies in an way that is low-cost and economically positive. Renewable electricity capacity is limited, and renewables available economically (<7p/kWh) more limited still (about 10% of total final energy consumption).

As pointed out, a widespread move to electric or hydrogen transportation would require much greater electricity generation, as would the widespread use of heatpumps instead of gas. Such a strategy would be consistent with the use of all low-carbon energy sources to the maximum extent that is

economically feasible.
Further policy to encourage large scale investment, including electricity and carbon price floors and incentives for fast movers, is essential.
6) I agree.
The current international designs may have greater expenditure on safety than can be justified on a rational basis, in the context of worries about climate change and the need to find a cost-effective alternative to coal. To minimise global risks, the UK regulatory regime needs to be extremely well coordinated internationally, so that the integrity and international consistency of reactor designs is maintained.

7) Yes, I agree with the Government's views.

8) Yes, I agree with Government's views. The ability to burn radioactive waste in future reactors should be researched further internationally and plans for interim storage should take place having considered the likelihood of this option seriously.

9) Plutonium could be burnt in Mox fuel in some of the new designs.

10) Dangerous climate change is a global risk of catastrophic magnitude and high probability. None of the risks associated with nuclear energy come close in magnitude, probability or pervasiveness, except perhaps the proliferation of nuclear weapons. Britain should keep its weapons and power programs separate and consider the implications (financial and skills) of a weapons programme given the urgent need for engineers to build power stations and the need to be diplomatically and ethically strong to prevent the spread of nuclear weapons.

11) Agree

12) There is 85 years of Uranium at current rates. Hence it is not a consideration for incremental or UK new build.

There are also reasons for considering that Uranium reserves will not be a binding constraint on a large nuclear renaissance, including large recent discoveries stimulated by higher price. Economic incentives are effective at encouraging discoveries. Long term we could consider seawater (could be used in existing reactors), waste burners (requires research) and Thorium (some reactors already being

developed). At a price of $300/tU, extraction from seawater may be economic, but this technology needs to be scaled up.

13) There is a huge concern over skills, especially in the context of a worldwide nuclear renaissance. The government should immediately consult with schools and universities to massively expand science and engineering places and provide incentives to encourage children to take up these subjects. A possible requirement for > 50,000 engineers if a large nuclear build takes place.

14) Agree

15) No, but the UK nuclear process must be coordinated internationally with regard to consistent, international, reactor designs and proliferation resistance.

16) I agree

17) International coordination is important.

UK Government Nuclear Consultation Response : by Stephen J. Stretton on behalf of EFN-UK (with Zero Carbon Society input)

18) Policy Proposal: http://zcarb.net/?p=69

A guaranteed minimum electricity price (indexed and time-averaged over each 5 year period, for the design life of each project) for long-term investors in carbon free (<50gCO2/kWh) electricity generation capacity.

How Would It Work?

There would be a long-term contract between the government and any investors that the time averaged electricity price over a certain period would not fall below a certain point. In effect this is an asian option on the electricity price. At the end of each time period the government would provide direct financial support in the event of a price falling below a certain level.

Contractual Arrangements
The government would write a contract for difference on the average price of electricity in each future 5 year period.

In order to further encourage investment quickly it would be possible to give away a limited number of higher price contracts for those who are first to produce electricity. This might include renewable energy on a large scale and the first-of series nuclear and first full-scale Carbon Capture and Storage plants. The price would be declining in cumulative installed capacity.

e.g An environmentally friendly option would be to offer 6p/kWh for first 10GW capacity, 5p/kWh for next 20GW, 4p/kWh for next 70GW.

This policy, when combined with an immediate carbon tax of 4p/kg CO2= £40/tonne CO2 (Stern - which would raise the price of electricity by 2p/kWh) could be achieved without initial cash subsidy.

UK Government Nuclear Consultation Response : by Stephen J. Stretton on behalf of EFN-UK (with Zero Carbon Society input)

Summary

Probable Effects

There would be strong investment in all electricity generating capacity with low or moderate cost. The basic policy would encourage nuclear, onshore wind. The advanced policy would also encourage other forms of renewable generation and coal with carbon capture and storage.

Economic Justification

* Corrects market underinvestment arguably associated with liberalised electricity markets
* Corrects market underinvestment due to policy uncertainty
* Corrects a market failure by filling a gap in the market for risk instruments
* Reduces the financing rate for long-term electricity investment to closer to the social discounting rate without market hazard
* Provides an extra policy tool to reduce carbon emissions

Political Justification

* Reduces carbon emissions
* Encourages investment and thus keeps the lights on
* Creates a low carbon industry thus providing impetus for a higher carbon price in the future

Extension

* Provides incentives for first movers
* Rewards social advantages of first-of-build (cost information revelation, cost and time reduction)
* Provides credible signal that policy might be less generous in the future, thus further encouraging rapid investment.

Conclusions

In order to encourage sufficient investment to decarbonise our energy system, we need to promote a more long-term framework for investors. This can be done by means of price risk mitigation for long term investors.