The Institution of Engineering and Technology

The UK's Energy Supply: security or independence?

Evidence to the Energy and Climate Change Committee

31 March 2011

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This evidence has been prepared by The Institution of Engineering and Technology (IET) who will be pleased to provide further information on request.

In addition the following bodies have signed up to this evidence under the banner of Engineering the Future: The Royal Academy of Engineering, The Institution of Mechanical Engineers, and The Institution of Chemical Engineers.

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Introduction

1. Energy security is a complex and multidimensional problem and solutions with a positive impact in some areas can have negative effects in others[1]. Broadly one can break the problem down into:

- Having sufficient access to primary fuel feedstocks in the long term.
- Managing short term interruptions to feedstock supply.
- Creating a diverse range of energy sources using different feedstocks (or a diversity of sources of the same feedstock).
- Having robust technologies that convert primary energy supplies into usable or transportable forms of energy.
- Having robust and resilient networks to get the appropriate form of energy to its point of use.
- Dealing with the intermittency of energy supplied by certain renewable sources.

2. In many cases energy price is a proxy for security (in other words if one can afford the energy, one can buy it, or over time develop new sources) however high energy prices create their own tensions, particularly if other competing countries are able to rely on low cost indigenous resources or legacy assets. Continued increases in energy costs will also have a serious effect on the economically disadvantaged members of society. There is also a political dimension to reliance on certain producer countries considered to be risky. This currently applies mainly to oil and gas but also, for example, to proposed schemes such as major deployment of wind and solar energy in North Africa and its transmission to Europe.

3. One of the best and cheapest means to improve energy security is simply to use less. One of the major risks to our energy security is that we don't make the investments in renewables, grid, electrified transport etc in time and at the scale required. Reducing energy demand reduces the scale of investment in these programmes, and hence reduces the risk of failure to deliver them in time. This can be achieved through a number of measures such as more efficient building stock and end-use appliances, smaller and more efficient personal transport choices, and improvements in industry. These could help to reduce the aggregate demand for energy over the course of a year or, equally importantly, could reduce the peaks of demand through the course of a day. Reducing demand is critical to the future security of the UK energy system.

[1] For example, using large amounts of wind energy reduces fossil fuel imports but makes the electricity system more difficult to operate.

4. Our answers to the specific terms of reference questions follow:

Question 1. How resilient is the UK energy system to future changes in fossil fuel and uranium prices?

5. The UK, in common with other fuel importers, is vulnerable to price increases in primary fuels, especially oil, gas and coal. Of these:

- concern over the volatility of the price of oil remains high because of increasing global demand, the vulnerability of supply to price shocks, and longer term concerns about resource depletion;
- gas is relatively plentiful with shale gas having eased global supply pressures substantially;
- coal is plentiful, globally traded and seems unlikely to suffer large price increases, in part at least owing to its poor carbon emissions profile. The adoption of carbon capture and storage (CCS) technology would almost certainly lead to increased demand. This is unlikely to happen in the near-term but could become an issue before long.

6. Uranium is a different case. The cost of uranium fuel is a small but significant part of the cost of nuclear electricity. The uranium can be bought ahead and is therefore not vulnerable to price shocks. If the global nuclear renaissance takes place[2] then there will be a price pressure but this will encourage greater exploration and production, something that has been subdued in recent years.

7. If renewable energy plays a substantial role going forward this will improve resilience to price changes but at a cost of higher capital charges for the technology likely to make most difference in the UK – offshore wind.

8. Resilience can of course be improved dramatically by focussing hard on energy efficiency and energy conservation. Any significant reduction in overall energy demand will mean that a major price swing will have a proportionately lesser economic impact.

Question 2. How sensitive is the UK's energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?

9. Energy security can be sensitive to investment in infrastructure because of the scale of investment required and the length of time required to build the infrastructure.

10. Traditionally, the demand for space heating has been subject to the biggest fluctuations both in the short-term and seasonally. In the UK this demand is met predominantly by gas. Gas storage in the UK is limited (historically it was assumed that the North Sea acted effectively as a reservoir) but work is under way to provide a sufficiently robust gas storage system.

11. The future energy system will be much more diverse both in primary fuel feedstock and generating technologies. Creating this system will take time and capital investment but it will also involve building power networks suitable for the 21st century. This will allow the effective management of demand to balance with intermittent renewable supply and enable the effective integration of transferred demand such as electric vehicle charging and heat

[2] Following the recent earthquake and tsunami in Japan there is likely to be a global reassessment of nuclear power but it is difficult to forecast the effect this will have on new nuclear build programmes.

pumps should the current policy direction in these areas be realised. This so called “smart grid” is crucial to UK energy policy and security and the investment needs to be made.

12. Dealing with intermittency presents a need for demand management, storage, back-up generating capacity and potentially greater international interconnection. Each of these has a role to play and there are complex technical issues in their optimisation and integration. For example, each storage technology has different technical characteristics which suit it to different roles over different timescales. Long-term storage over several days (for example,. to deal with prolonged low wind) may ultimately be possible but very costly.

Question 3. What impact could increased levels of electrification of the transport and heat sectors have on energy security?

13. The transfer of space heating and transport from fossil fuels to electricity would have a profound effect on the electricity system, potentially doubling electricity demand. This will make investment in low carbon generation, networks, smart grids and other infrastructure the key to energy security. The development of institutional structures that enable such changes will also be crucial. Should these investments not be made, measures such as rationing of vehicle charging could become commonplace. Other challenges such as privacy and information security will need to be solved when evolving the smart grid and its associated smart metering systems.

14. The upside, of course, is that the UK’s exposure to oil price risk will be reduced commensurately, but replaced by an exposure to the construction costs of new generating capacity and smart grids. These costs are largely locked in at project completion and there are choices to make in respect of construction start times to take the lowest prices where possible. It is worthy of note that construction costs of new generating capacity have, in recent years, proved almost as volatile as oil prices depending on global market conditions.

Question 4. To what extent does the UK’s future energy security rely on the success of energy efficiency schemes?

15. As stated above, reducing energy demand can only have positive impacts on energy security and exposure to price volatility in the long-term. Reducing peak demands in the short-term, also reduces the extent of plant construction needed and hence its capital cost and deployment risk. Energy efficiency is therefore highly desirable as a cost effective means of mitigating so many risks.

Question 5. What will be the impact on energy security of trying to meet the UK’s targets for greenhouse gas emissions reductions as well as increased penetration of renewables in the energy sector?

16. The main impact of a shift to greenhouse gas reductions and renewables is on the electricity sector and in particular the operability of the power system. We are moving from a world where flexible gas and coal fired power plant provide demand-matching capability in a straightforward, controllable manner. Going forward, power plant will become either relatively inflexible (nuclear and probably advanced coal with CCS) or intermittent (such as wind). This makes the minute by minute balancing of supply and demand more difficult and dependent upon intensive management of demand, use of storage, rapid response (thermal or biofuel) back-up plant and greater transmission interconnection. There is much still to learn about how to operate such a power system securely.

17. On the positive side, however, more renewables and nuclear power decrease the UK’s dependence on international supplies of fossil fuel.

Question 6. What would be the implications for energy security of a second dash-for-gas?

18. Many might argue that the second dash-for-gas happened some years ago and what is now proposed is the third or even fourth such dash. Gas fired power plant provides secure reliable baseload or load-following electricity, provided the gas is available. It can be built in dual-fuel format so liquid back-up fuel is available for a few days or weeks if gas is short.

19. Gas is now much less scarce in the world since shale gas has become widely available and it seems rather less of a security risk than once feared. However, a large build of new gas fired plant would expose the UK to price volatility and most likely slow progress towards meeting greenhouse gas reduction targets.

Question 7. How exposed is the UK's energy security of supply to international events?

20. With the UK becoming a net importer of fossil fuels, its energy system has become more exposed to international events. This is particularly true in terms of exposure to price volatility but there is also a risk of actual supply shortages in extreme situations.

Question 8. Is the UK's energy security policy sufficiently robust to be able to deal with uncertainties and risks inherent in all of the above areas? If not, how could this be improved?

21. UK energy policy (for example, the proposed electricity market reforms) does not place a financial value on diversity of input energy source and instead leaves it, in general, to the market to decide. This means that price and perceived future price volatility will be the main drivers in such decisions. This should, in theory at least, deliver a balanced energy system, but in practice the build incentives are skewed:

- Coal with carbon capture is difficult to get consented and built, has long construction times, high capital costs and complex regulatory issues. It is therefore more difficult to fund than gas. This situation would change if gas were also to be subjected to CCS requirements.
- Nuclear has even higher costs, more complex relationships with Government and financers and is arguably even more challenging than coal.
- Gas is relatively straightforward given the right incentives.
- Renewables vary but onshore renewables at any scale have demanding planning consent issues and offshore renewables have technical, commercial and funding challenges.

There is therefore no guarantee that an optimal scheme is taken forward.

22. Confidence in the future UK energy market is crucial if the necessary investment is to be made. It is therefore vitally important that the current electricity market reform is completed in a timely manner and to an appropriate level in order to allow the private sector to make its investment decisions.

Question 9. Are there any other issues relating to the security of the UK's energy supply that you think the Committee should be aware of?

23. Other relevant issues would seem to include:

Localism versus large scale solutions

24. There is significant opportunity for small scale integrated energy solutions and for meso-scale (community level) solutions that might integrate power and heat via a smart grid and a district heating network. This would allow maximum capture of local community heat pump systems, solar-thermal, biomass and other resources at high levels of operating efficiency. Such solutions need to be engineered robustly to provide security by creating the opportunity to reduce dependence on fossil fuels. They are not, however, a total solution.

Infrastructure resilience and interdependency

25. The recent Engineering the Future report *Infrastructure, Engineering and Climate Change Adaptation – ensuring services in an uncertain future* explored interdependencies between infrastructures. For example, a coal fired power station requires a functional rail system to deliver its coal as well as a functional private transport system so its employees can get to work. Networks of all kinds require telecommunications and information systems to be operable. This is equally true of supply chains during the construction phase of the infrastructure. It is important to consider the wider impacts of events such as flooding and cyber-terrorism in this context.

Uncertainties in technology pathways

26. None of the main technologies currently proposed for large-scale decarbonisation of the UK energy system can guarantee to be successfully deployed at large scale, for example:

- the full chain of carbon capture and storage has not yet been proven on a commercial scale;
- nobody has yet operated a large power system with very large percentages of wind energy;
- nuclear power is proven but support is vulnerable to the consequences of nuclear scares or accidents, as the current events in Japan remind us;
- many practical issues around electric vehicle or plug-in hybrid deployment on a universal scale are untried, for example mass installation of charging points at reasonable cost;
- estimating the future demand of certain technologies such as electric vehicles or heat pumps is extremely challenging;
- international agreements around major intercontinental transmission are a new area;
- the willingness of the public to engage in the process and to accept issues such as privacy impacts is untested and has been an issue elsewhere in the world.

27. This means that the risks of non-delivery in one or more areas of UK energy policy are quite large. There is a need to plan a degree of flexibility into the system and to provide contingencies should some aspects fail.

About the IET

28. The Institution of Engineering and Technology (IET) is one of the world's leading professional bodies for the engineering and technology community and, as a charity, is technically informed but independent of network company, equipment supplier or service provider interests.

29. This submission has been prepared on behalf of the Board of Trustees by the IET's Energy Policy Panel.