House of Commons

Energy and Climate Change Committee

UK Energy Supply: Security or Independence?

Eighth Report of Session 2010–12

Volume I

Volume I: Report, together with formal minutes, oral and written evidence

Additional written evidence is contained in Volume II, available on the Committee website at www.parliament.uk/ecc

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The Energy and Climate Change Committee

The Energy and Climate Change Committee is appointed by the House of Commons to examine the expenditure, administration, and policy of the Department of Energy and Climate Change and associated public bodies.

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The Report of the Committee, the formal minutes relating to that report, oral evidence taken and some or all written evidence are available in a printed volume. Additional written evidence may be published on the internet only.

Committee staff

The current staff of the Committee are Sarah Hartwell-Naguib (Clerk), Richard Benwell (Second Clerk), Dr Michael H. O'Brien (Committee Specialist), Jenny Bird (Committee Specialist), Francene Graham (Senior Committee Assistant), Jonathan Olivier Wright (Committee Assistant) and Nick Davies (Media Officer).

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Energy security has always been high on the political agenda, but its importance has risen as the UK has become increasingly dependent on imported energy, experienced high and volatile oil and gas prices, and addressed the challenge of reducing our carbon dioxide emissions.

DECC needs to define "energy security" and adopt a more strategic and systematic approach to provide a clear goal for policy interventions, taking a more holistic view in order to ensure that the energy system is resilient to both short-term shocks and longer-term stresses.

Primary Energy Supply

It is inevitable that the UK will become increasingly reliant on energy imports. This is not necessarily incompatible with increasing energy security; it can be maintained by a diverse energy portfolio that does not rely too much on either a single supplier or a single fuel. The decline of the UK Continental Shelf is not a major concern in terms of energy security, but the way in which the £2 billion levy on North Sea producers was announced in Budget 2011 may have undermined investor confidence. The Government needs to work closely with the industry to restore that confidence.

Infrastructure

The Government needs to communicate a clear strategy to incentivise more gas storage if it is to ensure timely investment. It is only by having sufficient gas storage that we can build up broader system resilience. We also recommend that the Government set up an independent stock-holding agency—funded by industry—to manage privately held strategic oil stocks.

We are not convinced that the proposals set out in the White Paper on reforms to the electricity market strike the right balance between encouraging investment in new gas-fired plant in the short-term (to fill the gap that will be created by the closure of around 19GW of nuclear, oil-fired and coal-fired plant by 2020) and the need to decarbonise the power sector over the course of the 2020s, which will ultimately entail only a very limited role for unabated gas-fired capacity. In particular, the proposed form of the Emissions Performance Standard could risk locking the UK into a high-carbon electricity system in the future.

Electrification of heat and transport will result in significantly increased loads on the local distribution network. An increase in distributed energy generation combined with greater use of demand side measures could mean that Distribution Network Operators will need to move away from the currently relatively passive operation model towards becoming Distribution System Operators with responsibility for balancing supply and demand on their network. The Government needs to do more work to ensure that Distribution Network Operators are sufficiently prepared for the changes ahead.

Energy Users

Even though improving energy efficiency will bring benefits for energy security, it is often difficult to deliver in practice. Failure to deliver could have serious consequences for energy security.

New "smart" technology will provide opportunities for energy users to engage in demand side response measures, which could play a vital role in ensuring the security of the electricity system. The full potential of such measures to contribute to energy security is not yet known and we urge the Government to investigate this further.

Although energy users are a key component of the energy system, they are perhaps not as well understood as the technologies that make up the supply side of the system. If we are to make a successful transition to a low carbon economy, it is essential that the Government understands both the social as well as the technical feasibility of new technologies in the energy system.

1 Introduction

1. Whilst energy security has always been high on the political agenda, attention to it has increased as the UK has become increasingly dependent on imported energy. This was highlighted in 2011 by the disruption to oil supplies caused by the Arab Spring, as well as the rethink on nuclear power triggered by damage inflicted upon Japanese nuclear reactors by the tsunami of March 2011. We decided to look at this essential aspect of energy policy both to assess the Government's performance in broad terms and to highlight specific areas of concern in the security of the UK's energy supply.

2. We announced our inquiry on 11 February and sought evidence on:

- the resilience of the UK energy system to future changes in fossil fuel and uranium prices;
- the sensitivity of the UK's energy security to investment (or lack of investment) in energy infrastructure;
- the potential impact of electrification of the heat and transport sectors on energy security;
- the extent to which energy security relies upon the success of energy efficiency schemes;
- the potential impact of greenhouse gas reduction targets and increased use of renewables on energy security;
- the implications of a renewed "dash-for-gas" on energy security;
- the exposure of the UK's energy security to international events;
- whether the UK's energy security policy is robust enough to deal with uncertainties and risks inherent in all of the above areas; and
- to what extent does the UK's future energy security rely on the success of energy efficiency schemes?

3. We received 70 submissions of written evidence and held six oral evidence sessions. A full list of witnesses can be found at the end of this report.[1] We are very grateful to all those who have contributed towards this inquiry. We are particularly grateful to Professor Jim Watson (University of Sussex) and Paul Domjan (John Howell and Company Ltd) who were Specialist Advisers to the inquiry.[2]

1 P 54-55

2 www.parliament.uk/documents/commons-committees/energy-and-climate-change/FM201012.pdf

2 Context

Security versus independence

4. The terms "energy security" and "energy independence" are often used interchangeably, but we have sought to distinguish between these concepts and explore their policy implications for the UK. It was suggested to us that while energy security and energy independence "are not mutually exclusive, only security is essential".[3] Energy independence has been defined as a reduced reliance on imports, but this was regarded as being of limited worth without security. Energy independence as a goal could be considered as "misleading and costly" as most countries do not have the resources to be self-sufficient.[4][5]

5. The UK was a net importer of electricity, coal, crude oil and gas in 2010.[6] Our net energy import dependency has been increasing, and is currently at almost 29%,[7] with fossil fuels accounting for the majority.[8] UK domestic production of oil peaked in 1999, and production of gas in 2000.[9] Imports of natural gas increased by almost a third between 2009 and 2010, and in September 2010 imports of liquefied natural gas (LNG) surpassed gas imported through pipelines for the first time.[10] Energy independence is not a feasible goal for the UK in the foreseeable future.

6. A balance needs to be struck between developing the security of domestic supplies and maintaining a reliable supply of imports.[11] In achieving this balance, it is important for the UK to not be reliant on a single fuel source: domestic and imported fuel and electricity generation should come from a variety of sources.[12] We examine the resilience of energy sources currently available to the UK in Part Four.

7. The challenge for the UK is how to attract the investment needed in the energy sector to create a more diverse domestic energy mix. If the UK fails to attract sufficient investment, it will be difficult to achieve our targets for cutting emissions and the country may even struggle to produce enough electricity to meet demand. We look at this issue in depth in Part Five.

8. There are also tensions between energy security, climate change policy and energy affordability. For example, the Government's aim of decarbonising the energy system could result in new energy security risks—such as the availability of carbon capture technology, inadequate gas storage capacity and greater intermittency of renewable electricity generation—

3 Ev w25

4 Ev 148

5 Ev w91

6 DECC, *Digest of UK Energy Statistics 2011*, Chapter 1 p 12

7 DECC, *Digest of UK Energy Statistics 2011*, Chapter 1 p 16

8 DECC, *Digest of UK Energy Statistics 2011*, Chapter 1 p 1

9 Ev 198

10 DECC, *Digest of UK Energy Statistics 2011*, Chapter 4 p 95

11 Ev w143

12 Ev 112, Ev 121, Ev w21, Ev w25, Ev w32, Ev w36, Ev w52, Ev w55, Ev 139, Ev 144, Ev 148, Ev w70, Ev w79, Ev w83, Ev 164, Ev w91, Ev 170, Ev 180, Ev w105, Ev w143, Ev 211, Ev w148

and ultimately lead to increased bills for consumers. Even so, there are ways of reconciling these three aims, including energy efficiency, that could address concerns about climate change, security and affordability. We examine the threats to energy security in Part Three and how energy efficiency could support energy security in Part Six.

3 DECC's approach to energy security

Definition of energy security

9. Over the course of our inquiry, it became clear that there was no agreed definition of "energy security". It can be used to describe the reliability of supplies, the resilience of the supply infrastructure to attack or natural disaster, the supply of affordable fuels, and the extent of national self-sufficiency. It is also used to refer more generally to the absence of interruptions to supplies of electricity, gas and petroleum products to end users.[13]

10. Despite having a departmental priority to "deliver secure energy on the way to a low carbon energy future",[14] DECC does not appear to have a categorical definition of what "secure energy" is. When asked to provide such a definition, the Minister told us that "It is a combination of matters. It includes the resilience of our energy supplies, inevitably now it includes low carbon issues and it includes an affordability aspect".[15]

11. **Our own suggestion is as follows: a secure energy system is one that is able to meet the needs of people and organisations for energy services such as heating, lighting, powering appliances and transportation, in a reliable and affordable way both now and in the future. We recommend that the Government adopts this definition.**

Threats to energy security

12. Witnesses identified a large number of potential threats to energy security in the UK. These ranged from generalised concerns—including the growing global demand for energy, and the risk that upgrades to electricity infrastructure might not keep pace with increasing demand—to more specific risks such as the 2011 "Arab Spring" resulting in a setback in oil and gas investment in Libya, Yemen and Syria, and the impact of a failure in the Langeled pipeline[16] on UK gas supplies.[17] (A complete list of all of the threats suggested to us during our inquiry is included in Annex 1 of this report).

13. While a range of potential threats were identified, an agreed set of headline risks did not emerge. Many witnesses found it hard to answer the straightforward question "what are the biggest risks to UK energy security?". Any robust energy security strategy needs to consider the system as a whole; a focus on a small number of specific areas is not sufficient.

14. One approach is to consider the resilience of the system as a whole.[18] This might involve ensuring that there is sufficient spare transmission capacity to cope with the loss of a major power line, or sufficient diversity in the sources and transportation routes of imported fuels to cope with interruptions to any one source or route. A resilience approach would acknowledge

13 Q 1 [Mitchell], Q 2 [Stevens], Q 174 [Meeks], Ev w138, Ev 177, Ev w68, Ev 170

14 DECC, *Business Plan 2011-2015,* available at www.transparency.number10.gov.uk, accessed 6 July 2011

15 Q 430

16 The Langeled pipeline transports gas from Norway to the UK and has the capacity to provide up to 20% of the UK's peak demand.

17 Ev w21, Ev w55, Ev 148, Ev 180

18 Ev w138

how difficult it is to identify and analyse all threats. As Dr Strachan, of University College London, pointed out, there are some threats that fall into the category of "sheer ignorance", which are simply impossible to quantify or predict (for example, a terrorist attack on energy infrastructure).[19] Focusing on resilience is a way of dealing with these kinds of "unknowable" threats.

15. As well as surviving short-term shocks (for example, spikes in fossil fuel prices, terrorist activity and accidental damage), the system needs to be resilient to longer-term changes such as the decline in global reserves of conventional oil or the need to decarbonise the energy system.[20]

16. Focusing on resilience requires a more holistic approach to energy security. The Institute of Engineering and Technology (IET) argued for a "systems approach" to energy security, which acknowledged the linkages between different parts of the energy system as well as the risks associated with individual components of the system.[21] The IET noted that "energy security is a complex and multidimensional problem and solutions with a positive impact in some areas can have negative effects in others".[22] For example, electrification of transport might reduce dependence on imported oil but would increase dependence on electricity infrastructure.[23]

17. **Understanding how changes in one part of the energy system will impact on others is an essential part of producing a resilient energy system. We recommend that work on energy security should focus on achieving system resilience—both to short term shocks and longer-term stresses—as well as focusing on individual components of the energy system.**

Development of an energy security strategy

18. DECC has not published a strategy for achieving energy security. This contrasts with its approach on climate change, where a headline emission reduction target has been adopted and strategies setting out how subsidiary targets will be achieved are published.[24]

19. The department outlined four key areas of its work on energy security: maximising economic recovery of indigenous reserves; reducing demand for energy; ensuring a strong, resilient market and infrastructure; and influencing other countries.[25] DECC's website states that the Government's approach to energy security "includes policies that encourage: free energy markets, both in the UK and internationally; diverse energy sources; international energy dialogue; and timely and accurate information to the market".[26] While each of these activities may well contribute individually towards greater energy security, they do not amount to a coherent or strategic approach to energy security.

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19 Q 55 [Strachan]

20 Modassar Chaudry, Paul Ekins, Kannan Ramachandran, Anser Shakoor, Jim Skea, Goran Strbac, Xinxin Wang, Jeanetter Whitaker, *Building a Resilient UK Energy System,* Research Report, ref UKER/RR/HQ/2011/001, 14 April 2011, pp 14-15

21 Ev 170, Q 360 [Harrison], Q 363 [Harrison]

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

23 Q 363 [Kemp]

24 DECC, *The UK Low Carbon Transition Plan*, 15 July 2009; (a new strategy on achieving the 4th carbon budget will be published in Autumn 2011)

25 Ev 112

26 www.decc.gov.uk/en/content/cms/meeting_energy/en_security/en_security.aspx (accessed 16 August 2011)

20. **An energy security strategy should be published in single, dedicated document.**

21. One approach to energy security is to develop different hypothetical scenarios and to conduct "stress tests" on the system to try to understand how resilient it would be to different types of threat. Examples of this kind of approach include Ofgem's Project Discovery, Pöyry's report on gas security of supply for DECC, Wood Mackenzie's report on downstream oil infrastructure for DECC and the UK Energy Research Centre's paper *Building a resilient UK energy system*.[27] A robust energy security strategy could be built around addressing the vulnerabilities identified in such studies.

22. DECC does carry out its own modelling work to assess the impact of multiple shocks on the energy system.[28] However, we were left unclear about the specific nature of this work. This raises several important questions: does this modelling consider the energy system as a whole, or is separate modelling carried out on individual components (for example, on gas, oil and electricity)? Does this modelling look only at potential shocks that may happen in the short-term, or does it also consider longer-term stresses on the system (such as increasing fossil fuel prices or the need to decarbonise the energy system)? Is modelling carried out at a macro level or does it takes into account the geography of the UK's energy infrastructure? Finally, it is unclear how the findings from this modelling work are used and whether they feed into any kind of comprehensive security strategy.

23. **We recommend that the Department describe the scope of its energy security modelling and how the findings are used. In addition, DECC needs to be clear about the "early warning" signals that it uses to assess the risk profile of each threat to energy security and be clear about the resilience measures that it would need to adopt to mitigate risk to energy security. It should then expose its methodology to public challenge.**

Assessing progress

24. Part of the Committee on Climate Change's remit is to assess progress towards climate change goals, and it makes a detailed report to Parliament each year. This provides an independent assessment against clearly defined targets. In contrast, DECC and Ofgem jointly publish their own annual Statutory Security of Supply Report, which provides a snapshot of the state of various components of the electricity, gas and oil systems. [29] The information in this report is not organised in a way that makes it easy to assess what progress has been made against the four priority policy objectives that DECC described to us. The way that the document is structured (with chapters headed "electricity", "gas" and "oil") tends to put the focus on the physical security of fuel supplies at the expense of other aspects of the energy system. The "oil" chapter of the 2010 report did not include any comment on the security of the petrol and diesel distribution system.[30]

27 Ofgem, *Project Discovery Energy Market* Scenarios, Ref: 122/09, 9 October 2009; Pöyry, *GB Gas security of supply and options for* improvement, March 2010; Wood Mackenzie, *UK Downstream Oil* Infrastructure; Modassar Chaudry, Paul Ekins, Kannan Ramachandran, Anser Shakoor, Jim Skea, Goran Strbac, Xinxin Wang, Jeanetter Whitaker, *Building a Resilient UK Energy System*, REF UKERC/WP/ES/2009/023, 31 March 2009

28 Q 432, Q 435

29 DECC and Ofgem, *Statutory Security of Supply Report*, November 2010, HC 542

30 DECC and Ofgem, *Statutory Security of Supply Report*, November 2010, HC 542, pp 42-46

25. It would be easier to monitor DECC's performance on energy security if a set of indicators were adopted against which DECC reported in the annual Statutory Security of Supply Report.[31] The UK Energy Research Centre has suggested that energy security indicators should cover three broad aspects: resilience of primary energy supply, resilience of energy infrastructure and resilience of energy users. A full list of the indicators suggested by UK ERC is included in Annex 2 as an example.

26. What a comprehensive set of energy security indicators should consist of is for debate. However, they should include:

- **Level of energy demand**—reducing demand for energy can help to increase energy security.[32]
- **Diversity of fuel suppliers**—a diverse portfolio of fuel supplies (both in terms of number and provenance) is more resilient than relying on a small number of suppliers.[33]
- **Energy prices—**Affordability is an aspect of energy security.[34]
- **Fuel stock levels—**Fuel stocks enhance energy security and gas storage in particular is an important component of UK energy security.[35]
- **Spare capacity**—spare capacity (for example electricity capacity margin) means that the system as a whole is able to withstand unexpected failure in individual parts.[36]
- **Capacity for Demand Side Response (DSR)—**the degree to which energy users can voluntarily reduce consumption.[37] Monitoring the level of reduction in demand that can be achieved through DSR measures shows how much disruption to energy supplies can be comfortably absorbed by the system.

27. DECC already collects much of the data that would be needed for a set of energy security indicators for various existing statistical publications (such as the Digest of UK Energy Statistics, Energy Trends and Quarterly Energy Prices). Collating this information and presenting an analysis of the implications for energy security as part of the Statutory Security of Supply Report would make it easier to assess the impact of policies designed to improve energy security. New data might be required for an indicator that measured the capacity for demand side response. The collection and reporting of this information would help Parliament and others to judge the Government's progress towards energy security.

28. The Government's Strategic Defence and Security Review contained a pledge to "strengthen the delivery of energy security objectives by more robust reporting and monitoring, including by

31 A forthcoming Parliamentary Office of Science and Technology POSTnote will explore this topic in more detail.

32 Q 27 [Mitchell], Q 55 [Strachan], Q 57 [Jenkins], Q 70 [Strachan], Q 360 [Harrison], Ev w134, Ev w138, Ev 139, Ev 211, Ev 112, Ev w105, Ev w83, Ev 170, Ev w149, Ev w62, Ev w59, Ev 204, Ev 164, Ev w35, Ev 148, Ev w25, Ev w154, Ev 228

33 Ev 139, Ev 211, Ev 121, Ev 159, Ev 144, Ev 112, Ev w70, Ev w83, Ev w131, Ev w75, Ev 180, Ev w36, Ev w8, Ev 204, Ev w143, Ev 164, Ev 148, Q 59 [Jenkins], Q 86 [Hanafin], Q 103 [Hanafin],

34 Q 1 [Mitchell], Q 2 [Stevens], Q 174 [Meeks], Ev w138, Ev 177, Ev w68,

35 Ev w40, Ev w138, Q 105 [Hanafin], Q 39, Ev 132

36 Q 65 [Strbac], Q 92 [Rigby], Q 148 [Winser], Q 418 [Ling]

37 Ev w83, Ev 180, Ev w36, Q 57 [Jenkins, Strbac and Strachan]

putting in place a transparent set of energy security indicators in which the Government and its partners can have confidence".[38]

29. **We recommend that the Government now publish a transparent set of energy security indicators as promised in the Strategic Defence and Security Review. These indicators should cover primary supply of fuels, energy infrastructure and energy users and include specific indicators on the overall level of energy demand, diversity of fuel supplies, energy prices, fuel stocks, spare capacity and capacity for demand side response.**

30. **We recommend that DECC should report against a set of energy security indicators on an annual basis as part of its Statutory Security of Supply Report as its contribution to the reporting on the Strategic Defence and Security Review indicators.**

38 HM Government, *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, Cm 7948, 2010, p 51

4 Primary energy supply resilience

31. Primary energy is energy that has been supplied without being subject to any transformation or conversion process, such as crude oil, natural gas, and coal. Indigenous production meets around two thirds of UK primary energy demand.[39] As coal accounted for less than 4% of final energy consumption by fuel in 2010,[40] we have focused on the production of oil and gas from the UK Continental Shelf, and the risks the UK may be exposed to as this resource declines. We also considered the conversion of crude oil into petrol and other fuels at refineries in the UK, and the risks to energy security as the number of these facilities decreased. We also looked at the fuel protests of 2000. Finally, we explored the nature and extent of the UK's energy dependence on Russia.

UK Continental Shelf

32. Virtually all UK oil and gas production occurs under the seas surrounding the UK, from the seabed known as the UK Continental Shelf (UKCS). Production of oil peaked in 1999, and production of gas in 2000.[41] As a result, the UK is moving from a position of self-sufficiency to increasing dependence on imported oil and gas. In 2009, imported gas accounted for approximately 32% of the total gas used.[42] Of these gas imports, about 58% came from Norway, 25% were liquefied natural gas (LNG) from various different countries, 16% came from the Netherlands, and 2% came via the Belgian interconnector pipeline.[43] The majority of the UK's crude oil imports (almost 70%) are from Norway.[44]

33. Greater reliance on imported oil and gas leaves the UK more open to supply risks associated with global supply constraints and price volatility.[45] The Government aims to reduce the need for oil and gas imports—and hence exposure to these energy security risks—by maximising production from the UKCS and through promotion of low-carbon alternatives such as electric vehicles, biofuels and fuel efficiency.[46]

34. The Minister told us that it was in the UK's "national interest" that domestic production of oil and gas were maximised.[47] In 2010, production from the UKCS still accounted for more than 90% of oil and 60% of the UK's gas demand by volume.[48] Oil & Gas UK believed that with the right investment climate the UKCS could still be producing and contributing to security of supply into the 2040s.[49] Shell believed that continued investment in new and incremental fields

39 Ev 112

40 DECC, *Digest of UK Energy Statistics 2011*, Chart 1.4 p 15

41 Ev 198

42 DECC, *Digest of UK Energy Statistics 2010*,Chapter 4 p 95

43 DECC, *Digest of UK Energy Statistics 2010*,Chapter 4 p100

44 DECC, *Digest of UK Energy Statistics 2010*,Chapter 3 p 68

45 Ev 112

46 Ev 112

47 Q 481

48 Ev 198

49 Ev 198

in the UKCS could "halve the [overall] decline rate" from 6.5% per year (observed over the last decade) to around 3%.[50]

35. Future resources will inevitably be more difficult to recover as the more easily recovered resources have already been exploited—which in turn will make it difficult to estimate future investment requirements.[51] Mark Hanafin of Centrica told us that if infrastructure ceased to be profitable it would likely be abandoned, and it was unlikely that production would be restarted.[52]

36. Oil and Gas UK believed energy security was not necessarily at risk because the UK domestic resources were in decline—it was more an issue of the "economic losses" to the country.[53] Nick Wye—for the Gas Forum—explained that as the UKCS had declined, UK industry had responded by building the necessary import infrastructure.[54] About £5 billion had been spent on gas infrastructure in the last five years, which allowed the UK to import a maximum of 140 bcm a year (compared to annual demand of between 90–100 bcm). [55] Oil and Gas UK believed that this import capacity meant the UK had the most diversified gas supply in Western Europe.[56]

Internal threats to supply

37. Many witnesses saw the main threats to the UK as internal. For example, domestic fuel blockades in 2000 or the mining strikes of the 1970s.[57] According to former Home Secretary Jack Straw, during the 2000 fuel blockades the Government, " worked round the clock to get the tankers moving [...] with no contingency plans of any kind for handling a fuel crisis, and not even a readily accessible map of where the refineries were".[58] Later in 2000, a Memorandum of Understanding was agreed between the UK government, the Trades Union Congress, the police, and fuel companies to "continue to be committed to the normal supply of oil fuels as a national priority and economic imperative".[59] The main elements of the planning, information and management system set up under the MOU include controlling the delivery of oil fuels in the event of disruption to supplies.[59]

38. **We welcome the Government's aim to move away from dependence on fossil fuels in the long-term. In the meantime, we recommend that the Government continue to monitor the diversity of sources and suppliers of oil and gas to the UK in order to avoid becoming overly dependent on a single source. This will become more important as dependence on imports grows. Government should also consider how vulnerable imports to the UK are to disruption and what sources would be available to replace imports in the event of disruption. The decline in UKCS oil and gas production could have economic impacts such as decreasing tax revenue and jobs, and a negative impact on our balance of payments. However, we conclude**

50 Ev 211

51 Q 275

52 Q 103 (Hanafin)

53 Q 274 (Odling)

54 Q 274 (Wye)

55 Q 274 (Wye)

56 Q 274 (Odling)

57 Ev w79, Q 280, Ev w79

58 www.guardian.co.uk/politics/2011/jul/07/diaries-alastair-campbell-power-review?INTCMP=SRCH

59 DECC, *Memorandum of Understanding*, 29 September 2000

that the UK's energy security is not threatened significantly by a decline in UK Continental Shelf production.

Budget 2011

39. On 23 March 2011, in his Budget speech the Chancellor of the Exchequer announced an increase in the supplementary charge on UK oil and gas production from 20% to 32%. It was intended that this would raise £2 billion in additional revenue to pay for a 1p per litre reduction in fuel duty. It appears that the Treasury did not consult the industry about the impact of this increase before it was announced.[60] Furthermore, it is not clear when the Treasury informed DECC about its intention to make this change.[61]

40. The oil and gas industry reacted furiously to the surprise announcement of a third tax increase in ten years and predicted that the lack of fiscal stability would lead to developments in the North Sea, particularly in the marginal and mature fields, being jeopardised with the risk that investment and production would move overseas. [62] There was particular objection to what was seen as a disproportionate impact of the tax on gas production where development costs were comparable with oil, but prices were much lower per barrel of oil equivalent.[63]

41. There was a fierce debate between the Government and industry witnesses over the impact of the previous increase in 2006 of the supplementary charge on production in the North Sea, with industry arguing that the long term impact showed a decrease in investments between 2006 and 2009.[64] Oil and Gas UK claimed that the UK was now regarded as one of the "most unstable oil and gas provinces in the world by many investors".[65] However, the Government's position remains that whilst the increase might, "affect the commercial viability of a handful of marginal investments [...] the Government does not expect a significant impact on investment or production in the forecast period as a consequence of this measure".[66]

42. **If the Government is serious about maximising production from the UK Continental Shelf, it needs to consider the long-term impact of changes to the tax regime on investment. The evidence on the impact of 2006 increase in the supplementary tax charge on oil and gas production in the North Sea is inconclusive, but there is a clear need to sustain investor confidence by avoiding surprises, such as the further increase announced in the 2011 Budget. It is not sensible to make opportunistic raids on UKCS producers. The Government must build a more constructive relationship if it is to restore industry confidence and maximise the benefits gained from the UKCS.**

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60 Energy and Climate Change Committee, *Implications for the North Sea Oil and Gas industry of the Budget* 2011, HC 1081-i, Oral evidence, Q 79

61 Energy and Climate Change Committee, *Implications for the North Sea Oil and Gas industry of the Budget* 2011, HC 1081-i, Oral evidence, Qq 13–17, 84

62 Ev w143, Ev 204, Ev 198

63 Energy and Climate Change Committee, *Implications for the North Sea Oil and Gas industry of the Budget* 2011, HC 1081, written evidence from Oil and Gas UK, NSOG 04

64 Energy and Climate Change Committee, *Implications for the North Sea Oil and Gas industry of the Budget* 2011, HC 1081, written evidence from Oil and Gas UK, NSOG 04a

65 Energy and Climate Change Committee, *Implications for the North Sea Oil and Gas industry of the Budget* 2011, HC 1081, written evidence from Oil and Gas UK, NSOG 04

66 Energy and Climate Change Committee, *Implications for the North Sea Oil and Gas industry of the Budget* 2011, HC 1081, written evidence from Oil and Gas UK, NSOG 08

Refined Products

43. Crude oil must be refined into petroleum products before it can be used. Although the UK is a net exporter of petroleum products, there is still a need for imports.[67] This is because there is a mismatch between the types of petroleum products used in the UK and the types that UK refinery technology can produce. The UK Petroleum Industry Association's (UKPIA) Director General, Chris Hunt, told us that the UK's refineries met the domestic demand in terms of capacity, but not in the "exact product mix" required.[68] In common with Europe as a whole, the UK produces too much petrol and too little aviation fuel and diesel.[69] This imbalance is expected to increase over the next 10 to 15 years.

44. UK refining capacity has declined from 18 refineries in the late 1970s to eight major refineries today. Of these, four have been put up for sale. UKPIA noted that market conditions (weak demand, low return on investment), along with competition from new "export orientated" refineries in Asia, could result in further closures of UK refineries.[70]

45. DECC recently commissioned a report from Deloitte to examine whether the Government should be concerned about the UK becoming more dependent on imported refined oil products as domestic refineries closed.[71] The report concluded that an increased dependence on imports would not necessarily threaten energy security because international trade in oil products has grown and new refining capacity was being brought online in other countries which would target export markets. However, Deloitte also noted that a higher proportion of future refined product imports may come from a small number of countries or regions, in particular from India and Middle Eastern countries such as Saudi Arabia and Kuwait. This may leave the UK more exposed to a disruption from a single source than is currently the case.[72] Most of the growth in global refining capacity by 2014 is expected to take place in China, the Middle East and India. Refineries in the Middle East and India are typically export-focussed and designed to meet Western quality specifications.[73]

46. Chris Hunt stated that the Government needed to have a policy framework for refineries.[74] He explained that exploration and production—the "upstream" side of the industry—was "far sexier" than the "downstream" side that dealt with refining and which tended to be left out of future energy scenarios.[75] The Deloitte report recommended that the Government should consider what, if any, is the minimum level of refining capacity that should be maintained as insurance against market breakdown or supply disruption. This might include an estimate of the baseline level of refining capacity required for the UK to be broadly self-reliant in an emergency.

67 DECC, *Digest of UK Energy Statistics 2011*, Chapter 1 p 12

68 Q 264

69 Q 265

70 Ev 164

71 Deloitte, *Downstream oil- short term resilience and longer term security of supply*, Final Report for DECC, 1 April 2010

72 Deloitte, *Downstream oil- short term resilience and longer term security of supply*, Final Report for DECC, 1 April 2010, p 8

73 Deloitte, *Downstream oil- short term resilience and longer term security of supply*, Final Report for DECC, 1 April 2010

74 Q 268

75 Q 268

47. **We recommend that the Government publish its assessment of the minimum level of refining capacity by product that should be maintained in the UK as insurance against market breakdown. Based on this, the Department of Energy and Climate Change should develop a strategy for how it will ensure the minimum level is met.**

Russian gas supplies

48. In 2010 Russian gas accounted for less than 2% of the UK's supply,[76] and Russian crude oil made up less than 10% of our imports.[77] For comparison, almost 37% of the UK's imported coal came from Russia in 2010.[78] Several witnesses agreed that Russia's dependence on Europe for its gas market is greater than Europe's dependence on Russia for its gas supply.[79]

49. Professor Stern, of the Oxford Institute of Energy Studies (OIES), added that "the Russians have proved generally to be highly reliable suppliers".[80] It was likely that the UK would experience indirectly any disruption in Russian gas supplies, as happened during the 2009 Russia-Ukraine crisis. [81] That incident led to an increase in gas prices on the continent, which incentivised companies holding gas in the UK to sell into that market.[82]

50. Despite the general belief that disruption of gas supplied from Russia was unlikely to impact adversely on the UK, DECC and others thought that the UK could benefit from increased integration with European gas markets and infrastructure, as it would allow the impact of any supply disruption to be diffused among EU Member States.[83] A European Regulation to safeguard security of gas supply was developed in response to the Russian-Ukrainian crisis of January 2009, which entered into force in December 2010.[84] The EU regulation required Member States to ensure that—by December 2014—exceptionally high gas demand (occurring once in 20 years) could be met in the event that supplies from the single largest part of their gas infrastructure (for example, domestic production, import pipelines, storage deliverability) or LNG capacity were disrupted.[85] However, Katinka Barysch, of the Center for European Reform, noted that the European Commission's efforts to encourage Member States to enhance their gas security had been met with a "slow and piecemeal" response that was likely to be insufficient to enhance the energy security of central and eastern European countries in particular.[86]

51. Many of Russia's existing gas fields are past their peak production.[87] The Government's recent Strategic Defence and Security Review stated that the UK faces a range of risks to its

76 HM Government, *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, Cm 7948, October 2010, p50

77 DECC, *Digest of UK Energy Statistics 2011*, Chart 3.2 p 68

78 DECC, *Digest of UK Energy Statistics 2011*, Table 2B p 44

79 Ev 229, Q 51 (Mitchell)

80 Q 51 (Stern)

81 Ev 226

82 Q 405 (Corbeau)

83 Ev 112

84 Regulation (EU) No. 994/2010 of the European Parliament and of the Council of 20 October 2010

85 Regulation (EU) No. 994/2010, Article 6 (1)

86 Ev 229

87 Ev w144

energy security, including "insufficient investment" in states that supply its energy. In terms of Russia, this would apply to Gazprom's own investments in its oil and gas fields.[88] Making that same point, the Minister and Chris Barton, DECC's Head of International Energy Security, told us that, even though Russia provided a small proportion of the UK's gas supply, active diplomacy was still important in terms of energy security to ensure that more gas entered the global market as demand increased.[89] Chris Barton added, "it is very much in our interests" that Russia developed its own gas and oil fields to meet global demand.[90]

52. **Whilst any future disruptions of Russian supplies to the EU could have some impact on UK gas prices, the more immediate domestic challenges are more directly within the Government's control. for example, energy infrastructure resilience and exploitation of the UK's domestic resources.**

International gas pipelines

Nord Stream

53. Russia's northern gas pipeline through the Baltic Sea—Nord Stream—began final preparations for operating in September 2011.[91] The Minister told us that the pipeline would be "part of the solution" to the kind of interruptions seen during the 2009 Russia-Ukraine incident.[92] The project comprises twin pipelines built by Gazprom and its German, Dutch and French partners, to bring gas directly from Russia to northern Germany, by-passing Ukraine and Belarus.[93] The pipeline is designed to lessen the potential political problems surrounding the pipelines that pass through the Ukraine corridor.[94]

54. The combined capacity of the pipelines (55 bcm per year) is about equal to two-thirds of Germany's annual consumption of gas. Oil and Gas UK argued that Nord Stream would "considerably improve the security of Russian gas supplies to NW Europe"[95] and Gazprom added that it would mean the UK would be able to "able to access a potential greater pool of supply".[96]

55. The Russia Foundation believed that Gazprom's Nord Stream pipeline was designed to segment the European market into East and West (and avoid a single energy market) and marginalise existing transit countries in Eastern Europe (to increase Russia's influence on them).[97] Anne-Sophie Corbeau, a Senior Gas Analyst with the International Energy Agency (IEA), told us that there was a "question mark" over whether Nord Stream would provide any

88 HM Government, *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, Cm 7948, October 2010, p50

89 Qq 486–487

90 Q 487

91 "Pipeline gives Moscow the edge in gas supply balance of power", Financial Times, 6 September 2011

92 Q 483

93 Ev 198

94 Q 51 (Stern)

95 Ev 198

96 Ev w131

97 Ev w144

additional gas to Europe, implying that the pipeline would merely re-route gas that would otherwise have transited Ukraine.[98]

56. **While the Nord Stream pipeline will mitigate the risk that transit countries could disrupt gas supplies between Russia and Europe, we conclude that the pipeline will not increase European gas security significantly as it is likely to re-route gas around Ukraine rather than add any new volume.**

Southern gas corridor

57. Only three countries supply the vast majority of EU gas imports—Russia (40%), Algeria (30%) and Norway (25%).[99] The development of a European "Southern Gas Corridor" through Turkey or the Black Sea was meant to address this over-reliance by providing a new pipeline route for Azeri gas from the Caspian region. There are a number of different southern gas corridor pipeline projects in various stages of development: "Nabucco", "South Stream", "ITGI", and "TAP".

Nabucco

58. The Nabucco Pipeline Company is made up of a consortium of Bulgarian, Turkish, Hungarian, Austrian, German, and Romanian companies, and is a multilateral approach to increasing Europe's energy security.[100] The European Azerbaijan Society (TEAS) described the Nabucco pipeline as the EU's "preferred project" to bring Azeri gas to Europe.[99] In June 2011 the Nabucco consortium signed agreements with transit countries through which the proposed pipeline would run, which came just a few weeks after a two-year delay in the project's target date for completion was announced.[101] During the signing ceremony, Gunther Oettinger—EU Energy Commissioner—said that "Nabucco has made the final step from a project to reality".[101]

59. The TEAS described the project as having been "hampered by disjointed European policy and lingering questions over supply", but added that it believed much of the latter was "scaremongering" on the part of Russia who has its own pipeline plan for the Southern Corridor (known as South Stream, discussed below).[102] Katinka Barysch, of the Centre for European Reform, argued that the Nabucco pipeline would reduce the ability of Russia to blackmail countries in eastern Europe that are currently dependent on it for gas imports,[103] and that, unlike the Nord Stream pipeline, the main benefit of Nabucco was the access it would provide to a "completely new source of gas" from the Caspian region.[104]

60. There is a case for European Governments to make themselves less dependent on Russian gas through subsidy of the Nabucco pipeline.[105] Professor Stevens of Chatham House believed

98 Q 404

99 Ev w52

100 "Shareholders", *Nabucco GmbH,* www.nabuccopipeline.com/portal/page/portal/en/company_main/shareholders_link

101 "Nabucco Signs Pipeline Accords", *European Dialogue,* 22 June 2011

102 Ev w40

103 Q 404 (Barysch)

104 Ev 229

105 Q 46 (Stevens)

that if "left to the private sector, it will not happen".[106] Katinka Barysch saw Nabucco as a "public good" because it would diversify European gas supplies away from Russia.[107]

61. Others argued that the potential security benefits of Nabucco were not so large as to justify putting between €12 and 20 billion into building it.[108] To those concerned about overdependence on Russian gas, LNG could be a much more "immediate" and "commercially viable" solution.[109] Some saw gas pipeline projects such as Nabucco and South Stream (discussed below) as too large and no longer relevant in the era of increased LNG capacity and "unconventional gas."[110] (Unconventional gas is "natural gas" held in an "unconventional" geological formation, such as shale rock—this was the subject of our fifth report of the 2010–12 parliamentary session.[111]) Peter Kaznacheev, of Khaznah Strategies, claimed that these projects only continued to enjoy support for "purely political reasons"—the EU support Nabucco while Russia champions South Stream—and neither of them appeared to be commercially viable.[112]

62. The Minister told us that while the Government was supportive of Nabucco—and the development of the southern gas corridor more generally—they believed it should be "market driven" without large amounts of European funding.[113]

South Stream

63. Gazprom plans to build its own pipeline through the southern corridor, called South Stream. The project will be developed by Gazprom and the transit countries through which the proposed pipeline could cross.[114] At a promotional event on 25 May, the Russian Energy Minister and Gazprom's top hierarchy advertised the South Stream project to politicians and investors in Brussels.[115] Commissioner Oettinger stated that "South Stream so far seemed more of a concept than a concrete proposal", based on Gazprom's insistence that Russia has "all the [gas] resources it needs" for the project while not identifying specific sources.[115] Alexei Miller, Gazprom Chairman, countered that South Stream "is more than a concept […] it is an incipient construction".[115]

64. Some commentators believe that the South Stream proposals are aimed more at delivering strategic political goals rather than genuinely delivering a new pipeline route. Peter Kaznacheev, of Khaznah Strategies, told us that "Russia is trying to see whether the EU […] would call [the Nabucco project] off and, if it does, then Russia can, with dignity, do the same because [building South Stream] is not in Russia's interests".[116] Professor Alan Riley agreed, and described Russia's current gas pipeline strategy as a "major difficulty for the Russian government and Gazprom",

106 Q 46 (Stevens)

107 Q 404 (Barysch)

108 Q 46 (Stern)

109 Q 6 (Stern)

110 Ev 229

111 Energy and Climate Change Select Committee, Fifth Report of Session 2010–12, Shale Gas, HC 795

112 Ev 229

113 Q 478

114 http://south-stream.info/index.php?id=4&L=1

115 "South Stream's credibility problems deepen after Brussels promotional event", *European Dialogue*, 22 June 2011

116 Q 403

because development of both the Nord Stream and South Stream pipelines will increase significantly the cost of gas delivery for Russia.[117]

ITGI and TAP

65. The International Energy Agency's Anne-Sophie Corbeau offered a further perspective on Nabucco when she compared it to smaller pipeline projects in the Southern Corridor, including the Trans-Adriatic Pipeline (TAP) and the Interconnector Turkey-Greece-Italy (ITGI)[118] Along with Nabucco, both of these pipelines are expected to be supplied by Azeri gas; however, it has been estimated that there is insufficient gas to meet the large planned capacity of the Nabucco pipeline.[118]

66. **Any development of the proposed Nabucco gas pipeline should be determined and driven by the market. Debate over the merits of the different gas pipeline proposals fails to acknowledge the broader energy landscape, with increasing liquefied natural gas (LNG) availability, smaller pipelines planned in south-eastern Europe, and increasing unconventional gas production having the potential to make such very large pipelines uneconomic and redundant.**

117 Ev w85

118 Q 404

5 Infrastructure resilience

Gas storage

67. Gas storage is a means of managing seasonal demand fluctuations—gas has tended to be put into storage in the summer months when gas is cheap and abundant and taken out in the winter months when demand and prices are higher.[119] The flexibility of gas storage facilities—in terms of the rate at which gas can be withdrawn and injected—is the crucial factor as to how well the facility can meet short term fluctuations in demand. DECC noted that gas storage would become increasingly important as the contribution of wind to electricity generation increased because gas fired power plants could provide cover for wind intermittency.[120]

Strategic gas storage

68. In addition to gas stored in order to manage seasonal demand fluctuations, it has also been proposed that "strategic" gas storage could be built to hold gas stocks that could be released in a supply emergency, such as the strategic oil stocks held by members of the International Energy Agency (IEA). Professor Stern thought there was a case for such "strategic [gas] storage"—facilities commissioned, built and controlled by Government—but explained that "nobody else does".[121] Oil & Gas told us that the costs for strategic gas storage would be "absolutely astronomical".[122] A study on natural gas storage in the EU estimated that gas would cost five times as much to store as oil.[123] We will not consider "strategic" storage, and instead focus only on gas storage used to manage seasonal demand fluctuations.

Different types of gas storage

69. There are three main types of underground gas storage: injection into water aquifers; into depleted oil and gas fields; and salt caverns.[124] Together these are described as underground gas storage (UGS). "Pore storage injection" (into depleted oil and gas fields, or aquifers) generally takes place during low demand between late spring and early autumn months, with withdrawals taking place throughout winter. Such facilities offer more seasonal storage that can balance demand requirements in the longer term. In contrast, salt caverns can be filled and emptied at a high rate, allowing them to deliver demand response in the medium to short term. Witnesses told us that in the future the UK was more likely to need the "quick-in, quick-out" storage facilities, rather than very large "quasi-strategic" storage.[125] [126]

119 DECC, Statutory Security of Supply Report, §4.3.27, November 2010

120 DECC, Statutory Security of Supply Report, §4.3.27, November 2010

121 Q 490

122 Q 300

123 Ramboll, *Study on natural gas storage in the EU*, DG TREN C1, Draft Final Report, October 2008, p192

124 Ev w40

125 Q 298

126 Q 106

Need for increased storage

70. Gas storage could be used to moderate the effects of gas price spikes.[127] The gas market tends to overreact to supply threats resulting in a short period of very high prices.[128] The main problem is who is going to pay for such gas storage.[129]

71. The British Geological Survey (BGS) believed that the UK's energy security is "closely bound up with how much gas it stores", and that at present the country does not have the underground gas storage that would be expected when comparing the UK to other countries. [130] In the past the UK could meet changes in demand by increasing or decreasing output from the North Sea and East Irish Gas fields; however, these offshore fields are rapidly depleting and the market is losing its ability to respond flexibly.[134]

72. The UK currently consumes about 100 bcm (billion cubic metres) of gas per year, but only has storage capacity equivalent to a little over 4% of this, which is much less than other European countries.[131] The UK's current storage capacity is equivalent to about 14 days' worth of supply, compared to 69 in Germany, 59 in Italy, 87 in France, and 66 days in the US.[132] The Sussex Energy Group argued that "an increase in the UK's gas storage capacity is long overdue" adding that it would increase the resilience of the UK's gas supply infrastructure.[133]

73. Many witnesses thought that the UK probably needed to double the amount of gas storage it currently had (about 4.4 bcm) by 2020.[134] BP told us that in order to bring gas storage capacity in line with other major EU Member States, the UK should increase its capacity to about 15 bcm.[135]

74. The Minister told us that, taking into account facilities that were under construction or had had planning consent, the UK's gas storage could increase four-fold by 2020.[136] However, Professor Stern believed that in the current commercial climate, many of these proposed projects were unlikely to be developed.[137]

Impact of intermittent renewables on gas storage

75. The issue of gas storage is likely to worsen as the proportion of intermittent renewable generation increases, since more flexible gas-fired power plants may be required to provide "backup" when the wind does not blow.[138] This requires "fast cycle" gas storage.[139] The UK's storage capacity may need to double by 2020 as more renewables come on stream.[140]

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127 Q 9, Ev w55

128 Q 9 (Stern)

129 Q 44

130 Ev w40

131 Ev w40

132 Ev w40

133 Ev w138

134 Q 105 (Hanafin), Q 39 and Ev 132

135 Ev 144

136 Q 489

137 Q 39

138 Q 39

Gas imports

76. DECC emphasised to us that the "huge growth" in the UK's LNG import capacity increased resilience to supply interruptions.[141] However, other witnesses did not agree with suggestions that LNG was a wholly relevant replacement for physical gas storage.[142]

77. **The UK needs more gas storage capacity capable of delivering gas at a high rate. The Department of Energy and Climate Change should be concerned about the lack of gas storage used to manage seasonal demand fluctuations. It should aim to double the UK's current gas storage from current levels by 2020 in order to avoid exposure to gas supply interruptions and price spikes, and, in the longer term, to ensure a resilient gas supply to flexible gas plants acting as "backup" to intermittent electricity generated from wind.**

Incentivisation and economics of gas storage

78. Oil and Gas UK explained to us that investment in gas storage had been hindered by "various obstacles".[143] Other witnesses also argued that new gas storage facilities were not being delivered because the economics did not stack up. Oil & Gas UK told us that "When gas prices are low, no one wants storage; when gas prices are high, no one can afford storage".[144] Gas storage company Stag Energy added:

> […] it is unlikely that most of the time there will be a price signal for storage, because it is one of these paradoxes that it is only when it is too late and there are severe conditions that the price signal is there.[145]

79. Centrica Energy also explained why an oversupply of gas—due to a combination of increased LNG availability and reduced demand owing to the economic downturn—had reduced the difference between winter and summer prices; as this seasonal price differential reduced there was less incentive to build facilities where gas is bought cheaply in the summer and stored in order to sell in the winter.[146]

80. Centrica is currently evaluating plans for a further 2.4 bcm of storage capacity at its proposed Baird Gas Storage Project, at a depleted offshore gas field off the North Norfolk coast.[147] However, they described the economics as "marginal at present".[148] It was this seasonal price differential that was the "key driver of value of these kinds of storage facilities".[147] While there was widespread agreement that the economics of gas storage remained challenging, there was not agreement on how this problem should be solved. We were provided with a range of different options.

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139 Q 107 (Hanafin)

140 Ev 204

141 Q 492

142 Q 105, Jonathan Stern, UK Energy Policy and the End of Market Fundamentalism (OIES, 2011), pp 150–151

143 Ev 198

144 ILEX (now Poyry), "Storage, Gas Prices and Security of Supply", for UKOOA (now Oil & Gas UK), 9 November 2005.

145 Q 112

146 Q 110 (Hanafin), Q 40

147 Ev 204

148 Ev 204

81. The Minister agreed that the real problem with gas storage was that "the economics do not add up", a problem that the Government aimed to solve through measures proposed in the current Energy Bill currently going through its parliamentary stages.[149]

Sharpening price signals

82. The Energy Bill contains measures designed to strengthen the market incentive for ensuring sufficient gas is available during a Gas Supply Emergency. A "supply emergency" (which has never happened to date)[150] is defined as "an emergency endangering persons and arising from a loss of pressure in a network or any part thereof" caused by an inability to match supply and demand.[151] Under the current arrangements, the gas price is frozen for the duration of the supply emergency, which Shell stated would "limit the effectiveness of price signals" to attract more gas into the UK if the price was frozen below market prices in continental Europe.[152] The Bill would give Ofgem powers to unfreeze the gas price in an emergency, which Shell said would "put a premium on stored and/or flexible gas" and act as an incentive for investment in gas storage.[153]

83. DECC believed that these measures would "sharpen the commercial incentives" for energy suppliers to meet their contractual obligations during a Gas Supply Emergency, and therefore the likelihood of such an emergency would be reduced.[154] However, Clause 79 of the Energy Bill, which deals with security of gas supplies, does not make explicit reference to gas storage. Stag Energy argued that DECC's proposals in Clause 79 went "against general industry advice" on what was needed to incentivise gas storage.[155] While these "sharpened" price signals may attract gas from continental Europe to the UK—unless a gas supply emergency was also being experienced on the continent—it is unlikely that this would incentivise the construction of new gas storage in the UK as industry would be unwilling to tie up large amounts of capital on the chance that it may receive a high price for stored gas in a supply emergency.

Public Service Obligation

84. National Grid and the Energy Networks Association concluded that their favoured option to support the development of gas storage was an amalgamation of the current "market based" approach with "suitable obligations".[156] Stag Energy believed a Public Service Obligation (PSO) would be "guaranteed to produce a [certain] level of storage".[157] A PSO could be placed on all gas suppliers, based on their sales in the previous year, and be designed so as to meet a targeted increase in gas storage capacity.[158] Professor Stern agreed that the best way to incentivise investment in the fast response gas storage that the UK needed would be a contractual obligation

149 Q 489

150 Energy Bill [*Lords*], clause 79 [Bill 167 (2010–12)]

151 Gas Safety (Management) Regulations 1996 (SI 1996/551)

152 Ev 220

153 Ev 220

154 DECC, *Energy Bill: Gas Security* (Brief), July 2011

155 Ev 132

156 Ev 189, Ev 194

157 Ev 132

158 Written Evidence submitted to the Public Bill Committee on the Energy Bill, Session 2010–2012 (EN 04)

on suppliers.[159] However, the Gas Forum argued that imposing PSOs on companies to store gas would "undermine the market".[160] PSOs tended to be used in markets that are "illiquid", where there is no ability to buy flexibly, which was not the case in the UK.[160]

Government intervention

85. Witnesses disagreed over whether Government intervention was necessary. While some saw it as a priority,[161] others regarded it as premature.[162] Shell believed that direct Government intervention in the market risked "crowding-out private sector investment" in storage.[163] Stag Energy, however, saw a role for Government to "set out a framework" to guide industry.[164]

86. The Minister did not want to be "prescriptive", Government preferred to "create a framework" and leave it to industry to decide.[165] He hoped gas storage would be a part of the solution, but believed the market should determine how supply obligations were met.[166] However, in its Electricity Market Reform White Paper 2011, the Government proposed to increase and ensure electricity security by "contracting for security of supply" through a "capacity mechanism", the details of which they were currently consulting on.[167] One of the options DECC asked to be considered was a "Strategic Reserve" mechanism in which a "central body" would procure reserve electricity capacity and withhold it from the market, to be released when prices rise above a certain level (for instance, due to a decrease in renewable electricity supply due to a lack of wind) in order to cap market prices.[168]

87. **The Government needs to explain and justify why it believes a strategic reserve is needed to ensure a secure supply of electricity—as suggested in its Electricity Market Reform White Paper 2011—but does not consider it necessary to intervene in the gas market to ensure more gas storage is delivered.**

88. **The UK needs to significantly increase its gas storage capacity. The Government must develop a strategy for achieving this. Doing nothing—or continuing to give inconsistent signals to the market about which approach it will choose—could result in no storage being built. This would diminish energy security.**

Oil stocks

89. The UK is required to hold emergency oil stocks as part of its membership of both the EU and the International Energy Agency (IEA). Under Council Directive 2006/67/EC on Strategic Oil Stocks, EU Member States are required to maintain minimum stocks of petroleum products

159 Q 43

160 Q 300

161 Q 50

162 Q 110 (Hanafin)

163 Ev 220

164 Q 112 (Rigby)

165 Q 490

166 Q 490

167 DECC, *Planning our electric future: a White Paper for secure, affordable and low-carbon electricity,* July 2011, p9

168 DECC, *Planning our electric future: a White Paper for secure, affordable and low-carbon electricity,* July 2011, p165

equal to at least 90 days of the average internal consumption during the previous calendar year.[169] As a crude oil producer the UK has a derogation that reduces the obligation by 25% to 67.5 days consumption.[170] David Odling, Oil and Gas UK's Energy Policy Manager, thought this derogation would be lost later this decade as production from the UKCS declined.[171]

90. The above directive will be repealed at the beginning of 2013 by Council Directive 2009/119/EC, which will bring all Member States into line with the existing rules of the IEA. The new directive requires Member States to maintain a total level of oil stocks corresponding to at least 90 days of average daily net imports (rather than consumption). In February 2011 the IEA calculate that the UK has 476 days' worth of oil imports in stock.[172] DECC'S projections foresee oil imports rising from 2011 onwards, while demand remains flat.[173] Therefore, stock requirements based on imports will require the UK to increase its capacity. As all of the UK's stocks are currently held by industry, the increased costs would have to be borne by them under the current arrangements. When the UK loses its derogation as an oil producer it would require £4–5 billion of additional strategic oil storage infrastructure.[174] The UK Petroleum Industry Association (UKPIA) argued that an independent agency, funded by industry in order to coordinate oil stocks, would bring the benefit of "slightly lower costs", but, more importantly, it would be "managed in a transparent way, rather than by individual companies".[175]

An independent strategic oil stock holding agency

91. In the UK, all strategic oil stocks are held by industry, whereas other countries tend to have a mix of public and privately-held stocks.[176] The "big difference" between public and private stocks is that the cost of the latter have to be borne by industry, but Professor Stevens argued that in practical terms "there is not a great deal of difference".[177]

92. UKPIA told us that most other Member States have recognised the "national" aspects of strategic oil stocks, and manage them through an independent stockholding agency, rather than leaving it to private industry.[178] In the light of declining North Sea oil production, UKPIA urged the Government to establish such an independent agency, explaining that the independent agency could be:

169 UK Emergency Oil Stocks, A guide to the measures the UK adopts to meet its international obligations to maintain emergency oil stocks, DECC, 2009.

170 UK Emergency Oil Stocks, A guide to the measures the UK adopts to meet its international obligations to maintain emergency oil stocks, DECC, 2009.

171 Q 255

172 IEA, "Closing Oil Stock Levels in Days of Net Imports", February 2011, www.iea.org/netimports.asp

173 "UKCS Oil and Gas Production Projections", DECC, March 2011 www.og.decc.gov.uk/information/bb_update/chapters/production_projections.pdf

174 Q 250

175 Q 250

176 Ev 164

177 Q 17

178 Ev 164

> [...] completely self-funding […] it will be a transfer really from the individual amounts that individual companies are [already] catering for […] there will still be some form of charge from the [independent] agency to the obligated companies.[179]

The Minister believed that that the UK policy of leaving it to the market has "delivered long-term security".[180] Even so, DECC are "reviewing [their] future approach to holding oil stocks", and while they excluded the idea of public owned stocks they acknowledged that there was scope for an "industry owned and operated central stockholding agency".[181] They intend to consult on this issue in 2012.

93. **We recommend that the Government set up an independent central agency, funded by the industry, to manage strategic oil stocks.**

Electricity Infrastructure

94. The Government's Electricity Market Reform (EMR) White Paper was published during the course of our inquiry. It contains proposals designed to "ensure the future security of electricity supplies; drive the decarbonisation of our electricity generation; and minimise costs to the consumer".[182] Legislation is expected in the next session, which starts in early summer 2012.

Generation infrastructure

95. There are two major challenges for electricity generation in the UK. The first is that by 2018, approximately 19 GW of existing capacity is due to close as aging plants come to the end of their lives or are forced to close under environmental regulation.[183] About half of this is nuclear capacity coming to the end of its working life and half oil and coal capacity closing under the Large Combustion Plant Directive. Some recent forecasts of demand project that the level of peak demand will remain broadly similar to current levels out to 2020 (because the uptake of new technologies such as heat pumps and electric vehicles is expected to be broadly offset by offset by improvements in energy efficiency and embedded generation).[184] This means that the 19 GW will need to be replaced with new power plants in order to retain today's level of capacity margin.

96. A great deal of evidence suggested that the 19 GW "gap" will most likely be filled by new gas plant. The Minister told us "we have a crunch coming and the technology that is best equipped for dealing with that, where the plant can be built quickly, where the fuel we know is currently broadly available, is gas".[185] In fact, there is already approximately 12 GW of Combined Cycle Gas Turbine (CCGT) plant either under construction or with consent granted, with a further 12

179 Q 252

180 Q 509

181 Ev 119

182 DECC, *Planning our electric future: a White Paper for secure, affordable and low-carbon electricity*, Cm 8099, July 2011, p 16

183 Ev 112

184 National Grid, *Operating the Electricity Transmission Networks in 2020*, June 2011, p 20; National Grid, *2011 National Electricity Transmissions System Seven Year Statement,* 2011, Chapter 2

185 Q 458

GW in the planning system.[186] In addition, there is approximately 4.5 GW of wind plant under construction or with consent granted.[187]

97. Ofgem pointed out that the timetables for some projects under construction or consideration will slip.[188] However, National Grid argued that despite this, there is probably sufficient new plant already coming through the system to fill the supply gap created by planned plant closures.[189] The evidence suggests they are correct.

98. **Even though it is likely that some of the projects under construction or consideration will slip, we agree with National Grid that, provided it materialises, there is sufficient new plant already coming through the system to fill the 19 GW "gap" created by planned plant closures before 2020.**

99. The second challenge is that the electricity sector needs to be almost entirely decarbonised by 2030 if the UK is to meet its long term climate change targets. According to the Committee on Climate Change (CCC) the average carbon intensity of the sector needs to be around 50 gCO_2/kWh by 2030 (compared with the current level of 490 g/kWh).[190]

100. This raises a question about the role for gas in the electricity system. A modern unabated gas plant has a carbon intensity of around 400 gCO_2/kWh.[191] While this is significantly lower than the carbon intensity of coal, it nonetheless represents a significant level of carbon emissions. The total emissions from a plant will depend on how often it is running. Base load power stations operate more or less continuously to meet the base level demand while others are brought in progressively as demand increases. Peak-load generation is used to satisfy short periods of maximum demand. "Mid-merit" or "load following" generation is that which falls between baseload and peak. Non-baseload generation that responds to demand is sometimes referred to as 'flexible' capacity. The Committee on Climate Change has said that beyond 2020:

> "there is […] only a limited role for [investment in] unabated gas plant (e.g. running at low load factors in balancing intermittent generation). If there were to be investment in either form of unabated fossil fuel capacity [i.e. coal or gas] for baseload generation, required sector decarbonisation would not be achieved".[192]

101. According to calculations by International Power, unabated gas would be able to generate approximately 46 TWh energy in a year before reaching the 50g/kWh threshold (and of course, this is on the basis that there is no unabated coal or oil operating at all, which may not be a reasonable assumption). This compares to 165 TWh generated from gas in 2009.[193] It is therefore clear that the role for unabated gas in the electricity system in 2030 will be very much less than is

186 National Grid, *2011 National Electricity Transmission System (NETS) Seven Year Statement,* May 2011, Appendix F; Committee on Climate Change, *The Fourth Carbon Budget, Reducing emissions through the 2020s,* December 2010, Box 6.8, p 266; Q 291 [Wye]

187 National Grid, *2011 National Electricity Transmission System (NETS) Seven Year Statement,* May 2011, Appendix F

188 Ev w36

189 Ev 180

190 Committee on Climate Change, *The Fourth Carbon Budget: Reducing emissions through the 2020s,* December 2010, p 13

191 *Carbon Footprint of Electricity Generation*, POSTnote 383, Parliamentary Office of Science and Technology, June 2011

192 Committee on Climate Change, *The Fourth Carbon Budget: Reducing emissions through the 2020s*, December 2010

193 Ev w149

currently the case.[194] This means that a balance needs to be struck between building enough new gas plants in the short-term to fill the "gap" between now and 2020 and ensuring that the number built is not so great that the UK misses its longer-term climate change goals or is forced to strand assets to avoid exceeding CO_2 budgets.[195] Emphasising short-term system stability over the long-term decarbonisation goals could lead to a "dash-for-gas", while focusing too heavily on climate change policy could stifle investment in new gas in the short term.

102. The Government's solution to this problem has been to propose an Emissions Performance Standard (EPS) that will initially only apply to coal but which would be reviewed and possibly tightened in 2015. Under the "grandfathering" principle, anything built before 2015 would be exempt from any subsequent tightening of the EPS for a suggested 20 year period.[196] This means that an unabated gas plant built in 2014 could in theory continue to operate as baseload capacity until 2034 and Government would have no power to either demand that CCS be fitted or to curtail operating hours. However, a very high carbon price in the future could serve the same function as an EPS by rendering high-carbon generation uneconomic.

103. **We believe that the proposal for a weak Emission Performance Standard (EPS) coupled with 20 year grandfathering will result in a hectic "dash-for-gas" ahead of the 2015 review. This increases the risk of locking the UK into a high-carbon electricity system and represents a huge gamble on the eventual availability of cost effective Carbon Capture and Storage technology for gas plants. This could pose a severe threat to the achievement of our long-term climate change goals. Moreover, applying the EPS only to coal puts the government in the position of choosing technology winners, exactly the outcome that an EPS, by mandating an outcome not a particular technology solution, is supposed to avoid.**

104. When we put this point to the Minister, we were alarmed by his suggestion that "if it were then considered that we were seeing too much gas coming on to the system, [as a result of the EPS arrangements] then that would be grounds for saying that we don't need to be seeing more consents to be granted".[197] Policy certainty is vital for attracting investment but changing the rules in that way would undermine confidence in the UK as a place to invest. The recent experience with feed-in tariffs for small-scale renewables is a case in point.

105. **DECC needs to think through the implications of its Emission Performance Standard (EPS) proposals more carefully. Changing the rules after the fact to avoid a dash-for-gas will undermine investor confidence in the UK so it is essential to get the EPS right from the start. We have recommended on several occasions that a more effective approach would be to set out an EPS with a long-term trajectory in line with Committee on Climate Change recommendations. If Government is really resistant to specifying the level of an EPS beyond 2015, an alternative but less satisfactory approach would be to simply set a date by which Carbon Capture and Storage would be expected on all coal- and gas-fired power stations operating as baseload or at mid-merit level.**

194 Ev w138, Ev w70, Ev 170, Ev w149, Ev w15, Ev 204, Ev w27, Ev w85, Q 73 [Jenkins],

195 Ev 211, Ev w70, Ev 170, Q 460

196 Q 460

197 Q 461

Intermittency and system flexibility

106. Many of the respondents to this inquiry pointed out the potential threat that a significant increase in the use of intermittent renewables (mainly wind power) combined with a new generation of inflexible nuclear power stations could pose to managing supplies of electricity in the future.[198]

107. We heard that there are four measures that could help to tackle this problem:

- More **dynamic management of demand** for electricity, in order to match demand with available supply. This could be facilitated by introduction of smart meters and smart grids.[199]

- Greater **interconnection** with electricity grids in neighbouring countries to allow export of excess generation at periods of low demand and to import electricity at times of low generation and high demand.[200] (This is an area we explored in more depth in our recent inquiry on a European supergrid.[201])

- Greater use of **storage** technologies to store energy at times of excess generation and to help meet demand at times of low generation.[202] This includes technologies that can store electricity (such as pumped hydro, compressed air and batteries[203]), thermal storage (where electricity is used to generate heat, which can then be stored, for example, as part of a district heating scheme[204]) and hydrogen (where excess generation is used to generate hydrogen, which can either then be converted back into electricity in a fuel cell or can be used directly as a fuel, for example by burning it in an internal combustion engine to power transport[205]). Batteries in electric vehicles could also provide a form of distributed electricity storage.[206]

- The use of **"back up" generation** at times when supply does not meet demand. This requires the use of "flexible" or "despatchable" technologies where output can be rapidly ramped up and down. Examples include coal, gas, biomass, energy from waste, distributed combined heat and power plants, hydropower and tidal lagoons.[207] Using fossil fuels for this purpose may have implications for emissions of greenhouse gases.

198 Ev w91, Ev 211, Ev 159, Ev w40, Ev w105, Ev w70, Ev w131, Ev 170, Ev w75, Ev w149, Ev 180, Ev w62, Ev 198, Ev w59, Ev w66, Ev w8, Ev w15, Ev w21, Q 71 [Strbac], Q 122 [Hanafin], Q 138 [Johnson], Q 236 [Chapman], Q 282 [Odling], Q 369 [Botting]

199 Ev w134, Ev 159, Ev 144, Ev 125, Ev 112, Ev 177, Ev w83, Ev 170, Ev 180, Ev w62, Ev w36, Ev w59, Ev w15, Ev w35, Q 71 [Strbac], Q 138 [Johnson], Q 159 [Winser], Q 200 [Hartnell],

200 Ev w134, Ev 159, Ev 125, Ev w55, Ev 170, Ev w75, Ev 180, Ev 173, Q 62 [Jenkins], Q 71 [Strbac], Q 159 [Winser], Q 201 [Hartnell],

201 Energy and Climate Change Committee, Seventh Report of Session 2010–12, *A European Supergrid*, HC 1040

202 Ev w134, Ev w40, Ev 125, Ev 112, Ev 170 [IET}, Ev w149, Ev w59, Ev w96, Ev w15, Ev w25, Ev 189, Ev 173, Q 62 [Jenkins], Q 71 [Strbac], Q 159 [Winser], Q 210 [Hartnell], Q 210 [Meeks],

203 Ev w15, Ev 189

204 Q 210 [Meeks]

205 Ev w96, Ev 189

206 Ev w59, Ev w15, Q 369 [Kemp], Q 450 [Hendry]

207 Ev w91, Ev 139, Ev 211, Ev w79, Ev 144, Ev 125, Ev 112, Ev w105, Ev w55, Ev w70, Ev w131, Ev 170, Ev w75, Ev w149, Ev 180, Ev w62, Ev w36, Ev 198, Ev w59, Ev w96, Ev w8, Ev w15, Ev w21, Q 71 [Strbac], Q 122 [Hanafin], Q 159 [Winser], Q 172 [Meeks], Q 174 [Hartnell], Q 231 [Chapman], Q 282 [Odling]

108. There is still a great deal of uncertainty about the scale of this challenge and how it could be resolved. There does not seem to be any understanding about how much intermittency the current system could accommodate.[208] On top of this, no-one knows exactly what the future generation mix will consist of or how quickly and to what extent new technologies like smart meters and electricity storage will be able to mitigate intermittency problems. This makes it impossible to specify a precise solution at this point in time. However, we believe that it is likely that each of the four options set out above will have some role to play in the answer.

109. **We recommend that DECC undertakes further work to enhance understanding of the role interconnection, storage and demand management can play both in enhancing energy security and in the context of its projections of generation demand in the future.**

110. This challenge, while significant, is not an immediate threat. The Association of Electricity Producers noted that "increased penetration of intermittent renewables in the generation mix will not happen in one step rather it will evolve over time and potentially in parallel with other developments [...] this will allow time for developing a greater understanding and experience of system operation with a growing percentage of intermittent generation".[209] However, other European countries will also have to grapple with the problem of intermittency, possibly rendering interconnection less effective.

111. **We believe that dealing with intermittency requires significant further research both in terms of scenario modelling and "learning from doing" activities such as smart meter trials. As we previously recommended in our report on Electricity Market Reform and a European Supergrid, the Government needs to investigate more thoroughly the potential impacts of intermittency on maintaining the energy supply and what the role of gas would be in balancing this intermittency in different scenarios.**

Carbon Capture and Storage (CCS)

112. The Committee on Climate Change has suggested that any new baseload fossil fuel plant being added to the system after 2020 will need to be fitted with carbon capture and storage (CCS) equipment. However, most witnesses for this inquiry (including the Minister) were sceptical about the chances of CCS being commercially viable by 2020.[210] Indeed, there is increasing uncertainty about whether even the planned four CCS demonstration plants will be operational by 2020 since DECC and HMT are still "discussing arrangements" for how projects 2–4 will be funded.[211]

113. If CCS technology is not commercially available by 2020, the UK could face an energy dilemma: either provide energy security but exceed carbon budgets by running new unabated fossil plant; or, meet climate change obligations but risk energy security by shutting down (or using only very sparingly) unabated fossil plant.

208 Q 71 and Q 72 [Jenkins], Q 369 [Harrison]

209 Ev 159

210 Q 127 [Hanafin], Q 128 [Porter], Q 284 [Odling], Q 347 [Mather], Q 458 [Hendry]

211 Q 468 [Hendry]

114. **The Government should draw up plans immediately for how the tension between climate and security goals will be dealt with if Carbon Capture and Storage is not delivered by 2020. This issue should be included in the energy security strategy.**

115. **We recommend that the Government asks the Committee on Climate Change to investigate—as a matter of urgency—the implications on long-term climate objectives of having large quantities of unabated gas plant on the system during the 2020s.**

Electricity Distribution Networks

116. The UK's electricity distribution networks[212] currently provide a very high level of reliability; over 99% according to the industry association.[213] In order to preserve this level of reliability in the short- to medium-term, some investment will be needed to maintain the existing infrastructure.[214]

117. However, looking to the longer-term if we are to meet our climate change objectives, it is likely that there will need to be significant changes to both the physical distribution infrastructure and the way in which it is operated. According to the industry association, "this transformation will be different in shape and nature from anything that has gone before".[215]

Physical changes to networks

118. Respondents to this inquiry explained that electrification of heat and transport will result in significantly increased loads on distribution networks (the impact will be less on the transmission system because increased embedded generation will offset the impact of heat pumps and electric vehicles to some extent. This effect is not seen at the network level.).[216] There were concerns that unless networks were reinforced and demand actively managed, these changes in electricity usage would be likely to overload networks.[217] This would present a clear threat to energy security.

119. There appeared to be some discrepancy between the Government and industry view of when these upgrades will be required, and how much they are likely to cost. The Government's Electricity Market Reform White Paper states that "over £110bn needs to be spent on new generation, transmission and distribution assets in this decade".[218] However, the Minister confirmed that this figure did not include costs associated with local networks.[219] In supplementary evidence, the Minister told us that Ofgem had estimated that around £40bn of investment in transmission and distribution would be needed by 2020.[220] Ofgem provided

212 The lower voltage part of the system that delivers electricity from the high-voltage transmission system to consumers such as households and businesses.

213 ENA, *UK and Ireland Energy Networks: Sustainable, secure and essential*, November 2010

214 Ev w138, Ev w79, Ev 112, Ev w55

215 Ev 192

216 Ev w138, Ev 112, Ev w105, Ev w55, Ev w70, Ev 177, Ev w149, Ev w36, Ev 204, Ev 192, Ev w35, Ev 179, Q 138, 147 and 168 [Johnson], Q 189 [Meeks]; National Grid, *Operating the Electricity Transmission networks in 2020*, June 2011, p 20

217 Q 138 [Johnson]

218 DECC, *Planning our electric future: a White Paper for secure, affordable and low-carbon electricity*, July 2010, CM 8099

219 Q 445

220 Ev 119

estimates over a slightly longer timescale and suggested that by 2025, £21-27bn of investment in transmission and £26bn in distribution would be needed.[221]

120. The Distribution Network Operator (DNO) Electricity North West told us that the increased electricity load resulting from the use of electric heat pumps and electric vehicles could require a minimum of £250m investment in its network alone between 2015-2023 with a further £750m by 2030.[222] It also expressed some concerns about Ofgem's new regulatory framework ("RIIO") and whether this would allow sufficient investment in networks to keep pace with an ambitious programme of decarbonisation.[223]

Operational changes to networks

121. The increased use of distributed generation,[224] and the need for demand side management (see paragraphs 141-145) to balance intermittent sources of power, will mean that Distribution Network Operators may need to take on a more active role in balancing networks in the future.[225] As noted by our predecessor Committee, DNOs may ultimately need to move away from the current relatively passive operation model towards becoming Distribution System Operators (with responsibility for balancing supply and demand on their network).[226] Such a significant change will require a great deal of planning and work from DNOs to ensure they are able to manage the transition effectively. We note that our predecessors recommended that such major changes could not be delivered by the market alone and would require strategic leadership from Government.[227]

122. Smart meters and smart grids are expected to play an important role in helping to facilitate demand side response and in balancing networks.[228] However, the Royal Academy of Engineering has suggested that current plans to introduce smart meters to every household by 2020 do not include the functionality required to manage electric vehicle charging, which could potentially render the first generation of smart meters obsolescent as the electric vehicle market grows.[229] In addition, Professor Kemp of the Institution of Engineering and Technology told us that the Government's approach to smart meters and smart grids was "back to front" and needed to start with a set of overall objectives (which might include managing the charging of electric vehicles so as not to overload the grid) to determine what functionality was needed in smart meters rather than starting with delivering smart meters and then deciding how they might be used.[230] We note that the Government's response to the consultation on smart meter

221 Ev w36

222 Ev 177

223 Ev 179

224 Small-scale electricity generation (such as solar panels on buildings) that feeds directly into the distribution network, rather than the transmission system.

225 Ev w55, Ev 177, Ev 192, Q 138 and 168 [Johnson], Q 172 [Edge]

226 Energy and Climate Change Committee, Second Report of Session 2009-10, *The future of Britain's electricity networks*, HC 194-I, para 144; Ev 177

227 Energy and Climate Change Committee, *The future of Britain's electricity networks*, para 13

228 Ev 112, Ev w55, Ev 204, Q 172 [Edge]

229 The Royal Academy of Engineering, *Electric Vehicles: charged with potential*, May 2010

230 Q 382 [Kemp]

implementation does suggest that smart meters should have the functionality to support the use of electric vehicles.[231]

123. Ofgem's Low Carbon Network Fund (LCNF) is funding a portfolio of projects that are designed to help the industry understand how to meet the changing needs of generators and consumers and how to ensure that the networks are prepared for the transition to a low-carbon economy. The first tranche of projects will explore how to make the best use of flexible demand from smart meters and smart white goods and ways in which electric cars can be charged without overloading the network (among other things).[232]

124. **We recommend that the Department carries out a full review of the technical and cost implications to Distribution Network Operators of the electrification of heat and transport. It should also carry out a systems appraisal of the security benefits and risks of such electrification strategies, both at national and local levels.**

125. **We welcome the introduction of Ofgem's Low Carbon Network Fund, but recommend that Ofgem should also monitor what steps all Distribution Network Operators are taking to adapt their role to deal with increased distributed energy on the system and to facilitate demand side response. It should also liaise with the Department of Energy and Climate Change to ensure that the Low Carbon Network Fund trials that are now underway consider system security implications as well as those for emissions. The Department must ensure that DNOs are adequately prepared for dealing with distributed energy and demand side response.**

Securing investment in infrastructure

126. It is clear that significant investment will be required in the UK's energy infrastructure in the coming decade. According to DECC, £110 billion of investment in electricity generation and transmission is likely to be required by 2020.[233] On top of this, investment is also likely to be needed in (among other things) local electricity networks,[234] gas transmission networks,[235] gas storage,[236] energy efficiency,[237] CCS,[238] load management[239] and offshore oil and gas operations.[240]

127. The table below shows Ofgem's estimates of the nature and level of investment required in the energy system under the four different scenarios investigated as part of its Project Discovery (which examined whether or not future security of supply could be delivered by the existing

231 DECC and Ofgem, *Smart Metering Implementation Programme, Response to Prospectus Consultation, Overview Document,* March 2011, p 26

232 Ev w36, Ofgem, *Low Carbon Network Fund Brochure*

233 DECC, *Planning our electric future: a White Paper for secure, affordable and low-carbon electricity*, Cm 8099, July 2011

234 Ev w138, Ev 177, Ev 180, Q 138 [Johnson]

235 Ev w70

236 Ev w55

237 Ev 170

238 Ev 125

239 Ev 177, Q 150 [Winser]

240 Ev 211

market arrangements). The scenarios are based on the combination of two drivers: the speed of global economic recovery and the extent of globally co-ordinated environmental action. This produced four scenarios:

- Green transition (rapid economic recovery, rapid environmental action)
- Green stimulus (slow economic recovery, rapid environmental action)
- Dash for energy (rapid economic recovery, slow environmental action)
- Slow Growth (slow economic recovery, slow environmental action)

Table 1: Energy system investment figures estimated as part of Ofgem's Project Discovery

Source: Ev w36

	Cumulative investment, £bn, 2025			
	Green transition	Green Stimulus	Dash for energy	Slow growth
Nuclear	12.8	12.8	6.4	3.2
Renewables	67.2	62.7	35.7	31.3
CCS	15.8	16.7	3.3	0
CCGT	4.4	4.3	20.9	17.3
Distribution	26	26	26	26
Onshore transmission	19	19	17.3	17.3
Offshore transmission	7.9	7.4	4.3	3.7
Interconnectors	1	1	0.5	0.5
Energy efficiency	16	16	8	8
Renewable heat	52.8	52.8	9.5	9.5
Smart meters	10	10	10	10
LNG terminals	0.9	0.6	1.5	0.7
Gas storage	1.1	0.7	4.6	0.7
SCR	1.2	0.6	1.2	1.2
Total	**236.1**	**230.6**	**149.1**	**129.4**

128. We heard that there are many potential barriers to investment in UK energy projects. These included:

- Changes to the offshore oil and gas taxation regime in the 2011 Budget were unexpected and may have undermined investor confidence by increasing perceived policy risk.[241]
- Fiscal, policy and regulatory uncertainty around the development of CCS could inhibit investment in this sector.[242]
- Policy uncertainty (particularly around electricity market reform) could lead to a hiatus in investment.[243]

241 Ev 211, Ev w79, Ev 198

242 Ev 125

243 Ev w55

- A perceived focus on renewable and nuclear forms of electricity generation may undermine confidence in gas investment.[244]
- The EU ETS carbon price is too low to stimulate investment in low-carbon generation.[245]
- Falling global gas prices as a result of the recession, which have had a chilling effect on investment.[246]
- The Weightman report on Fukushima will delay the interim design assessment of new nuclear power stations, which could delay investment in this area.[247]
- Ofgem's regulatory regime (RIIO) may not allow sufficient rates of return for investment in networks to attract debt and equity investors.[248]
- The nature of some infrastructure projects means that the returns are not of the right sort to appeal to investors (for example, district heating provides long-term, low returns rather than short-term high returns).[249]

129. The proposals in the Government's Electricity Market Reform White Paper are intended to "bring forward the level of investment needed in new low-carbon generation capacity and infrastructure at the required pace".[250] Our report on the Government's proposals contained an assessment of what investors needed in order to make new low-carbon electricity infrastructure an attractive investment proposition. We were disappointed that the White Paper did not address our concern that the proposed package of measures is too complex and may therefore introduce too great a level of political risk for investors.[251]

130. We also recognised that a delay in implementing the electricity market reforms could result in a hiatus in investment. We were pleased that DECC published its White Paper before the summer recess, but were very disappointed that it does not plan to legislate this session, as we recommended.[252]

131. Several respondents to this inquiry highlighted the importance of regulatory certainty and a stable policy regime for investor confidence.[253]

132. **Government must give proper consideration of the long-term potential impact of changes to the tax regime on investment, especially where these are not the subject of advance consultation. The Government must also recognise that complexity is a barrier to investment and still has not been addressed.**

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244 Ev 198

245 Q 69 [Strachan]

246 Q 97 [Hanafin]

247 Q 102 [Hanafin]

248 Ev 179, Q 147 [Johnson]

249 Q 177 [Meeks]

250 DECC, *Planning our electric future: A White Paper for secure, affordable and low-carbon electricity*, CM 8099, July 2011, p 16

251 Energy and Climate Change Committee, fourth Report of Session 2010-12, *Electricity Market Reform*, HC 742, chapter 9

252 Energy and Climate Change Committee, *Electricity Market Reform*, para 276

253 Ev w79, Ev 159, Q 291 [Wye]

6 Energy users

Demand reduction

133. It is widely accepted that reducing overall demand for energy will improve energy security by reducing the need for primary fuels and for delivery infrastructure.[254] We therefore welcomed the fact that DECC highlighted "reducing demand for energy" as one of its key priorities in the area of energy security in its evidence to us.[255] However we would like to see greater focus placed on measuring progress towards this aim and believe that DECC should report total energy demand as part of a set of annual energy security indicators.

134. DECC told us that in 2020, post 2007 Energy White Paper policies to improve energy efficiency will lead to an overall reduction in domestic final user energy demand of roughly 9% compared to business as usual.[256] DECC's most recent energy projections at the time of writing (published in June 2010) forecasted a 6% reduction in total energy demand between 2008 and 2020 (assuming central fossil fuel prices, central policy and central growth).[257] The breakdown in projected energy use across sectors is shown in Figure 1 below. It should be noted that this forecast does not include the impact of the Green Deal.

Figure 1: DECC projected final energy demand by sector (NB impact of the Green Deal is not included)

Source: DECC, Updated energy and emissions projections, June 2010, URN 10D/510

135. The Government's proposed "Green Deal" initiative as set out in the current Energy Bill aims to "improve the energy efficiency of existing building stock in the UK, including households and non-domestic properties, in order to reduce our carbon emissions […] and

254 Q 27 [Mitchell], Q 55 [Strachan], Q 57 [Jenkins], Q 70 [Strachan], Q 360 [Harrison], Ev w134, Ev w138, Ev 139, Ev 211, Ev 112, Ev w105, Ev w83, Ev 170, Ev w149, Ev w62, Ev w59, Ev 204, Ev 164, Ev w35, Ev 148, Ev w25, Ev w154, Ev 228

255 Ev 112

256 Ev 112, NB this figure excludes international aviation.

257 DECC, *Updated energy and emissions projections*, June 2010, URN 10D/510

improving the security of energy supply".[258] According to the Bill's Impact Assessment, the Government expects the Green Deal and Energy Company Obligation (ECO) (which will be an obligation on energy companies to provide energy efficiency measures to vulnerable consumers and those with hard to treat homes) to save approximately 18-28 GWh of energy each year from the end of this decade up until around 2050.[259]

136. However, many of the respondents to our inquiry pointed out that in the past, progress in delivering energy efficiency improvements has often been less successful than predicted, and has not always produced an absolute reduction in energy demand (although, it may be the case that relative savings have been achieved).[260] Based on this experience, some witnesses were concerned that the Government might be somewhat over optimistic in its energy efficiency projections, which could in itself pose a threat to energy security if expected reductions were not achieved.[261] They cautioned that Government should not be overly reliant on achieving energy efficiency goals and that energy security strategy should not be based on energy efficiency alone.[262] E.ON suggested that the Government needed to consider the impact of limited policy success in this area.[263] Ofgem highlighted the risks associated with not delivering on energy efficiency policies:

> Impact assessments that accompany the Government's renewable and carbon reduction strategies assume that energy efficiency schemes will successfully drive down energy use, and these assumptions are then integrated into the cost and impact analysis of wider strategies and associated policies. It is vital that these schemes are well coordinated and deliver on their ambitions as efficiently as possible. […] If this demand-side reduction does not deliver, consumer bills will rise without increasing security of supply.[264]

137. Centrica suggested that a step-change in effort would be needed to avoid this situation. It told us that "uptake is nowhere near where it needs to be to make the savings DECC expects to bring down bills—we need to have a huge push to make [DECC's projections on energy bills] a reality".[265] The Committee on Climate Change's (CCC) 3rd Progress Report to Parliament highlighted some areas of underperformance on energy efficiency, including progress against loft insulation, cavity wall insulation and solid wall insulation indicators. Penetration of efficient cold and wet appliances was also below the CCC's recommended trajectory.[266]

138. **Delivering on energy efficiency policies will be vital not only for improving energy security but also for mitigating the impact of anticipated energy price rises on consumers' bills. Failure to deliver will have extremely serious consequences for both security and affordability aims. We will keep a close eye on the Government's performance in this area.**

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258 DECC, *Energy Bill Green Deal Impact Assessment,* 2011, p 18

259 DECC, *Energy Bill Green Deal Impact Assessment,* 2011

260 Ev 139, Ev w149, Ev w96, Ev 164, Ev w68, Q 29 [Stern]

261 Ev w68, Ev 139

262 Ev w68, Ev 139, Ev 159, Ev w55, Ev w149, Ev w68

263 Ev w55

264 Ev w36

265 Ev 209

266 Committee on Climate Change, *Meeting Carbon Budgets – 3rd Progress Report to Parliament*, June 2011

139. We also note that the focus of the majority of energy efficiency policies (including the Green Deal) has been on heating efficiency.[267]

140. **We are concerned that insufficient attention has been given to encouraging efficiency in electricity consumption, for example through the use of building controls and more efficient appliances. We recommend that the Government sets out how it intends to improve efficiency in this area.**

Demand side response

141. Demand side response (DSR) is used to shift the time at which energy is used to smooth out the peaks and troughs in usage. Although DSR does not reduce the amount of energy being used in total, it could benefit energy security because it could help reduce the height of peak demand and could also be used to overcome short-term supply shortfalls (for example, if technical fault caused a power station to shut down unexpectedly). This could reduce the need for additional capacity and system reinforcement to cover peak usage.[268] Dr Strachan (UCL) told us:

> I would argue again that the role of demand side response is absolutely key, and our long term modelling says that if you are trying to meet security of supply and decarbonisation targets without such a major demand shift, it is either impossible or extremely expensive.[269]

142. Some large industrial gas and electricity consumers already have "interruptible" contracts with National Grid. This means that they stop energy intensive processes when instructed, in return for payment. "Economy 7" tariffs used by some households (where electricity used at night is cheaper than that used during the day) are another form of DSR. Decarbonisation of the energy system will increase both the *need* and the *opportunity* for DSR. As we described in our report on Electricity Market Reform, DSR could play a part in helping to balance out intermittent wind power.[270] The electrification of heat and transport would also require DSR to ensure that the increased load due to recharging cars and heating homes was spread out across the day and did not all fall at times of peak demand.[271]

143. Although DSR is mainly limited to large industrial consumers at the moment, the introduction of smart meters to homes across the country provides an opportunity to extend DSR to domestic consumers. National Grid suggested that the key would be the ability to interrupt use without appreciable loss of amenity. It has identified existing wet appliances (such as washing machines) as offering the greatest opportunity for demand response in the immediate term, with electric heating, cooling and electric vehicles potentially offering further opportunities in the future.[272] Professor Strbac concurred with this analysis.[273]

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267 Q 175 [Meeks]

268 Ev w83, Ev 180, Ev w36, Q 57 [Jenkins, Strbac and Strachan]

269 Q 57 [Strachan]

270 Energy and Climate Change Committee, Fourth Report of Session 2010-12, *Electricity Market Reform*, HC 742, para 254; Ev w70, Ev 180, Ev w36, Q 63 [Jenkins], Q 138 [Johnson], Q 369 [Harrison]

271 Ev w55, Ev w36, Q 138 [Johnson]

272 Ev 180

273 Q 80 [Strbac]

144. In order to facilitate DSR, it is likely that time of use tariffs will need to be introduced for all users in conjunction with a wide-scale education and consumer engagement programme.[274] Steve Johnson, of Electricity North West suggested that DSR for domestic customers was likely to be much more difficult to introduce than with large industrial consumers and that further research and trials on this would be very important.[275]

145. **Demand side response (DSR) should play a significant role in delivering energy security. New technologies such as smart meters, electric vehicles and heat pumps will provide opportunities to expand demand side response beyond large industrial consumers and could provide new options for dealing with unexpected supply interruptions. We recommend that the Government analyses the potential for domestic and other small-scale consumers to provide DSR as part of an emergency response to short-term supply interruptions. This should include an assessment of what level of flexibility DSR could provide and over what timescales (e.g. minutes, hours or days).**

Public awareness and understanding

Adopting new technologies

146. The transition to a low carbon economy is expected to involve the use of many new technologies. Some of these will be used on the supply side (for example carbon capture and storage and new types of nuclear power station), while others will be used on the demand side (such as smart meters and electric vehicles). Throughout the course of our inquiry, witnesses pointed out that consumers will have to both accept and learn how to operate new demand side technologies to exploit fully their technical potential.[276] For example, smart meters combined with time-of use tariffs could encourage people to avoid using energy at times of peak demand and move usage to off-peak times. However, this would require people to understand and engage with the information from the smart meter and make the effort to plan their energy use more carefully. Dr Harrison of the Institution of Engineering and Technology told us:

> From a systems point of view, the people are a key part of the system; people as users. If people do not buy into or understand their role in a low-carbon secure energy economy, they are not going to be able to allow us to optimise the use of energy and the mix of energy in the way that we would otherwise want to.[277]

147. Witnesses suggested that public attitudes and behaviour change is an under-researched area.[278] Steve Edwards (Energy Networks Association) explained that a recent stakeholder engagement exercise had shown that customers had very little awareness about new technologies like smart meters.[279]

274 Ev 180

275 Q 168 [Johnson]

276 Q 138 and 150 [Johnson], Q 192 [Meeks], Q 65 [Strachan]

277 Q 360 [Harrison]

278 Q 65 [Strachan], Q 82 [Jenkins]

279 Q 170 [Edwards]

148. **Government must understand both the social as well as the technical feasibility of new technologies in the energy system. We recommend that the Government set out how it believes people are likely to respond to and utilise new technologies (such as smart meters, electric vehicles and heat pumps) and what plans it has for further research in this area.**

Communication

149. The UK's energy system will undergo major changes in the next decade, which will in turn have significant impacts for consumers. Energy prices look set to continue to rise, driven mainly by increases in the price of fossil fuels but also by the need to invest in new replacement and low-carbon infrastructure. Even though the Government's EMR proposals may lead to lower relative prices, they will still be higher in real terms than they are today. Consumers can mitigate the impact of rising prices on their energy bills by using energy more efficiently, but this will require action on their part, for example making sure that their properties are adequately insulated or choosing to buy the most efficient appliances. In addition, the roll-out of smart meters has the potential to radically change the way that consumers use and pay for energy, particularly if—as is expected—energy companies begin to offer new time of use tariffs.[280]

150. As we noted in our report on electricity market reform, consumers are not aware of the changes that are coming and the impact they will have on the way that they use energy.[281] Communication with consumers will therefore be vital to enable them to adapt to the forthcoming changes to the energy system.

151. The scale of the communications challenge is enormous. The Digital Switch Over campaign, which ultimately required consumers to carry out only one simple action (to purchase a digital TV or set-top box) needed the establishment of a new organisation (Digital UK), which conducted a £150m communications campaign. Activities ranging from national advertising campaigns through to local communications, community support and one-on-one help for the most vulnerable consumers were necessary to communicate the message effectively. A low-carbon switch over campaign involves a much more complicated message.[282]

152. Two obvious opportunities to begin this communications effort are the launch of the Green Deal scheme and the roll-out of smart meters to homes and businesses across the country. We welcome the Government's is planned communication strategy to accompany the latter and look forward to reading its proposals in due course.[283]

153. **The Government must resist relying on the energy companies to deliver this message on demand reduction as the lack of consumer trust will undermine the communication.**

280 Q 83 [Johnson], Q 65 [Johnson]

281 Energy and Climate Change Committee, Fourth Report of Session 2010-12, *Electricity Market Reform*, HC 742, paras 250-252

282 Q 85 [Edwards]

283 Q 439 [Hendry]

7 Conclusion

154. Delivering energy security—keeping the lights on, buildings warm, vehicles moving, businesses operating and electrical appliances running—is a crucial aspect of DECC's work. Achieving this goal requires a reliable supply of primary fuels, a secure delivery system and smart and efficient usage by consumers. Failure in any one of these three areas is likely to mean that energy needs go unmet.

155. While this report has identified a number of specific risk areas where Government action could improve energy security, we believe the single most important thing for Government is to adopt a more strategic approach to this area. This should include identifying clear policy objectives and setting out plans for achieving them. It should also involve annual reporting against a set of indicators, which would allow Parliament and others to assess the Government's performance. These indicators should cover the supply, infrastructure and demand side to ensure adequate scrutiny of all parts of the energy system.

156. Energy security policy must take a holistic view of the energy system in order to understand the interrelationships between disparate parts of the system. A "systems approach" would guard against unintended consequences when changes in one part of the system have knock-on consequences for other sections. It would also create a more resilient energy system that can endure both short-term shocks and longer-term stresses.

Recommendations

DECC's approach to energy security

Definition of energy security

1. Our own suggestion is as follows: a secure energy system is one that is able to meet the needs of people and organisations for energy services such as heating, lighting, powering appliances and transportation, in a reliable and affordable way both now and in the future. We recommend that the Government adopts this definition. (Paragraph 11)

Threats to energy security

2. Understanding how changes in one part of the energy system will impact on others is an essential part of producing a resilient energy system. We recommend that work on energy security should focus on achieving system resilience—both to short term shocks and longer-term stresses—as well as focusing on individual components of the energy system. (Paragraph 17)

Development of an energy security strategy

3. An energy security strategy should be published in single, dedicated document. (Paragraph 20)

4. We recommend that the Department describe the scope of its energy security modelling and how the findings are used. In addition, DECC needs to be clear about the "early warning" signals that it uses to assess the risk profile of each threat to energy security and be clear about the resilience measures that it would need to adopt to mitigate risk to energy security. It should then expose its methodology to public challenge. (Paragraph 23)

Assessing progress

5. We recommend that the Government now publish a transparent set of energy security indicators as promised in the Strategic Defence and Security Review. These indicators should cover primary supply of fuels, energy infrastructure and energy users and include specific indicators on the overall level of energy demand, diversity of fuel supplies, energy prices, fuel stocks, spare capacity and capacity for demand side response. (Paragraph 29)

6. We recommend that DECC should report against a set of energy security indicators on an annual basis as part of its Statutory Security of Supply Report as its contribution to the reporting on the Strategic Defence and Security Review indicators. (Paragraph 30)

Primary energy supply resilience

UK Continental Shelf

7. We welcome the Government's aim to move away from dependence on fossil fuels in the long-term. In the meantime, we recommend that the Government continue to monitor the diversity of sources and suppliers of oil and gas to the UK in order to avoid becoming overly dependent on a single source. This will become more important as dependence on imports grows. Government should also consider how vulnerable imports to the UK are to disruption and what sources would be available to replace imports in the event of disruption. The decline in UKCS oil and gas production could have economic impacts such as decreasing tax revenue and jobs, and a negative impact on our balance of payments. However, we conclude that the UK's energy security is not threatened significantly by a decline in UK Continental Shelf production. (Paragraph 38)

8. If the Government is serious about maximising production from the UK Continental Shelf, it needs to consider the long-term impact of changes to the tax regime on investment. The evidence on the impact of 2006 increase in the supplementary tax charge on oil and gas production in the North Sea is inconclusive, but there is a clear need to sustain investor confidence by avoiding surprises, such as the further increase announced in the 2011 Budget. It is not sensible to make opportunistic raids on UKCS producers. The Government must build a more constructive relationship if it is to restore industry confidence and maximise the benefits gained from the UKCS. (Paragraph 42)

Refined products

9. We recommend that the Government publish its assessment of the minimum level of refining capacity by product that should be maintained in the UK as insurance against market breakdown. Based on this, the Department of Energy and Climate Change should develop a strategy for how it will ensure the minimum level is met. (Paragraph 47)

Russian gas supplies

10. Whilst any future disruptions of Russian supplies to the EU could have some impact on UK gas prices, the more immediate domestic challenges are more directly within the Government's control. for example, energy infrastructure resilience and exploitation of the UK's domestic resources. (Paragraph 52)

International gas pipelines

11. While the Nord Stream pipeline will mitigate the risk that transit countries could disrupt gas supplies between Russia and Europe, we conclude that the pipeline will not increase European gas security significantly as it is likely to re-route gas around Ukraine rather than add any new volume. (Paragraph 56)

12. Any development of the proposed Nabucco gas pipeline should be determined and driven by the market. Debate over the merits of the different gas pipeline proposals fails to acknowledge the broader energy landscape, with increasing liquefied natural gas (LNG) availability, smaller pipelines planned in south-eastern Europe, and increasing

unconventional gas production having the potential to make such very large pipelines uneconomic and redundant. (Paragraph 66)

Infrastructure resilience

Gas storage

13. The UK needs more gas storage capacity capable of delivering gas at a high rate. The Department of Energy and Climate Change should be concerned about the lack of gas storage used to manage seasonal demand fluctuations. It should aim to double the UK's current gas storage from current levels by 2020 in order to avoid exposure to gas supply interruptions and price spikes, and, in the longer term, to ensure a resilient gas supply to flexible gas plants acting as "backup" to intermittent electricity generated from wind. (Paragraph 77)

14. The Government needs to explain and justify why it believes a strategic reserve is needed to ensure a secure supply of electricity—as suggested in its Electricity Market Reform White Paper 2011—but does not consider it necessary to intervene in the gas market to ensure more gas storage is delivered. (Paragraph 87)

15. The UK needs to significantly increase its gas storage capacity. The Government must develop a strategy for achieving this. Doing nothing—or continuing to give inconsistent signals to the market about which approach it will choose—could result in no storage being built. This would diminish energy security. (Paragraph 88)

Oil stocks

16. We recommend that the Government set up an independent central agency, funded by the industry, to manage strategic oil stocks. (Paragraph 93)

Electricity infrastructure

17. Even though it is likely that some of the projects under construction or consideration will slip, we agree with National Grid that, provided it materialises, there is sufficient new plant already coming through the system to fill the 19 GW "gap" created by planned plant closures before 2020. (Paragraph 98)

18. We believe that the proposal for a weak Emission Performance Standard (EPS) coupled with 20 year grandfathering will result in a hectic "dash-for-gas" ahead of the 2015 review. This increases the risk of locking the UK into a high-carbon electricity system and represents a huge gamble on the eventual availability of cost effective Carbon Capture and Storage technology for gas plants. This could pose a severe threat to the achievement of our long-term climate change goals. Moreover, applying the EPS only to coal puts the government in the position of choosing technology winners, exactly the outcome that an EPS, by mandating an outcome not a particular technology solution, is supposed to avoid. (Paragraph 103)

19. DECC needs to think through the implications of its Emission Performance Standard (EPS) proposals more carefully. Changing the rules after the fact to avoid a dash-for-gas

will undermine investor confidence in the UK so it is essential to get the EPS right from the start. We have recommended on several occasions that a more effective approach would be to set out an EPS with a long-term trajectory in line with Committee on Climate Change recommendations. If Government is really resistant to specifying the level of an EPS beyond 2015, an alternative but less satisfactory approach would be to simply set a date by which Carbon Capture and Storage would be expected on all coal- and gas-fired power stations operating as baseload or at mid-merit level. (Paragraph 105)

20. We recommend that DECC undertakes further work to enhance understanding of the role interconnection, storage and demand management can play both in enhancing energy security and in the context of its projections of generation demand in the future. (Paragraph 109)

21. We believe that dealing with intermittency requires significant further research both in terms of scenario modelling and "learning from doing" activities such as smart meter trials. As we previously recommended in our report on Electricity Market Reform and a European Supergrid, the Government needs to investigate more thoroughly the potential impacts of intermittency on maintaining the energy supply and what the role of gas would be in balancing this intermittency in different scenarios. (Paragraph 111)

22. The Government should draw up plans immediately for how the tension between climate and security goals will be dealt with if Carbon Capture and Storage is not delivered by 2020. This issue should be included in the energy security strategy.(Paragraph 114)

23. We recommend that the Government asks the Committee on Climate Change to investigate—as a matter of urgency—the implications on long-term climate objectives of having large quantities of unabated gas plant on the system during the 2020s. (Paragraph 115)

Operational changes to networks

24. We recommend that the Department carries out a full review of the technical and cost implications to Distribution Network Operators of the electrification of heat and transport. It should also carry out a systems appraisal of the security benefits and risks of such electrification strategies, both at national and local levels. (Paragraph 124)

25. We welcome the introduction of Ofgem's Low Carbon Network Fund, but recommend that Ofgem should also monitor what steps all Distribution Network Operators are taking to adapt their role to deal with increased distributed energy on the system and to facilitate demand side response. It should also liaise with the Department of Energy and Climate Change to ensure that the Low Carbon Network Fund trials that are now underway consider system security implications as well as those for emissions. The Department must ensure that DNOs are adequately prepared for dealing with distributed energy and demand side response. (Paragraph 125)

26. Government must give proper consideration of the long-term potential impact of changes to the tax regime on investment, especially where these are not the subject of advance consultation. The Government must also recognise that complexity is a barrier to investment and still has not been addressed. (Paragraph 132)

Energy users

Demand reduction

27. Delivering on energy efficiency policies will be vital not only for improving energy security but also for mitigating the impact of anticipated energy price rises on consumers' bills. Failure to deliver will have extremely serious consequences for both security and affordability aims. We will keep a close eye on the Government's performance in this area. (Paragraph 138)

28. We are concerned that insufficient attention has been given to encouraging efficiency in electricity consumption, for example through the use of building controls and more efficient appliances. We recommend that the Government sets out how it intends to improve efficiency in this area. (Paragraph 140)

Demand side response

29. Demand side response (DSR) should play a significant role in delivering energy security. New technologies such as smart meters, electric vehicles and heat pumps will provide opportunities to expand demand side response beyond large industrial consumers and could provide new options for dealing with unexpected supply interruptions. We recommend that the Government analyses the potential for domestic and other small-scale consumers to provide DSR as part of an emergency response to short-term supply interruptions. This should include an assessment of what level of flexibility DSR could provide and over what timescales (e.g. minutes, hours or days). (Paragraph 145)

30. Government must understand both the social as well as the technical feasibility of new technologies in the energy system. We recommend that the Government set out how it believes people are likely to respond to and utilise new technologies (such as smart meters, electric vehicles and heat pumps) and what plans it has for further research in this area. (Paragraph 148)

Public awareness and understanding

31. The Government must resist relying on the energy companies to deliver this message on demand reduction as the lack of consumer trust will undermine the communication. (Paragraph 153)

Formal Minutes

Tuesday 11 October 2011

Members present:

Tim Yeo, in the Chair

Dan Byles	Christopher Pincher
Barry Gardiner	John Robertson
Dr Phillip Lee	Sir Robert Smith
Albert Owen	Dr Alan Whitehead

The following declarations of interest relating to the inquiry were made:

Tuesday 28 June 2011:

Mr Tim Yeo declared the following interest: Chairman TMO Renewables.

Tuesday 24 May, Wednesday 15 June, Tuesday 28 June, Tuesday 5 July and Tuesday 19 July 2011:

Sir Robert Smith declared the following interests: Stakeholder in Shell Transport and Trading, honorary Vice President of Energy Action Scotland, a fuel poverty charity, and Vice Chair of the all Party Group on Offshore Oil and Gas Industry., where the secretariat is provided by Oil and Gas UK.

Tuesday 24 May and Tuesday 5 July 2011:

Christopher Pincher declared the following interests: Member of Friends of Azerbaijan and Member of the All Party Group on Azerbaijan.

Draft Report (*The UK's energy supply: security or independence?*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 156 read and agreed to.

Annexes and Summary agreed to.

Resolved, That the Report be the Eighth Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

Written evidence was ordered to be reported to the House for printing with the Report (in addition to that ordered to be reported on 4 May, 7 June, 5 July and 19 July).

[Adjourned till Thursday 13 October at 10.30 a.m.

Witnesses

Tuesday 19 July 2011

List of printed written evidence

List of additional written evidence

(published in Volume II on the Committee's website www.parliament.uk/ecc)

List of Reports from the Committee during the current Parliament

The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2010–12

First report	Emissions Performance Standards	HC 523 (807)
Second report	UK Deepwater Drilling–Implications of the Gulf of Mexico Oil Spill	HC 450 (882)
Third report	The revised draft National Policy Statements on energy	HC 648
Fourth report	Electricity Market Reform	HC 742 (1448)
Fifth report	Shale Gas	HC 795 (1449)
Sixth report	Ofgem's Retail Market Review	HC 1046 (1544)
Seventh report	A European Supergrid	HC 1040
First Special Report	Low carbon technologies in a green economy: Government Response to the Committee's Fourth Report of Session 2009-10	HC 455
Second Special Report	Fuel Poverty: Government Response to the Committee's Fifth Report of Session 2009-10	HC 541
Third Special Report	The future of Britain's electricity networks: Government Response to the Committee's Second Report of Session 2009–10	HC 629

Annex 1: Summary of potential threats to UK energy security identified by witnesses to this inquiry

Outcome to energy services	Possible threats	References
Insufficient physical oil supplies to meet demand	• International events constrain production (e.g. unrest in Middle Eastern and North African—MENA—countries, natural hazards, accidents, terrorism) • Reduced investment in oil production (e.g. as a result of "Arab Spring" in Libya, Yemen and Syria) • Growing global demand for oil • Declining UKCS production • Failure to deliver on energy efficiency ambitions	Q 26, Ev 112, Ev 139, Ev 148, Ev 159, Ev 180, Ev w55, Ev w68, Ev w149
Insufficient physical gas supplies to meet demand	• International events constrain production (e.g. unrest in MENA countries, natural hazards, accidents and terrorism) • International events result in increased demand for gas elsewhere e.g. as a result of Fukushima disaster • International events disrupt transportation of gas (e.g. natural hazards, accidents and terrorism) • Failure of import infrastructure e.g. Langeled pipeline and LNG terminals • Declining UKCS production • Increased volatility of demand making it harder to ensure sufficient supply • Lack of gas storage infrastructure • Failure to deliver on energy efficiency ambitions	Ev 112, Ev 139, Ev 159,Ev 180, Ev 226, Ev w1, Ev w36, Ev w55, Ev w68, Ev w132, Ev w138, Ev w149
Insufficient electricity generation capacity to meet demand	• Scheduled closure of existing coal and nuclear plants • Delays in building new generating capacity e.g. because of lack of investment, or changes in public sentiment towards nuclear power following Fukushima disaster. • Cost of building new generating capacity is unaffordable • Failure of upgrades to keep pace with growing demand • Increased demand for electricity resulting from plans to electrify heating and transport • Increased level of "peak" demand • Over-reliance on wind generation poses a threat on cold, still days • Managing intermittent sources of electricity / insufficient flexible plant available • New technology is not delivered as hoped (e.g. no large CCS demonstration projects are completed) • Failure to deliver on energy efficiency ambitions	Q 9 [Mitchell], Q 431 [Hendry], Q 55 [Jenkins], Ev 112, Ev 121, Ev 139, Ev 148, Ev 159, Ev 170, Ev 198, Ev 226, Ev w1, Ev w21, Ev w55, Ev w68, Ev w75, Ev w105, Ev w149
High oil prices resulting in unaffordability	• Decline in the global availability of cheap oil • Reduced investment in oil producing countries (e.g. Saudi Arabia and Iraq) • Increasing global demand for oil	Ev 148, Ev w27

Oil price volatility (resulting in uncertainty about future affordability)	• Temporary physical shortages caused by e.g. civil unrest in MENA countries, natural hazards, accidents and terrorism) • Lack of long-term contracts in the UK	Q 8 [Stevens], Q 26, Q 433 [Hendry], Ev 112, Ev w55
High gas prices resulting in unaffordability	• Increased global demand for gas (e.g. as a result of Fukushima disaster) • Over-reliance on gas in the UK results in a greater risk of exposure to high prices (e.g. as a result of delays in building new nuclear power stations and/or in accessing viable CCS technology)	Q 9 [Stern], Ev 121, Ev 148, Ev 159
Gas price volatility (resulting in uncertainty about future affordability)	• Temporary physical shortages caused by e.g. civil unrest in MENA countries, natural hazards, accidents and terrorism) • Lack of long-term contracts in the UK	Q 433 [Hendry], Ev w55
Failure of electricity infrastructure	• Aging electricity infrastructure • Cyber attack/terrorism • Delays in upgrading transmission and distribution infrastructure • Cost of upgrading transmission and distribution infrastructure is unaffordable • Natural hazards (e.g. tsunami, geomagnetic storms) • Accidents	Q 55 [Jenkins], Ev 112, Ev 170, Ev w79, Ev w138, Ev w143
Failure of petrol/diesel distribution infrastructure	• Closure of rural petrol stations leading to "rural fuel desert" • Natural hazards • Accidents • Terrorism	Ev 112, Ev w110
Failure of gas transmission/distribution infrastructure	• Natural hazards • Accidents • Terrorism	Ev 112

Annex 2: A set of candidate energy resilience indicators proposed by the UK Energy Research Centre

Possible resilience indicators for primary energy supply

- Import dependence
- Largest single source of supply
- Diversity/concentration of energy supply
- Energy portfolios

Possible resilience indicators for energy infrastructure

- Statistical probability of supply interruption in network industries
- Expected number of hours in which energy is unserved
- Value/level of unserved energy
- Energy storage capacity and/or stocks by fuel and market
- Largest single source of supply in a market energy
- Redundancy in network architecture

Possible resilience indicators for energy users

- Energy demand level
- Energy intensity
- Energy costs
- Back-up arrangements for energy sensitive users, e.g. hospitals, banks.

Taken from: Modassar Chaudry, Paul Ekins, Kannan Ramachandran, Anser Shakoor, Jim Skea, Goran Strbac, Xinxin Wang, Jeanetter Whitaker, *Building a Resilient UK Energy System,* Research Report, ref UKER/RR/HQ/2011/001, 14 April 2011, pp 14-15.

Oral evidence

Taken before the Energy and Climate Change Committee

on Tuesday 24 May 2011

Members present:

Mr Tim Yeo (Chair)

Dan Byles
Barry Gardiner
Dr Phillip Lee
Christopher Pincher
John Robertson
Sir Robert Smith
Alan Whitehead

Examination of Witnesses

Witnesses: **Professor Paul Stevens**, Chatham House, **John Mitchell**, Chatham House, **Professor Jonathan Stern**, Oxford Institute of Energy Studies, gave evidence.

Chair: Welcome to the Committee. Thank you for your time in coming in to see us. This is our first public session on this particular inquiry, although we have done some work in private first. As we have another set of witnesses, we have about an hour, if we can just pace ourselves with that in mind. I believe one of you has to leave at 11.30 am anyway.
John Mitchell: Sort of.
Chair: It will provide a natural opportunity because we have some more witnesses later on.

Q1 Chair: Could I start off with a general question? Do you think that we can be energy secure if we are not energy independent?
John Mitchell: Both those slogans upset me somewhat. Firstly, energy security is not a standard product. It is a bit like health; it is a bundle of problems and a bundle of insecurities for which there is no single answer. "Energy independence", President Nixon's phrase, did not work in the United States and I think it is extremely unlikely to work here. I think those are not really the right points to start, if I may put it that way, but there is a security problem for energy, yes, and I think we need to differentiate it and say what we are worried about and what the policies appropriate to that are. In that, I think there is a big distinction between security against disruptions and more strategic security about prices and economic things. Finally, I think we don't know all the answers yet. The future is very uncertain. We need to take it step by step.
Professor Stevens: I reinforce that view. I think putting energy independence and energy security together is a mistake because it implies that energy independence, somehow defined as not being dependent on imports, will generate energy security. You only have to look at a little bit of history. If you look at the UK over the last 40 years, two of the major energy crises were created by problems with domestic energy supplies, namely the coalminers' strike. The French President is kept awake at night by the thought that the nuclear engineers will go on strike, in which case the French lose 80% of their electricity. Putting the two together, I think, is a mistake.
Professor Stern: In what I specialise in, which is natural gas, virtually all the major natural gas security incidents where large numbers of people and firms have lost gas have been due to domestic incidents. I really hope that we can put behind us what I call this kind of 1970s view of energy security which is that you can measure it in terms of import dependence. Basically, you can't.

Q2 Chair: To put it the other way round, though, if we were very, very import-dependent, would that not also make us even less secure?
John Mitchell: That depends on how we prepared for the risks. Japan is very, very import-dependent. Their main problem is not an import-related issue at the moment. They have mechanisms to deal with disruptions in the form of very high stocks of oil and they have strategic policies to minimise their use of energy in general, which protects their economy. I think it is possible to separate them.
Professor Stevens: Yes, again I would reinforce that. Having high import dependence, it depends on what strategies Governments have in place to take account of disruptions, whether the disruptions are physical disruptions or disruptions associated with price.
Professor Stern: I think that is a crucial distinction between physicality and price, because I think it can be argued that if you are self-sufficient in energy, you have less of a problem with price spikes, although you have to be careful there, because obviously if you lose a crucial facility, you lose a lot of production and the price can go up. There is at least some credence to be given to the argument that says if you are not importing all your energy, you may have some greater control over price—but, I would argue, not over physical security.

Q3 Dr Lee: Would you say that it would be better to describe it by saying that it would be better to be independent of unnecessary risk in terms of where you get your energy?
John Mitchell: I think it is possible to define policies that reduce the risks of dependence on any source, whether domestic or imported, yes.

Q4 Dr Lee: My point being—and we are going to get on to it later—if we were to get our fossil fuels from a country that had a history of stability and

maybe close geographical proximity, that would make us more independent of unnecessary risk in terms of getting our fossil fuels from further afield.

Professor Stevens: Possibly, but you do have to bear in mind the fact that these are international markets, so events in one country will have knock-on effects. This is particularly true for oil. Gas is a more regional commodity, but if anything happens in the international oil market to a particular supplier, it will have knock-on effects throughout the whole market.

Q5 Dr Lee: Does that then point to having a long-term contract at a fixed price?

Professor Stevens: If you can get a long-term contract at a fixed price, that may be an option, but again it depends on what level you fix the price at and what happens in the future as to whether that is seen to be a good or a bad move. If we are talking about oil, oil is largely traded on spot or short-term contracts. Long-term contracts are a thing of the past. Whether that could or should change is another issue.

Professor Stern: For gas, this is a major issue, and the UK is quite unique in having no—what the gas industry call—long-term contracts, which of course is a product of the way it has organised its market for the last 25 years. Now there is, I think, quite an interesting argument about having longer-term contracts, but fixed prices do not exist in this world. You have to set a price, and the price will move with the market price.

Q6 Chair: Is it just luck that we haven't had the lights going out in that case, or have our contingency arrangements been robust?

Professor Stern: I do hate this phrase "the lights going out" because it really conjures up for me completely the wrong impression. We have had a number of gas security incidents over the last 10 to 15 years, including a very interesting one earlier this year, but no one has mostly known about them. I have written extensively about this, explaining how basically we came very, very close to a major problem in 2006, but it is totally unknown because the media were not interested in it. Nobody picked it up. Again we came close—not as close—earlier this year through a constellation of unusual events, but I would say we have been lucky in the case of gas. I think probably because of our huge import capacity, the problem will be less serious in the future, but I have made a very strong case in my own work for a much greater level of gas storage, which so far has not happened.

Professor Stevens: I would just add that for oil, of course, it is not an issue of the lights going out because we do not use oil for power generation. But again, if you look over the last 30 or 40 years, apart from the fuel protests, there have been no physical problems with supply. If there has been a problem, it is to do with price.

John Mitchell: I think I would just add that in the case of oil, the diversity of the international markets combined with our facilities for importing oil mean that it is not a problem. I remember when the lights went out in 1973 because of the coal strike, and the fact is one can diversify. The problem is that there may be dislocations, and during that period of dislocation, if you are dependent on a particular supplier and that supplier is affected by the dislocation, there will be a couple of weeks or three or four weeks while the suppliers get reorganised, and there will be a price effect, of course.

Q7 Chair: From the point of view of oil, given the just-in-time delivery arrangements on which retailers now largely operate—perhaps we had sight of this during the tanker drivers' strike in 2000, where suddenly people started to realise they might not be able to get what they wanted in the shops, which is a different issue from the lights going out, but one that could be almost equally disruptive to most people's lives.

John Mitchell: I think you have hit the nail on the head, if I may say so, because in analysing the 2000 crisis, there was not an overall shortage for more than a day or so, but the stocks were mostly held at refineries, which were blockaded, and therefore the lesson was to try to disperse the stocks nearest the point of consumption. I think that is a generally recognised principle now. I think the problem, however, for oil, is that deliveries, not so much in the refineries where they have back-up facilities but in retail stations, depend on electricity to work the pumps and so on, so one goes back to the question of how secure the electricity supplies are.

Q8 Chair: So what would you say that the main threats to our security are?

Professor Stevens: For oil?

Chair: Start with oil.

Professor Stevens: For me, the main threat is in terms of price. As John said, you have plenty of supplies; you have plenty of logistical options, so if one big supplier goes down, you can move things around. The problem is the impact on price and the macro-economic implications of that and the impact on consumers. That is, for me, the largest oil threat in the near term.

Q9 Chair: For gas?

Professor Stern: Price as well. I think we have now had enough episodes in the last two or three years that we can see the UK can cope with very cold weather. What it cannot do is to moderate the price effect of storage being run down very quickly and then to have some sudden threat to any one source of supply, which will cause a price spike. Empirically the market does not react to threats on the demand side. It reacts to threats on the supply side and it tends to overreact, so we might get a period of very high prices for a protracted period of time, which we could moderate through storage.

John Mitchell: In my view, the most serious threat is in electricity because of the run-down of capacity as the oil-fired and coal-fired stations are closed, because of the directive on sulphur and any possibility of a delay in the commission of new nuclear plants, or any delay in the forthcoming renewable supplies. I think the forecasts of Ofgem and others already suggest quite a significant drop in the capacity margin in the latter part of this decade. That is when, if a crisis of any kind hit, we would be in serious trouble.

Q10 Sir Robert Smith: First, I should remind the Committee of my entry in the Register of Members' Interests as a shareholder in Shell and other oil and gas-related interests.
On the oil stocks, the EU are looking at some changes to the way oil stocks are handled. Do you think they have a clear strategy on how we can draw down those oil stocks?
Professor Stevens: I think the short answer is no. There has been historically a sort of—not a conflict, but a situation where you have the IEA emergency stock-sharing scheme and the EU scheme. It is not at all clear how the two are co-ordinated—I suspect because they are not co-ordinated—so it is not at all clear what would happen in the event of a serious emergency. Certainly, in terms of the IEA emergency stock-sharing scheme, there are questions being asked about how relevant it is in today's oil markets.

Q11 Sir Robert Smith: Because there is enough confidence in the market?
Professor Stevens: No, because it excludes a large number of the major oil consumers. I am thinking here of the Brazils and Indias and Chinas. Also, there is no connection with the producers. It seems to me it would make eminent sense if the IEA scheme talked to OPEC and offered them a carrot to carry spare capacity and say, "If there is an emergency, you can have first go at the shortages with your spare capacity." There are all sorts of things that are being discussed, but I am not sure how relevant the EU scheme is, given the existence of the IEA scheme.

Q12 Sir Robert Smith: Looking at the UK, which is traditionally an exporter and still a major producer, do we need to start thinking about physical stocks, or is there still time to rely a lot on the fact that we have spare production?
Professor Stevens: Are you implying a sort of unilateral approach to this as an oil producer?

Q13 Sir Robert Smith: The UK gets some benefits from being a producer but it does not have to physically hold the stocks, because it can surge production. Do we have to, as a matter of policy, start to think ahead?
Professor Stevens: Certainly. If the North Sea is likely to decline, and all the signs are that it will do, then yes, there will need to be consideration of this.
John Mitchell: Changes made by the EU in the compulsory stock-holding bring the levels into line with the IEA levels, and that helps and should help the UK slightly. The UK gets a derogation from that, which I imagine will shrivel away as time progresses, but slowly.

Q14 Sir Robert Smith: In terms of our own security and strategy, does it make sense to try to maximise the production from our own resources?
John Mitchell: It depends on the cost.
Professor Stevens: And it depends on your view of what the prices might be in the future. Are you talking about UK depletion policy? Should we produce it sooner or later?

Q15 Sir Robert Smith: I suppose what is at the back of my mind is that the Treasury's recent sudden change in the fiscal regime has caused a lot of uncertainty in the investment market—whether that, strategically, is the best way to secure your energy supplies.
Professor Stevens: What, by slowing development and keeping the oil for the future, as it were even if it is done by accident rather than—

Q16 Sir Robert Smith: I was probably thinking the other way round: by risking the loss of the infrastructure, that means that there will be a lot of stranded oil that will never be produced.
Professor Stevens: That certainly is a possibility, given the fact that a lot of the existing infrastructure must be coming to the end of its natural life, and to renew it or upgrade it is going to cost a lot of money.

Q17 Sir Robert Smith: One other thing on stock-holding. Does it make any difference whether the stocks are held by the industry or by a public Government body?
John Mitchell: It makes a big difference to the industry, because if they hold the stocks, the cost is on their balance sheets, whereas it is not if it is held by a public body.
Professor Stevens: In practical terms, I suspect, apart from that, there is not a great deal of difference.

Q18 Sir Robert Smith: One other thing came up in the earlier evidence about oil being a spot market, a global market. Is there any change in that in the way China is trying to develop a supply relationship right through from production to its use in China with its relationship with resource-rich countries?
John Mitchell: I don't think so, no. The short answer is no. Firstly, there is no evidence of this in the existing Chinese deals. The oil is sold at market prices. Remember that the host Governments have a great interest in what their price is because their tax intake is based on that, so they will be very reluctant to give away, by means of some kind of a long-term contract, an advantage to the Chinese. I don't think there is any big divergence. Having said that, there are some advantages in just being in there and knowing what is happening, but that is a matter of cents rather than dollars. I think, in that sense, China will be doing the sensible thing.
Professor Stevens: In most cases, to the best of my knowledge of the Chinese companies operating abroad, the oil is simply sold into the international market. There is no sort of integrated chain. It does not go back to Chinese refineries necessarily.

Q19 Sir Robert Smith: Finally, do you three have any views on the debate about whether conventional oil is globally peaking in its production capacity?
John Mitchell: It depends what you mean by "conventional oil". If you take the reservoirs that were in production 10 years ago around the world, yes, they are peaking, but new fields are being discovered. New methods of recovery are being developed and so-called unconventional oils. The border line is getting very fuzzy, so in terms of total liquid supply, no.

Professor Stevens: I would agree with that.
Professor Stern: I will leave the oil to these guys. There is no sign of peak gas production.

Q20 Dan Byles: Going back to oil, half the world's oil obviously is transported by sea, and there are a number of key chokepoints that have been identified. Would you be able to identify one or two of those chokepoints that particularly affect the UK, or is it more complicated than that?
John Mitchell: I am afraid I take the view that "chokepoints" is another of those treacherous phrases. Suez used to be a chokepoint. It was closed for some years. The immediate effect of closure was very disruptive but the industry got around it. The ships took a longer voyage, more ships were built and so on. I think that is true of all the other so-called chokepoints. I do not think the UK is particularly exposed. We do not import very much oil from the Middle East, for example. We import it mostly from Norway, which is a friendly country that does not carry the same risk as some of the other sources of supply. I would say, no, I don't think there is a particular chokepoint.
Professor Stevens: Not an obvious one. There was Bab-el-Mandeb, which is the entrance to the Red Sea, and I think that is more to do with LNG transport than crude oil transport as a potential threat.

Q21 Dan Byles: Because we buy on the open market, it is not the case that oil that would be destined for the UK would then be blocked; it is more a question of the impact on global oil prices, for example.
Professor Stevens: Prices are another aspect, yes. Price is definitely another issue. If the Iranians said, "We are going to close the Strait of Hormuz tomorrow", even though they could not do it, just watch the oil price.

Q22 Dan Byles: That was going to be my next question; exactly that. If the Strait of Hormuz was to close tomorrow indefinitely, what would be the impact? Not just on oil, but the knock-on effect on food security and so on, because it would have a ripple effect.
Professor Stevens: If it was closed permanently, the impact would be huge because the oil price would head—think of a number and double it—and stay there for quite some considerable time because the alternatives to getting the oil out at this stage are fairly limited. There are pipeline options, but their capacity is nothing like the amount of crude that goes through the Strait of Hormuz. But the idea of the Strait being closed for any length of time is inconceivable unless somebody puts a dirty bomb in there.

Q23 Dan Byles: Which is not entirely beyond the realms of possibility.
John Mitchell: The other big effect, of course, is that if the Strait was closed for a length of time, the economy of Iran would collapse; the economy of Kuwait would rest on its overseas assets; Saudi Arabia has alternative outlets, but through the Red Sea and not very large. So, yes, it would be enormously disruptive, but one of the points that I made in my submission is that we are now in the state, and will be for the indefinite future, where Middle Eastern oil basically goes east, not west, and therefore the physical disruption would not be to us; it would be to the East. That would of course generate a huge price explosion, but we would still fill up the tanks here.

Q24 Dan Byles: I am curious, because energy security in this sense and food security I think are quite closely linked. If this inconceivable event was to happen and a terrorist was able to explode a dirty bomb and actually close the Strait of Hormuz, I am just curious to know who, anywhere, is doing the details—knock-on, "what if" work—on what that would mean for the UK in terms of energy security and food security. I know food security is not necessarily your issue, but it is an obvious knock-on consequence of a semi-permanent explosion in oil prices.
Professor Stevens: I don't know—

Q25 Dan Byles: Sticking to the price of oil, has anybody done any modelling on what the impact would be other than saying, "Watch the oil price explode"? Has anyone done any modelling on what might happen if the Strait of Hormuz—
Professor Stevens: I am not sure anybody has, and part of the reason for that is if you take a model that has been designed to look at the impact of oil prices on the macro-economy, if you double the prices, then the model goes out the window, so it would produce pretty silly results, I suspect.

Q26 Dan Byles: One final thing. Leaving aside physical chokepoints such as the Strait of Hormuz, are there any other infrastructure chokepoints, for example in refinery capacity or anything else, that could have a noticeable impact?
Professor Stevens: The big one is the Abqaiq facility in Saudi Arabia, which processes over six million barrels a day. It is an identifiable target and in fact has been targeted on a couple of occasions in the last eight years. If they were able to get in and do serious damage—and of course if you know what you are doing, you could do serious damage—then you would suddenly overnight lose six million barrels a day of crude capacity. Again, that would be replaced. There would be spare capacity out there eventually, but in the meantime the price impact would be spectacular.
John Mitchell: I think it comes back to the point about temporary dislocation. It affects the UK because in our system we export as much oil as we import. There is a huge in-and-out flow because the shape of our demand is different from the shape of our production. We have seen a little bit of this in the case of Libya. Low-sulphur crude not available; UK refineries are slightly less affected than others, but there is a shortage of a particular type of crude. This might be the case in many different kinds of disruption. I think there is a UK question here. Would the UK be able to deal in its refining mix with refining significantly different mixes of crude that would be available, just like this slightly heavier crude is available but it is not necessarily what we are

accustomed to? There would be a time lapse, but it would be fixed.

Q27 Dan Byles: Before we go on, LNG was mentioned. Rather than exclude you, Professor Stern, the LNG chokepoint: what sort of an issue or impact could that have on the UK? Is there a specific risk to our supplies of LNG?

Professor Stern: I would say not really, although there was a threat of a strike in the Suez Canal earlier this year and that would have disrupted tankers. What it would have meant was, as John mentioned earlier, they would have taken longer to arrive. That could have happened at a very inconvenient time. If there is a major chokepoint, it may be Qatar. It is a very small state. It has two very large export terminals. The tankers pretty much have to take the same route. If for any reason either of those terminals were disabled through some kind of hostilities, that would have a big price impact on the LNG market, but again, more likely in the Pacific than here.

Q28 Dr Lee: I am looking at table 3 of Mr Mitchell's documents. These are possible events and I am quite struck by this. I remember attending a conference about six or seven years ago and asking a distinguished former politician about democracy in the Middle East and something like "Arab states do democracy" has generally been the response of the Foreign Office for decades. That has all been found out to be baloney in the last few months and there is a sense that foreign policy is being made; they are making it up on the hoof at the moment to try to work it out. Obama has made some attempts to carve out a policy for changes that we had no control over other than providing them with the internet. I just wonder: in view of the fact that we are absolutely useless at predicting the future, it seems, does that not point towards weaning ourselves off fossil fuels in general?

John Mitchell: That is rather similar to saying, "It is dangerous to cross the road, so let's stay at home".

Dr Lee: Not really, because you can cross the road by another way.

John Mitchell: Exactly. This is my point. The question is to find out what tools are available to deal with these different contingencies, and as we learn more about which contingency is coming to the fore, to lean on that particular policy instrument. For example, the one technology that would help on the lines you suggest is to improve the efficiency for which energy is used, because reducing the demand for energy, especially electricity, has a knock-on effect on the demand for imports, and therefore not only insulates us to some extent against shocks but also reduces the cost to the economy of surges in price, because the cost to the economy depends essentially on how much we import. In that sense, there is a universal strategy, which is to make the use of fuel more efficient.

Professor Stevens: There is an argument based on that to wean ourselves away from dependence on fossil fuels. There is also the climate change argument for the same thing, but it comes down to what it would cost and the speed with which you would want to carry out this weaning process. It can be done—for sure, it can be done—but the costs would be absolutely horrendously high.

Q29 Dr Lee: And our costs of being in Iraq, Palestine and Libya are not?

Professor Stevens: I suspect they are a lot higher than that. Again, it depends on how quickly you wanted to do this and what the political will was. For example, Western Europe could slash its gasoline consumption tomorrow if the European Union, if Brussels, introduced a law that put a national speed limit of 50 mph across the whole of Western Europe. Politically, that would be a very interesting exercise if the Germans could not drive down the autobahns at 200 km an hour. It comes down to the costs and the political will.

Professor Stern: I think also the three of us may be veterans at having seen these arguments come round again and again but for different reasons and now for carbon reduction reasons. I came into energy studies around 1973, and since that time it is very disappointing how little progress we have made towards what everyone considers to be a desirable objective, although for different reasons.

Q30 Dr Lee: Do you think that is a lack of political will?

Professor Stern: Absolutely a lack of political will to do things, as Paul was talking about and John also, particularly on the efficiency side. These are things that have been talked about for a very, very long time. I have been hearing about smart meters my whole career. I have still never seen one, although I am hoping to do so soon.

John Mitchell: If I could just add on a slightly more optimistic note, firstly we have to remember, after the second oil shock, the price of oil increased by about threefold in real terms and it stayed at that level, again, in real terms, for about 20 years. Oil lost 10% of the world's energy market as a result of that, and the demand for oil fell. There was a big impact. Now we have a situation where the price of oil has increased five times above that higher level. It is unimaginable that this does not have a big effect on demand. Now, how will it have that effect on demand? I am talking now about an effect on supply as well, but the effect on demand is very difficult to pin down because we consume oil and energy in so many different ways.

There is not some big thing where we could say, "Well, let us track incandescent lights," but that is a simple example of a technology forced in this case by Government action and by EU legislation but supported now by the economics of a technology that springs from outside the oil and gas sector, but it enables substantial reductions in demand. Insulation standards do the same, and I know that companies like United Technologies, General Electric and so on and Japanese companies incentivised by what is happening in Japan are already developing and offering a whole raft of things. It is unimaginable that the technology we put on our mobile phones cannot be used to control the energy at the point of use. It will happen.

Sir Robert Smith: You mention, Professor Mitchell, about the refineries having to be tuned to their supply, but also there has been a sort of dislocation in the consumption of refined products. It no longer fits the profile of the refineries we have. The owners of the refineries seem to feel they do not have much margin and the question mark seems to be over where the next investment for the upgrading of those refineries is going to come from. Are there any supply security implications for the profile of the UK's refinery supply side, or are we just going to go to India and import refined products?

Professor Stevens: That certainly would be an option, and you are right to point out that the refining problem, not just in the UK but globally, is that refineries are a very bad business to be in. The returns and the margins have been poor since the early 1970s. The result of this is that companies have always been reluctant to invest in refineries, and if you look at the history, the only reason investments have taken place is largely because of environmental legislation imposed by Governments on the product quality and the processing. This does present a problem, but, as you say, it is a global market, so if you cannot produce it here, you can simply go and buy it somewhere else.

John Mitchell: Paul is talking about the West. New refineries are being built in the Middle East and in Asia and particularly in India, and they are very profitable. People are building them and making money because the demand for refined product is surging. It is not surging in Europe and the US and the refineries are having to cope with a whole raft of climate-induced restrictions, so investment is not taking place. I don't know the details of the change—

Q31 Sir Robert Smith: Given the Chairman's earlier observation about the consequences of refined products not reaching their destination and how quickly things start to go wrong, will that alter our stocking of refined oil? Obviously, at the moment, if you have the bulk of your refinery on your doorstep—the response time and so forth when something goes wrong—if there is a much longer supply chain, will we need to alter any capacity products or refined products?

John Mitchell: There is already a requirement to stock a proportion of the compulsory stocks as refined products, yes. One could review that. I don't know the details.

Professor Stevens: Again, it comes down to a cost issue. What are you willing to pay for insurance?

Q32 Christopher Pincher: Just following on from Robert's point, between 2005 and 2025, the demand for oil in China alone is going to triple, and as I understand it, although you have said that there were more refineries being built in India, there is not much extra refining capacity outside the Middle East and Saudi Arabia right now. Does that not present a chokepoint that Dan referred to?

Professor Stevens: I would be very careful of taking too seriously these projections on China. The IEA, the last world energy outlook, projected that of the increase in oil demand expected by 2035, something like 63% was going to come from the MICs. You have heard of the BRICs; the MICs are Middle East, India, China. Now, the reason they are significant is that all three, for a long time, have had highly subsidised prices for their consumers. In India that process stopped in 2002, and in China it stopped in 2009. The result is that the final price to the consumer in those countries has been rising dramatically—around a 350% increase in the retail price of gasoline. A lot of Middle East countries are talking about the same sort of thing. Prices work and markets do operate, so eventually those sorts of price increases will impact on demand. I think the IEA is likely to find itself being way out on those sorts of projections.

John Mitchell: I think it is probably true that the surplus in refining capacity in the Atlantic region is much less than it used to be. The question is: what are we trying to protect? If we are trying to protect petrol at the pumps, building refineries is a very expensive way of doing that. Having a bit more storage near the spot is a more achievable alternative.

Q33 Barry Gardiner: Can I move to specifically gas markets now and ask some questions around that? Mr Mitchell, you said that the high transport cost of gas relative to energy content limits consumption mainly to countries with their own production or access to regional supplies, and Professor Stevens, you said that gas is essentially a regional rather than a truly global market. Now, BP have been saying that, in fact, gas is now becoming a global commodity as the increased US production of unconventional gas will led to more LNG cargoes. Am I quoting you from a period before that became a reality? Have things changed? Do you agree with BP now or do you maintain your position? If so, why is BP wrong?

John Mitchell: I think one has to define the terms. In my study on *More for Asia* et cetera, which you are quoting from, essentially I never said there was not going to be a global gas price. There is going to be arbitrage charged between all these markets, undoubtedly, but the main bones will be regional, and therefore regional prices and things that drive them will be very important. If you look at China, Russia and so on, it is the domestic price that determines the profitability of those industries, but Jonathan is the person you probably should ask.

Professor Stern: I am hesitant to agree with the proposition that gas is a global commodity, but it is globalising in the sense that the markets are beginning to influence each other in terms of price and availability. If you look at the statistics, what you discover is that only about 30% of gas that is produced in the world crosses an international boundary. Of that, only about 28% is LNG, and of that 28%, only 2% is committed to any specific market, so it is a very small spot market. The problem with using terms like "a global commodity" is it makes it sound as if gas becoming like oil, and it is not, and it almost certainly will never become like oil. It has moved a long way from the rigid international trade business that it was 10 years ago, and it will move further, but it is a very different commodity to oil and it needs to be seen in that context.

Q34 Barry Gardiner: Remind me again of the percentage that you said was being traded by LNG.
Professor Stern: It is only 28% of total internationally traded gas.

Q35 Barry Gardiner: Do you think that that is a driver of the globalisation of the increasing LNG—
Professor Stern: Absolutely.

Q36 Barry Gardiner: What percentage might that become?
Professor Stern: It might become as much as 40%, but again following the way John sees the world, which I think is right, in the Pacific it might be much more than that. In the Atlantic basin it will be less, especially with the apparent disconnection of the North American market due to unconventional gas—and that is something that it appears is going to continue at least for a few years. Europe is basically a pipeline market with LNG round the edges. Obviously, a country like Spain is very much more important, whereas the Pacific is really an LNG market with very little pipeline gas. There is more now that China is starting large scale pipeline imports and possibly India, but essentially the Pacific is where the bulk of the LNG gets traded.
Professor Stevens: I think it is worth remembering why oil is an international market, and the reason is because of the very low transport costs. If you are in charge of a cargo of crude oil heading to New York across the Atlantic and the prices change in Singapore, you can phone the captain and say, "Turn round and go to Singapore", and it does not take a great deal of price differential to get that arbitrage kicking in. Because gas is much more expensive to transport, that is more limited, but it is beginning to happen. As you say, it is globalising; it is not global.
Professor Stern: Could I could say one more thing specifically about the UK? The coming of LNG in the UK has exposed the UK to the global gas market, and that is really terribly important and a very new phenomenon. The UK in the last two years has become this fascinating transit market where we import LNG in Wales and to some extent in the Isle of Grain, and then we export equivalent quantities of pipeline gas out to the Continent. As a result of that the UK has really engaged with both global and regional markets for gas, which is a phenomenon I think we are going to be seeing a lot of in the coming years.

Q37 Barry Gardiner: In a previous inquiry, we concluded that the impact of unconventional gas was likely to be beneficial but not significant. Is that something that you agree with?
Professor Stern: I think we need to be terribly careful here. I mean, in North America, the coming of unconventional gas, which is not as the literature makes it seem—something that happened in the last five years—but something that has been happening over the last four decades, took everybody by surprise. That can justly be called a game changer for North American gas, and that is going to continue, although in my view not at the prices that we have seen in the last two or three years. I am very cautious about the development of unconventional gas anywhere else outside North America. I think it will happen, but I think it will happen quite slowly, and I am uncertain whether it will have the same kind of impact on the general gas market that it has had in North America. If there is a place where that will happen, it could well be in China. I doubt whether it will be in Europe, although for certain European countries, Poland and perhaps some others, it could be significant, but the work that we have done suggests that it is not going to be significant in general terms for the European gas market—certainly not in this decade, possibly not even in the 2020s.

Q38 Barry Gardiner: What about for the UK?
Professor Stevens: If you look at the reason why the shale gas revolution happened in the US and you look at the many reasons that built up to it, and then you apply those reasons to the Western European or the UK context, it is simply not there. There are property rights issues and lack of service capability; it is a long list that says that yes, shale gas is going to happen, but it is going to be a very slow process. It is not going to be the same sort of game-changer that we have seen in the United States.
Professor Stern: And, crucially, it is going to need a different business model to the model we have seen in the United States.

Q39 Barry Gardiner: Given the threats to international supplies, looking at UK policy, are you confident that the policy the Government has in place will lead to adequate provision of both stocks and storage of gas?
Professor Stern: I am not sure I would necessarily eaute stocks with storage. I do not specialise particularly on the UK, but the work I have done on the UK has all been looking at the lack of storage and saying, "This is a serious problem in terms of gas security". I think it is less serious now that we have substantial import capacity, but it remains a very difficult problem, and new work that we are going to publish this year shows that because of intermittent renewables and the role of gas in backing up those renewables, it is going to become even more important.
We have a very odd situation in the UK. We have built very little storage in the privatisation era, and that is not because we do not have a lot of projects. There are lots of projects out there, but the commercial environment has not been such as to see them come forward in a timely fashion, and we have had serious problems with the Rough facility several times. We are not in any sort of panic situation, but we still have only about 5 bcm of storage, and we probably need at least twice that and possibly even more than that. In the current commercial climate, I do not see that coming forward.

Q40 Barry Gardiner: What is constraining them?
Professor Stern: Essentially the commercial way you look at whether you are going to invest in a storage facility is the spread between summer and winter prices, and you look at what happens when prices go up and see whether storage gets used. When you look

at the last two or three winters, you do not see a justification for building new storage. In other words, it does not get remunerated at the kind of hurdle rates that commercial companies need. A lot of these companies, as I say, have gone through the permissions process. Some of them are ready to go; some of them are not but have done a lot of preliminary work, but many storage projects have been under consideration for a very, very long time and they really do not seem to be moving forward.

Q41 Barry Gardiner: Given what you said about the need for balancing fuel and the grid, and increasingly that being the case as we move forward to greater reliance on renewables, do you believe the Government should be focusing more clearly on incentivising storage or encouraging new storage to be built?

Professor Stern: I think the Government has two options. I think for me it just is incontrovertible that we need more storage. What you could argue is, "Well, a lot of storage is being built on the Continent. We have connections with the Continent. Why don't we simply get access to those storages?" That is a good commercial argument. But should we have a problem with any of those pipelines from the Continent, that will, of course, sterilise our access to the Continental storage. I think there is a balance to be struck here between access to storages in Continental Europe—and there is a lot of German storage, Dutch storage; it is perfectly possible to do that—but also fast response storage in the UK from projects, and that we know about with different developers. It is high time that policy addressed that issue.

Q42 Barry Gardiner: How?

Professor Stern: There are really two ways of doing it. We have been through the arguments for strategic storage: that is Government-built and commissioned storage with Government controlling it. Nobody likes that. Everybody says, "Well, then you have to make up rules of when it is going to be released and it will adversely affect the development of commercial storage". I still think there is a case for it, but nobody else does, so that is not going to happen.

I think what we have to look at are obligations on companies to provide some kind of surge supplies. That could be storage. It could also be some kind of contractual mechanism that says, "You have to have contracts in place that additional gas will be delivered", mostly from, abroad in certain circumstances. The problem with that is that if there is a problem with the LNG market or a problem at a terminal or with a pipeline, that may not be possible. So The problem has to be looked at in terms of obligations to supply, and that probably means a mix of domestic storage and access to foreign storages.

Q43 Sir Robert Smith: I just ask on the access to foreign storages. You have the pipe and you have got the—but history tells us that if you are a German supplier and you fail in any way to meet the needs of your German customers, you are going to get into so much trouble that the last thing you will do is respond to a market signal and supply the UK.

Professor Stern: This could not be done in terms of the old model of market signals. I mean, back in those days, British suppliers were told when they went and asked for access to storage, "Yes, sign a long-term contract with us and we will give you access to storage. If you show up in November or in February and say you want stored gas, we are not going to sell it to you because we have our own obligations", but so much storage has been built on the Continent since then that it seems entirely possible that British companies could sign contracts for storage to be delivered when they need it—but they would have to make those obligations.

Q44 Barry Gardiner: Should the IEA or some other organisation provide co-ordination of how stocks would be drawn upon?

Professor Stern: We now have the EU Regulation on Gas Security, which does go into some detail there. The problem is that countries are in a very different situation, so, for example, the Belgians do not have any storage, but they are right next to the Dutch who have a huge amount of storage. The regulation includes "n minus 1" concept that a country must be able to cover a certain proportion of the loss of the biggest supplier for a period of days. The difficulty with this is that what happens in reality is almost certainly different to what you plan for, but in my view for the UK (which is either the biggest or the second biggest gas market in Europe depending on what the Germans are doing at any particular time, but probably with more CCGTs it will be the biggest). It is really not a feasible situation that a country that depends so heavily on gas has so little storage, because unexpected events do happen. The problem of course is: who is going to pay for that?

Q45 Dr Lee: Developing the discussion on European gas security, in particular the pipelines from the former Soviet Union, do you think that the Nabucco pipeline is going to be built?

Professor Stern: Let me try to reiterate in as brief a way as I possibly can. I have continued to say that I think that 30 billion m^3 pipeline will be built from the Caspian Middle East region. Sometime in the 2020s. Whether it will be called Nabucco, I do not know. Before 2020, I do not see gas available and I do not see markets available for such a pipeline. And not just Nabucco; all the southern corridor pipelines are very odd constructs, because the way gas pipelines get built is very simple. You have someone who finds gas and then you have a market for gas, and the two talk to each other and they build a pipeline between them. All these pipelines have been dreamed up by pipeline builders without reference to a gas source or even a substantial market, so I doubt very much whether Nabucco, as currently conceived, is going to go ahead before 2020. It could go ahead around 2020, but it is going to be very difficult.

Professor Stevens: I mean, there is a fundamental problem here of the difference between social cost-benefit analysis and private project appraisal. If Nabucco were to be built and was operating only at 10% capacity, this would be great news for the Western European gas consumers; in terms of the

contestable market hypothesis, if somebody is a monopolist but there is a threat of entry, it forces the monopoly to behave as though it were in a competitive market.
The existence of Nabucco would constrain other gas suppliers putting gas into Europe to be, let us say, reasonable over the prices. The problem is that no private investor is going to build a pipeline unless it is going to be operating close to capacity, so you have this fundamental contradiction. I have to say that, in my experience, Brussels just does not get this. In other words, Nabucco is only going to be built if the European Union or Governments put money into it. If it is left to the private sector, it will not happen in the current circumstances because you need to operate pipelines at full or close to full capacity if you are going to make any money on them as a private investor.

Q46 Dr Lee: Developing this, Russian foreign policy seems to have a component of wielding this energy weapon as in, "You can have it; you cannot have it", and there is some evidence of that in 2009 in the Ukraine. Are you saying that if Western European Governments want to try to put themselves in a less dependent position on Russian gas that they need to subsidise a Nabucco line?
Professor Stevens: I think there is a case for that, certainly.
Professor Stern: I personally think that the difference Nabucco will make, assuming it is built—even if it is built quite soon which, as I say, I do not expect—is not going to create such large security benefits that I would recommend putting between 12 and 20 billion euros into building it. I mean, for me, to those who are concerned about the overdependence on Russian gas, LNG is a much more immediate and, I think, more commercially viable answer.

Q47 Dr Lee: Supplementary to that, is there any work done on whether it would be better for the UK to say, "Right, okay, we are not going to put 5 billion into Nabucco. We will put it into nuclear power"? Is there any sort of discussion about what is in our best interests? I mean, do you really think the UK is best served by going down this joint European energy security path or do you think we would be better off just looking after ourselves?
Professor Stern: I do not think the way to look at it is "looking after ourselves" because as many of us have said before, we are in a European market, certainly for gas, and arguably a global market as well.

Q48 Dr Lee: Yes, but you just said we will have to get it built. It needs to be outside of the market, so it is not within the market, is it, if you are talking subsidy?
John Mitchell: There has to be a trading market but the costs might have to be subsidised.

Q49 Dr Lee: But I am just suggesting that maybe we might choose to subsidise something else.
John Mitchell: Sure. I mean, in the Nabucco project as I understand it, nobody has signed up money yet and I would be surprised if the UK signs up anything. It would not be a direct beneficiary. It will be foreign countries who—

Q50 Dr Lee: My point is that if you were going to choose to subsidise something at the moment, would you subsidise a gas pipeline or would you subsidise some other form of energy saving or generation?
Professor Stern: If I was going to subsidise anything, I would subsidise gas storage.

Q51 Christopher Pincher: I should make clear I am a member of the Conservative Friends of Azerbaijan. Phillip has made a point about pursuing an energy independence line—about subsidising nuclear instead of a gas pipeline, for example—but is there not a risk that while we have economic co-dependence on Europe, then as long as countries in Europe have only one easy source of access to gas, through the Nord Stream for example, economic partners risk having their lights turned off, that type of phrase that you hate, which will damage their economies and damage ours too? Is not the real solution to dealing with a perceived problem to diversify supply from Russia?
Professor Stern: The Nord Stream, which is a very expensive pipeline, is specifically designed to lessen the problems through the Ukraine corridor. That is why Nord Stream and possibly also South Stream are being built. The events of January 2006 and January 2009 and a whole lot of other lesser incidents essentially persuaded the Russians that they could no longer rely on the Ukraine, and to a lesser extent, Belarus as well. Of course there is a perfectly reasonable perception that we should not be relying on the Russians anyway, but my view on this is the Russians have proved generally to be highly reliable suppliers. In fact, if you compare them with the reliability of a whole lot of other suppliers, they look pretty good. January 2009, which understandably is an event everybody remembers—we have written a great deal about this—in fact caused very, very little disruption to supplies except in South Eastern Europe. It is something that we all need to be concerned about. The Nord Stream pipeline, as far as I am concerned, is an additional security benefit. Of course, should the Russians decide to politically act against Europe using energy as a weapon, that will make no difference, but I think they have rather strong incentives not to do that.
John Mitchell: One has to remember that with very small exceptions, Russia is dependent on pipelines for all its exports, and most of that goes to Western Europe. The cost of destroying that market would be enormous, so it would be a very extreme political situation to lead to that.
Professor Stevens: As we are concerned about security of supply, they are concerned about security of demand.

Q52 Dr Alan Whitehead: China has been engaging in what one might call vertical integration of their energy resources in terms of bilateral deals with a large number of countries to source and transport energy supplies. Should we be concerned about that particular move, and is that likely to develop further in the future?

Professor Stevens: I do not see why there is any reason to be concerned about it. If you are concerned about the supply of oil in a global market, it doesn't really matter who produces it from where so long as it is produced and goes into the market. Whether it is the Chinese companies that are doing it or the Western international oil companies doing it, it does not make a great deal of difference.

Professor Stern: The case of gas is different because unlike the oil situation, the Chinese have a pipeline from Turkmenistan and will shortly have one from Myanmar, which will deliver gas directly to China, and in all their LNG projects they insist that those physical molecules are delivered in the ships to China, so they have a direct vertical integration. But again, I do not think there is anything to be particularly concerned about here. What is interesting is that I think China is a major competitor and a much more successful one so far than anyone else, compared to Europe, for Caspian gas. The Chinese have shown, certainly as far as Central Asia is concerned, that they are prepared to buy very large supplies of Caspian gas and they are prepared to finance all the necessary infrastructure in contrast to the European situation we were just talking about.

John Mitchell: I do not know quite how—whether "concerned" is a red light or amber light. I think I would go on pale amber, because the Chinese companies who are going abroad, as the US and European companies went abroad in the past, are very much the same sort of thing. The advantage they have at the moment is that, thanks to the huge trade surpluses of China, funds are not a problem, and the Chinese Government has many agencies through which development aid, investment aid, soft loans and so on can be channelled in parallel to what the companies are doing and are often linked to it. That is something Western companies do not have, so it is a problem for the Western companies. There is no question about that.

I do not think it is a problem for world suppliers for the reason that has been given, except there are some kind of nuances about that. One question is that in times of crisis or in times of stress, would the Chinese have an advantage? If they were there in the country, they would obviously have some political advantage, and they would have a huge advantage because the host country would always want to get the best price. The question arises, I think, in two particular areas. One is the effect of the China Inc approach in certain particular suppliers, what I call the pivot countries: West Africa, Iraq, Central Asia, where logistically the suppliers can go either way. I am talking about oil now. The suppliers can go either way and a little bit of a push can help them. Their welcome to investment by the Chinese, not tied to human rights and other concerns, gives them a competitive advantage, and I think probably it will be fair to say that Western Governments need to think about the competitive position of their companies in those situations, and whether it is possible to adopt a more coherent view about EU or British aid to those particular countries to keep the flag flying. I think that is one issue.

I think the other issue is there are certain countries where the dependence on China, not just for investment in oil but also for markets, defence procurement and other things, is rather serious. An example of that is the Sudan, because the Sudan has been excluded from access to a lot of Western markets, but that is an exceptional case.

Professor Stevens: It is also worth pointing out that the Chinese oil companies have done a brilliant job in convincing their own Government that because they are concerned about energy security of supply, they should be allowed to go out and explore and develop oil outside of China, and if you are China, concerned about your oil security of supply, does having oil in Sudan really help you from that point of view? I wonder if at some point the Chinese Government is going to realise that it has been victim of a very, very effective campaign by their own companies. It is principal agency; it is a classic example of principal agent analysis. Why a lot of national oil companies go abroad is to disguise from their own Governments what they are really doing.

Q53 Dr Whitehead: Mr Mitchell, the suggestion that you have made appears to suggest that European oil interests in particular ought to have regard to the extent to which by, for example, shunning countries that have desperate human rights issues, they are losing out to energy capture by China. Would that be a fair summation of what you were saying?

John Mitchell: We had a conference in Chatham House about this subject a couple of years ago when it was just beginning, and the representatives of countries like—I won't particularly name them, but the developing countries who are receiving Chinese investment said, "This is great. This is a degree of freedom that we do not get when we go to the World Bank or to international banks that are bound by the Equator Principles or any of those other people who tried to impose all sorts of conditions on how we run our country. The Chinese don't do that." They are very happy to have that additional component in their investment pattern. I don't suggest that Western Governments or companies should give up their attention to human rights and all those issues, but I think some attention could be paid to a more holistic approach to relations with those countries that are, as I say, in a pivotal position.

Q54 Dr Whitehead: Is this, in your collective view, an emerging issue of energy being used as a tool of foreign policy, or is it just business as usual? You have mentioned, Professor Stern, the question of the role that oil companies in China have played in terms of convincing the Government that they ought to go and capture supplies elsewhere in the world, but conversely, I think the Chinese Government in May has announced plans to restrict the sale of oil overseas in order to keep high supplies within the domestic market and prices low. So is there an emerging pattern of policy development as far as energy management in oil supplies are concerned, or are there other factors, do you think, as far as China is concerned?

Professor Stevens: It is very difficult. I would not claim to be a specialist on China. You would need to ask somebody who had much better insight into the way the Chinese Government behaves, but it seems

any Government is going to be pursuing its own self-interest, however it perceives that self-interest to be. If the Chinese objective is to win friends and influence people, then certainly this is one way of doing it, although one has to say that the experience in Africa, particularly somewhere like Angola, has not been particularly good from that point of view, because they have made themselves extremely unpopular in countries like Angola.

Professor Stern: I wouldn't claim great expertise in this, but in the cases I am very much familiar with, which are the gas cases, I think a big issue, along with foreign policy, is that the Chinese are willing to except commercial terms that nobody else, and that includes the Russians and anybody else, can compete with. What the Chinese are prepared to do in terms of just committing vast amounts of infrastructural money is beyond what any market-oriented company could possibly do.

Professor Stevens: It is the cost of capital.

Chair: All right. I think we are out of time, unfortunately. Thank you very much indeed for your helpful advice and views.

Examination of Witnesses

Witnesses: **Professor Nick Jenkins**, Cardiff University, **Professor Goran Strbac**, Imperial College, London, and **Dr Neil Strachan**, University College, London, gave evidence.

Q55 Chair: Good morning, and thank you very much indeed for coming in. You will have heard some of the previous session as well. Could I start with a general question? What would you say are the key risks we should consider in assessing energy security?

Professor Jenkins: It is probably useful to explain our limitations on that very broad question. I think generally the expertise we have—the limited expertise we have, of course—is on the energy networks. Anything I say, and others can speak for themselves, will be on that point.

Chair: Fine.

Professor Jenkins: The generally accepted issues in terms of electricity networks are: aging assets, common mode failures stimulated by those aging assets, and the fact that as we move towards a sort of decarbonised power sector, which is what we are charged to do, we are likely to end up with much greater electricity flows, so they then stimulate risks on the electricity network.

Professor Strbac: To reinforce that, the area of interest that we might contribute to this is about the infrastructure provision for security rather than the energy itself that goes into it, so I think I would—I don't see anything else. It doesn't cover the area of infrastructure, which we hope to maybe give you some useful information.

Dr Strachan: I am much broader than networks, so let me try to broaden out your question. You may have heard this typology before. I think it is important to make a distinction between risk, uncertainty and ignorance. Risk is things that we know about that we can attach a probability to, whether failure of infrastructure; uncertainty is things that we know will happen, but we can't assign a probability to, so the risk of oil shock; and just sheer ignorance is about things that we don't know won't happen.

Clearly, we would like to do some blue sky thinking to move our ignorance into uncertainty, but I think it is important to think those three things. As a general process, the more specific something is, if it is a risk, the easier it is to identify a strategy and the cheaper it is, and as you go broader and broader, you get a broader response to security and it gets more expensive. To just close with an example: if your risk is to do with your electricity network, one response would be to increase your spare capacity in your network, and that is relatively cheap. I mean, these things have a lot of positive zeros, but it is relatively cheap. If you are trying to address a whole host of uncertainties—and indeed, ignorance—one robust strategy would be to reduce your demand. Economists like myself will argue as to how expensive that is, but that is much more expensive—perhaps an order or two orders of magnitude more expensive than doing something specific.

Q56 Chair: Just going back to infrastructure, do you think we should be focusing on trying to improve the resilience of our infrastructures rather than addressing specific risks?

Professor Strbac: The infrastructure security is a kind of balance between the cost you put into it to have a spare capacity, as it were, versus the benefits it brings in terms of avoiding shortages of supply driven by the problems in the infrastructure. Striking that balance requires—and we are very good at understanding what the cost of the infrastructure is, but not quite as good at understanding how we quantify in cost the pain if things go wrong. That is what I think we need to start to understand.

You can also divide infrastructure into two big areas: connected, like networks; and generation, particularly electricity, which is where I come from. The networks are natural monopolies, and they provide security of supply in terms of how good they are. This is based on standards that we developed quite a long time ago and haven't been reviewed since the late 1940s. In my view, there is lots of evidence to try to review those, and if anything, what I was interested in is that we have perhaps more security than we need in terms of the network infrastructure in particular.

In fact, it gets worse than that in that the security considerations are costing us potentially quite a lot in terms of the ability of the system to absorb cheaper generation, particularly if you go to look in places like Scotland. We want to try to extract wind out of that, and we have 1948 security standards that tell us how we operate, so we are restricting the amount of power that can go across because we are worried about security and follow up. If you were to calculate how much consumers would place value on that security,

you would come up with a 100 times bigger value than any number anybody uses anywhere else, so I think there is a strong case to review the level of how we run the system. Are we overly cautious? If you compare with other countries, it seems to me that certainly the network infrastructure in the UK is currently okay—more than that—and it seems to me there is a potential case to worry less about security of networks rather than worry more about security of networks. If I can start with that, we can explore it a bit later then as well.

Generation is obviously a competitive business, and there is no prescription at the moment as to how much capacity we should have. That kind of market would come up with that solution. I am sure you are all informed about EMR, Energy Market Reform, which is addressing some of these questions and saying, "Will the market deliver the sufficient capacity, given that there is a lot of interest in wind generation and so forth?" Again, that is the balance between cost of spare capacity versus the pain that we might have if we don't have enough of it. Given there is so much interest and it looks as if this is going ahead in terms of smart meters and so forth, we will potentially have a chance to hear demand as to how we value capacity and how we value security. We would continue to rely on market forces in that area.

Q57 Chair: Getting back to the demand side measures, isn't there a natural merit in tackling energy security through demand side measures, because also we are addressing the climate change agenda, and in the long term it may make economic sense as well?

Professor Jenkins: I think it is helpful when considering the demand side to again divide the question into two. We have the overall clearly desirable goal of reducing energy demand, and that makes almost everything that I think we are talking about easier to do. We then have the question of load shifting, peak lopping and moving power or energy for small periods of time to avoid system peaks. Clearly, both are very desirable. One reduces your overall requirement both for energy and assets, but the other only reduces your requirement for assets. But yes, clearly both are highly desirable.

Professor Strbac: We have conducted recent analysis, particularly if we move into electrifying transport and heat sectors. Moving into electricity here is not that easy to decarbonise. They come with a significant amount of flexibility. If you drive a vehicle, you have to have a battery, and when you do an analysis, it turns out that the cars are 90% or more of the time stationary. The energy behind what we need is not very big and the power is very large, so there are huge amounts of opportunity to do that in a controlled fashion so that we don't need to invest in new infrastructure reinforcements, but we can achieve those; I am not saying we can with everything, but we can avoid a very significant proportion of investment in infrastructure by manipulating demand.

Dr Strachan: I would argue again that the role of demand side response is absolutely key, and our long term modelling says that if you are trying to meet security of supply and decarbonisation targets without such a major demand shift, it is either impossible or extremely expensive—and those two may be the same thing.

Q58 Sir Robert Smith: One of the conventional wisdoms is that if you have a mix of supplies and a mix of sources, you will be less under threat for any shocks or disruption. Is that something you share?

Dr Strachan: I mean, if I could just break it down, if you are talking about the diversity of supply, you can break that down into variety, balance and disparity, and you may have come across these terms. Variety means the number of different options you have, balance is the unequal shares, and disparity is how different they are. For me, the most interesting thing is how different they are, because you can have two technologies, for example, that rely on the same control system, or you can have two technologies that are affected by the same human failure or weather event or social change. Certainly I think diversity as a whole is a major aspect of supply security, but there are others.

Q59 Sir Robert Smith: Is the UK reasonably diverse?

Dr Strachan: I think it depends what sector you are. I mean, in transport, clearly we are not; in home heating, we are not. Right now in electricity, you could make a much stronger argument that we are. I think it depends on what you think are the weak points of your system as to whether we have sufficient variety.

Professor Jenkins: We did work looking at the interactions of gas and the electricity system, when, if you like, for a variety of reasons that we put in the models, the gas supplies to the combined cycle gas turbine power stations had to be constrained. What the models were telling us was either to revert to coal, when of course that will be increasingly difficult, or to revert to distillate fuel for the gas turbines. I think that does tend to indicate the benefit of diversity in energy supplies into your generating stations.

Q60 Sir Robert Smith: Do you think the market has delivered effectively on import capacities and diversity of imports?

Dr Strachan: It depends whether you are talking about a short run or a long run issue, and it also depends what you think as the market. We were talking the demand side; on our demand side, we don't have market responses in that. I don't see my tariff, for example, changing on a seasonal basis, never mind a daily basis, so I think I would leave it there.

Q61 Sir Robert Smith: The view of many is that the markets have delivered the new sources of gas infrastructure into the country at least. Can we just rely on the markets?

Dr Strachan: I think you probably cannot rely on the markets if the reasons for having security of supply link into other factors, particularly environmental factors. I don't think people think that a broader diverse set of resources, such as electricity-focused renewables or biomass, is going to be delivered by the market. You are going to have to have public mechanisms to drive down the cost first.

Professor Strbac: Can I make a point regarding the imports and exports? There is some evidence that there is a significant commitment towards decarbonising energy sector UK and also mainland Europe, for example. Analysis conducted in trying to see what solutions might be appropriate for lower carbon European systems, including UK, clearly shows that what you want to do is try to put your renewable sources with the best resources, given that the wires are relatively inexpensive. In that sort of world, the UK turned out not to be an island, given the significant potential wind resource on and offshore that the UK has.

If you would like to run that world cost-effectively, you would then want to see significantly bigger integration between the UK and others; on windy days we export, and on non-windy days we import would be the cost effectiveness. In that case, one would see that if you want to treat it cost-effectively, solutions of larger integrations will be very attractive from the cost perspective. You have these issues about what sort of security that implies, but having that system strongly integrated, and does that require order of magnitude bigger into the connections from the UK and Europe—significant, we are already bigger. That would make the overall system significantly cheaper than if we tried to maintain the UK as an island and decarbonise it.

Q62 Dr Whitehead: Are there different ways in which one could look at energy independence? I appreciate that at first sight this looks a little counterintuitive, but doesn't the possession of substantial wind resources, exported or not, together with other forms of effective control of energy production and supply, constitute independence, in effect? If one were to have that as a goal for energy security, what might that look like in a modified form?

Professor Jenkins: I think where you are taking us is the idea of significant amounts of renewables and demand control in GB, for example. I think, given the nature of the wind resource, and supporting what has just been said, it is likely to be much cheaper to integrate GB with mainland Europe rather than develop other mechanisms for providing electrical energy when you don't have that wind resource available. Running your island system with either fossil fuel back up, with the consequent costs in carbon dioxide emissions, or energy storage, which remains a real challenge—the more practical solution is likely to be interconnection with mainland Europe.

Professor Strbac: Can I just stick with that? It is also potentially interesting to see that out of the concern for security, you could potentially say, "Well, this is maybe a business opportunity to become a big exporter of resources"—that the UK is the best place in Europe to build wind farms. The yield factors in Germany are half this; it is a different league. If you look at the focuses of the energy debates, they are pretty much kind of UK-specific, in the sense of how we are going to secure our supply. I think there is a potentially interesting avenue to explore as to how we are going to benefit out of all these resources that we have and resolve our issues about all this, because when you analyse all these futures in terms of electricity, the security of supply of the UK is no problem at all.

Q63 Dr Whitehead: If it is no problem at all, doesn't that suggest something about energy independence development, whether based on the fact that one exports a good proportion of what one produces, but has the security of that production, especially when the significance of UK-produced fossil fuels is decreasing and there are potential "independence threats" in terms of the increased reliance on imports coming in that direction? How would those different factors balance up into something that, yes, was interconnected, but on the other hand gave, as you say, Professor Strbac—what might the overall picture be of a mediated independence particularly interconnected with Europe, but nevertheless balancing a independence of production with the reduction in production that we are now seeing in fossil fuels? What might that look like in terms of costs and outlook?

Professor Jenkins: I think the difficulty I have in the discussion is that in electricity terms, if we follow the Climate Change Committee's strictures, we are not going to end up using very much fossil fuel for generating electrical energy, because you can't just in terms of your carbon dioxide emissions. The numbers do not work for you. Therefore, that will be a decarbonised electricity system, and the question that then comes to us is: how much of our domestic transport and domestic heating is shifted from fossil fuels on to the electricity sector? That gives us all sorts of challenges.

To operate that system where we have essentially constant output plant, or plant that is broadly constant output—the thoughts are nuclear, fossil with CCS and renewables. You have to strongly engage the demand side to balance that system, but on top of that, to be able to balance over a larger balancing area by interconnecting with Europe through some sorts of links. I know there is another inquiry on the North Sea Grid, but that is likely to be one of the aspects of this lowest cost outcome for that future. How much that will cost I don't know, but one of the things that will certainly drive the cost is the security of supply required by the customers. As Professor Strbac is indicating, there is probably movement there, given the very high security of supply we have at the moment, both on electricity and on gas supplies.

Dr Strachan: I would just like to quickly broaden that out, because when you look at long-term decarbonisation, that is a game-changer, so one thing you start worrying about is security of supply for biomass. If the UK does not import biomass, our long-term decarbonisation costs are high. Land in the UK is expensive and we don't have very much of it, so then you are talking about energy-dependent links with hopefully friendly countries like Canada or South American countries. But it is even more critical the tighter and tighter your decarbonisation targets gets. Nick mentioned that fossil fuels would not be part of a decarbonised electricity supply. That is certainly true if you are going for a zero carbon electricity supply, because carbon capture and storage doesn't get you down to zero carbon.

Q64 Barry Gardiner: How resilient is the UK's electricity system, and what do you believe are the major threats to its reliability?

Professor Jenkins: I am sure you can get a clearer guidance from the National Grid and the distribution companies, but as I see the evidence, it is very resilient. That is what history tells us.

Q65 Barry Gardiner: They said a 1% reduction in reliability would result in around 230,000 households not being supplied for an entire year. That doesn't sound greatly resilient to me.

Professor Jenkins: Yes, but that is going from their numbers, and 230,000 households not being supplied for a year? No. Generally, electricity interruptions last a rather short period of time. Occasionally there are events such as that storm affecting the forest or whatever that takes out overhead lines for a week, but those are unusual and only affect a fairly small number of people because of the way the network is arranged.

I would have argued that reliability of electricity supply is very good and the numbers will support that. In terms of long-term threats, as I was indicating, I think for 15 or 20 years we have been talking about aging infrastructure, and in truth, I think we are still talking about it and how that is resolved—common mode failures, clearly. The evidence that was being given earlier that restrictions on fuel supplies, for whatever causes, on to the power station—I mean, that gave trouble in the 1970s. I pick up on Dr Strachan's point, this idea that we move towards a game-changer. If one of the potential routes is that we will load the electricity network harder, we will significantly require more capacity—and we cannot build capacity, as you know, because of the difficulties with public inquiries and so on, so we will end up loading those assets harder. That will potentially lead to challenges.

Professor Strbac: Maybe just to complement this, how we deal with security of supply in infrastructure is that there are these standards and, for example, at a National Grid level, the standards are—I will paraphrase them, simplify them—that we operate what is called an "N minus 2" security study. That means that any two lines simultaneously can go out of service, but the system must continue to operate. We have built security to redundancy of assets. That is what we have been doing so far. The technology has moved on significantly since the 1950s. There were a few revolutions in computer science and all that, and what we see is that there is a significant opportunity to substitute security from assets to being clever in terms of how we operate the system.

If you analyse big blackouts over the last 20 years—New York, London, Tokyo—none of them have been caused because of lack of investment in the infrastructure. It was always a credible outage and there was then an internal fault of the protection system or the controlled management wasn't quite right. They are these sorts of data and communications-related issues rather than not having enough pylons and cables and transformers on the ground. I think there is a potentially significant opportunity to increase the resilience of the infrastructure by being cleverer in operating them, and there is technology and lots of work going on in this area. If that gets enough support from the—I think the regulation here is very important, because currently network companies make money more on building assets than being clever about operating them, so we need to shift that. There is a movement in the recent real consultation, which is a new way of how we are going to regulate this. There is a bit of movement towards that direction, but we need to look into how these assets perform rather than how many assets we have. All of that would lead to an increase in the resilience and security of supply delivered by the things that we already have.

Dr Strachan: I would argue that one of the opportunities and threats are people. I think we understand technology is better than people, and we have argued that demand response is the key to a cost-effective management of a more intermittent electricity network. From our evidence base on how people behave and how they respond to price and in our own individual lives, we know that we have behaviours that are set and are hard to change. This is an under-researched area, in my opinion.

Q66 Barry Gardiner: Given that what we want to do is to move to a low-carbon system but we want to maintain the resilience within it, how do you see us doing that? What are the changes that we are going to need to make to achieve that?

Professor Jenkins: I think we are beginning to see the changes, and as we move to the next 10 or 15 years, the main low carbon contribution is going to come from wind; it is going to come either from Scotland in the North or from offshore. We see that the initiatives the National Grid are taking at the moment to put submarine cables across the North—they are the Scottish-English interconnectors—are giving us difficulty. Because of the difficulty of building overhead line transmission circuits on the ground, you then have to go underground, and even that is a problem, so they are having to go offshore.

I would take a slightly different perspective on your question. If we are to decarbonise, we are going to require more transport capacity for electricity. If we are going to require more transport capacity, one way is to try somehow to install more assets, and if you put them underground or under the sea, that is very expensive. Alternatively, as Professor Strbac is saying, you can try to operate the system in a more intelligent fashion, but there is then a conflict, because I think you can argue the highest resilience route is just to have lots and lots of assets, and then you have no troubles.

Professor Strbac: But the costs.

Professor Jenkins: Oh, the costs are absurd, and the difficulty of putting them in is enormous.

Professor Strbac: Engineers can deliver any level of security you want if the budget is big enough.

Barry Gardiner: And if the planning system allows.

Professor Jenkins: I think we are going to be driven by the planning system.

Barry Gardiner: Please, continue.

Professor Jenkins: No, only of the difficulty. I think we started this by asking about decarbonising.

Decarbonising will require additional transmission capacity for electricity. For that, the obvious solution is overhead lines. It is the cheapest, most effective and it has all sorts of technical advantages. If that is not possible, you have to go either underground or under the sea at very considerable cost.

Professor Strbac: Twenty times higher costs in your terms.

Professor Jenkins: There are technical challenges of moving from overhead lines to cables.

Q67 Barry Gardiner: Could you perhaps give us a note on the differentials in cost?

Professor Strbac: In writing?

Barry Gardiner: Yes.

Professor Strbac: Yes. Moving underground is much more expensive.

Barry Gardiner: Much more expensive, I appreciate that.

Dan Byles: Much more.

Professor Strbac: Yes, significantly.

Q68 Sir Robert Smith: Can I just ask one question on the subsea route? Is there not sort of a two-pronged thing that is also connecting up renewable resources that will be out there?

Professor Jenkins: That in the jargon is known as multi-terminal DC. In practice, it does not exist. There are three schemes in the world, and obviously the National Grid Company will have their views as to where they are going. I would believe that it is likely to be point to point initially, and then we will move towards this multi-terminal arrangement.

Q69 Barry Gardiner: Looking at the current policy framework, do you think that it is up to delivering the levels of investments that are going to be required for such new infrastructure?

Dr Strachan: Perhaps one flippant answer to that is that we haven't had the market signals. We have a very low carbon price. The ETS carbon price is far too small to stimulate large capital investment, so until you have a sustained and more certain carbon price, you won't—

Barry Gardiner: Of course, the Government just gave a signal in terms of the increase in the fuel price of carbon within the UK, but isn't the risk there that certainly for things like gas, it might push it over to the Continent to avoid that and then put it back by interconnect, unless you operate—I mean, you rightly talked about operating on a European scale, but if we are trying to operate on a UK scale, some of those levers have perverse consequences rather than beneficial ones, don't they?

Dr Strachan: I think that is certainly true about the details of carbon policies, and there are overlapping energy policies. You may have perverse incentives and you may have effects that go counter to that. I would perhaps raise on the gas issue that if you are talking about long-term decarbonisation, there is no guaranteeing that there will be a gas network. I mean, gas is a high carbon fuel, so in terms of energy security, yes, under short-term stresses the gas question is very important. Under long term stresses, maybe the gas question is not so important.

Q70 Barry Gardiner: What do you think the impact of the targets contained in the *Fourth Carbon Budget* are going to be on making sure that we get this low-carbon but resilient system?

Dr Strachan: It is no shock to anyone in this room that these carbon targets are challenging in the timeframe we have. A lot of our modelling finds that electricity is an infrastructure and generation mix that changes quickly and changes a lot. Part of that is the turnover of capital. We have aged generational capacity at the moment. The interface between resilience and decarbonisation is, I think, most interesting in the reduction of energy demand, because that is a common platform for meeting both those goals.

Q71 Dan Byles: We have touched on the need to balance the intermittency of wind power. It is obviously the sort of biggest challenge when increasing the percentage of our electrical production that comes from wind. Do you have a view on how much wind the UK system can take before balancing the intermittency problem starts to become a problem?

Professor Strbac: We have done quite a lot of work supporting the Energy White Papers on these questions. That is highly dependent on everything else that is happening in the system. The worst case scenario from the perspective of wind intermittency balancing is that we build a significant amount of inflexible nuclear generation in combination with variable and difficult-to-predict wind generation. We need to balance demand on a second-by-second basis. The power system is quite demanding from that perspective, and we don't have any demand side with Europe any more than we are now. We could end up in a situation of potentially not being able to absorb maybe 20% of that energy. Whether we want to go nuclear or wind being curtailed, it doesn't matter. That is obviously a disastrous situation, because both these models are very expensive, so not being able to absorb them and displace fossil fuel is very expensive.

If we analyse what else might happen, there are four mitigation measures against intermittency. One is demand side, and it can play an enormously big role in that, and it could remove that problem almost completely. Then flexible generation, and manufacturers are coming up with the flexible plant so that the gas plant becomes better in managing the variations in the demand supply. You have transmission. In about 2000, it was about 120 GW of wind, which is kind of 2050 where the whole entire Europe is decarbonised and all the things work. Also, storage is another technology that can be used to support that.

Now, which one of those would be more suitable would depend on what the system is. The cost of these will also play a major role, and if some sort of high level order is to be established in there, the transmission and demand side participation, particularly if we start electrifying transport and the heat sector, would provide potentially a very cost-effective solution for this. If you want to drive a vehicle, you have to have the battery, so the only question is how we charge the battery when the wind blows, type of thing. That, according to analysis and

philosophy of other people, would provide very significant support and would enable the system to run cost-effectively with a very significant contribution of new build generation and inflexible nuclear generation.

Professor Jenkins: I think the only other thing I would say to that is that a few years ago there was a metastudy done by the UK Energy Research Centre, looking at all the studies on intermittency up to 20% of electrical energy. It was a very good study, reviewing perhaps 100 other studies, and that I think is quite solid. Beyond the 20%, up to the 30% and on, we don't have that body of evidence brought together. To make decisions about very large sums of money, it seems to me that we now need to raise our game, if you like, and start looking at these higher penetrations and then conduct a metastudy on those studies. That would be the way through that.

Q72 Dan Byles: That is interesting—so above 20% at the moment?

Professor Jenkins: 20% by energy. At times, that was corresponding to—

Professor Strbac: In the UK.

Professor Jenkins: Yes, but the power implications—

Professor Strbac: 30 GW that is put on.

Professor Jenkins: Yes, 30 GW. I think the general view is that that is comfortable. People are comfortable with that future. Beyond that, I think it is fair to say that the evidence is not as well collated.

Dan Byles: So there is some homework for someone to do?

Professor Jenkins: I think there is homework for us to do, yes.

Q73 Dan Byles: There is obviously a lot of discussion at the moment that we might now be locking in a new generation of gas to provide that peaking plant. Interestingly, you said that perhaps you feel that demand management and interconnectivity with Europe is a more cost-effective approach. Do you fear though that because that is not there, because the demand management systems are not there, because the super grid is not there, we might end up locking in gas at a peaking plant and end up with the wrong solution? Is there a real danger that that might happen?

Professor Strbac: It is more of a carbon dioxide issue.

Professor Jenkins: Yes. The perspective I would put on that, and perhaps my thinking is not entirely consistent, is that if you look at the either decarbonised power sector or zero carbon generation, with the numbers we look at, you cannot use gas-fired generation without CCS on it. So for the longer term, almost any fossil generation—because you are trying to decarbonise the electricity sector, the power sector—is not open to you, so that will only be an interim step.

Dr Strachan: Although, if you have gas as back up and it doesn't run very often, your cumulative emissions from those plants are relatively low. I think people have such focus on a decarbonised electricity system, because under the overall carbon budget there are some sectors that are much, much harder. If you don't manage to crack aviation, then you will have to crack electricity—and it is not just aviation; there are some industrial sectors that are very hard to decarbonise also.

Q74 Dan Byles: The Government are talking about some sort of capacity mechanism to try to make sure that the capacity is there. Do we know at the moment how much extra capacity we are going to need? How can they design a capacity mechanism if the work isn't there to know how much capacity we need?

Professor Strbac: There is obviously a very diverse spectrum of views on whether the capacity is required or not required. One of the key questions is how much is required and who is there to tell us how much we need, and given that we are definitely entering into smart metering, making energy infrastructure smarter is only a question of when. We would like to see evidence of the consumers responding, and to ask consumers how much they value security, rather than de-risking the investment of companies who are investing in our generation system without asking us how much we value security.

Professor Jenkins: I am not a markets design person, but I think your point is absolutely right. It is very unclear to me, if we say we are going to have a capacity payment, what magnitude of capacity would be purchased. I do not think that is clear at all.

Q75 Dan Byles: A final question, if I may, Mr Chairman, on the whole businesses of interconnectors interconnecting with Europe as a possible solution to this. Is that not so much a solution as just putting the problem across the Channel to somebody else to decide how to manage capacity?

Professor Jenkins: I think you need again to differentiate between long-term energy and fuel and shorter-term power, although in terms of hours, it is also energy. A key advantage of that interconnection is to extend your balancing area, and I think the evidence is showing that extending your balancing area, particularly on the supply side, gives you very significant benefits. It is that trading of shorter-term energy, if I can use that word, that gives you that, rather than just saying, "We want this fuel or energy in from abroad".

Q76 Sir Robert Smith: I will just ask on this zero carbon electricity and security of supply: if we cannot deliver effective CCS for gas, are we going to be able to achieve these targets?

Dr Strachan: Perhaps it is worth breaking down your zero generation capacity into three categories: one is CCS, one is nuclear and one is large-scale renewable sources. In a crude sense, if one of those does not work, you are still okay. If two of those do not work, it starts getting very difficult.

Q77 Sir Robert Smith: Are you saying we could just have nuclear and wind?

Professor Strbac: That system certainly can work. The only question is—which maybe I am not specialised to answer—how sensible that would be from the cost perspective. We can certainly decarbonise. From the technical feasibility perspective, there are no obstacles to delivering zero

carbon. The question is how expensive these solutions might be. We certainly can power the UK with wind only. There is no problem there. We can run with wind only. If you built 600 GW of wind power, it is going to work. That solution would be incredibly expensive, but it can work.

Q78 Chair: Is the electrification of heat and transport going to improve energy security?
Dr Strachan: Yes and no, I think, is a fair answer, because it depends where you get your electricity from. Certainly you have a new set of challenges. If you are trading oil import issues versus biomass import issues, the answer could be yes or no.
Professor Jenkins: The perspective is rather a new one to me, because we tend to be driven, I think—or the thinking tends to be driven—by the fact of how you are going to meet your carbon targets. By not electrifying heat and domestic transport, you are driven for transport either using your fossil fuel for transport or down a hydrogen route.

Q79 Chair: Yes, but on the assumption we are going to try and meet our carbon targets, we have to end our dependence on oil for transport and we have to end our dependence on gas for heat.
Professor Jenkins: That is right.
Chair: The question was: in that process, is there a way of enhancing energy security? Clearly, it reduces our exposure to a number of price fluctuations and import dependence.
Professor Jenkins: In technical terms, it is making sure we capitalise on the flexibility of using electricity as our energy vector both for transport and low-grade heat.

Q80 Chair: What about on the demand side? I mean, if we all have electric cars and we go home and plug them in at 6.00 pm, will it be possible to smooth out the peaks in demand? If we are going to use more and more electricity and people want to heat their houses at the same time of day and they want to charge their vehicles the same time of day, is there a way of addressing what otherwise may be a terrible increase in the level of peak demand?
Professor Jenkins: Yes, and there are all sorts of ideas, if you want to talk on this.
Professor Strbac: Yes. I mean, the transport sector is particularly well placed to be managed, as it were, in terms of demand, and we have done detailed analyses of how people use vehicles in the UK. That shows that first of all, as I mentioned, vehicles are 90% stationary. Imagine: when you drive your car, if you can plug it in when you arrive at work, you want your car to be fully charged before you go back. If you do analysis, you could charge lots of people's vehicles in that multi-storey car park without any need for any reinforcement. When you come back home, if you plug in your car and say, "I want it to be fully charged by 6.00 am" and if everybody in the street says something like this, then there will be massive opportunity to flatten out those charges and have everybody having the same level of service without any restrictions, but not needing to reinforce the infrastructure and have lots of wires and generators. The heat sector is similar, particularly if we insulate buildings between now and, say, 2030 or 2050. There will be two elements there. There will be less energy required, and secondly, buildings themselves become kind of storage devices. There will be again opportunity to manipulate the load even under very cold conditions. That would be incredibly useful. What our notes suggest, for example, is that the benefits in the infrastructure costs avoided in that future are about £45 billion. If you talk to manufacturers in terms of what they need to be able to make this smart thing work, they talk about 10% of their cost, so it looks like a very good idea to ensure that we have infrastructure communication with business in place that will support that and enable that clever use of demand.

Q81 Chair: But this will have an impact on distribution networks, won't it, because it will switch to this kind of point where everyone is using electricity very much more, particularly for transport.
Professor Jenkins: Yes, and there is an obvious potential conflict that must be managed between the effect of these loads on the distribution system and on the generation system. But the modelling so far indicates that that is manageable.
Professor Strbac: We could send you, if that is useful in terms of numbers, how much in the UK is going to be spent on distribution systems and generation systems against these futures. We can support you with that, if that is helpful.
Chair: Thank you.

Q82 Sir Robert Smith: On this consumer who will tell you that they want their car at 6.00 am, there is a strongly embedded sense of the freedom that cars have given. One of the freedoms is the flexibility that if your child gets taken ill that you can drive to the hospital. Obviously, if the car is plugged in and the computer thinks you don't need it until 6.00 am—have you modelled that cultural—
Professor Strbac: There will be minimum levels of charge that you would need to have in order to be able to, you know, go to—
Sir Robert Smith: But still achieving the—
Professor Jenkins: I think your point reinforces an earlier point from Dr Strachan. We don't have enough research and understanding of the human response, and I think that is absolutely the case. They are better placed in the US with their battery swapping. We would respond to that situation by saying, "Well, we will always have a battery swap station close enough, like a petrol station"—but how people respond to anxiety, I think that more work does need to be done on that.
Chair: Given the addiction to cars which the public already displays, almost regardless of price and other factors.
Dr Strachan: Yes.
Chair: It requires, I think, quite a leap of faith to think people are going to say, "Okay. I am home now, don't need the car until tomorrow morning" you know, and suddenly want to march down the pub or something. I can see the theory but I can't see the practice, given literally what it is.

Q83 Dr Whitehead: Talking about human response and energy efficiency, you have mentioned the importance of the fact that you need energy efficiency in relation to overall security issues. Has the so-called rebound effect on energy efficiency measures, to your knowledge, been taken into account in terms of the likelihood of absolute energy reductions being delivered over the next decade or so?
Dr Strachan: Yes, it has, and of course there are a couple of distinctions to make. One is between behavioural change, which is just patterns of consumption, and one is an efficiency change, where you are still using the same energy service demands but with a more efficient process. I think, though, that has been more work done on the direct rebound effect—i.e. "Energy is cheaper, therefore I use more", whereas this is the indirect effect—i.e. "Energy is cheaper, therefore I have more money to go out and spend on something else".
Dr Whitehead: Or on the effect of, "Well, my home is now more efficient in terms of its insulation, so I will use more energy".
Dr Strachan: That is the direct one, but if you saved money on your home energy bill and went off and bought a larger car, or went off on another flight, that would be an indirect effect.

Q84 Dr Whitehead: The projections that DECC is putting forward in its central growth scenario are energy demand falling by 6% and a decrease, I think of 21%, between 2008 and 2020 in the domestic sector. Those are the post-rebound effect analyses, are they?
Dr Strachan: I think it would depend which DECC forecast you're actually talking about—whether it is the DECC energy model or the DECC Calculator. I am not quite clear.
Dr Whitehead: Yes, it's the central growth scenario in terms of energy.
Dr Strachan: Yes, if it is the energy model that is producing that kind of energy model chart, then yes.

Q85 Dr Whitehead: What do you think in the longer term is the risk of overestimating the impact of energy savings, perhaps because of those features? How cautious does one need to be in terms of factoring in the real achievements that energy efficiency can make as far as achieving an energy balance is concerned?
Dr Strachan: I think there has been a fair amount of critical work on the rebound effect, and a number of 30% might be a useful rule of thumb, as long as you recognise that not all of your efficiency savings will be captured—but 70% out og 100% is still pretty good.
Dr Whitehead: Is that likely to be invariable over time, for example, in the development of new devices or assistance, even though they are more energy efficient—the actual number becomes the same, for example?
Dr Strachan: I don't think you can say whether the rebound effect would be larger or smaller in the future. Certainly if you have capital turnover or if you buy a new car or a new house, you have more opportunities to rebound, but one would also expect things like consumer preferences to change. One might expect your children's attitudes to energy to be slightly different than your attitude to energy due to the fact we are under this low carbon prognosis.
Chair: All right. I think we are out of time. Thank you very much indeed for coming. It was a very interesting session.

Tuesday 7 June 2011

Members present:

Mr Tim Yeo (Chair)

Dan Byles	Christopher Pincher
Barry Gardiner	John Robertson
Dr Phillip Lee	Laura Sandys

Examination of Witnesses

Witnesses: **Mark Hanafin**, Managing Director, Centrica Energy, **Mark Rigby**, Commercial Director, Stag Energy, and **David Porter**, Association of Electricity Producers, gave evidence.

Q86 Chair: Good morning and welcome. Thank you very much for coming in. This inquiry is attracting a certain amount of interest, so we are delighted to have you all here. May I start off with a general question about how resilient you think our electricity and gas infrastructure is at present? In other words, how easily would it recover from a shock such as interruption to supply?

David Porter: Generally certainly the electricity system is pretty robust against things like weather events. That is partly down to the diversity that we have in types of power generation and partly a matter of geography. We are conscious of issues such as the risk of drought, which could affect cooling water, and also at the other end of the scale the risk of flooding. We work very closely with people such as the Environment Agency on those issues. The industry, of course, takes that matter very seriously indeed.

Mark Hanafin: I would just add that the key to energy security and resilience is having the infrastructure and a diverse range of supplies. If you look at the gas market, we have more than 150% of import capacity against gas demand, so that is very robust. We have an increasing range of sources now for natural gas. Then on the power side we currently have about 30% reserve margin of generation above peak demand today. If we look forward, that becomes more challenging, clearly, as coal plants begin to come off the system through the LCPD and some of the older nuclear plants come to the end of their lives. So, very much challenges ahead but today quite good security and quite good resilience.

Q87 Chair: The implication of what you say is that even if it is relatively easy at the moment to switch to different fuels, it will get more difficult unless we make some further investments.

Mark Hanafin: Clearly, a lot of further investments are required. Policy in the UK is to decarbonise. That will require new forms of base-load low carbon generation. It will require flexible generation to meet that and to replace those plants that are retiring. That is a big challenge.

Q88 Chair: Is there more that can be done through emergency demand reduction arrangements?

Mark Hanafin: The demand side of the energy security equation is important. We tend to focus on the supply side—how do we balance supply and demand through more generation or through more primary energy supply—but increasingly demand-side management will be important. We need to see the continued rollout of smart meters, hopefully to every home by 2020. We can have time-of-day pricing and we can begin to use that demand side to help balance the system. It probably needs a change in attitudes as well. Currently, if you are watching the European Cup Final and at halftime you put the kettle on, you will fully expect to be able to boil your kettle. In the future, we need to think about how that last, very expensive megawatt hour is produced, how it is used, and whether we can have better ways of balancing the system. Two years ago, probably the coldest winter on record, we had some interruptions of large industrial users. This was actually part of the system design. Those were companies that contracted to take their gas on an interruptible basis. When it happened—the system coped very well with that challenge—it was seen as somehow a failure of the energy system, but, in fact, it was the energy system working properly.

Q89 Chair: Other witnesses have said there will be changes in social attitudes. All I can say is I detect absolutely no willingness on the part of the public to make those changes at all.

Mark Hanafin: The key is to provide greater information about how energy is used and how it can be provided. If you ask customers, "Are you interested in saving money?" they will absolutely say yes. If you ask them, "Do you see the need for energy efficiency measures in your home?" they perhaps don't see the need as strongly. We have to find a way of making that relationship clear.

Q90 Chair: That sounds like a polite way of saying you ought to be warned five minutes before halftime that the price of boiling your kettle is going to go up 10 times and you should switch it on now.

Mark Hanafin: No, with smart meters you will be able to see how you are using energy. You will have much better information about how your home is using it, how you can save it, and with time-of-day pricing how you can actually lower your bill.

David Porter: The domestic customers, of course, have not yet been given the means by which to make these decisions and judgements. Industrial customers are rather more used to that sort of thing.

Q91 Chair: Going back to what you were saying about preparing for flooding or drought and so on, the expectation is, I think from the scientific assessment, that those are going to become more extreme. There

is at least a probability of more violent storms and longer periods of drought and possibly rising sea levels and so on. Given the length of life of the average bit of generating plant, are those long-term possibilities factored in sufficiently in your view to the investment that is being made?

David Porter: The planning of new power stations takes in those considerations. I mentioned earlier that we were working with the Environment Agency and also with DECC and the Cabinet Office because there is a rolling review going on of the resilience of our sector. That includes, for example, the modelling of the effects of a one-in-200-year storm surge in the North Sea. This is taken pretty seriously.

Mark Rigby: If I can just make a comment about the resilience of the gas system, essentially there are nodes on the gas system that are vulnerable to interruption. There are four key nodes: the St Fergus import facility in Scotland, which is becoming less important as the fields decline; the area around Theddlethorpe, which is where the Rough and Norwegian facilities come in; the Bacton area, which is the interconnector in the southern North Sea fields; and the Milford Haven Port. Failures on one of those can cause problems. The system is resilient, but when you have multiple failures then there are questions that could be raised. I am sure the National Grid is in a better position than we are to comment in detail. When Mark talked about the problems last winter, what we had was a partial failure on only one of them, the Norwegian pipeline system.

Coming back to your question about any impact in terms of severe weather conditions, there is an issue, I think, possibly on the offshore facilities, the Norwegian pipelines and maybe the Rough facility, in relation to more extreme offshore weather conditions. But what we have to be satisfied about is how robust the system is to a failure maybe of two or three of these facilities at one time, and that could be an unfortunate coincidence or it could be weather dependent because the compressors, particularly in the Theddlethorpe and Bacton area, will possibly be affected by extreme weather conditions.

Q92 Chair: Just broadening that out, are we also somewhat exposed to the resilience of European infrastructure as well now? If we are going to have more interconnection, possibly even get towards a super grid of some kind, is what is happening in the rest of Europe also something we need to take account of here in assessing risks?

Mark Rigby: In the sense of the European interface at the moment, that is my node point again. Effectively, there are two key nodes. We count Europe as Continental Europe and not Norway, which are the two interconnectors. On the other side of the Continent, the system is much bigger and things like storage is more evenly distributed across the Continent rather than concentrated in a number of key nodes. Therefore, you can argue the whole European system is a more integrated and self-supporting system, whereas we are more isolated definitionally with those two interconnectors. It does not necessarily mean that if you change trading rules or put more resilience in the continental system it makes any major contribution to us if we are still limited to those two interconnectors. They are what they are; they are two dedicated pipes and, therefore, a potential area of vulnerability by definition.

Mark Hanafin: On the power side, there is interconnection now with France, with the Netherlands. There are plans to significantly increase those interconnections with Continental Europe and Norway. I think that that is a help to energy security because you are broadening the base of the infrastructure and you are making it more resilient to a single or a double failure. That is probably a positive thing, but clearly we will need to keep an eye on how those issues develop in Europe.

Mark Rigby: All these things are trade-offs. It is what are we looking for here, how much security, how much certainty are we looking for against the possibility of building in redundancy to the system. That is the judgement that always has to be made. Whether that judgement can be made purely commercially or whether you need that judgement to be made by more regulation is a difficult issue to address.

Q93 John Robertson: Just before we move on, the interconnectors have not exactly been seen to be reliable. Are you satisfied that deals made will be fulfilled by the other side of the water?

David Porter: I am not sure that they have been that unreliable. In fact, the interconnector with France, of course, has been around for a long time and has proved beneficial to countries on both sides of the Channel. The Dutch one is rather newer; I think that is just a few months old. I think if there is an issue with interconnectors it might be that the issue is how long it takes to actually build one. I think the Dutch one was about 10 years between conception and delivery.

Mark Rigby: An electricity connector is a much more reliable interface. I would argue that the gas interconnector for purely physical reasons, the issue of compressors, issues of dew point temperature, all of those affect a gas interconnector; they don't affect an electricity interconnector. I think your point is absolutely right, but it is about electricity interconnectors.

Q94 John Robertson: DECC is anticipating the demand for natural gas to fall by 30% in 2020 and then by 90% by the mid-2040s. What implications does this have for the immediate investment in gas, and do you accept these figures?

Mark Hanafin: Let me start with the longer term figure. Energy markets are notoriously difficult to predict what will be happening in five years' time, 10 years' time, and certainly 30 years', 40 years' time nigh on impossible. To give you an example of that, I used to live and work in Houston and in 2007–08 we were building regasification terminals as quickly as we could in North America because of the major imports that were expected. The issue was not do we need imports into North America; it was just what quantity. Within a year, with the dawn of shale gas, that position was completely reversed and we have now perhaps North American self-sufficiency, energy

security for gas for perhaps 100 years. It is an example of just how difficult it is to be very precise about what the energy market will look like at a given time. I think predicting what that will look like in 2040 is very difficult. If we look forward over the next 10 years, different commentators will have a different view. The general trend, however, will be that gas is either flat to gradually falling. We will see less use in heat, for example, but more use in power.

Q95 John Robertson: Could I come in there? The National Grid have told us that they see gas share of power generation rising by 50% by 2015. How does that fit into the equations and do we have the existing infrastructure in place?
David Porter: I think when sane and sensible organisations like DECC and National Grid disagree over forecasts like that, as in the rest of the world it is usually to do with the assumptions that are being made. This may well be differing assumptions about how much new nuclear power comes forward by when and how much wind power comes forward in that period.

Q96 John Robertson: What is your assumption?
David Porter: I am not making an assumption other than the one that the Government makes and that is, for example, that we will get new nuclear power around 2018 and we will meet our renewable energy target in 2020 because the Government's response to the EU officially is just that.

Q97 John Robertson: How do you think the volatility of the price of gas—it can be up, it can be down, and the effect in the market that will cause—is going to affect things?
Mark Hanafin: The first thing to say about price volatility is that if you have the right infrastructure and you have the right diversity of supply, you are going to avoid the major shocks in price that come from a dislocation in that. But then within that you will see price variation season to season and year to year, and that is the natural working of the market. For example, in gas in 2009 you had a world recession, you had liquefaction, LNG projects, being delayed, being cancelled, demand coming out of the picture and prices falling. That had a chilling effect on investment. As gas prices recover, those investments will come forward. That cycle is a normal cycle. The key I think is that those first steps around diversity of supply and the energy infrastructure means that you don't have the dramatic shock.

Q98 John Robertson: If we get to the stage where nuclear is put back and we get to the stage where wind is not supplying the necessary power, as has been seen already, and we get to the stage where we need gas to fill in that space, does that not put a demand on gas that will automatically bring an increase in price?
Mark Hanafin: Well, it certainly will increase the demand for gas and gas-fired generation will need to increase its share of the load. But the UK is operating within the context of a global market and you have to look at what that demand means in relation to the rest of the market. The UK is a big gas market but in global terms it is only a small percentage.

Q99 John Robertson: How does gas compare to other fuels with volatility? Is it more volatile or is it less volatile price-wise?
Mark Hanafin: The volatility has been actually reducing and this is one of the challenges around the storage projects.

Q100 John Robertson: I get from that it is more volatile then?
Mark Hanafin: No, we have seen the volatility, for example winter-summer differentials, reducing and that is a concern in terms of how we get those storage projects coming forward.

Q101 John Robertson: You talked about weather there. I can't remember which one, I think it was you, Mark, that said that two years ago was the worst winter. Well, last winter where I come from was a lot worse than the previous one, but that is two bad winters in a row we have had. What happens if we keep getting these bad winters and we have to expect this? An add-on to the other thing: what happens if we have a good summer and the air conditioners start coming on and we start buying—because one of the things that has been said by many companies is that the actual use in summer is starting to approach the use in winter.
David Porter: There are parts of the world, of course, where the peak occurs in the summer.
John Robertson: Absolutely, yes.
David Porter: But that is not here and it is probably not likely to be for some time. But the point that you make about—
John Robertson: I will remember you said that.
David Porter: Thank you.
Mark Rigby: Could I pick up on a couple of your points, Mr Robertson? I think, first of all, going back to how much security we want, you hit the nail on the head when you talked about demand because, of course, it is how much security we want against an assumption about demand. Looking at some of the material that has been published both by Government organisations and consultants over the last two years, I compiled a list of I think nine long-term gas demand forecasts. The lowest number I have seen is in 2023 72 BCM, and the highest number I have seen is 124 BCM. That is David's point, it depends what assumptions you make, but all of these are from perfectly respectable consultants in the industry.
I think the baseline number that DECC is using at the moment is something of the order of 83–84, but when Ofgem looked at the issue in Project Discover and they did a scenario analysis, they had a variation of between 113 and 76. In that context, you have an enormous variation and to decide security you have to say, "Am I providing security against these higher numbers or am I providing security against the Government's base case?" and I think you have different answers to that.
Coming to your point about volatility, as someone from Edinburgh who is acutely aware of your point—I live in Edinburgh—I think the Government, to be

fair, its policy in the sense of sharpening balancing incentives and the SCR process they have in clause 79 of the Energy Bill is precisely about that point. They see the way to encourage more gas storage is to send a signal to the industry that reform of the balancing rules, which is what essentially drives the wholesale market, will introduce more price volatility and, therefore, there will be a signal to invest in gas storage. I think that is the current view of the Government and what they are trying to do through the Energy Bill. Whether or not that will be effective, of course, is subject to quite a lot of debate within the industry at the moment.

John Robertson: A good time to move to the next lot of questions, Mr Chairman.

Q102 Chair: Just before we do that, it is clear, I think, is it not, that given that range of possibilities for gas demand that security in 10 years' time would be greatly enhanced if we had a substantial amount of new nuclear capacity? David Porter is saying he is happy to accept the assumption that this will start in 2018—that is the official assumption—but on any realistic assessment of what has happened in the last six months there can't be any hope at all there will be significant new nuclear working by 2018. So we are in danger of being at the higher end of that gas demand range, are we not?

David Porter: I ought to say that the preliminary report on the nuclear industry that the inspector made did suggest that we need not expect any significant delay to the nuclear programme. I would accept, of course, that there are other reasons why it might be delayed, finance being one of them perhaps, but that was the official signal. I don't know whether Mark wants to add anything to that in terms of your stake in the nuclear industry.

Mark Hanafin: Yes. I think the events of the last six months do put pressure on the timeline without question. You have had the generic design assessment for the reactors due out this month. That was the original plan. Clearly now that interim design assessment can't happen until after the final Weightman report on Fukushima. That is a six-month type slip in the generic design assessment. You have then had some slippage in the planning process with all of the requirements to get to a point where you can submit applications to IPC, so a lot of these things are interrelated. I think it is fair to say that it is probably too early for us to say what is the new date because we need to see what the final Weightman report actually says. If it says, "You need to test against these design parameters" and those lead to relatively modest design changes, then the delay can be quite minimal. If they are major design changes, then in the nuclear industry that always needs great care and attention, so that would be a longer delay. It is a bit premature to say at this moment what it would be; probably in the next six months it will become clearer. But I agree with you that the pressure is on the timeline.

Chair: We are taking evidence from Professor Weightman on Thursday.

Q103 Laura Sandys: Just following up on international; we have been talking very much about the domestic infrastructure and the European infrastructure. When you start to look at price volatility we have not really discussed some of the more politically unstable areas that we are importing gas from, the increase in demand globally, and also the German decision to in many ways make their nuclear redundant, which will put an extra strain on the whole European infrastructure. How much do you examine and look at that political instability, the politicisation of energy, and how we are going to be able to hedge that and not in many ways find that on the gas, which is the resource that fills the gap when we have problems, we are being hijacked on price due to those politicisation and instability issues?

Mark Rigby: Well, I was hoping my esteemed colleagues would take that question first. I am just a simple man, not looking at global markets, but I guess there would be two points. First of all, when we talked about price volatility and I talked about short-term price volatility incentivising storage, if you like that is prices going up and down very much in the short term against an average underlying price. I think what you are talking about more is a structural movement of gas price due to the fundamental world supply-demand balance and, therefore, the whole gas environment is tighter and prices are higher over a sustained period, which is a different sort of volatility that I am sure you are better placed to deal with than I am.

Mark Hanafin: I think the context to the question is that if you go back seven years we were self-sufficient in gas; today we are importing about 45% of our gas needs, and perhaps in 2020 that might be up towards 70% of our needs. That is the broad trend and clearly there can be variations from that. What it means is that we have to do a number of things. We have to make sure that we do everything we can to get all of the reserves of gas out of the North Sea that are there before they are stranded and left there forever. We need to start competing on the international stage for our share of that gas. There are countries that have never been blessed with indigenous sources of gas that have been doing that for years and years and their governments work hand in hand with their businesses to compete for that gas internationally. I think we will need to do more of that. The previous Government was very supportive of Centrica's efforts to get a term LNG contract signed with Qatargas. That was continued with the current Government, that very good support. I think that was a great example of Government and business working together to secure the UK's energy needs.

Yes, it leads us into all sorts of other risk areas and political areas but, as I said at the beginning, the key is diversity, the key is having the sort of contracts that we are building long term with Norway, with the Netherlands, with Qatar and with other countries.

Q104 Laura Sandys: Would you make additional recommendations to Government on what they should do to support particularly greater gas security, not just what they did in Qatar but in other parts of the world? Do you feel that we are proactive enough from the Government's perspective?

Mark Hanafin: I have been back in the UK for three years and over that period I have seen a change in this respect from a little bit of hands-off, that is a commercial matter and we don't deal with that, much more to a recognition that the Government does need to be interested in this, does need to be involved, does need to recognise that when we land in places like Doha you will see the German Chancellor or somebody else arriving. I have seen great response in that respect and I think it is a continuation of that that we need to see.

David Porter: I think as with all aspects of our energy infrastructure it might be worth mentioning planning consent. People have had problems getting consent for storage. A great deal of will to do it, but it has not always been as easy as it might be.

Q105 Christopher Pincher: On the storage question, do you think that we would benefit from a security aspect from having a larger amount of storage? You said, Mr Hanafin, that we need to compete hard in the world marketplace to get gas, that we need greater diversity of supply, but surely a corollary of that is that we should also have greater storage capacity to guard against short-term supply interruptions?

Mark Hanafin: I agree. I think that the country does need more storage. The National Grid has said that of the 4.6 billion cubic metres of storage we have today, probably we need something like twice that in 2020. I think it is difficult to be precise about exactly what is needed, but that direction and that order of magnitude seems reasonable.

It is important to recognise, though, that the actual need of the market is not storage per se, it is flexibility. There is a need for the market to be able to balance supply and demand. Traditionally, a lot of that flexibility came from the North Sea gas fields that could be ramped up and down. As those deplete that flexibility reduces, but at the same time LNG in the last couple of years has provided a remarkable amount of flexibility. The send-out rate from these LNG terminals can be turned up and down. We talked a little bit about the demand side earlier and how the demand side now can begin hopefully to help with that balancing. But having said all of that, I still think that there is a case for more storage, and I know Mark is passionate about that.

Mark Rigby: I am the union rep, yes. What I would say is that there is an active debate within the industry as to whether or not more storage is technically necessary, quite an active debate, and the Poyry report for the Gas Forum, which David Porter quotes in his evidence, is saying for day-to-day purposes the system is quite resilient. I agree with that, but I cite those problems with nodes. It really is a fine judgement as to how much extra facility you want for storage, and I think Mark is absolutely right to talk in terms of flexible storage.

What I have always argued from my point of view is that storage is different in kind. It is providing security compared with other mechanisms in that flexible contracts ultimately are between good partners. What the Labour Government did when it took a great lead with both the Norway and Qatargas contracts were tremendous contributions to this country's security of gas supply. But at the end of the day they are paper contracts that are subject to physical interruption over long distance. That is different in kind to actually having the stuff in the ground inside UK jurisdiction and under UK control at all times. That is a different qualitative type of security if at the same time on paper it is no more flexible than a flexible contract is. That is the quality of judgement I would argue from a storage point of view.

Q106 Christopher Pincher: In terms of storage balance, what do you think the balance should be between salt caverns and high-pressure containers and storage in existing reservoirs?

Mark Rigby: I think that is a very good question. What is normally put forward is that people quote the number of days storage cover, which I think is very misleading because it is a question of whether you can get at it or not. If you look at the UK, two-thirds of our storage is from the Rough facility, which empties in 67 days. So, while Rough contributes massively to our 14 days' cover, you can't empty Rough in 14 days. The reason for that is that Rough is a reservoir and reservoirs have lower flexibility and you can't empty them so quickly. If you are looking for security you do need high deliverability facilities, the salt facilities. The problem with that, of course, is they are more expensive so you have the usual trade-off between getting what you need and paying more for it or having a second best but at least getting something.

Q107 Christopher Pincher: What sort of expense are we talking about here if you compare it, for example, with the cost of renewables?

Mark Rigby: Cost between salt and reservoirs, maybe salt is about double. If you compare the cost of putting in four or five BCM of storage in the sense of a mixture maybe of reservoirs and salt, a sort of balance of the two, and you compare that with the cost of the current renewables programme and ask how much that would impact on the consumer, the number that I have calculated is that the insurance premium on storage would be something between one-fortieth and one-fiftieth of the total cost of the current renewable programme on the current consumers. So it is much smaller but it is always the issue of one more straw on the camel's back, isn't it? I guess that again is a concern people might quite rightly have. We must be quite sure we really need to do this, and that is what the debate is about, I think.

Mark Hanafin: I think in some respects renewables can add to the need for storage, not take away the need for storage. If you have more intermittency, probably the fast cycle storage that Mark is talking about is needed. I don't think it is a case of seasonal storage is second best; I think we need both. It is a cheaper form of storage, but you need fast cycle and you need seasonal storage as well.

Mark Rigby: I think that is what I said. It is absolutely vital to our current security.

Q108 Christopher Pincher: What about quality of gas coming through the interconnectors, the two nodes that you mentioned? Does that affect the security of supply?

Mark Hanafin: Yes, gas quality is a potential issue in the UK because on the Continent the quality is different to the UK spec. It is a slightly higher heat content. It is technically relatively easy to resolve. The LNG terminals, for example, have nitrogen injection facilities and, depending on the specification as the gas arrives, that can be used to bring it on spec relatively simply. I think the only real issue is the interconnector from Zeebrugge where occasionally the quality in Zeebrugge does not meet the UK spec and it can't pass through the line. Normally that is not a problem, but clearly if there was a time of stress on the system you would not want to be interrupted because the quality was not quite right when there is an easy solution there. It seems like it should be just resolved. I think the challenge is that the shippers on that line all have different commercial interests and it is difficult to get them aligned to pay for this relatively modest investment for nitrogen injection at either despatch or the receiving end. Another option would be for grid to have that as part of their cost recovery mechanism; that they make that investment and they recover that cost. Spread over the whole gas system, it is a very small cost indeed. So, easily technically resolved; for some reason commercially has not managed to get done.

Q109 Christopher Pincher: Do they currently monitor the quality of the gas?

Mark Hanafin: Yes, the quality has to be monitored. Both the BBL pipeline and IUK can only transport gas if it meets the UK spec because otherwise there would be problems with burners.

Mark Rigby: I think Mark has hit the nail on the head here when he said why isn't a comparatively small problem easily resolvable. I think that raises perhaps the general issue of governance and how these processes and how these decisions are ultimately made, where the buck stops, who actually has the final decision. Understandably, in a lot of these complex areas where there is an interface between quite elaborate market rules and an awful lot of companies and a legal process around Ofgem where everything has to be done by the book so it is not subject to judicial review and so on, it is quite difficult to unpick some of these knots, and blending is one of those because it ticks so many of those difficult process boxes, I think.

Q110 Dan Byles: I am interested in exploring the economics of gas storage a little bit more. Mark, you referred to the fact that the seasonal price difference, for example, between summer and winter is reducing.

Mark Hanafin: Yes.

Dan Byles: It strikes me that that is one of the big problems that we have in looking for a commercial solution to this. Would you like to elaborate on that a bit more? Why is it that the market is not solving this problem for us?

Mark Hanafin: Yes. I think what you are seeing is we are coming out of a period where there was plenty of gas around. There was an oversupply of gas and that essentially blankets the market, so it deadens the difference between winter and summer when that happens. If you are investing in seasonal storage, you are looking at that differential, putting the gas in in summer, taking it out in winter, trying to project that forward. We talked earlier about the difficulties of forecasting. It is extremely difficult to forecast an energy price. It is even more difficult to forecast future differentials.

What I would say is that there are numerous projects in the pipeline on storage, both fast cycle and seasonal, and we have some of those projects. They are real projects, they are good projects, and they need to come forward. At the moment those commercial conditions are very challenging for that, so the question is what we do about that. Does Government need to do something? Mark and I might have a slightly different view on this. I think we are agreed that we need storage. Our view is that intervention at this point is a bit premature. I really like to see whether markets can work; whether companies can deliver these solutions without running to the Government for help. I am very hopeful that in the next couple of years two or three of these bigger projects are going to come forward, they are going to be viable and we are going to get those storages being built.

Q111 Dan Byles: Are you talking about things like the Baird gas project?

Mark Hanafin: The Baird project. This is 60% the size of Rough. It is a very big project. It is over a billion pound project. It is an excellent project. We are in detailed engineering work on that project now and when we complete that we can take a real assessment of whether it can move forward. If in the next couple of years, however, the market is not delivering and there is a sense that this is more like an insurance product than the old reliable winter-summer product that it used to be, and that the market is not going to invest to provide that insurance, then we need to look at what Government intervention would be appropriate. I think there are the support mechanisms that could be considered, there is strategic storage and there is a storage obligation. Very quickly, I would say let's see if we can make the market work without the support mechanisms first. Strategic storage I am very concerned would have unintended consequences like chilling other commercial storage ventures. It is probably around the storage obligation that any intervention would work.

Q112 Dan Byles: Just briefly on your concern, if the Government start pushing for strategic storage, will commercial operators see that as a threat and see no point in investing in shorter term commercial storage?

Mark Hanafin: I think that is clear, yes.

Mark Rigby: I think to a certain extent, Mr Byles, strategic is always a bit of a red herring in that nobody at all argues for strategic storage in this country. Jonathan Stern, who I think you heard from last week, was the only major pundit who did think it had a role, but even he now has doubts if I understand what he had to say to your Committee. What we are talking about are some of the other measures that Mark mentioned that have been subject to regular DECC consultation. I am not actually saying there should be direct intervention by the Government now on any of

those. All I was arguing for in my evidence was that such long lead time is involved in these projects between making the decision, marketing, investing and so on, that you may be talking five to seven years from start to finish. I was saying, given that there is an active debate now, why not have an active debate about everything and at least agree what we are going to do if we have to do it. Not do it, just set out a framework of how we might do it so the industry knows where we are, because there are so many different angles in the way this could be approached. Could I quickly answer your question? On price mechanisms, it has only been for three or four years that there has been a summer price differential that relates to storage, and you could argue that in the liquid markets where you only have a price curve that is discoverable and transparent three or four years forward anyway, it is unlikely that most of the time there will be a price signal for storage, because it is one of these paradoxes that it is only when it is too late and there are severe conditions that the price signal is there. Most of the time it will not be there and, therefore, relying on the short-term market curve to produce a storage signal for storage is not going to work and it really is a strategic judgement. It therefore comes down to either the sort of things I have been talking about, about Government measures, or you are relying on the big companies like Mark's to take a strategic view that storage will happen irrespective of what the price curve might say. Maybe things like the Third Package make those things more difficult for his company to do that sort of thing.

Q113 Dan Byles: Do you think that the sorts of measures that the Government have announced to date are the right ones? I detected in your answer earlier, I think it was to Chris or it might have been to John, that you were not entirely confident that what the Government has said it is going to be doing will have the right effect.

Mark Rigby: What we have said is we doubt that the price balancing mechanism reform in itself will incentivise more storage for the reasons I just said, that it probably won't have an impact on the forward curve and it will only be after the crisis that people will see the effect and they can price it in. You are asking people to second guess a future unknown at the moment, which is a very difficult sell to an investment committee.

Q114 Dan Byles: What should we do?

Mark Rigby: That is not to say it is the wrong thing; I am just saying that possibly we do need more things as well along the lines that Mark talked about. He and I seem to be in agreement that if more storage doesn't come forward in the next two or three years maybe we need to do something like that. I have supported the supplier stocking route as the way forward. All I am arguing at the moment is that it is better for the Government or for Ofgem in particular to look at all of these things now holistically and say, "This is the way we are going to go," rather than just do one study on one particular measure, which may not work.

Q115 Dan Byles: Plan now for what Government might have to do and hope they do not have to do it?

Mark Rigby: That's right.

Q116 John Robertson: Most companies have a forward plan, whether it is a short-term, medium-term or long-term plan, and they always tweak them about. I am a bit concerned about some of the things you are saying here about basically not planning because you are not sure of how things are going to be. We have the Government saying one thing about where they think things are going to go. We have other companies who have their own ideas. In between we have a case of do we need gas, do we not need gas? We have asked various questions of various people in the chairs you are now sitting in and nobody seems to be willing to come forward and say, "We need to go down this road". Unless we get some kind of forward planning ahead, we will be caught or could be caught rather badly off in energy circles. Let me ask you a question here. You have talked about winter, you have talked about summer. You have not actually talked about what might happen with new technologies, for example if electronic cars start to take off, and the actual extra burden that would be put on to electricity through these new technologies. Is there a plan for that and, if so, when will we get a definitive answer of what this country is going to need? To be honest, gentlemen, we cannot wait until 2015 for an answer. We need an answer like yesterday.

David Porter: The other side of that coin is the message that we give quite often, and that is that it is, of course, very difficult to make some of these investment decisions. The industry can see reasonably clearly the general direction that we are going. We have a renewable energy target to meet, we have a decarbonisation target to meet, but the mechanisms for getting us there are not yet as clear as they need to be. We are going to get some preliminary signals on those reasonably soon if DECC fulfils its promise, and we shall see a White Paper taking forward the energy market reform before the summer. But there is a great deal to be done after that comes out and I think the Energy Minister himself said at one point a few months ago that we do have to go through a period of uncertainty before we get to the certainty.

Q117 John Robertson: You see my predicament here. You have said exactly what everybody else has said, and that is basically nothing. You are not giving me any idea whatsoever. Your profit margins are pretty good; you are making lots of money. The fact of the matter is there does not seem to be much risk management going on. Yet I always thought that one of the things in business risk management was you saw a chance to make a few bob and you moved in. What is happening?

David Porter: There are also opportunities to lose a few bob and that is why—

John Robertson: That is called risk management. You take the risk, and you have plenty of money to throw about.

Mark Hanafin: Can I come in here, Mr Robertson? You said that it is frustrating that there isn't clarity about the direction and what is needed. I will give you

a perspective from an investor side. If we decided that the only mechanism that we needed to worry about was cost price and returns, what were the best investments to make money, I think probably the industry would go out and build coal plants today. If that was the only condition that was placed on the market, that is what you would see happening. As a country we have decided, quite appropriately, that that is not the right course of action and that we need to take into account the environmental impacts of that, not just climate change but the environmental impacts of coal, so most of the coal plants are being phased out. You then have a very complex situation where you are trying to provide security of supply, decarbonise the generation, and do all of that in an affordable way. The policy framework that will enable that to happen is EMR and the Government has been consulting on EMR. There are good proposals there around how we bring on low carbon base-load generation, how we bring on flexible generation, but that framework has not been put in place yet. If you are waiting on an investment in biomass or you are waiting on investment in offshore wind, you really do need to know what that framework is for the future. Hopefully, it does not sound as though I am making too many excuses, but that is the reality of where you sit as an investor today faced with those challenges.

Q118 John Robertson: But it has always been that way in business. When the atom was split, you must have thought, "I wonder where we are going to go here." It has always been like that.
Mark Hanafin: It has always been like that, except the difference now is that you don't just invest in what you think is the cheapest technology, because what is the cheapest technology will not deliver the other policy requirements around decarbonisation.

Q119 John Robertson: Yes, but you know that and I know that. The question is how do you deliver? You are telling me what can't be done. You are not telling me what can be done and how it will be done.
Mark Hanafin: We need to see EMR coming forward with pace. We need to make sure there is no further slippages to that plan, provide the clarity, provide some confidence for investors, make sure that we do not have nasty surprises around taxation or policy shifts, and the investors will make the necessary investment.
John Robertson: There are always nasty surprises.
David Porter: It is vitally important that the energy companies are profitable. They are already major investors. People tend to forget that. But what is ahead of us is massive compared with what we have been doing in the past. The figure that has been bandied around, the £200 billion that needs to be invested in the next 10 years or so, is pretty real. It is so substantial that the companies can't meet that from their normal operations, and this means that investors are going to ask pretty tough questions. Some of those questions the companies themselves can't answer until the Government has laid out in a bit more detail how it intends to reform the market.
Mark Hanafin: I don't want to leave the impression that investors are sitting around dithering. In the case of my own company, we have invested £4 billion in the last three years in the UK's energy infrastructure. We built the largest wind farm in the world at the time. We built the most advanced gas-fired power station in the country. We have invested £3 billion in upstream oil and gas. These investments are happening, but in terms of longer term energy security we do need that clarity of what the framework is.

Q120 John Robertson: The big wind farm you are talking about, if you had not had Government subsidies to do that, would you have done it?
Mark Hanafin: Wind farms cannot be built economically without Government support. It is more expensive to produce low carbon generation than high carbon generation. That is just a fact that we have to deal with.

Q121 Dr Lee: Moving on to intermittency and the future role of gas, where do you see gas in the electricity generation mix in the next 10,15 years? Is it base-load, is it mid-merit or is it peak?
Mark Hanafin: That is one of the challenges about how new gas-fired plants get built. A modern gas-fired, efficient plant will want to run base-load. The investor will want to see that happening for returns. The way that an investor is rewarded for building a gas-fired plant today is through one revenue stream, which is energy, so the price of electricity. In the future, if large amounts of wind come on and off the system, the intermittency issue, it will mean that gas-fired plants will effectively be providing that back-up service. That produces a problem with that business model because you are only getting revenue when you run; you are not being rewarded for providing that back-up service. Part of EMR consideration is whether there should be a capacity market, as there is in north-eastern US, so that an investor in gas-fired plants has a revenue stream from energy and a revenue stream from a capacity market, perhaps an auction process.

Q122 Dr Lee: Which renewable energy form would be easier in terms of security of electricity supply? If you were going to have a form of renewable energy in the mix, which one is the easiest one to deal with if you are the gas supplier who is providing the peak demand?
Mark Hanafin: Well, I think that probably biomass is the renewable energy source that has the least impact in terms of intermittency. Providing there is a good supply chain in terms of the feedstock then that plant should be able to run relatively base-load. Obviously, wind is subject to the climatic conditions, which vary week to week, month to month, year to year, and that is where the back-up comes from. You then get into wave and tidal, but there the cost equation starts to really bite because some of those technologies can be 10 times the price.

Q123 Dr Lee: Sure. I just wonder whether being a gas supplier you benefit greatly from having a large wind farm component to the energy mix.
Mark Hanafin: As a gas supplier?

Dr Lee: Yes, because the intermittency of wind is a problem. We have had people in front of us about super grid and how we can export it when it is windy and so on, but ultimately the gas suppliers benefit, don't they, from wind? In comparison to, say, tidal, the Severn Bore or whatever, where it is, "Right, press the button, boom, here it comes", and it comes every day. Irrespective of weather, you know you are going to get 10%, 12% of potential national demand.
Mark Hanafin: I don't really see—
Dr Lee: My point is that is there a danger here? Is there a conflict of interest danger here?
Mark Hanafin: I don't think so. You have to compare how much carbon are you abating and what is the cost of the electricity that you are going to be producing. As I mentioned earlier, if carbon was not an issue, you would be building coal plants and some gas plants, and maybe that is around the £60 to £80 a megawatt hour level. Maybe nuclear is around that higher end. Then you are into onshore wind, which is a bit cheaper but more difficult to build for local reasons, and then offshore wind, maybe £140 per megawatt hour levelised cost. Then you get into tidal and wave, which may be more predictable but perhaps five to 10 times the cost.

Q124 Dr Lee: I guess what I am trying to say is, is there a danger with going for wind like we have done that we are actually not enhancing our energy security in the same way we could have done if perhaps we had built more nuclear or gone down the tidal route, because ultimately if the wind does not blow we are importing this gas? We have already heard about the problems with Zeebrugge and quality and what have you. Is there not a danger here that we are increasing our energy insecurity by relying upon a form that is intermittent?
Mark Hanafin: No, I think that the investment in gas infrastructure that we have had, in securing diverse gas supplies, in different forms of renewable energy, in a nuclear renaissance in terms of new nuclear stations, all of those things are necessary. As a company, Centrica is reasonably technology neutral. We are not a global nuclear company. We are not a global wind developer. We are quite reflective in a sense of what the UK's demands are, which is how do we get that right balance in the mix. I think the—

Q125 Dr Lee: I am looking at from a UK as in Government-country position, not, with respect, about Centrica. Centrica is in the business of making money and good luck to it to do so. Ultimately, though, if we have a greater proportion of our energy need coming from imported gas, we are less secure.
Mark Hanafin: I think the security, as I say, comes from diversity and gas is an important part of the mix. It can provide a path towards a low carbon future cost-effectively. Gas-fired generation is very cost-effective. It brings with it risk. I do believe that we should be investing more in nuclear. That is why we are participating in it. But let's say, for example, we said, "Let's be less reliant on gas, let's quadruple, let's multiply by 10 the number of nuclear plants we want to build," does that immediately reduce risk? It changes the risk profile. It makes you less reliant on international risks, perhaps, but what if there was a type fault in that technology so that you had to take all of the reactors offline at once? If we over-build on offshore wind, what if there is a change in the weather patterns and the jet stream moves to Spain rather than the UK? These are all unknowns and they are certainly risks. We are not really different from the UK Government in that sense. We want to diversify those investments and that risk so that we can cope with them.

Q126 Dr Lee: I am sold on the need for diversity. I suppose, leading on from the rather baffling decision of the German Government on nuclear, clearly they are not going to replace it with renewable in the next 20 years. Let's get real, that is not going to happen. So they are going to start burning more gas. That is going to impact upon our security, is it not, as a country? If we are becoming more dependent on gas, for the reasons we have just been discussing, isn't that strategic decision by the German Government going to impact upon our energy security?
Mark Hanafin: I don't think it has a huge impact. It is one factor in a global market where you have large changes in demand for all different reasons: the German demand being up; huge changes in supply with the advent of shale gas; new LNG; coal bed methane in Australia providing new sources of gas supply. So there is probably one to 300 years of gas supply and it is a question of do the markets operate properly and does it bring the gas when it is needed. So I don't see it as a huge immediate threat to the UK.

Q127 Dr Lee: Finally, on carbon capture and storage, do you see that technology playing a big part by the 2020s?
David Porter: We are hoping that it will. We have members that want to—
Dr Lee: Is that a yes or a no? We always get back to CCS here and it always strikes me that we are all sort of fingers crossed under the table, aren't we?
Mark Hanafin: I would say no, in answer to your direct question about whether we will have CCS in 2020. If the question is will we have scaled commercial carbon capture and sequestration in 2020, I think the answer is clearly, no.

Q128 Dr Lee: So the conclusion is that if nuclear is delayed, for whatever reason, our gas demand goes up because, as you have alluded to, we are not really thinking about how all the electric cars are going to get charged, and everything else, and on top of that CCS isn't working, what hope us hitting our carbon targets? I do not see how this all adds up to—
David Porter: Our carbon target is, of course, for 2030.
Dr Lee: Well, even 2030.
David Porter: By 2030 a great number of things may have happened, and if carbon capture and storage is going to come forward it is likely to play its part after 2020, I would have said, and so would more new nuclear power, but it remains to be seen.

Q129 Dr Lee: It is all a bit uncertain. Is that a fair assessment?

Mark Hanafin: The main contribution to meeting the carbon targets is the replacement of coal-fired plant with gas-fired plant, which is happening over the next three to five years. We are having a build out of renewable energy. EMR will clarify that. It will clarify what are the mechanisms and the market policies around such things as biomass. So that will be happening. The nuclear programme needs to proceed as quickly as possible. So the carbon targets are mainly going to be met from energy efficiency and displacing coal, and I don't think there is a threat to that. If we say, "Well, that creates an additional threat because we are too reliant on gas," what I would say is that Mark showed the range of predictions but I think the majority of predictions are that gas will be flat to slightly down, because energy efficiency will reduce the heat load for gas and there will be a greater need for gas in power generation. British Gas has seen its customers' gas consumption decline by 22% in the last five years, and where we have worked with customers on specific energy efficient measures we have seen up to 44% reduction. So a flat to slightly declining gas market, given all I have said about diversity and sources of supply, is manageable.

Chair: It may be manageable but it would be reckless, I think, to assume we can base policy on the availability of carbon capture and storage within a decade and the likelihood of any new nuclear power coming on stream within a decade. We have to live in the real world, however much we regret both those things. The CCS is a matter of whether we make the technical progress or not but the nuclear is a matter of political will, which is singularly absent at the moment. So the truth is that we are going to be using an awful lot more gas with all the risks that that implies. There seems to be absolutely no alternative. You have given very balanced assessments of how you see it, but it is hard to draw any other conclusion.

Q130 Barry Gardiner: First of all, gentlemen, my apologies, I am going to have to leave shortly for the *Natural Environment White Paper* launch, so I will try and make my questions succinct and if you could make your responses succinct that would help us all.

I want to focus on the EU Third Energy Package and to look at the ways that, by March of next year, we will have to have done the unbundling proposed there, either ownership unbundling, the independent systems operator or the integrated transport and transmission systems operator. Can I ask the two Marks, initially, which model of unbundling would you prefer for your company? The second question is which model of unbundling do you think would aid the UK's security of supply best? Then I will turn to David to answer the same questions, but not obviously in relation to his own company.

Mark Rigby: If I could just confine my comments, as usual, to the gas storage area. This is an area where our trade association have been very active in dialogue with Ofgem on the application of the Third Package. Essentially, the model in the Third Package, in terms of so-called third party access, is one where gas storage is treated as a utility return business, with price regulation and elements of price capping in it and no preferred access to the owners of that particular facility. That is a model that fits very well with the European gas storage industry, which, as I have explained before, largely is a capacity payment-type system with guaranteed throughputs, guaranteed return, regulated return. It is very difficult to apply that model to the UK because we don't have that framework at all. We have a virtual framework where, understandably, people are looking for good returns when the times are good for storage and accept the fact that you are not going to make much money when times are bad, like at the moment.

Therefore, the paradox is that what I think the Government has done is it has negotiated an arrangement where we have a negotiated access, and Ofgem will grant exemptions to new facilities so they don't fall under this European framework. So you have a paradox here that we are actively supporting a framework that possibly will not be applied to new storage projects.

Mark Hanafin: Perhaps I will limit myself then to electricity, given Mark's answer on gas. I think the UK market operates with largely integrated energy companies and so the question might be: is that the appropriate model? Should retail be separate from generation and distribution? Of course, in terms of the pipes and wires that is the case. I think, in terms of generation and supply, there is a very important linkage between the two. Energy markets are very volatile. The world is littered with examples of companies that have gone bankrupt because they were pure generators or they were pure retailers. British Energy went bankrupt a few years ago as a pure generator. In the US you have seen lots of examples of pure retailers going bankrupt as the volatility of pricing impacts them. So I think that integrated approach is the appropriate one. It gives a robustness to the energy companies.

Q131 Barry Gardiner: To respond to the question that I asked, the model that you would favour would be what, the integrated transmission system operator out of the three?

Mark Hanafin: I am not as familiar with precisely how that is working. Maybe David can help.

David Porter: First of all, at a high level I ought to say that we see the Third Package as being generally helpful in that it should improve security of supply. That, of course, does not happen unless you have some of the physical things developing. Your trading does not have a great deal of meaning unless you have more interconnection and so on, and at the moment some of the suggestions as to how to bring that about we are not entirely comfortable with. There has been a draft code for connections across Europe where the level of harmonisation that they are seeking has been, in our view, seriously over the top. I think you have to bear in mind that the EU in this regard is really following what we kicked off 20-odd years ago. We know here how to run liberalised markets and we are very conscious of the possibility that something being imposed centrally from Brussels may actually disadvantage us here if we had to follow it.

Q132 Barry Gardiner: Mr Porter, we do have to follow it by 3 March next year, don't we? We have to

implement one of the three unbundling strategies, do we not?
David Porter: Yes.
Barry Gardiner: So which one do you favour?
David Porter: I don't have a view on that at the moment.

Q133 Barry Gardiner: You are the industry spokesperson. Is that because your members have different views on this?
David Porter: Our members do have different views, of course, but what has concerned us, as an industry association, is the risk of something being imposed that would make the UK's market, which has worked so effectively, less effective. There was a proposal recently that we had to look at rather carefully, which we concluded would make it impossible for France to operate its nuclear power fleet. The whole thing was so clumsy in its drafting that it was almost laughable, but we are closely engaged—

Q134 Barry Gardiner: But that has not got to do with the unbundling proposals, has it, which is what I specifically asked you about?
David Porter: We don't have strong views on the unbundling issues. We feel that we have managed in the UK to run our market successfully in the way that we have and we want to be able to go on doing that.

Q135 Barry Gardiner: Therefore, you have no view as to which of the three models that will have to be introduced by March of next year might aid or deplete the energy security of the UK? You have no view on that?
David Porter: Not at the moment.

Q136 Barry Gardiner: Have you a view on how other countries may implement the unbundling proposals might have an impact on security of supply in the UK? Have you looked at the way in which they might choose one of those three to their advantage and our disadvantage? Please, if there are people behind you that can help then we are very happy to get it not from the horse's mouth but from the—
David Porter: We will do what we usually do when in a position like this at a Select Committee and offer you, Mr Chairman, some comments on that in writing afterwards as fast as we can, if that is acceptable to you.

Q137 Barry Gardiner: Thank you. That is helpful. The European Commission was of the view that national energy regulators alone and the existing advisory group, the European Regulator Group for Electricity and Gas—ERGEG, I presume—were insufficient to cope with the task of regulation at the EU level. Do you think that their response in setting up the agency for co-operation of energy regulators will actually do what it says on the tin and ensure greater co-operation between energy regulators? If so, what impact will that have on security of supply in the UK?
David Porter: It is necessary to do that, and I believe that it will eventually but we should expect it to take some time before an organisation like that can become a mature and effective regulator of the type that we are used to in the UK.
Chair: Unfortunately, I think we are out of time as we have another set of witnesses. There are one or two other issues that we had hoped to explore with you, so perhaps we might write to you on some further points, but we are grateful to you for coming in and we have had an interesting session. Thank you.

Examination of Witnesses

Witnesses: **Nick Winser**, Executive Director, UK, National Grid, **Steve Edwards**, Head of Regulation & Commercial at Wales and West Utilities, and Energy Networks Association (ENA), and **Steve Johnson**, Chief Executive, Electricity North West, gave evidence.

Q138 Chair: Good morning, and thank you for coming in. I think you have heard all or most of the previous exchanges and these are interesting and important subjects. May I start, as I did before, with a fairly general question? What would you say the biggest risks to the security of our energy transmission systems and networks are right now?
Nick Winser: In terms of just straightforward transmission we often forget, in our enthusiasm to, rightly, look at the future and moving to a low carbon economy, to review the assets as they are today. A lot of our transmission systems, a lot of the components date back 40 or 50 years. We are pretty busy already getting into asset replacement of those components. Like a lot of our national infrastructure, quite a bit of it is starting to get towards the end of its life. So, I think if you were to ask me what is the principal risk associated with transmission leading to a lower level of security of supply, straightforwardly it is probably the need for us to get on and replace the assets. We are working closely with Ofgem in the context of the next series of price controls to make sure that there is sufficient funding to get on with that.
Clearly at the moment we have, internationally, levels of reliability that Britain can be very proud of: 99.9999 is right up there. As far as we are concerned, it is all about keeping that level of reliability for our citizens, which they have come to expect. Looking forward, of course there are a variety of other issues coming out of decarbonising, in particular the electricity supply, replacing our indigenous natural gas with those new imports of gas through LNG and through interconnection from Norway. So we need to invest strongly in our systems to make sure that they adapt and are reliable with those new sets of energy inputs.
Steve Johnson: If I perhaps talk a little bit about the electricity distribution network. It is the part of the

network that takes electricity to people's homes. I would echo what Nick says; we should be very proud of the levels of customer service we currently provide. They are some of the best in the world. I think if I look at the threats that we are going to face in terms of security, they are probably linked to the move to a low carbon economy.

A couple of factors in that. Clearly, as you have already heard this morning, the advent of renewable energy, more distributed generation connected to my network, as opposed to the National Grid perhaps, is going to bring different demands on our network. Also, as we move to a low carbon economy, and perhaps the decarbonisation of heat and the decarbonisation of transport, it is going to place significant demands on the local network, demands that we have not seen to date.

If you think about our planning standards, when we look at domestic properties and we look at housing estates, we assume an average of about 1.5 kilowatts for that type of dwelling, which is fine for the type of environment that we live in today but if you roll forward to 2020 or 2030, when perhaps there is going to be an awful lot more heat pumps, there are going to be an awful lot more electric vehicles around the UK, that places a massive strain on our network. We can see with heat pumps, perhaps we are going to see 6 to 8 kilowatts of demand for perhaps six hours' duration, during the night, during the day; electric vehicles, depending on the type of charging, 3 kilowatts to 8 kilowatts again, perhaps for eight hours a day. That is a massively different profile.

There are two issues for us, I think, as a distribution company. One is demand-side management, and you will be aware of some of the discussion around that. Nick currently manages the generation to match demand, brings on generation to make sure that we can cope with whatever demand that is out there in the UK. In the future with the intermittent and the inflexible generation that we have, as people bring on more demand with the electric vehicles, with the heat pumps, we are going to have to see more demand-side management to match with generation. That is going to be quite a change for people in this country, and is an education process for everybody to go through. That is one element that we are going to have to look at.

The other element from my perspective is: can the networks cope with the increased load? At the moment I have to say we are spending in this five-year period about £100 million or so on network reinforcement. If the projections that we are currently looking at, and that DECC are looking at, in the next 10 to 15 years come to fruition, in the next regulatory period from 2015 to 2023 we may have to spend up to £1 billion on network reinforcement, simply because of the rollout of electric vehicles and of space heating. So that is going to be quite a demand for us, and demand-side management in the future will not just be about matching the demand to the generation, it will be ensuring that we have some control of the demand-side management to make sure that we do not overload the local network. So, again, that is going to be quite a change for us and something we need to think about if we are going to maintain the levels of security that we have had so far.

Steve Edwards: I work for a gas distribution company and probably face slightly different challenges to Steve in that we don't see a huge increase in demand on the horizon. I think most scenarios either have gas demand, annual and peak, slightly falling with a range of scenarios. So we are about to submit our business plan to Ofgem for the period 2013 to 2021, and the keys for the gas distribution networks are to ensure that we get the kind of no regrets investment funded at a reasonable rate of return.

The other area that clearly we are looking forward to working on is introducing more biomethane into the gas network to aid the indigenous security. There is probably not a great deal more to say on the transmission and gas distribution side.

Q139 Chair: Is there anything we can learn from what is going on in other countries?

Steve Johnson: We do look at what is happening in other countries, but certainly in terms of the move to a low carbon economy, while there are quite a number of companies that have a greater penetration of renewable energy, in terms of distribution businesses, which I look at, we are clearly doing a lot of work now looking at smart networks and what that might mean in the next five, 10, 20 years. There aren't many places in the world that are a great deal more advanced than we are. Certainly the work that we are doing now with the DECC/Ofgem Smart Grids Forum, which has just been set up in the last few months, is going to be looking at the kind of benchmarking that we are looking at around the world, but at the moment there is not a great deal more than we are currently doing.

Nick Winser: I think it is a great question. We should make sure as we go through these very significant times of change that we do look at other countries. China is obviously very interesting in that sense. In terms of shipping very large amounts of power around the country from very remote sources, although our distances are somewhat smaller we have the same general trend that the sources of low carbon generation are going to be further from where power needs to be used than the fossil sources that we are used to. When you look at China, they are very much rolling out DC and AC transmission systems that allow them to ship power from remote areas.

The other thing I think we should think about, as we look around Europe in particular, is how we connect up offshore wind, because we have a very different approach here to all of the other countries across Europe. I think I am right in saying all of them. We have here a point-to-point sort of arrangement where each of those point-to-point links are brought forward individually and in a contestable framework. Everyone else around Europe is trying to have an integrated approach to connecting up offshore wind. It brings greater resilience and greater economy, and is less disruptive onshore because you end up with less landing points for the offshore transmission system as it comes to shore. We think that probably would halve the number of places that you actually have to build facilities on the shoreline to bring in

offshore wind. So I think we should very much look at other countries in that and make sure that we are looking far enough ahead and being ambitious enough and making sure that we build an integrated solution to offshore, a solution that also links in with the need for a more integrated and more interconnected Europe as well, so linking in our approach to greater interconnection and bringing in that offshore wind. I think that is a huge learning point for us at the moment, and we are quite frustrated that as yet that does not seem to have got the traction as an idea that it will deserve.

Q140 John Robertson: Mr Edwards, I was interested to hear your forward planning. The plan you are going to put forward, was it 2013 to 2021?
Steve Edwards: 2021. That is correct.
John Robertson: That is really interesting, because when we asked the gentlemen that were in before you they couldn't do that. How are you going to have a plan when they don't have a plan to get the gas to you?
Steve Edwards: As a gas transportation company what we did prior to setting off on this journey was we commissioned a piece of work that complemented the DECC Pathways analysis and the Project Discovery analysis, which obviously gave a range of energy mixes and solutions over the next three or four decades. We expanded that out to 2050 and looked at costed solutions. So what we are looking to do out to 2021 is obviously look at the no regrets behaviours that we can carry out during that period. I think everybody acknowledges that beyond 2030 the gas in the mix or not, the success of renewables, nuclear, there are a lot of questions to be answered. Clearly, over the next 15 to 20 years as a gas distribution company we see a significant role over the transition period and possibly into the longer term. So what we are looking to do is obviously make sure that we invest to align that and also try to meet the needs of the environmental challenges, so to bring more biomethane into the network.

Q141 John Robertson: So that I understand exactly what you cover here, is your gas after the power station or to the power station?
Steve Edwards: Yes. We receive the gas predominantly from the national transmission system and the gas distribution companies then transport it to homes and small business.

Q142 John Robertson: So you would see a reduction in gas. Is that just on general terms due to people cutting back the use of, or is this due to works and buildings and homes being built that will not be putting gas into their homes?
Steve Edwards: I think it is a combination of many factors. There is clearly a drive for efficiency and there are clearly improvements in the housing stock, insulation initiatives there, but also people are now looking to alternative technologies as well to provide their own source of heat and power.

Q143 John Robertson: Why do you think that is? Do you think it is something to do with the fact that everybody talks about renewables and they don't talk about gas, and yet we have already been saying today that we expect basically a second Dash for Gas? Do you think there might be a change in attitude when people start seeing that there is more gas being used and, therefore, your predictions may be wrong, and if they are wrong how can you change them?
Steve Edwards: I think that is why we said we are looking to support the kind of no regrets decisions and that is why you are not seeing, probably in any of the gas distribution networks, huge expansion plans over the next 10, 20 years, but a lot of the investment is to ensure the maintenance of the infrastructure and the viability. I don't know if there will be a second Dash for Gas, but what I do know is that it has been the fuel of choice. It is reliable. It manages our peak demand effectively. I think as the previous discussion went ahead you are now not talking about the most cost-effective investment, you are talking about the investment that is acceptable within the policy guidelines and the environmental targets.
Nick Winser: Your question probably goes to gas transmission, really, because most of the power stations get their gas through the transmission system. Like Steve, in fact all of our networks go through periodic reviews with Ofgem on the transmission systems, on gas distribution starting 2013 right through to 2021. So we are all putting together those plans. Yes, you are right, it is a long period, it is a very uncertain period, but I think Ofgem are absolutely right to push us to put forward plans. Just because it is uncertain it doesn't mean you can't plan for it. In fact, part of what we will do in those plans is plan for the uncertainty. So we will put forward things that we know are "no regrets" but also flexible options, depending on how it looks like the energy scene is evolving over that period, which particular investments should we then bring forward, and we will be catering for all of that uncertainty in our plans. In terms of burning gas in power stations, we have two things going on in terms of gas transmission over this period: we have the continued decline of UKCS gas, so I think we will see more gas coming in through LNG and other of the newer importation facilities. We will also see probably that intermittency from renewables reflecting through on to the gas system, because when the wind doesn't blow we will see gas-fired power stations starting up to replace that wind. We are also seeing a much more volatile set of suppliers for gas that change from day to day, depending on whether they come from Norway, from Milford Haven, from Grain, from UKCS, from interconnectors. So, from a gas transmission system point of view, it is about catering for all that uncertainty and building not only the right capacity but a more flexible gas transmission system that is able to react more quickly to those changes that are going to be imposed on to it.

Q144 John Robertson: Will that flexibility be built into your future plans?
Nick Winser: Yes.

Q145 John Robertson: And you do have a long-term plan?

Nick Winser: Yes, we will be submitting to Ofgem, among many other things, a plan for producing a more flexible system, some extra investment that enables us to move gas around more flexibly and respond more quickly to changing needs for gas and changing sources of gas on a UK basis.

Q146 Dan Byles: We are all aware of the enormous investment challenge that is required to ensure the resilience of our networks going forward. How confident are you that that investment is going to come through in the timeframes that DECC are assuming?

Nick Winser: This is a great time to ask this question, for exactly the reasons that we were just discussing. We are just about to engage fully with Ofgem on all of our plans for the next eight years. That is something we are paying huge attention to. It is absolutely up to us to demonstrate very clearly the need for that investment and give Ofgem the confidence in providing funds for that investment. That is a critical moment, and we look forward to that debate going through to the end of next year.

The other key thing that I would focus the Committee on would be planning. A lot of the investments on the transmission system are significant. We are in the early stages engaging with the planning process laid out in the Planning Act 2008, getting timely decisions on what is the right balance between the various different ways that we can connect up these low carbon sources of generation, and indeed building gas pipelines. That is going to be very important. We know that legitimately these are significant investments; they have significant impacts on society and on individuals and communities. We know that we must have a deep and serious discussion with individuals and communities about that balance between the good of the overall energy system and the impacts we will have. That takes time, and that time should be allowed and it is allowed, and we will do that very professionally. Having gone through that, we will need timely decisions because the timescales that we may face to build major new links start to get into a length that if they dragged on we might not be in time. So we can easily see timescales of five years to get major new links built, to go through the planning process and then to go through construction. You can imagine that starts to be towards the longest you could tolerate that being in the decision-making and construction process.

Q147 Dan Byles: How resilient are these plans to the possibility that it simply might not be an attractive investment for international capital? People who are looking to invest tens of billions of pounds in these sorts of projects might rather put their money in India and China and Brazil; why would they come to the UK? We have discussed this quite a lot. We know that DECC are confident that they will attract this level of investment, but it seems to me that it is a huge risk in our plans going forward, that if even a small part of that investment does not come forward we are not going to be able to do a lot of these infrastructure changes that we are saying we have to do.

Nick Winser: Just narrowly, on the transmission and distribution systems, of course they are regulated assets, so as long as we can mobilise the supply chain in time, we can get through planning and we get sensible discussion and decisions from Ofgem, we should be able to deliver our part of that. The broader question you are asking, which is one about, "So, Nick, you may well have built the link but the power stations hasn't turned up", that is all about market reform and making sure, as the Government are at the moment, that we have a commercial system that encourages international capital to come and be deployed on these projects in Great Britain.

Steve Johnson: I will perhaps add to that. I think there are two aspects to funding, certainly from a distribution point of view. One is, quite rightly, a discussion with Ofgem about the funding requirements and the investment we need in our network, and I touched a little earlier on the reinforcement needs, certainly on the distribution networks. We are going to have to change the way we look at that. Quite rightly at the moment we have to demonstrate to the regulator that this system is fully loaded, if not overloaded, before we get investment to upgrade the network. If that continues I can see certain parts of our network being a bottleneck, in terms of people wanting to bring on extra load or perhaps even distributor generation. So we need a debate with Ofgem about perhaps funding some reinforcement slightly ahead of need and a new mechanism to make sure that that is still done efficiently. It has to be done efficiently.

I think the point you are making is that, once we have agreed with Ofgem what our funding requirements are, we still have to access the debt and equity markets to make sure we can fund our investment. Again, we are having those debates with Ofgem. I think some of the early discussions when they were first looking at RIIO, we had some concerns that perhaps this regulatory environment wasn't going to be as attractive to the equity markets as perhaps it should be. I think your point is absolutely right. There is going to be huge investment in infrastructure right around the world in the next 10, 20 years, and certainly the investors that look at our kind of business are global investors; money does move. So I think, first and foremost, we have to make sure that appropriate returns are there for debt and equity investors and it is appropriate so that we can compete for that scarce resource on the international market.

Steve Edwards: If I could echo the comments that Steve made on the distribution side. The new form of regulation is about delivering outputs and, quite rightly, a greater stakeholder engagement, which we welcome, but for that we must have an appropriate rate of return because, as Steve has said, like ourselves our investors are global and they have choices.

Q148 Dan Byles: I believe that the Government's ongoing Climate Change Risk Assessment is due to report in 2012. Have you had any input into that, and in your view are they dealing appropriately with the risk to energy security from climate change and the impact that climate change is going to have on the resilience of the systems?

Nick Winser: Yes. We are certainly involved with that process, assessing all of our assets from essentially two things: flooding risk and higher temperatures. Those assessments are going on. Our systems are built with some redundancy and resilience included in them anyway. There will certainly be things for us to think about in the future design of the system, and we are incorporating those but we would expect to fully account for how we see those risks and how we expect to respond to those in the discussions that are going on as part of that process.

Steve Edwards: To add to Nick's point: one thing that we clearly look at in climate change is a change in behaviours winter to summer. So if the weather is going to become more peaky in the winter and the new boilers require a different start up, then we are clearly trying to keep an eye on localised changes in that behaviour to make sure that our system is capable of dealing with those changes.

Steve Johnson: Similarly, clearly, we look at local changes in demand, depending on what the weather patterns are but, like Nick, our main focus has been on the impact of flooding. We have been looking at that for some time and during this five-year period we are already investing in flood prevention measures. I am sure that, along with the rest of the industry, we will continue to look at that and the discussions we have had with Ofgem to date on that have been very useful.

Q149 Laura Sandys: In many ways the last session and this session is all very concerning, not from your perspective but from where this country's energy security lies. We have a long-term investment model and in many ways an energy supply sort of vision, which is low carbon, high renewable, and so on. From our investigations, not just on this particular subject but right across the board, there is this problem about the next 10 to 15 years, whether CCS comes on board, nuclear, and so on. I am very concerned that we have a long-term investment objective, which is specified by the Government at £200 billion, right across the whole of the energy sector, but that it looks as if we are going to have to make an additional, very short-term investment on Dash for Gas, securing some of your transmission processes, making the current model robust enough to get us through for the next 15 years. Do you see that that short-term investment will undermine, in many ways, the long-term investment and that the cost of uncertainty is also going to impact the investment profile in the UK?

Nick Winser: In terms of the amounts we will have to spend on our transmission and distribution systems, there was an amount in the £200 billion that related to that.

Laura Sandys: £32 billion?

Nick Winser: Yes. So whether that is a good number, it is probably—

Q150 Laura Sandys: The question in a strange way is that £32 billion is about the big vision, is about this low carbon, totally new and innovative system of energy security and energy supply.

Nick Winser: Yes.

Laura Sandys: What strikes me is that we have this interim period that will also require investment. It is a step change but it will absorb investment, it will take focus away from the bigger vision and, as my colleague Dan Byle says, is that money there ready for, in some ways, the sellotape that we need for that 15-year period, or will that be seen as in many ways redundant investment?

Nick Winser: I think that the assessment of £200 billion—I very much agree with your point—included how to get in a straight line towards our goals, and that was a sensible assessment. Picking up on the previous panel, to the extent that we can't roll out, as an industry, nuclear, wind, CCS in the timescales that most of the models predict, it is difficult to see what will replace that, other than more burning of gas for electricity generation, and that is what we would expect. There is a very substantial amount of gas-fired CCGTs that already have connection agreements that can come forward and are going through the planning process. To the extent that we need to do a dog leg on our way rather than a straight line, and there are a lot of gas builds that will involve extra spend on the network because we will be connecting up plant that ultimately is not the plant that is going to meet the targets all the way through, part of our job with politicians, the industry, is to try to minimise that dog leg and try to move as smoothly and efficiently as we can to the set of assets that we need right through 2020, 2030, 2040 and 2050.

Steve Johnson: Certainly from our perspective, we do tend to look at things I guess in the next 10 years and then 10 years beyond, and as far as the distribution companies are concerned there is quite a bit of work that is going on now that is planning for the future. So Ofgem established the Low Carbon Network Fund as part of this current price review, and that is extremely useful because it enables network companies to look at smart networks, whatever that may mean in the future, look at innovation, planning for 2020 and 2030, but it is discrete projects. The learnings from those projects will be shared right across the industry and will enable us to plan the investment in the next five, 10, 15 years. So I don't think that is sunk investment; that is very sensible investment in innovation and new thinking.

As Nick said, the move to a low carbon economy will not happen overnight. It is going to take some time. So I think we do have a little bit of time, certainly as far as the network companies are concerned, to get it right and to think about what smart technology means. I think some of the issues we do need to think about are, as I mentioned earlier, the demand-side management, and how do we actually start talking to our consumers about what it might mean for them in the future to have the smart technology. Again, there are trials that we are undertaking at the moment to try and think about that. The vast majority of our investment over the next five to 10 years will be the traditional type of investment that we have always done. It is just these trials are going to be very important for us and will start to lay the foundation for the investment that needs to come in the next 10, 15 years, as we start to see the introduction of the move to a low carbon economy.

Nick Winser: There are some elements that are not already deployable, which are worth thinking about and I think worth the Committee considering. We have a traditional model of research, development, demonstration, deployment, and we focus a lot on deployment, but part of minimising the regrets and moving as smoothly as we can to the right sort of plant is making sure we are paying attention to things that need research now to bring them through, things that need development, things that need demonstration. So the current discussions around trying to build demonstrators for CCS are terribly important. That technology isn't yet mature enough for deployment. It needs demonstration. That is how we will prove the economics of it and find out whether it is going to play its part in 2030 onwards, which is probably where that technology will significantly help us get to the targets.
So it is not just about the deployment phase. It is about looking at all the phases of maturity of technology and making sure that those earlier phases are encouraged and there is money to take those phases forward, and that comes back to the whole question of funding and attracting capital, both into the regulated area and into the competitive area of the market.

Q151 Laura Sandys: Do you believe that we will attract the right level of investment, and what would be the energy security impacts if we don't?
Nick Winser: Steve spoke eloquently of the need for Ofgem to make sure that the regulatory returns are attractive to international investors for the contestable part. It is about EMR and delivering a satisfactory package that will bring forward investment. That will tend to focus on the deployment end, though. There may well be the need for demonstration and research to get different types of encouragement, and of course we are seeing the Government come forward. I am very encouraged the Government is seeking to come forward with amounts of money to fund demonstration projects on CCS, which are outside of the EMR process.

Q152 John Robertson: I am interested in the problems of looking ahead and planning, which were referred to earlier. Can you tell me the cost for the Beauly Denny line when it was planned compared with where it is now, still not completed?
Nick Winser: That is obviously not our line, in that it is being built by SSE and SP. So I don't have those numbers in my head.

Q153 John Robertson: I raise it simply because it is an example of where your planning goes out the window; something that was planned 10, 12 years ago, probably even more, and still isn't in existence, and you meet a planning regime that stops you from building. So my question, and I am being a bit parochial here, is does devolution help you or does it hinder you when it comes to doing the grid itself? We have more than a fair share of wind farms in Scotland and Mr Salmond has made a big thing about how we are going to be the renewable capital of the world, and yet I don't know where the money is coming from to get this renewable energy on to the grid to where people need it. Who is paying for this and have you planned for it?
Nick Winser: There are some curiosities around how to plan across Great Britain.
John Robertson: Curiosities; we have been talking about them for years up our way.
Nick Winser: So we remain supportive of the Planning Act 2008. It applies to England and Wales.
John Robertson: Yes, but it doesn't apply to Scotland.
Nick Winser: Scotland has its own planning framework that does similar but slightly different work, and I wouldn't seek to compare the two.
John Robertson: Okay, but remember that Scotland is an exporter of energy to the south of the border. You would quite like that energy to keep coming that way, so you have a vested interest in ensuring that it does.
Nick Winser: Certainly, I would like to see the planning regimes, both in England and Wales and in Scotland, work effectively, allow the right consultation and listening to individuals and communities, but then come to a timely decision and be delivered. I think that is in the interest of customers in Britain, so I would like to see them both work very well. There are other curiosities there. Although the Planning Act 2008 applies to England and Wales, it does not apply to specific sites in Wales so we still have to go out, separate from the IPC process, or what will be the MIU process, and look for consent at substations where our lines are switched with other lines. So we do have quite a complicated backdrop. From our perspective all of that can work but we need to see it work otherwise we will struggle to deliver the infrastructure.

Q154 John Robertson: I would be interested to know how much money is wasted on fighting planning applications. How much money do you spend on that and how much time is wasted on planning applications that are opposed and then eventually go forward?
Nick Winser: It is difficult to say how much is wasted, in a sense, because I think the sense of that word is if we put something forward and it is rejected that that was wasted, which I would not immediately agree with. I think it is very important that we take part in this process where the needs of the overall system can be balanced against the needs of individuals and communities. So sometimes, I am afraid, we do have to accept that the answer will be no and we need to regroup and come back with a different set of proposals. I am not being facetious but I think there is bound to be—

Q155 John Robertson: Let me interrupt you there, because you are now getting into the same game as our previous speakers got into, "Let's prevaricate as much as we can". You know that the locals will object to a set of pylons because they don't want to see it and they don't want it there, and you know if you put it underground they will accept that but it will cost more. How much money do you spend in the planning process to fight these objections, whereas if you put

in the higher cost grade cable in the first place you might have saved money? Do you ever look at that and think of these things? We are talking billions and billions of pounds here, and yet I can bet you that is not part of the money that has been put aside in that £200 billion.

Nick Winser: The difference in the capital spend to do the job in the different ways that you have said, is very, very large. It costs an awful lot more money to put all those cables underground than to put them overhead—an amount that you could never spend on going through the planning process. You are comparing figures on some of the projects that we are looking at at the moment of £100 million plays £1 billion. It is absolutely right that we should have legitimate and sensible debate about what is the right way to balance the interests of local people with the overall interest of the system. What we need to do is then make sure that, having had that debate and done a great job of consulting and amending our plans to try to get the best balance, we then get clear decisions so that we can move on.

Q156 Chair: I think we are going a little bit further from the security issues than we need to. I have a lot of sympathy with the arguments being put by my colleague and have addressed these myself with National Grid from time to time, but could we come back more directly on to the subject of the inquiry.

Can I talk about intermittency for a little while? I think that all the Government's plans seem to include a greater proportion of intermittent sources of renewable energy, notably wind. Would you like to say—I think this is particularly for National Grid—what effect this is going to have on how you have to balance the system in future?

Nick Winser: It is going to have a profound effect. The system will be a very different system to run. We are already looking at that, and have been looking at that for some time. We will have to change the way we run the system. I expect us to be able to do that. It is our job to respond to the need to accommodate very valuable low carbon energy on the system, but it will be a very different system to run. So if we do end up with 30 gigawatts of installed capacity of wind you could easily see variances on a day-to-day basis of 10 gigawatts, 15 gigawatts. We will need to be able to forecast clearly, very accurately, what are the wind conditions, and if there are other types of renewables what conditions are likely to pertain to them on the day, and make sure we deploy both our technical skills and our commercial skills to make sure that there is back-up plant that can run. So it is an issue for us, in terms of how we design our networks, to design in flexibility. It is an issue for our control room systems and it is an issue for market design, because the market design needs to make sure that the right elements, an appropriate amount of back-up, is available when the wind doesn't blow as an example.

Q157 Chair: Let us be blunt, and you have said it is difficult to switch to underground transmission systems on grounds of cost, but the truth is that dealing with a huge percentage of intermittent sources is going to greatly increase the transmission cost.

Nick Winser: I didn't say it would greatly increase the cost. I said it would be a very different system to manage.

Chair: It is going to be more expensive, isn't it?

Nick Winser: I would expect balancing the system to increasing cost with the greater amount of intermittency on the system. That does not necessarily mean that that is not the appropriate and economic solution to providing security of supply and hitting the low carbon targets. That will be a cost of hitting low carbon targets.

Q158 Chair: I understand that, but you have explicitly rejected the opportunity to prevent environmental blight on communities by overhead transmission lines on grounds of cost. But you are saying that it is okay to accept much more expensive transmission cost because of the need to cope with intermittency?

Nick Winser: No, we haven't explicitly said that we won't underground lines. As I think you know, that is not what we have said at all. What we have said is that we will go through a process of consultation, as we are obliged to do, rightly, under the Planning Act 2008; we will look at sites of environmental sensitivity; we will listen to individuals and communities and their views and, with Government, we will try to strike the right balance between individuals understandably not wanting their visual amenity affected and the costs, which are quite significant, of undergrounding. We haven't been through the whole of that process on any of our proposed lines, including the one close to your heart. That will play out over the next couple of years and we will try to do a very serious and responsible job to get the right answer for society.

Q159 Chair: I accept all that, but I am interested in the comparison between these two things. You have said we have to go through all this process to decide whether it is okay to spend a bit more money on undergrounding, but we appear to be assuming, taken as a sort of given, that because we are going to have more wind, particularly offshore wind with all the intermittency that that implies, that we are going to accept without any debate at all the fact that costs much more to transmit.

Nick Winser: We have binding environmental targets for the UK that we are doing our part in trying to hit. Part of the reason that you will see consultation papers coming out from National Grid, as well as from DECC, on the future design of the market and how to balance the system is that we are seeking views from stakeholders as to what are the right ways of balancing the system. For example, in National Grid we have just commissioned the new interconnector to the Netherlands, which will provide the opportunity for power to flow in and out, to try to balance. We have three other plans to connect, again to France, to Belgium, to Norway. They form a great opportunity in themselves to provide balancing services, perhaps at a cheaper level. So it is important not just to look at low utilisation fossil plant as balancing, but to look at demand management, to look at greater interconnection, to potentially look at energy storage,

and so minimising those costs you are talking about is absolutely something you should expect us to be doing.

Q160 Chair: I agree with all that, but as a consumer one might think if there are reliable sources of low carbon electricity, as opposed to intermittent sources—and by reliable sources we might include nuclear, we might include some forms of energy from waste, we might include tidal, all seem to be reliable—that we should, at the very least, factor in any extra transmissions costs that may be caused by relying on intermittent sources, that the extra transmission cost should be thrown into the overall equation.
Steve Johnson: I guess it is not just the transmission costs. It follows on from what Nick said. If the future is far more renewables and far more wind and intermittency, there will be a whole strategy to mitigate that. It might be low fossil fuel plant waiting to come on line; it may be storage; it may be interconnection to Europe; it may be demand-side management. I guess when we look at the future strategy for energy security in the UK, all of that needs to be taken into account and there will be a cost overall of moving to a low carbon economy.
Chair: Many of those sensible strategies do involve a cost.
Steve Johnson: They do.
Chair: I am saying we should factor in that cost, which would not arise if we built more nuclear or more energy from waste, or maybe even tidal. That may be at the moment more—
Nick Winser: That is being done, of course, because as Ofgem looks at their Project TransmiT, which is all about allocating transmission charges and who should pay, those types of costs are obviously able to be looked at as well as the costs of just providing the hardware, and have been looked at a number of times.

Q161 Chair: Is it the case that National Grid have recently paid wind farms not to generate power on very windy days?
Nick Winser: Yes, it is. Over the years we have paid gas-fired plant not to generate at some times, coal-fired plant not to generate at some times and nuclear plant not to generate at some times. That has been happening for the last 21 years. That is the way that the market has existed for that period. Built into the market arrangement there is a compensation where you can't generate because of a lack of transmission infrastructure. We work very hard to minimise those amounts by investing sensibly but vigorously in the transmission infrastructure, and those amounts of money have been managed very, very vigorously over the 20 years and we have driven those down very strongly. It is right, ultimately, that an economic balance is struck between building a completely unconstrained transmission system, where every bit of generation could operate at any time in any combination, which costs money itself to build more lines, and occasionally paying generators to not run when, for a period, there is not enough transmission capability. That is an economic balance that should be struck and is struck.

Q162 Chair: Nevertheless, would you not agree that the public might think that to pay offshore wind farms a huge extra subsidy to make it worthwhile generating and then to pay them again, if it is too windy, to pay them not to generate, is a lunacy that borders on the Common Agricultural Policy?
Nick Winser: We are vigorously tackling that. We have brought forward, through anticipatory investment with Ofgem, plans to substantially reinforce the transmission system from Scotland, building new transmission links from Scotland to England and Wales. We obviously have the Beauly Denny being built. We have plans beyond that to reinforce the network to make sure that it can always shift the low carbon resources that are going to be so valuable for us. So we are working very hard to increase our investment on the system to make sure that those valuable low carbon megawatts can be used as much as they can. Of course, interconnecting more to Europe also gives the opportunity for some flexibility, that when we have more low carbon energy than we can use it can be absorbed into Europe and displace fossil plant in Europe.

Q163 Dr Lee: As it stands at the moment, there is a possibility that we could be paying the wind farms not to generate at the same time as importing gas?
Nick Winser: Yes.

Q164 Chair: Is there anything the network operators could do to alleviate this situation?
Steve Johnson: This particular situation?
Chair: The problem we are talking about: excess power and paying people not to produce it.
Steve Johnson: It would be difficult because I guess it comes down to constraints on the transmission network that Nick is talking about, and of course we are on the distribution network. So I doubt in this case the distribution networks could help with that particular issue.

Q165 Laura Sandys: Would increased storage capacity assist?
Nick Winser: Certainly energy storage is a very attractive option.

Q166 Laura Sandys: Should we not be paying to create that storage rather than paying them not to generate?
Nick Winser: Siting energy storage next to wind farms is, in my view, a very attractive option. There are some great technologies that can be brought forward, and are being brought forward, to allow low carbon energy that is not either needed at a particular time or able to be transported to be stored and then released. I think when we see the investments out on the Dogger Bank for offshore wind, if we have an integrated system out there, rather than point-to-point links, we should very much expect to see the incorporation of very substantial energy storage. That will minimise the amount of transmission links we can build. It will make sure that we get absolutely maximum value out of those low carbon megawatts. So, energy storage is going to be a very important part of the picture.

Q167 John Robertson: Some of the things you said there are just unbelievable; to pay something to buy from somebody else seems absolutely ludicrous to me. Are we not throwing a lot of money into this wind stuff, just purely throwing bad money after bad in a product that doesn't even give us much of a supply? During the coldest spell in Scotland this year we got less than 1% of power coming from wind, and yet we were supposed to be getting at that point in time something like 17%. Is this not a waste of money and do we want to put all this money into this basket, where we have a future where we may be somewhat short of gas when we are going to need it? Should we not be looking at storage for gas, should we not be looking at the transmission from gas power stations and from the new power stations that hopefully will come along? A lot of the new power stations will need new transmission because they are much bigger than the old ones that were built in the past. I know it is flavour of the month that we talk about renewables and everybody wants to be nice and carbon friendly, but—and I declare an interest as Chair of the Nuclear Energy Group in Parliament—I find it absolutely ludicrous, absolutely ludicrous that we are spending this kind of money on something that, when we really needed it, didn't work. It is not the first time it hasn't worked in cold spells when we have been desperate for energy, and nearly got to the stage of putting the lights out. I just find it absolutely crazy that companies such as yourself are not using the power that you obviously do have, and put it in places where it is absolutely needed and where you are going to get a return for your money.

Nick Winser: In my view it isn't ludicrous at all. I believe that the picture that we have described, of very substantial increases in energy efficiency, substantial increases in distributor generation and then a blend of renewables, nuclear and CCS, is absolutely the right target for us. Renewables definitely, in our view, have a significant role to play. In our view, it is likely that it will be about a third, a third, a third. The great thing about renewables is that this is something that is deployable that we can move on now. There are obviously significant timescales and barriers to overcome to deploy nuclear and CCS. So building a significant amount of renewables now seems to me to be a very rational response to getting secure, affordable and low carbon sources.

I think we have to change our mindset about intermittency. We had a mindset, because we relied so substantially on fossil fuel, that we only admired a particular way of creating energy if it was necessarily going to be there at the peak. That, in my view, is an old fashioned mindset and we need to move on from it. In the future we need to recognise that low carbon energy is going to be very valuable; we need to adapt our systems to have enough transmission, enough energy storage to change the characteristics, enough ability to flex demand, so that we can get the best out of sources of low carbon energy, which may not be there on the peak. We need to move on; we need to change our mindset.

John Robertson: People have been known to disagree with me, I do appreciate that, but I have to tell you this: the taxpayer has to foot the bill here and has to pay, and what you are requesting and what you are saying I don't believe we can afford.

Q168 Dan Byles: We are moving towards a much greater electrification of the heat and energy sectors. What is the impact of that likely to be on the transmission systems and the distribution networks?

Steve Johnson: I think I alluded to this a little earlier, and certainly from the distribution network point of view it is going to have a significant impact. If we look at the DECC work that has been done in the past, there is perhaps up to a doubling of the electricity consumption in 20 to 30 years' time. Certainly from the distribution network's perspective, that brings a profound change to the way we operate. We have been operating, I guess for the last 100 years, a fairly passive network. We are going to see a distributor generation connected to that network; we are going to see electrification of transport, more electric vehicles; perhaps electrification of heat, as I alluded to earlier; and that significantly increases demand on our network. So there are a couple of responses to that that we need to think about.

Clearly, there is a lot of investigation going on at the moment into smart networks and how we manage the demands on our network and the different energy flows in a different way. Demand-side management—as I have mentioned a couple of times this morning—is going to be increasingly more important and we should not underestimate the challenges that will bring. We are running a couple of trials at the moment on demand-side management but it is with commercial customers, fairly easy to engage with and they are used to having discussions around their energy. When you talk about demand-side management with domestic customers, which we need to get to, that is going to be far more difficult. So some trials on that in the future will be very important. Then, of course, there is the reinforcement aspect that I have talked about a couple of times today. That is something that is going to have to be addressed over the next few years. The role of the distribution companies may have to change, in that we may have to look at some local balancing and managing of energy in a way that National Grid does on a national level. Those are all things that we need to think about over the next few years and things that we will be talking about with DECC and Ofgem as we go forward.

Nick Winser: From a transmission perspective, we have talked about some of the principal issues already: the need to invest, to make sure that that additional demand that is moving on to, hopefully, a low carbon electricity system can be met, and that the intermittency can be dealt with. The other thing to reference, which comes back to John's point probably as well, is all about the role of gas in the system. We do see a significant continuing role for gas in the system, which will enable us, we think, to balance those low carbon sources economically, to continue to provide—to your point—a fair amount of the space heating through gas that will mitigate some of the cost that would come of electrifying all of that. It will mitigate some of Steve's costs, in terms of not making him quadruple the size of the distribution system but

perhaps just double it. Steve, you may want to pick up on the savings of costs that that would lead to.

Steve Edwards: Yes. You asked the question about the impact on the network and transmission. There is also the impact on the end consumer. That is exactly why part of our role now, we feel, is to make sure that we participate in the debate, provide transparent, open, costed scenarios going forward, as we did, to make sure that the policymakers have all the objective evidence to satisfy John's questions, to make sure we are not selecting technologies that don't provide value for money and the best solution in regards to the environmental targets, security and the cost to the end user. Quite clearly, full electrification would bring us a really big stranding issue for the gas distribution networks.

Our role is to try to bring the evidence to show what appropriate energy is appropriate for the right part of the country. There are many people just off the existing gas network, for example, on oil or coal, but the most appropriate solution, from environment, security and cost, is actually to slightly extend the gas network. For other communities who are well away from the network, quite clearly there will be a different solution. So I think part of our role is to make sure that we get the appropriate technology to the appropriate part of the country.

Q169 Dan Byles: What about the regulatory regime, is there going to be a need to change the way we regulate?

Steve Edwards: I think most definitely what we have seen obviously now is a move from the RPI-X basis, which acknowledges it is not just about squeezing cost; it is about encouraging investment, looking at the new obligations that both the regulator has and the networks have, looking at the environment, and looking at security. We do need regulatory commitment. We are engaging with our stakeholders to define the outputs—it is in its infancy—and we will find out now, over the coming weeks, months and years, whether the new regime will promote exactly the behaviours that we want.

Q170 Dan Byles: Do you think that industry and Government are engaging enough with the end users about the changes that are going to have to happen? When we talk about demand management, I sometimes get the feeling that Government and industry and academics are all very geared up for this but nobody is really having that discussion with Mrs Miggins at number 32 about the way she is going to have to manage her household.

Steve Edwards: The others will comment in a minute, but we have just gone through some stakeholder engagement and asked this kind of question, "What do you know about smart meters? What do you think about ground source heat pumps?" They don't have a clue what is going on, and there is a lot more to be done in comparison to, say, the digital TV move. So I think there is a lot more to be done.

Steve Johnson: I think it is going to be one of our biggest challenges, to be honest, and we haven't started yet to a large degree. I think the debate has all been about renewable energy and about generation. It is now moving on to what does that mean for networks. But, as we have heard quite a bit this morning, it is really going to mean a change in behaviours for the general consumer and it doesn't just stop there. We have to have some consistency and some correct standards for vehicle manufacturers, for appliance manufacturers. We have to have smart appliances, because in the future if demand-side management is going to work, by and large once the customer has agreed that it can happen it should happen without their intervention. There is a lot of work we need to do as an industry and beyond the industry in thinking about that and, as I have said before, trialling some of these procedures and processes in the next few years.

Chair: I think we are out of time. Thank you very much indeed for some very useful answers and we look forward to continuing this debate with all of you.

Wednesday 15 June 2011

Members present:

Mr Tim Yeo (Chair)

Dan Byles	John Robertson
Barry Gardiner	Laura Sandys
Dr Phillip Lee	Sir Robert Smith
Albert Owen	Dr Alan Whitehead

Examination of Witnesses

Witnesses: **Dr Gordon Edge**, Director of Policy, Renewables UK, **Gaynor Hartnell**, CEO, Renewable Energy Association (REA), and **Graham Meeks**, Director, Combined Heat and Power Association, gave evidence.

Q171 Chair: Good morning and welcome. Thank you for coming in. You have probably seen what we have done so far in this inquiry. Could I start with a general question about how big a contribution you think distributed energy can make to the total generation need in this country?

Graham Meeks: Thanks very much, Chairman. Thanks very much for the opportunity to give evidence to the Committee. My name is Graham Meeks; I am representing the Combined Heat and Power Association, so I can speak for Combined Heat and Power and perhaps my colleagues can give a better perspective on some of the renewable technologies. We have been very much guided by the analysis that Government itself has done on this over time. The last official communication, which was a statutory obligation to the European Commission in 2007, estimated something around 16 GW—16,000 MW—of combined heat and power capacity, expressed in terms of electrical capacity, was economically viable in the UK. That pretty much equated to analysis that Pöyry, the consultants, had done for Greenpeace looking at CHP or major industrial installations.

A couple of conditions around that figure; if we were to have far more widespread use of district heating in the UK providing heat into urban concentrations, then that would give the potential for a much greater CHP capacity. That wasn't really modelled because it was highly conditional upon that other factor. I think the other thing that that analysis did not take into account was the potential for micro CHP, which, at the time the analysis had been done, had not shown up and proven itself as a potential customer proposition. There is now something like 750 units in the field and the Carbon Trust have estimated that micro CHP may be suitable for something like 8 million homes in the UK. I would say that the potential from combined heat and power in its various forms is fairly significant. We are talking there of something between 10% and 20% of UK electricity supply on that sort of data.

Gaynor Hartnell: To answer the question in terms of electricity—and correct me or say if you want to elaborate on other forms of energy—a study was just published for the renewables obligation banding review, which is quite helpful. They had three scenarios there and the scenario with the constraints lowered shows that we could have well more than 30% of our electricity from renewables by 2020 with those constraints removed. So I think the answer is that we are not resource constrained. It is really a question of how much we get the policies right to encourage investment, how much that investment may be there and so the outlook is good provided there is the right framework for the industry to respond.

To put that in figures: this study was done by Arup, and we may feel that some of it is underestimated anyway, but it estimates that around about 200 TWh of renewable electricity could be available with constraints relaxed by 2020, and to meet the 2020 renewable electricity element of the target, which is 30%, would require about 120 TWh, so it could well exceed that.

Dr Gordon Edge: To add to that; essentially the amount of distributed renewables you can get is not limited by the resource. It is merely a matter of timing and, for instance, we estimate that the small wind scale, there may be as many as 4 million properties in the UK that could host a 10 KW scale wind turbine. We may get 600,000 of those at most by 2020 but there will be a further growth beyond that, so "when?" is an important question when you ask the question about the amount of distributed resource you can get. It also depends on where you draw your line. If your line is generation that is connected to the distribution system in England and Wales, 132 KV or below, that can be some very significant generation. Some offshore wind farms are connected at the distribution level for instance, so it kind of depends what you mean. Of the numbers that Gaynor was talking, it is only large offshore wind farms and large wind farms essentially in Scotland onshore that will be connecting at the transmission level and therefore would not be counted in those numbers.

Q172 Chair: If we have lots and lots of distributed generation, are there any difficulties about the distribution networks at that point? Obviously we have talked about large ones but we have lots and lots of small ones. Does that pose any problems?

Dr Gordon Edge: We need to invest in smart grid, the control architecture at the distribution level. I think there is an argument for having distribution system operators in the same way as we have the transmission system operator, the national grid. It takes that role for the high voltage networks. The individual DNOs, I imagine, in the future, when we have much more distributed generation connected, when we have more demand response on those systems that they will need to take that role as well as having major investment,

both in the hardware and the software with which to run it.

Gaynor Hartnell: There is an issue in terms of infrastructure on the distribution network being needed. I understand the estimation is about £8 billion, estimated by Ofgem till 2020, to meet the environmental expectations and targets. That is a small component of the overall £200 billion that is often mentioned.

Graham Meeks: I think what I would say is "it depends", and it very much depends upon the nature of the generation capacity that is connected to the network and, to some extent, where it is connected as well. You have a mix of types of plant connected to a distribution network that have different operating characteristics. You may have plant that is quite readily despatched to be able to manage constraints on the network. You may have other plant that has less flexibility but certainly disconnects if it is required to do so. What I would say is that if we look at other international examples- if you look at Denmark, for instance, which at the moment has 21% of its electricity generated from wind, of which a major proportion is onshore and I guess analogous to distribution connected wind here in the UK- Denmark also has 50% of its electricity supplied by co-generation CHP plant. A large amount of that is connected to district heating networks where they have that infrastructure. That combined heat and power plant is now despatched to help manage any impacts from that higher penetration of wind, and the system operator deliberately operates despatch strategies and incentives; puts the incentives in place to permit that type of flexible operation. So it is looking at the resources that it has available to it and the synergies that exist between those different parts of the system, and is operating to make sure they are complementary rather than conflicting with the needs of the system and, indeed, the attributes of the different technologies themselves.

Q173 Chair: Do you think, if we have more distributed energy, that is going to improve our security position?

Dr Gordon Edge: I think when we talk about security in this context we need to be very careful that we take apart two separate concepts. Security is the macro security level: do we have enough of these resources to meet our anticipated demands? Then there is reliability, which is more technical, which is about: when I flick the switch will the light come on? Obviously, there is some relationship. If you are insecure, there may be a situation where you flick the switch and it doesn't come on because you have not planned ahead far enough, but there may be situations where you have an unreliable supply when it is perfectly secure in that kind of political macro sense. So it may be that having more distributed energy allows you to have more security in the first sense of the term, but if not carefully managed it may impact on the reliability, where we think the reliability is perfectly manageable but you need a different approach; it is a different thing that needs attention on a different scale, but you can have both.

Gaynor Hartnell: I would add or answer it in maybe a very slightly different way and say that if the question is partly about intermittent renewables or variable renewables, by definition, adding more intermittent renewables to the system can only make it more secure. The thing that makes it less secure is if you then take off other despatchable plant, thinking that you are safe because you have more intermittent plant added. So it is a question of what you choose to take away rather than what you add to the system that impacts on security.

Q174 Laura Sandys: The issue about security is also about price too, and in your responses none of you has mentioned affordability. I think that is obviously crucial to the security from the UK consumers' perspective.

Graham Meeks: Absolutely and I think part of the issue—and I am sure we don't need to tell the Committee this—in addressing the question of security of supply, there are many different pictures of what security of supply is in people's heads; it is the people who you ask the question of. I think it is one of the things we have been focusing on, in the discussion about reliability of the electricity system, in some of the comments that my colleagues have made. Of course, security of supply is a much bigger question than that and part of that is around the amount of resource that we import, the amount of imported energy that we have, and then with that the quantum of the exposure that we have to international energy prices, which then leads into this question of price.

One thing I would say is that if we are employing a far higher degree of energy efficiency—resource efficiency, if one likes—then of course we are mitigating the overall effects of any energy price movements. Certainly, talking parochially from a combined heat and power point of view, that is why customers invest in combined heat and power plant because it is a more energy efficient process; it reduces their overall consumption of energy and, therefore, their exposure to energy prices. It doesn't remove them, it doesn't take them away entirely but it mitigates that because they are reducing the amount of energy they consume. If we then extend that to talk more broadly about renewable energy source as well, then of course the more energy efficiency we have, the more renewables we have employed, whether at a transmission connected or at a distributed level, that is less exposure that we have to imported or to fossil fuels. What we are importing is a price so we are mitigating our exposure to that. So I think the energy efficiency benefits of distributed generation, as well as the diversity and diversification away from fossil fuels, help to provide the sort of security benefits that you are inquiring about.

Dr Gordon Edge: I think it is also worth noting that prices will not go down; they will only go up, whatever route we take. If we take the renewables route, which is the distributed generation route, then, yes, what we will buy is a stable price. It will increase our security through being maybe slightly higher than you might otherwise pay, but it is one that you know is going to be at that level. You are not exposed to

volatility of global fuel prices, which will be increasingly so going forward as well as increasing over time.

I was quite frustrated recently; Scottish Power raised its prices and suddenly everybody was talking about the price of renewables and I thought, "Hang on a minute; that is to do with the price of gas. Why isn't everybody jumping up and down about the price of gas and how volatile it is?" So I do express some frustrations around that.

Gaynor Hartnell: I would like to add that we must not overlook that some of the sources of renewables can be despatchable and they can be low cost. Some of the cheapest forms of renewables do tend to get overlooked, like energy from waste. We looked at the contribution that residual waste could make to energy, and that is if you do all the recycling you can and you deal with what is left. We worked out that it could meet 17% of the UK's electricity requirements by 2020. That was total; that wasn't just the renewable element, but the renewable part was about 50% of that. There are a whole family of renewables and some of them are at the cheaper and less glamorous end of the spectrum.

Q175 Chair: I think we are all familiar with the problem of retrofitting existing buildings with more efficient systems or lower carbon systems. It is easy enough when you are doing a new development to specify. How much of the district or the micro CHP renewable energy is going to help, in terms of making our existing housing stock more low carbon and energy efficient?

Graham Meeks: Maybe if I take that one first, Chairman. When we talk about a lot of the existing energy efficiency initiatives, those are pretty much addressing the thermal properties of buildings, of houses and office buildings and buildings such as this, so the focus has very much been on reducing the thermal demand that those buildings present. A lot of the challenges I think that we are looking forward to, in terms of the future low carbon electricity system, are problems around electricity demand and supply and the interaction of the two. I think it is certainly the case that energy efficiency efforts focusing on the electrical consumption of buildings have not had the degree of focus from successive Governments, successive policies, as they probably should have done. As I say, most of the effort is focused upon the fabric and the thermal properties of the building. So I think, looking forward, there is probably huge potential to start to address energy efficiency in terms of the electrical energy performance of buildings, and the appliances and systems that we use within those buildings. In that respect, combined heat and power is part of the story but I would not pretend that it is the whole story; building controls, more efficient heating, ventilation systems, lighting systems, a whole suite of building energy management systems are available and we probably have not had the right incentives to operate or to invest in them up until now.

Q176 Chair: Yes; that is a rather separate agenda we can address at a different time. Is there any justification of the claim that a distributed energy system is more resilient than systems that are based on large centralised power stations?

Gaynor Hartnell: I would say you definitely need both. Often proponents of a more distributed generation system would seek to diminish the importance of the large scale interconnected centralised network. You need both, and at the moment the cards are stacked in favour of the large centralised players, so it is important to build up and make a level playing field for distributed generation to come through.

Q177 Sir Robert Smith: You mentioned earlier about district heating being a way of unlocking more CHP. This Committee, in a previous Parliament, went to Copenhagen and saw large scale district heating that had been rolled out across a whole city. Is there anything in this country that could unlock district heating?

Graham Meeks: Thanks very much. Just as a matter of interest, later today we are accompanying a DECC official and others to Copenhagen and Malmö, so that they have the opportunity that you have enjoyed. On that point, I think it is very encouraging that this Heat Directorate is going to be formed within DECC, which I think is a big step forward. Are there things that can be done? Certainly, it needs to start with a much more bottom-up analysis and understanding of what energy—and particularly thermal energy—requirements exist within built environments in particular: where the demand is, what potential sources of supply exist, in order that one can then build up a picture and a map of what the energy profile is of a particular region or urban centre. That then helps to identify the opportunities. Most of the heating requirements that exist within a city such as this are relatively low grade heat. It is a simple commodity that one can easily transport through pipeline networks, so the understanding is one of the things that has to come first. The co-ordination is then required between different parties to be able to make sure that, in aggregate, they begin to present the economic case, because it is a major capital investment to put in place the district heating infrastructure that is necessary to make it a viable proposition.

Thirdly, there needs to be the investment models that allow it to make sense. I think this where we do need to plan for the future. We are seeing district heating going into UK cities; there is a tender for Leicester that closed in the last few months, so they are moving down a pathway with Southampton, parts of London and Nottingham. Sheffield too has already moved down that pathway, and we know that there are major plans now in place for some form of district heating in most of our major cities. The problem is the model that is then going to be used to adopt them. The difficulty that most development has is you are talking about an infrastructure investment; district heating is pipes in the ground. It is a long-term, low return, unexciting infrastructure investment. At the moment, it is being asked to effectively compete in a market where it needs to provide the sort of returns that investors would expect from a different class of asset, from power stations and the like, which are a very

different asset. What we need to do is to make sure that district heating is recognised for what it is, which is infrastructure investment that has a lifetime of 50 to 60 years, which presents a pathway to decarbonisation and energy efficiency, and put in place the investment framework that allows people to invest at lower rates of return. Once that happens, then it becomes a much more economically viable proposition that then exists to provide a pathway for renewables to be used in urban concentrations but also to provide the sort of system security benefits that we are seeing in countries like Denmark.

Q178 Sir Robert Smith: The other issue that was raised earlier, everyone nods very sagely and says, 'Yes, before we worry about more supply, let's reduce demand; let's have more energy efficiency". Everyone says it is a no-brainer. I have been saying it for years and I have been going out to speak every year trying to put some insulation in houses, but the reality is, we haven't achieved anything like the potential that could be physically done. What do you think the barriers are?

Graham Meeks: I think that much of the problem is the economic analysis that we apply to it. Energy efficiency suffers from the problem that it pays for itself; through the energy savings, it offers a positive economic return. Once something is put into that category, then it becomes very difficult for Government economists to then justify public expenditure to support energy efficiency investment, if indeed it has been demonstrated to show an economic return to the beneficiary. The problem is it is the "£5 note on the pavement" story. Most people have probably heard the story, you are walking down the street and there is a £5 note on the floor and you point to it and say, "There is a £5 note on the floor" but the person next to you is an economist and says, "No, there isn't, because if there was a £5 note on the floor someone else would have picked it up already". I think energy efficiency suffers from the fact that, yes, it does offer the £5 note on the pavement but over here there is a £20 note, and the person walking down the street only has the opportunity and the time to pick one of those notes and they will pick up the £20 note. So, if I am an industrialist and I have a choice between making an investment that offers a 20% rate of return over here, or an energy efficiency investment that offers a 5% rate of return and I have scarce capital, I am going to make the investment that offers me a 20% rate of return. So if energy efficiency offers the benefits but isn't attractive enough as an investment proposition, because of the hassle factor and all the other elements that go into that—and I think one of the problems that we have had, is the economic models that we have used to try and make those assessments have ignored the fact that people have other options to use for their capital and the hassle of making energy efficiency investment is too high. I think that is the biggest failing we have.

Dr Gordon Edge: I think there is also an issue around who is making which investment. Investors in large scale energy infrastructure; we are talking about 20-year project lifetimes and rates of return of a certain amount. People investing in energy efficiency are homeowners or businesspeople, whose hurdle rates and other approach to these investments is completely different. If they were the same companies coming at the same opportunities, then maybe the energy efficiency ones would be taken up a lot quicker, but I can't speak in a terribly expert way, I focus on the supply side.

Q179 Dr Lee: In terms of driving energy efficiency, do you think energy is too cheap?

Gaynor Hartnell: Certainly higher energy prices do focus the mind on energy efficiency measures.

Q180 Dr Lee: Is there any evidence, any work being done on how high the price has to go per unit to be able to drive it?

Gaynor Hartnell: Again, it is not an area of expertise for us. We just hope that it gets sorted because it is very important.

Dr Lee: Any other comments?

Dr Gordon Edge: Certainly there must be research out there on the elasticity of energy demand to the price signal. The trouble is with most people, it is very inelastic. You could raise the price quite highly and people are just going to go, "Well, I just have to pay it" because the hassle factor of dealing with their energy usage is pretty high, even if the more you increase the price the better return on an investment in an—

Q181 Dr Lee: That would then drive the infrastructure changes that you want. You should get more money coming in.

Dr Gordon Edge: Yes, but—

Q182 Dr Lee: I am playing devil's advocate here because we talk about fuel poverty all the time. I personally don't like to talk about fuel poverty. I talk about the poverty of insulation. It is the case of that I would rather the state gave money to people who are poor to insulate their homes rather than giving them a winter fuel allowance to pay for the fuel.

Gaynor Hartnell: Yes, I think the thing is it is about consumer uptake. It is not my area of expertise but you have to help people to do this; you have to have a street by street approach, have a concerted effort and make it easy for people. If policy can unlock that, that is good and the Green Deal sounds like it could, possibly. I don't know a great deal of detail about it but I think that is the aspiration and it is a good aspiration.

Dr Gordon Edge: Your point about prices is quite interesting because we are in a competition for capital to invest in our energy systems, particularly in renewables, and contrasting now with Germany, or even Italy now that the people have spoken there about nuclear, increasingly there will be a competition for the resource to build and operate renewable sources of energy. If we make the UK more attractive, make the income greater, the return greater, then maybe we will win that competition but you would not want to be overly competitive because then the price goes up and up and that could be a real problem.

Q183 Sir Robert Smith: On the economics of individual decision-making, because of all the other factors that are not following the economists pure model, in a sense do you think you have to accept that more has to be done through the regulatory approach of setting standards that have to be met and, therefore, you can get the whole street done?

Graham Meeks: A recent experience that we have seen in the new build housing market has demonstrated that a regulatory approach is certainly starting to work there, in terms of the move towards zero carbon—in fact, towards zero carbon is probably a better expression—but in terms of moving that forward, and certainly within that part of the CHP market, it has certainly been very strongly stimulated by that market. Probably something like around 50% of sales in that particular market sector are now driven by the zero carbon buildings' conditions, and the fact that they are now being adopted ahead of time by certain planning authorities. So there is certainly evidence that a regulatory approach works.

I would also say that we should not necessarily turn our backs on incentivisation, coming back to your point. There is a great danger, sort of a carbon tax problem, of raising price so high to achieve a certain benefit here that you are imposing costs that have no impact, and there is no response over here, so it is a difficult move. So we do target incentives. What we have done, and we have recognised that in low carbon power generation by targeting incentives against a certain class of actors who we want a response from. We have offered the renewables obligation and feed-in tariffs, and now we are looking at some form of extended feed-in tariff arrangement to target investment from that class of actors.

What I find quite strange is that we haven't seen fit to apply the same approach to investment in energy efficiency measures, when fundamentally the problems are the same and perhaps every more acute. Often we are looking at a capital investment that needs to be made in the system, whether it is a CHP plant or a building management system or even insulation. We haven't seen fit to make those same targeted incentives, which are sufficient to allow those individuals to make a return on their investment. Quite often, in terms of carbon savings, we might find that we were seeing far greater efficiency in terms of capital spend, spending public money or consumers' money, if we were to apply that approach to energy efficiency as well as generation technologies. So hopefully that has answered both your questions.

Sir Robert Smith: I should remind the Committee of my interest, in the Register of Members' Interests for this inquiry, as honorary Vice President of Energy Action Scotland, a fuel poverty charity, and a shareholder in Shell.

Q184 John Robertson: Some of us have been jumping about ScottishPower, believe me. I was interested in some of the things Gaynor Hartnell said. I wonder if she could clarify what she means. You talked about the viability of power and then you said that some were unreliable sources. What do you mean by "unreliable sources"?

Gaynor Hartnell: Did I say "unreliable"?

John Robertson: Yes.

Gaynor Hartnell: I said "intermittent and variable".

John Robertson: Okay but you also talked about the reliability of—

Gaynor Hartnell: The reliability of the system. I was talking about the reliability of the system and the point that I was making was: if you add a variable generating station, like a wind farm—or intermittent; the word "variable" tends to be used now more—if you add that to the system you cannot, under any circumstances, make the system less reliable. You are adding the potential for electricity generation. It is really a question of taking things away. If you have the same other baseload despatchable power generation infrastructure on the grid, by adding more variable renewables on to the system, you are not going to make it less reliable. It is only if you then take away other generating stations, on the assumption that the variable renewables will be there to provide when required that you may possibly have a problem. All those things are fed into an evaluation. That issue is not often understood. One assumes that if you have more wind on the system, the system will, therefore, be less reliable and that is just not a logical conclusion to make.

Q185 John Robertson: You will never get less reliable but what you might not get is you will not get more reliable. It does not matter how many wind turbines you have in the system, if they don't go round you don't have any power.

Dr Gordon Edge: I think there are a couple of things going on here.

John Robertson: You will never get less. You can't talk about less. If it is zero, you don't go below zero. Let me give you an example and you can comment on it. In Scotland, during the coldest winter that we have had, we had 1% contribution from renewables in Scotland, which I think was supposed to be running something like 17% at the moment. I would call that unreliable, 1% did not hit the mark. It brings me on to another bit that I wanted to talk about. I am disappointed that you don't understand cost. When you talk to people in the nuclear industry, they have to tell us exactly when a break even cost comes in, and they always say, "Something over $100 a barrel of oil, then we are in the profit area". How much would it be for renewables to be profitable? I mean taking away any kind of money that is supplied by the Government, how much would you have to get for a barrel of oil to break even and make you profitable?

Dr Gordon Edge: We tend not to talk about barrels of oil,

John Robertson: I know, but in relevant terms to power.

Dr Gordon Edge: Only if the link between gas prices and oil prices continues and that is increasingly coming apart, so it is a case of at what point of gas prices would you break even? We can give you—

John Robertson: Well, gas is linked to oil.

Dr Gordon Edge: I am not saying it is oil but it is what you would compete against in that gas is what is generated—

John Robertson: I know that. Forgive me, but you have to deal with what you have, not what you don't

have. At the moment we know what we gain good service on, I am asking you to do the same.
Dr Gordon Edge: I haven't done the analysis in terms of the price of oil because—

Q186 John Robertson: Well, could you do that and maybe write to us because I am really interested. It is not that I am against renewables. I am just against paying more money than I have to, because I do care about fuel poverty and I do care about the people that can't afford to do the improvements to their homes.
Dr Gordon Edge: I understand that, but I am not sure if it is a meaningful analysis when the price of electricity, which is what wind generators produce, is not directly related to the price of oil. I am not quite sure what the nuclear industry does to make that kind of calculation because it is not one that I would see as particularly useful, certainly against the price of gas, which has some link to the price of oil but increasingly less so. We have numbers in terms of what our generation costs are and are very happy to share those with you if you so wish, but if it is a case of: what is the relative cost of generating electricity? I would argue that the nuclear industry are being very disingenuous. I would say a lot of their numbers are not borne out by the experience of people building nuclear power stations. Whereas, we build wind farms: we can see the costs, we know exactly what they are.
Gaynor Hartnell: May I answer the question, in terms of no longer needing subsidy. I will just answer it for one renewable technology, as an example, and that is solar photovoltaic; PV. There have been a lot of studies recently looking at all European countries, looking at the trend of electricity prices and the dramatic reduction in terms of PV prices. At various stages before 2020, PV should reach what is known as "grid parity", which means that it costs the same to generate a unit of electricity from a solar panel as it costs to buy a unit of electricity from an electricity supply company. In other words, it should no longer need subsidy at that point, and it is estimated that may occur in the UK somewhere about 2016, 2017.

Q187 John Robertson: Can I ask, is that a solar field power? What is a solar power—
Gaynor Hartnell: No. It is on the roof of a house or a building because that is the right comparison. You are purchasing electricity off the supply company and using it right at the source or generating it at that source.

Q188 John Robertson: Does that include the cost of the panel and fitting on the roof?
Gaynor Hartnell: Yes, absolutely everything, and it is surprising, which is why I wanted—
John Robertson: What was the date, sorry?
Gaynor Hartnell: The date?
John Robertson: My wife is really interested in this, she wants these things.
Gaynor Hartnell: The date occurs in different countries at different times, but for the UK it may be around 2016 or 2017.

Q189 John Robertson: Can I ask one other question, Chair, about basically the fitting out of houses and trying to make them more effective. Have you considered new technologies and what the trend will be as a result of, say, electric cars? I know we always talk about efficiency but technology would suggest that we are going to use more electricity, not less.
Graham Meeks: I think that is an interesting one. There is a certain line of thought that underpins quite a bit of the thinking that certainly DECC seem to be doing, which suggests that the pathway to decarbonisation is going to be one that sees much more use of electricity for heating and for mobility. My own feeling is that there needs to be a lot more comprehensive understanding of what the system implications of that are likely to be. Certainly, if we do not have properly insulated buildings then the widespread use of heat pumps is going to present enormous strains on the electricity system. A typical domestic house has an average load of around about 1 KW. Most of our electricity distribution networks have been designed through the wires in the ground, the transformers, the substations, and so forth, to deal with an average load of 1 KW. When you are then talking about putting in place a heat pump, which is asking the system to give it 3.5 KW, and you are then asking for an electric vehicle, which might be asking for a similar amount, you are going to put enormous strains on the electricity system.
Certainly our understanding is that, within the £200 billion figure that is widely used by Ofgem and others to characterise the cost of investment in energy infrastructure, the discrete cost relating to those new demands have not been fully incorporated into that analysis. You are then talking about tens of billions of further investment that is going to be required if we are going to accommodate those technologies on the system, and then you are talking about the degree of insulation that is going to be required to make those work effectively in the home. So I think you are right to ask those questions. I don't have all the answers I am afraid.

Q190 Dr Lee: That figure about the 2020 solar power, does that include the significant subsidy that has taken place to that point? You say that the power in 2020—
Gaynor Hartnell: No, it does not. That money has been spent and it is then looking forward. That money has been effectively an investment to bring the cost of generation by PV down.

Q191 Dr Lee: Yes and that has been a significant sum of money, hasn't it?
Gaynor Hartnell: It has been, compared to the amount of electricity generated. Take Germany, as an example, it has been a significant amount. They are paying something now for PV and other countries will reap the rewards of that, but I am just talking about the generation cost that has been arrived at as a consequence of that investment. Let us not forget, all forms of energy generation have had significant investment behind them and subsidy till now.

Q192 Laura Sandys: I would like to come back in some ways to the energy demand and our response to that. Mr Meeks, you talked about building regulations. You also explained that we could be looking at a sixfold increase in electricity usage, with pumps and electric cars. Do you believe that we are looking broadly enough at how we respond to energy consumption, that is: are we investing enough in technologies that are beyond just building regulations and the energy sector, i.e. white goods? Are we investing and focusing enough on our consumption right across the board? In many ways, we mainly talk about energy generation. We sometimes talk about energy efficiency, but we don't really talk about what I would call "low carbon living", which is a very different mind change, needs possibly to be incentivised by new technologies that excite change in behaviour. I would like to understand from you whether you feel that we are meeting and getting the opportunities, that those new technologies—in many ways, a revolution in how we live—are being addressed?

Graham Meeks: I would say almost certainly not. I think the current drift towards trying to present a solution to the decarbonisation problem by the simple route of saying, "Let's build more low carbon power stations" has an attraction. It certainly has a political attraction, because it takes it away from interfering with the everyday lives of people and I guess Governments don't want to be doing that, particularly not the present administration. So it is a convenient approach to try and push the problem elsewhere.

Personally, I don't think it is viable. I think it is a systemic problem that we have to address and we can't put off the evil day when we are going to have to ask consumers, voters, householders and businesses to behave in a very different way. We need to begin to be preparing and, as you say, putting the investment signals right across the economy that enable that innovation to happen; not focusing the incentives and the investment signals into one corner of the electricity problem. I was going to say "electricity supply", but it is energy as a whole. It needs to be reaching into every corner because it is a comprehensive solution that is going to be required, not one that we can deal with hundreds of miles away on the coast of East Anglia or Somerset.

Gaynor Hartnell: I just know that whatever is put in place in terms of white goods, say, has to be easier on the interface with somebody. You know, you have to have a button that you can press on the washing machine that says, "I don't care what time it is done, I want it done by the time I get back from work", and just making it easier for people to use. I look forward to those kinds of appliances happening. So they are appliances that allow people to be even fairly dumb in their use of things; they just say, "Okay, you do the clever thinking, machine. I will just say that I am happy for you to do that on my behalf". So you need a combination of those kinds of appliances and a smart grid to send the signals to those appliances to take those decisions.

Dr Gordon Edge: Investment is going on in those kinds of appliances, but you do need the infrastructure to integrate them with the grid.

Q193 Laura Sandys: Do you see that we might need to go further than that? As we have building regulations that say to us exactly what sort of level of insulation and energy efficiency, should we be putting a change in the incentives; not just the incentives to generate but the incentives on sorts of white goods, energy-using products?

Gaynor Hartnell: I think we certainly should and I think we should also check that the things we think we are doing, in terms of high building standards and all that, are being used by people in the house to deliver that; because the way people use buildings can undermine quite a lot of the clever decisions and energy efficiency measures that have been put in, and sometimes these things just are not gone back and checked. There is an assumption made that the carbon savings are going to be delivered.

Q194 Laura Sandys: In some ways you are saying that possibly Government has a role in education as well as incentives, but the incentives are all on generation; they are not on usage, and I think—

Graham Meeks: We can look elsewhere and certainly in the US, in a number of the electricity markets there, there are significant demand-side programmes that equate and effectively open the market, equitably, to both generation and demand-side action. If one takes the New England market, there is about 32 GW of capacity in that particular market; so two-fifths of the UK. Around about 10% of that capacity is provided by demand-side action; be that energy efficiency, just reducing the absolute level of demand, demand response, which I think accounts for about 6.5% of that 10%, and distributed generation. They have come forward and are able to access that market on an equitable basis. So that is around 10%. In the PJM market, a much bigger market—about 1.5 times the size of the UK market—about 6% or 7% of capacity is provided by demand-side actions because it has been able to enter the market and play by the same rules. So there is the opportunity to do that.

There are mechanisms to put those incentives in place that are already here, and one of the things that we have been arguing strongly is that the electricity market reforms, which the Government is putting in place, should begin that process of bringing demand-side into the market, which hopefully will provide the sort of incentives that we are looking for to make the actions that you are talking about. The encouraging factor is a lot of them are a lot cheaper. The analysis suggests that by bringing demand-side into the New England market, costs of providing the security and the reliability on the system are about 15% lower than if they had gone wholly for generation, assets and facilities to provide that security.

Q195 Laura Sandys: Have there been any comprehensive studies on behaviour change; what mechanisms change behaviour and how that would work within the United Kingdom market?

Dr Gordon Edge: I believe the Sustainable Development Commission was doing some of that before it was disbanded, but I would also perhaps point at some work that was done with people who had micro-generation, micro-renewables, in their

homes. They became much more aware of their own energy use and ended up having a positive impact on their demand levels there. It is arguable that the early adopters of micro-generation might be the ones who would be more aware, but if that was replicated that could be a very important impact of having solar panels on your roof or something similar.

Q196 Dan Byles: I would like to come back to energy security and the impact of increased renewable production on the UK's energy security. I would also like to probe a bit further something two of you have said, which I take issue with. Dr Edge, you made a distinction between energy security and energy reliability, and you seemed to imply that we could consider ourselves to have energy security even if power doesn't come on when we turn the switches. I understand perhaps there is a subtle distinction between the cause of the fact that you do not have that power, because either you are not getting it in from abroad or because there is a problem with your internal distribution or something, but I would argue the ultimate result is the same. We need to be able to turn on the lights and know that power comes through, and I would argue that anything we do that impacts on that has an impact on our overall security.
Ms Hartnell, I am interested in this idea that you can add more and more variable power to the system without influencing the reliability of the system. I sort of understand what you mean, but I would suggest that it is not a case of taking other sources away. It is the fact that other sources are coming to the end of their lives and we have to make decisions about replacing them or not. We have a very limited investment pot and there is an opportunity cost. In every extra wind farm we invest in is potentially a nuclear power station we don't build or a gas-fired power station we don't build. So I don't think it is quite as simple as saying there is no link at all between adding more variable power to the system and not potentially having a less reliable energy system. I would like us to tease a bit more the real impact on energy security to the UK of increasing our reliability on potentially variable renewable power.
Dr Gordon Edge: If I can take the first of those in my example, I point back perhaps to the situation a couple of years ago where Sizewell B fell over and large parts of the country had blackouts. There is no question that we had plenty of resources available. Our security of supply in that sense was completely fine, but we had unreliability in the power supply because we had a technical problem with one nuclear power plant and a kind of cascade effect.

Q197 Dan Byles: I do understand that distinction, but I am saying at the end of the day it is about outcomes not process. It is about: when we flick the switch is there power, and is moving towards renewable energy going to increase or decrease the likelihood that when we flick that switch there is power?
Dr Gordon Edge: What it will do is it will increase the whole security bit, because you are importing a lot less fuel because you are using a lot more domestic renewables. I think what you are focusing on is the reliability bit and you can have a perfectly reliable system with a large amount of renewables at a reasonable cost. The analysis that Pöyry did, for the Committee on Energy & Climate Change recently for their renewables report, indicated—even with a 65% penetration of variable renewables on the system—that would only add one pence per KWh to the cost. So you can do this and you can have the same amount of reliability with renewables at a reasonable cost.

Q198 Dan Byles: I would suggest that you are confusing energy security with energy independence, people use these terms in slightly different ways.
Graham Meeks: It is a cost issue, isn't it: how much are we prepared to then pay for the insurance policy that comes alongside the investment in the variable renewables? Gordon picked up one figure. UKERC, the UK Energy Research Council: their study on intermittency was talking about something between £5 and £8 per MWh of intermittent renewable electricity that is supplied. The cost is around £5 and £8 per MWh of that. So I think it comes down to pounds, shillings and pence at the end of the day, and how much insurance we need to buy at the same time. I guess the trade-off that Gordon is making is what we are getting is a benefit of reduced imports of fuel and energy independence.

Q199 Dan Byles: We have to increase our energy independence, but that is not necessarily the same as energy security if it is not reliable.
Dr Gordon Edge: You can get that reliability. It can be done. We are into a new paradigm.

Q200 Dan Byles: It is different risks; the risk of shifting from not being able to import gas or coal to making sure that we can make our domestic power keep the lights on. Is that right?
Dr Gordon Edge: That is fair. I think what we are doing is moving from a kind of 20th century electricity supply, which is about uncontrollable demand and controllable supply, to one where you have a partially controllable demand through the smart grid and smart response and a partially uncontrollable supply. That is not better or worse; it is just different and it requires different challenges and a different system operating across Europe, particularly responding to that. So, for instance, you have Spain, which is badly interconnected with the rest of Europe; they can cope with over 15% of their electricity coming from wind power and that is going to basically double in the next 10 years. So people can do this and still have reliability.
Gaynor Hartnell: You clearly do have to have a certain proportion of totally despatchable power that you can rely on. Even with despatchable power stations that you think you can rely on, sometimes they fall down too, as Gordon mentioned. Yes, you need to have a portfolio of things and that is important and some renewables are despatchable: biomass power stations, for example, thermal, energy from waste and also baseload. So you need a combination of things. You can add variable renewables to a system, provided you have enough despatchable power there to cater for what you need, and you can also make it more cost-effective by adding into the

mix interconnection with other countries. You can add in demand management, peak shifting; all these things. They are all an important part of the mix. The only point I was trying to make was the mere act of adding variable renewables on to the system does not, by definition, make that system less reliable. It depends on the whole package of things you do. I take your point about: it is also a question of looking at what you might be replacing, because my point—

Dan Byles: There is an opportunity cost element of where you put your investment going forward.

Gaynor Hartnell: Yes but having enough despatchable power in the system is a very important element.

Q201 Dan Byles: Do any of you on the panel take a view on what the ideal proportion of renewable energy on the system is, to maintain energy security in particular; not so much looking at the emissions targets—obviously the emissions targets are hugely important—but balancing that with energy security? Is there an upper limit, for example, on the amount of offshore wind beyond which you would feel uncomfortable?

Gaynor Hartnell: We have not looked at it individually, but there is an IEA study that has looked at intermittency recently that has concluded very significant amounts can be added to the system and it looks at these three components: interconnections, demand management and storage as well. Storage is important. We haven't even talked about storage.

Dan Byles: No, that is true.

Dr Gordon Edge: I don't think it is a technical issue. It is an economic one. It is: how much are you willing to pay for in order to get it? I would argue that you should be willing to pay quite a lot because the benefit side of the equation with renewables is very high: an industry in offshore wind, the amount of the imports you will be able to not have, keeping the domestic energy pounds within the UK economy. I think these are all positives. Tax-take for the Treasury goes up. If you do that analysis and you do add up all those benefits, you would be willing to spend quite a lot of money to achieve those renewables.

Q202 Albert Owen: You mentioned about imports and, quite rightly so, in terms of energy security. Isn't there also some imports that are needed for renewables to work as well and the risk applies equally to them? For example, there are some rare metals in the offshore wind industry and I know biomass—the project they are talking about within the United Kingdom now—rely quite considerably on imported timber. Forget about the carbon footprints, I am talking about security. Isn't there an issue there for renewable energy in the same way there is for nuclear and various others?

Dr Gordon Edge: To address the rare earth issue specifically, not all wind turbines need rare earths.

Albert Owen: So that can be overcome?

Dr Gordon Edge: It can be overcome, and also the fact that, despite the name, they are not that rare. The reason why China has a stranglehold on them is because they drove the prices down and all these other mines went out of business, and now they are being reopened because they have driven the price back up again. So it is just a matter of time and it will be—

Q203 Albert Owen: That is a very real threat, isn't it; that other countries will develop that technology themselves or they will control the price?

Dr Gordon Edge: There is demand for rare earths for many uses: iPods, mobile phones, any form of efficient electric motor or generator. There are many uses. Electric vehicles will need quite a lot. So the demand is there and people know where there are deposits to be found. It is just a matter of time before those mines are re-opened. I don't think that is a particular issue in terms of security of that, and we would be looking to manufacture quite a lot of these technologies in the UK, certainly offshore wind, and that is a major export opportunity as well; so increase our security through trade.

Q204 Albert Owen: So there is the R&D. Can you also deal with the biomass? Again, a big proportion of it will be coming from—

Dr Gordon Edge: Pass on me then.

Albert Owen: I am not pointing just at you.

Dr Gordon Edge: Okay. We don't deal with biomass.

Gaynor Hartnell: To address the biomass question; first of all, I will do the carbon footprint—although you will not want it—just to knock it on its head. If you bring biomass even halfway across the world in a very large cargo ship the emissions from it add a very tiny amount to the overall emissions from power generation. I think it is about 36 grams of carbon per KWh. So that is not an issue. Of course, if you build a power station that relies on imports you become reliant on imports, but that is not a unique situation. The UK is importing a lot of energy at the moment anyway and biomass power generation is never going to be a hugely substantial part, such that the biomass imports will threaten security of supply. It will be part of a portfolio of technologies.

Q205 Albert Owen: Sure, but the question is: it does apply to renewables in the way that it does with other forms of energy generation?

Gaynor Hartnell: Indeed. Renewables are not unique in many aspects, but biomass and biofuels are globally traded commodities.

Q206 Albert Owen: Sure, but my supplementary to that is are we moving towards a place where we will have greater independency, because the research and development will come on stream here in the United Kingdom and we will be able to produce those? I think that is what you are alluding to. Yes?

Dr Gordon Edge: Certainly. If you look at resources like wave and tidal, we are by far the world leaders in the technology side. Therefore, we would hope to be establishing ourselves; as Denmark is to wind, the UK should be to wave and tidal and, similarly, that would be an enormous boon to our energy independence.

Graham Meeks: The other dimension—following on from that and relating back to biomass—is how we capture the indigenous bioenergy resource that exists in the waste stream. There is certainly a lot more that

needs to be done technologically, perhaps more importantly, in terms of the organisation of the waste management infrastructure, so that we are able to capture that and use that energy resource that we are producing and retaining that resource locally. Certainly that is something that Birmingham have done a lot of work on, and it is happening now in London. It is a resource that we are exporting out of communities into remote waste facilities, which are very difficult to deal with politically, when in fact the resource is something that should be there for communities. It may be made much more acceptable to use that energy resource if people can understand the link between something that they are producing and then something that they gain a benefit from. So there is lot more that needs to be done to focus on that part of the resource and to make sure we are making the best use of it.

Q207 Albert Owen: Then a final point with regard to renewables and imports. Of course, DESERTEC is talking about Europe getting some 15% of its energy from renewable sources in North Africa. With the current and potential threat to security there—with geopolitics, in the same way with oil in the Middle East—isn't this, again, a difficulty that we have to deal with, and it does apply equally to renewables as with oil and gas?

Dr Gordon Edge: Just on DESERTEC, we would be at the far end of the wire and I think other countries—most notably Italy—would be more interested. I personally would flip it slightly on the head, in that one of the best ways to ensure stability in North Africa would be to tie them, economically, more closely into the European Union, and this would be a pretty good example of that. On the other hand, I am a bit suspicious of DESERTEC technically because if you have large amounts of concentrated solar power, thermal generation, that needs a lot of water and we are talking about the Sahara here. So I am not quite sure if it is that feasible.

Albert Owen: Sure. Okay.

Gaynor Hartnell: Nevertheless, there are companies looking into that seriously.

I want to make a very general point about renewables and security. We didn't send in written evidence, but had we done so we would have pointed out that generally you improve security by having a more diverse energy supply. Generally you benefit from having your eggs distributed in many more baskets, and by bringing in renewables you are talking about a whole family of different technologies. Many of them use domestically produced fuel. Others you are importing; but generally you are having more import routes, more different types of fuels coming in. Some of these fuels deliver themselves to the power station and there is nothing you can do to stop it; talking about wind or wave or tidal. They come at different times of the day, different times of the year, the month. It all helps; you just have to think about how to integrate it all together.

Q208 Dr Whitehead: I think we covered some of these thoughts earlier, but we have heard previously that there is a general lack of evidence about the extent to which more than 20% of generation from intermittent sources could securely be accommodated on the UK's grid system. National Grid has just published a report, "Operating the Electricity Transmission Networks in 2020". Have you looked at that and are you able to give us any thoughts on what that might—

Dr Gordon Edge: I haven't personally had a chance. It was only published a few days ago and I have been occupied with the Arup report instead, which is 300 pages in itself. What I would say is I think there is more evidence, not necessarily from systems that have gone that far—though there are areas, in places like Schleswig-Holstein in Germany, where you have extremely high penetrations of wind power, admittedly very highly interconnected—but would I point towards the All-Island of Ireland Study, which underpinned their objective of heading for 40% renewable electricity by 2020, and that indicated that is very doable and, again, Spain where they are moving beyond 20% wind in the very near future. So there are definitely examples of systems that are going that way and which are confident that they have the tools with which to manage it.

Q209 Dr Whitehead: The National Grid report posits something like 27% to 28% wind by 2020 as part of a 100 GW installed capacity resource. It appears to say that a combination of demand management, smart grid switching, and indeed storage, would be perfectly manageable. In terms of what you know about other studies elsewhere—and I think you have partly answered this—is that something that you would think is in the right region?

Dr Gordon Edge: The short answer is yes. We think National Grid has come a long way in terms of understanding the nature of these resources and how they might be integrated into our system. We think they can go further, but certainly that is a good point to continue this conversation about how we manage the system in 2020 and beyond is part of the process. I think it is the second report in the series where they have been thinking about these issues. Certainly we don't see there being a major problem with that level of wind generation in our system.

Q210 Dr Whitehead: The National Grid report and other reports also emphasise that the question, in terms of security of the system—and Gaynor Hartnell has emphasised this, I think—of the interaction and the different variability between renewables. To what extent do you know from studies, or from direct experience, of the extent to which those renewables, to some extent, provide security between themselves in combination? Could you envisage a circumstance where it would be feasible to have getting on for a 100% renewable electricity power supply system in the UK, based on that sort of analysis?

Dr Gordon Edge: We have one specific one. We did a piece of work a couple of years ago, where we commissioned Redpoint to do a bit of modelling for us; a mixture of supply of wind, wave and tidal. There was a kind of sweet spot of about 20% marine against wind where you brought down the cost of balancing that system. I think it was in the region of £400

million. It has been a while since we did that piece of work; I will quite happily supply it to you. So having that mix, for the same proportion of energy you would have a considerably lower cost of managing it. So there is some direct evidence of that from that modelling.

Graham Meeks: If one is looking for the real world demonstration of that, and I raised the experience in Denmark earlier, which has 21% wind at the moment and I think the objective is to move to something like 40%—50% is their target—and they probably have the greater experience in terms of understanding what the capability of the system is. As I said, their system operator recognises that on their district heating system there are large amounts of thermal stores. So when you have an excess of power on the system, rather than paying someone to be constrained off the network, and imposing another set of costs, effectively you buy that electricity at zero cost, use the energy to charge the thermal store, which you are then using to provide the heating for businesses and homes.

So you are able to effectively manage the surplus; at the same time you have a flexible generation plant that is then able to run when the wind isn't blowing and compensate for that. A lot of that is renewably fired and in Denmark a lot of it is still fossil-fired, but they have been progressively decarbonising that cogeneration fleet to use increasing amounts of biomass, biogas and energy from waste as well. So you do have, through the infrastructure that exists in the heating network, in the thermal storage, the ability to effectively arbitrage between those different markets, so the infrastructure is giving them that ability.

We talk a lot about storage—we haven't necessarily done so much today—but in terms of costs of thermal storage, the US studies suggest that the cost of thermal storage is in tens of cents per KWh compared to electrical storage, which is hundreds of dollars per KWh. So there are major opportunities.

Q211 Dr Whitehead: Presumably electrical storage would be one of the factors that would be necessary in order to balance the system? Certainly some of the suggestions in the National Grid report point in that direction, and also the Pöyry study of "Pathways to 2050" looked at things such as battery storage but said these were only tenable over a few hours or a few days. Is that your understanding? Do we need more research perhaps into that?

Dr Gordon Edge: The problem with electricity storage, in terms of going beyond the "within day" management of energy, is the sheer quantity of it. We don't have an energy storage technique, which gives you gigawatt hours or even terawatt hours of storage. It is in the megawatt hour level. That gives you an opportunity to regulate and to delay, but it does not deal with a situation where you may have a low of wind generation for a few days, in which case you have to be falling back on imports through interconnectors, flexible plant or demand response; demand response is mostly within day as well. You would have to be thinking about shutting things down at the extreme, but you wouldn't want to get anywhere close to that. So I think there is more to be done in terms of storage, but there are difficulties in getting us into that gross amount of electricity storage. I think the heat point allows you to arbitrage between two systems, which gives you some more capacity, but electricity back to electricity: I think we are going to struggle in terms of large scale gross electricity storage.

Gaynor Hartnell: I would just say that, given we have about 10% of renewable electricity in the UK at the moment and we are not hitting these difficulties yet—I mean a combination of storage, interconnection, demand management; a combination of renewables: some of them will not be variable, some of them will be—I think we could go a long way. We are more concentrating on the shorter term; getting the Government's policy framework right so we can make progress. I would rather look at the shorter term, get on with accelerating deployment, because these issues are a long way away and are definitely manageable.

Chair: Thank you. I think we are running out of time. We have more witnesses to come. So thank you very much for covering a lot of ground this morning. We much appreciate you coming in.

Examination of Witnesses

Witnesses: **Jonson Cox**, Executive Chairman, UK Coal Mining, **David Brewer,** Director General, Confederation of UK Coal Producers (CoalPro), and **Dr Jeff Chapman,** Chief Executive, Carbon Capture and Storage Association (CCSA), gave evidence.

Q212 Chair: Good morning and welcome. I think you have heard most or all of the previous session. As ever we are driven by time. Mr Cox, I think you wanted to make a brief opening statement. Is that right?

Jonson Cox: Very, very brief; 60 seconds, thank you, Chair. My name is Jonson Cox. I am the Chairman of UK Coal. I am new to the coal industry. I arrived six months ago with a view to try and rescue UK Coal from its near bankruptcy and near closure last year. I don't come here as an expert on coal and I just wanted to say very clearly that, although I am here representing coal, I have a full understanding of the importance of climate change and I spent six years as a founder member of the Prince of Wales's Climate Change Group. So I want to be able to put forward the arguments of coal having a place in the mix and the immediate consequences for coal, and I hope you will accept it in that spirit.

Q213 Chair: Fine. Okay, that is understood. One of the things that may help coal have a place is CCS. I would like to start with some questions about CCS. When do you think CCS for full-scale coal and gas pipelines might be commercially available?

Dr Jeff Chapman: When will it be available?

Chair: When it might be available. It certainly isn't available at the moment; so when do you think it might be available?

Dr Jeff Chapman: The first thing I have to say is in the UK we had our first demonstration; hopefully we'll be signed up by the end of this year. Incidentally, the call went out for tenders for that first demonstration on 9 October 2007. So if it happens to be 9 October when it is signed up this year, it will have taken exactly four years to get it signed up and that is not adequate. We now have a commitment to a further three projects and we need those three projects underway as quickly as possible. We cannot wait until those three projects are built before we start developing the next round of projects. That will take us up to a capacity of 1.6 GW, or thereabouts. They should be operating by the late part of the decade, and we need to be bringing on a lot more than that by then if we are going to meet the Climate Change Committee's commitments.

Chair: We know what we need to be doing, and it is quite clear the progress so far doesn't give us the remotest change of getting to where we need to be by the time we need to get there. Can I repeat the question? When do you think we might have commercially available CCS for coal and gas pipelines?

Dr Jeff Chapman: I think we have it now and I think, to the extent that we could build attractively, competitively priced power plants with CCS now, then we have it now. We will have to optimise that and make it a lot more attractive as we go on and build, but there is no doubt that the technology is available. It can be built and it can be built at commercial sizes. It needs optimisation.

Q214 Chair: In other words, do you mean it costs far too much to be viable; that is a polite way of saying it is nowhere near being economic?

Dr Jeff Chapman: No, no. I have a graph in front of me here that comes from the Climate Change Committee's study, prepared by Mott MacDonald, and if you look at the cost in 2011 of gas with CCS or coal with CCS, gas is between 6p and 15p per KWh and coal is between 8 and 15 pence per KWh. That is a lot, but when you compare it with other low carbon technologies it is on the lower end of the scale as time goes on and in 2040 that drops down, most especially with gas.

Chair: In 20—

Dr Jeff Chapman: 2040.

Chair: 2040?

Dr Jeff Chapman: Yes.

Chair: Twenty-nine years from now?

Dr Jeff Chapman: Yes. They track it through 2011, 2020, 2030 and 2040.

Chair: We can all pluck things out of the air and say what is going to happen in 2040, that is—

Dr Jeff Chapman: Yes, sure.

Q215 Chair: If it is so tremendously attractive, why is there only one entrant in the competition?

Dr Jeff Chapman: There were nine entrants in the competition in the first place. The competition was—

Chair: Eight of them have dropped out.

Dr Jeff Chapman: No, five of them were discarded in the competition process. A shortlist was drawn up of four and I can easily say that, of the four, three of them did drop out but for various good business reasons.

Q216 Chair: I can't understand how they can be good business reasons. If the viability of CCS is as close as you claim and the world desperately needs this technology—not just the UK but other countries with big coal reserves—why on earth would three companies drop out of a competition, give up £1 billion to do something that was going to be viable

Dr Jeff Chapman: One good business reason would be the unreliability of decisions coming from Government. Another good business reason would be the fact that, during that time, the relative prices of coal and gas moved against one another and perhaps made it uneconomic to build, for example, at Tilbury and Kingsnorth.

Q217 Chair: What are the decisions that DECC have made that have put all these people off?

Dr Jeff Chapman: I am sorry?

Chair: What has DECC done? You said it was the unreliability of decisions made by Government that caused the 75% drop out rate.

Dr Jeff Chapman: Well, it is just been a very slow and very laborious process, as witness the four years—and we are not there yet—we expect it will take to come to completion.

Q218 Chair: Perhaps I could ask the other witnesses: do you agree with DECC when they say they are going to require a new coal plant to have CCS fitted from the outset?

Jonson Cox: I cannot represent to you whether CCS has a viable future or not. My concern is the UK—and if you take my own company—has access to 200 million tonne of coal reserves. Under current immediate short-term policy initiatives the company will not survive. The proposition I would put in front of you is: the survival for a slightly longer period of the coal industry under current technology is an option price to keep those reserves open while we establish whether CCS does or does not have an economic future. The failure of operators will sterilise mines and sterilise reserves.

If I understood your question, Mr Chair, "What is Government doing that is a hindrance?" I think the hindrance is immediately around the carbon support price, which perhaps we will be coming on to. We absolutely accept the need for the burning of coal in the UK to be under far cleaner technology. I am not here to make any other representation on that. I am concerned about how we move from today to that cleaner future, without relinquishing the ability to exploit the domestic reserves that we have.

Q219 Sir Robert Smith: Do you think the current competition at £1 billion is enough to cover the project?

Dr Jeff Chapman: I honestly can't comment on that, Sir Robert, but I would refer you back to the time of the Energy Act 2010, which created the CCS levy. I

think the impact assessment at the time said that for the four projects there would be needed, over the lifetime of the projects, £9 billion to £11 billion. So £1 billion seems to me to be a part of the cost but not the whole cost.

Q220 Sir Robert Smith: Is there more that Government should be doing to maximise the chances that CCS will take off when we need it, because all the calculations see CCS coming to the rescue, are they doing enough to get us there?

Dr Jeff Chapman: No, not at all. Referring back to the Energy Act, it was a pity that we had to drop the CCS levy. It has caused yet another delay. I can understand the reasons for it. There are very good reasons for electricity market reform and we hope that the electricity market reform—and, of course, we are talking to DECC all the time about this—will be sufficient incentive in the long run to drive CCS when it becomes business as usual, but at the moment it isn't.

The projects at the moment are required to be 400 MW or less, and that is not the size of a large coal or gas-fired power plant. So they are inherently expensive because of being lower than the normal size. They are inherently expensive because they are the first and, therefore, suppliers of equipment and contractors will build in contingencies. They will over-engineer, and those things have to be driven out of the system by getting on, building the plants and gaining the experience. They are also inherently over expensive because of the infrastructure. I am afraid, so far the Government has not properly tackled the issue and the cost of installing CO2 pipeline infrastructure and the cost of developing stores. These costs will be a great burden to the first projects and will make the first projects appear very expensive. The ensuing projects will be able to capitalise on those costs later on.

Q221 Sir Robert Smith: More should be done early on in the pipe network to make sure that they can be shared in the future?

Dr Jeff Chapman: Well, for example, on Humberside a lot of analysis has been carried as to what sort of pipe network could be planned around the Humberside area. It has been done elsewhere but it has been done most extensively at Humberside. There are about 60-plus million tonne a year of CO2 that can be collected from large point sources around Humberside, and it would be daft not to put in place appropriately sized pipe work in the first place to be able to collect this CO2 as time goes on.

Q222 Sir Robert Smith: At this stage, is there any sort of sense of which of the three basic technologies for CCS—pre-combustion, oxy-fuel combustion and post-combustion—is the most optimal?

Dr Jeff Chapman: No. I think we have to live with an open mind on that situation for the moment. There are advantages and disadvantages to the three different technologies. The oxy-fuel and post-combustion are attractive to conventional power station operators because they use the kind of power stations that have been in existence and in use, and they have become very comfortable with, over a very long time. Pre-combustion is more of a completely process engineering concept, but brings with it enormous other opportunities in terms of the ability to produce hydrogen for a possible hydrogen economy; in terms of the ability to remotely decarbonising lots of different power plants from one central gasification source; and not just power plants but also communities, vehicles and industry.

Q223 Sir Robert Smith: Finally, how much of a role is there in altering the economics for using the CO_2 to enhance oil recovery in our remaining fields in the North Sea?

Dr Jeff Chapman: It would certainly be of benefit in your part of the world. Let me say, to begin with, enhanced oil recovery has been practised in the USA for 40 years. At the moment they have probably taken at least a third more oil out of Texas than otherwise they would have done if it wasn't for enhanced oil recovery. Just like Texas was an easy win for exploitation of oil in the first place, it has also been an easy win for enhanced oil recovery. The same doesn't apply to the North Sea, but the North Sea will come along marginally later on. So at the moment obviously it is going to be expensive to develop EOR in the North Sea.

The next thing I would like to say is that EOR is already practised in the North Sea by the injection of natural gas and other residues from oil production. So it is no stranger in the North Sea, it is just that you don't use CO_2, but CO_2 is a better material for enhanced oil recovery than is natural gas. For example, if you take the business case for the CCS project in Abu Dhabi, which is a clone of the original Peterhead proposal, the business case for that is partly predicated on using CO_2 for enhanced oil recovery, saving the natural gas and selling the natural gas as a fuel. So there is some potential for that.

The kind of companies that screw out the last drops of oil from oil reservoirs are not the large mainstream oil companies. Their business plan specialises in this kind of area, and I don't think we have listened sufficiently hard to those people who think that they can make business out of EOR in the North Sea. I think there is a lot more to be done because the benefits of it, of course, are: making better use of UK reserves, more tax-take, more employment and the reuse of existing assets that we would have to spend money on to decommission at an earlier stage. So there are tremendous benefits and we should look at it a lot more closely.

Q224 Barry Gardiner: Mr Cox, you talked about taking an option on the future, in effect. Where do you think that 200 million tonnes of coal is going to go if UK Coal Mining does go into liquidation?

Jonson Cox: Those that are accessed through current mines will disappear because a mine cannot be mothballed and kept closed for very long. It has to be sealed by the shaft being filled. So my concern is: we sit here at the moment where, if we take last December, 42% of electricity in the UK was generated from coal; 42% through December. It does not have to be UK-produced coal, of course. It can be imported

coal, but there is a security of supply issue. That was a very practical issue last December with the inability to move coal out of ports, let alone from a more national security point of view.

I suppose I speak for the largest producer of coal in the UK. If we fail to make it through the next investment decision that comes in 2013, which is exactly the time that I worry that the carbon support price is going to make it—both by the level, and by the unpredictability of the level—not viable to make that investment decision, that coal is largely closed to future exploitation, because the cost of sinking the shaft and the infrastructure underground to access the reserves is closed once and for all. Of course theoretically it is possible to re-open it, but the costs of that become even more prohibitive.

Q225 Barry Gardiner: What is the cost of the subsidy that you are requesting and what is the alternative cost of reopening?

Jonson Cox: I am not here asking for any subsidy, as such. The company may be on the edge; it may be struggling to survive. My job is to try and make it survive on its own feet in a commercial market. I am not here to argue for subsidy.

Q226 Barry Gardiner: Sorry, I thought what you said was that the Government, through the regulatory framework, had to ensure that the floor price for carbon was sufficiently high so that you could maintain commercial operations. If that is not subsidy I don't know what is.

Jonson Cox: Sorry, I may have balked slightly at the word "subsidy". What I am asking for is an approach to the carbon support price, which is different. I am concerned about it because it has—

Barry Gardiner: That is a subsidy, isn't it?

Jonson Cox: It is a subsidy to others. It is a subsidy to non-coal generation. Yes, that is correct. It is not a subsidy that the coal producers benefit from.

Q227 Barry Gardiner: No. Basically you want the Government to regulate the market in such a way that coal gets a relative advantage vis-à-vis its competitors.

Jonson Cox: I would put it another way to you: I believe the carbon support price is regulating the market to the disadvantage, at a particularly critical time, of the coal industry. I am not asking that we be advantaged by it. I am asking that we are not disadvantaged in the way the current proposal gives a subsidy to the existing fleet of nuclear and renewables at a time when it is not going to bring forward a future investment decision. I completely understand the need to incentivise future capacity, but it seems to me the time for that subsidy to be given is the time at which, realistically, that new capacity could come on stream, which I would put three to four years later than 2013. I would also put it to you that the level of it particularly disadvantages UK-produced coal because, unlike the way the ETS works in Europe, this will operate per tonne and it has a particular disadvantage on UK-produced coal compared to imported coal. That would be the second point about it. The third point is: I think the interaction with the European market mechanism, or what I frankly see as a tax in the carbon support price, may produce some perverse effects. So I am absolutely not asking that anything is given as a subsidy to the coal industry—I couldn't bring myself to do that—but I am asking that the subsidy being given to new generation is not set up in a way that quite so blatantly disadvantages UK coal production, particularly at a point in 2013 when the investment decision will be made about the next three to four years, which secures the life of the mines. I hope that—

Q228 Barry Gardiner: No, that is very helpful and you have been very clear. So what you are saying is that the Government's decision on the carbon floor price, you believe, prejudices the future of a viable coal production in the UK in the short to medium term. Thereafter, you would be happy to see the carbon floor price put back to levels that they are at now, or even more, as long as it did not have a disparity. It would be better to do that within the ETS and within the European-wide framework?

Jonson Cox: Absolutely. The four-year period is absolutely critical. I am not here in any shape or form to argue for long-term subsidies for coal. I think that is not the right way to go. I could run all those arguments about the 10,000 jobs that are critical at the moment. I do not want to do that. I just want to argue that the introduction of this mechanism and the level of it, in 2013, comes at a crucial time that, frankly, will kill UK production, particularly out of the more sustainable deep mines.

Chair: Okay. Mr Brewer.

David Brewer: Thank you, Chair. We all know that the existing fleet of coal-fired power stations will close. The rate at which it closes depends upon the interaction of a number of different things; particularly European legislation, but also the influence of any UK Government policy initiatives that may be put in place, such as carbon price support, because that may affect the investment decisions for the existing coal-fired generators; the extent to which they are prepared to invest in that fleet to meet the requirements of those directives.

Notwithstanding that, the fleet of existing coal-fired plant in the UK is on the decline. It is old. It is ageing. It may be capable of having its life extended but it will, over a period of time, close. It will be replaced by new CCS-equipped coal-fired plant, again at some point in time. As electricity demand throughout the 2030s and on into the 2040s perhaps increases, and as low carbon electricity, from whatever source, replaces fossil fuels used for residential, industrial, heating demand and motive power, then we believe that coal with CCS and gas with CCS—not without it—will play an important part in that future.

So we see a decline in coal burn now; a rise in coal burn from new power stations. The problem is the low point, which may occur in the mid 2020s, may be insufficient to support the capacity of the UK coalmining industry, which is on the increase. We are increasing output in the UK for the first time for many years. As an industry we have set ourselves a target of reaching 20 million tonnes a year. It is an output that can be reached without any kind of subsidy and the reserve base is there to sustain it for many years.

Bearing in mind that our customers will not wish to totally forego the import option for commercial reasons, if that level of demand is not there at that point in time then it threatens UK capacity. The way that that will manifest itself: first, will be the advance long-lead investment decisions in replacing mining capacity that have to take place and—as Mr Cox has referred to—those are likely to take place over the next three to four years, mainly for our deep mines. Similar considerations affect the surface mines. They are less acute but they do, and there may be a permanent fall in UK surface mine output if, for example, individual producers find themselves without sites to operate and they elect to withdraw from the business.

Chair: I might just mention that our report on electricity market reform recommended that the carbon floor price be introduced at the nominal level.

Q229 John Robertson: A couple of things. If my memory serves me right, the coal that we have in the ground in the UK is not good for power stations compared to the coal from other areas. Is that not true?

Jonson Cox: From a different point of view, the criticism made of coal in the UK as to higher sulphur content, but that is capable of being addressed by technology. The counterview that could be put, of course, of the current fleet, which I accept is a shorter lifetime, is designed around UK coal and it is one of the things our customers talk to us about benefiting from; that the coal that we produce is the coal their station were designed for.

Q230 John Robertson: You will appreciate that environmentalists talk about it as well and that these coal-fired power stations are the problem.

Jonson Cox: They are, but may I make the point that if the UK—and, please, I am not in any way trying to argue this about not decarbonising the UK—if we set up a mechanism through the carbon price support, which incentivises the import of coal-produced electricity through an interconnector from the Continent, we are merely exporting our problem. We are not dealing with it; we are just encouraging others to transmit to us electricity that has been produced under a slightly different economic regime than the rest of Europe.

David Brewer: UK coal's sulphur content is relatively high on average. A state-of-the-art coal-fired power station, equipped with flue gas desulphurisation and other emissions control techniques, can burn UK coal and meet the requirements of the large combustion plants and industrial emissions directives, no problem. If the UK power stations invest to meet the requirements that are there anyway under European legislation, it can burn UK coal with no problem.

Q231 John Robertson: Can I just ask something else. Going back to the very first question that the Chairman asked about the time it takes to have a commercially viable CCS power station. Two years ago, when we first looked at it and this Committee first came into operation—I think, Dr Chapman, you were one of the people that we spoke to—my recollection is that a viable, fully-operated power station working on CCS and coal was not likely to be happen before 2025. I listened to what you said about the pilot and how we are already a few years behind where we should be, and the pilot was never to be the operative power station. All it was was a pilot, and while it might contribute something it was never going to contribute the size that we wanted—now I could be wrong—and therefore it was the next power station that we were really talking about in relation to what would be a commercially viable power station. Is that right, or have I misunderstood it?

Dr Jeff Chapman: If I can pick up on the wording slightly, the Longannet Power Station is called a demonstration, not a pilot. For example, a pilot would be the kind of equipment that Longannet had on site as a kind of experimental plant in advance of that, and the kind of equipment that is currently being built at Scottish and Southern's power station at Ferrybridge at the moment. The concept of a demonstration—and it is a difficult word because in a sense you are not demonstrating the technology because we know the technology works, in a sense you are demonstrating the concept and getting experience from it—is to do it at a scale that is commercial. You can't perhaps afford to do it at the full scale such as, for example, Kingsnorth would have been 1,600 MW, the full output. I think Longannet is about 2,200 MW or 2,400 MW, or something like that, the full scale. So you don't want to spend that much money but at least you are getting a commercial size of operation at this level.

Incidentally, I think the idea of what is commercial and what is not has to be compared with other low carbon technologies. I come back again—and I would like to share this with the clerk, it is not our paper, it is the Energy & Climate Change Committee's paper—to the comparison between CCS now and other technologies, which is very favourable indeed. The fact is that you need fossil fuels. Another thing that the Energy & Climate Change Committee will say is that if we have to decarbonise power by 2030, then we have to build about 70 GW of baseload equivalent, between now and 2030, of low carbon power, and of course at the moment fossil fuels, coal and gas, produce 70% of our requirements. Now you can, as you said earlier, Chairman, you can make all sorts of speculations about what the technology will be that fulfils that in the future but I think as far as fossil fuels are concerned, they are here to stay. They are needed for the flexibility, and a big proportion of that 70 GW is going to have to be built as fossil fuels with CCS, so we have to crack on and start doing it now.

Q232 Dr Lee: The question I have is with regards to: if we can CCS to work, do you see coal playing a significant part in the future energy security of this country, and for how long? I mean, you talk about for how long the reserves will last, if we can get it to work, is it in our interests to increase coal production in terms of energy security?

David Brewer: Coal produced from the UK will replace imports one way or another. They will either replace imported coal or they will replace imported gas. It is unlikely that coal production in the UK will ever reach the level again at which it can replace all

the fossil fuel that we require for electricity generation. So maximising UK coal production, increasing it as much as possible and for as long as possible, will result in economic benefit to this country, compared to economic benefit overseas. We will reduce imports of fossil fuel, be it coal or gas.

Q233 Dr Lee: Is it your belief that if CCS works coal should play a significant part?

David Brewer: I think then that depends upon the way the market plays out. If CCS works, it has to work for both. It is no use just putting CCS on coal, CCS has to apply to gas as well because if we don't get CCS on gas there is no way we were going to achieve our climate change objectives, a reduction in carbon emissions of 80% by 2050. CCS has to be there on gas too, just as much as on coal. Our problem at the moment is that the Government is requiring CCS on new coal-fired plant but not CCS on new gas-fired plant. So why would you do anything else other than build an unabated gas-fired power plant? If CCS applies to both coal and gas, then the market plays itself out and we will be in competition for a price at which we can sell our fuel with the price of gas.

Jonson Cox: I wonder if we should widen the answer beyond CCS. It seems to me, if I just look at the company I chair, we have 25 years of reserves, taking known technology for exploiting it, and that technology for exploiting it, traditional as it is, is inefficient. Very large amounts that could be accessed are left underground. Some members of the Committee have visited some of our deep mines, and have seen that it is not the best way we could do it. Over 25 years, I think we have to take the view that if it is seen as a critical part of the energy mix, that technology will improve. It may improve not just towards CCS. That is great. There may be other ways of exploiting the calorific value underground from that coal. I am not yet myself sufficiently briefed to be able to come and argue that in front of the Committee. I am too new to it, but there are clearly parties who are coming to us with other ways of exploiting that coal underground in a cleaner method, and getting a larger amount out of the existing reserve than current technology allows, which of course would then extend the 25 years.

So it just seems to me—and I can only argue it at the common sense level—we have that reserve. It is in the UK. It looks like there are ways we can exploit it, for which CCS is top of the list but there are others. Why wouldn't we just slightly modify this impact in regulation, which I believe is a distortion to the market—we have had that discussion—in such a way we secure the survival of this industry through the next few years of critical technology development and market development. I don't know if that helps.

Dr Lee: Yes. I guess what I am trying to say is: is there a danger that, in our attempts to try and reach rather tough targets by 2020 or 2030, we are shooting ourselves in the foot. I mean, the technology comes through after the mines have closed.

Jonson Cox: I think it would be completely shooting us in the foot. We have a mine that is temporarily mothballed, and we are going to have to make a decision on that within the next 12 months because we can't keep it mothballed, and under the current rule it needs £200 million of investment and it has 40 million tonnes of coal. That is a very significant resource. We can't sit on that any longer than the last couple of years we have been doing that. We are getting very interesting approaches from companies who have either CCS or other ways of exploiting that underground, and not using quite such conventional mining technology. I am afraid, based on the carbon support price at 2013, I could not go to the equity investors from whom I would have to raise 200 million, or more, to ask that we continue to exploit that reserve, and that just seems to be a loss to the UK.

Q234 Dr Lee: A small point. In your memo submitted to us, you say that Norway cannot be seen as a long-term secure supplier. Are you comfortable with that assertion?

Jonson Cox: It is an assertion in the brief that my company has submitted. I don't particularly want to sit here—and I remind you I am new to this—making any assertion about gas because I don't think that is my business to do so. The argument is there. It has been properly researched and put together, but I think I should take the line sitting here that really I am concerned about a level playing field. I am very concerned CCS goes on gas as well as coal. Of course I worry, as I hope you all do, about the security of supply, physical and national, but I don't wish to go further on commenting on gas.

Dr Lee: Yes, it is based upon an announcement at the start of the year, since when there has been the large discovery in the Barents Sea, and their hydroelectric power is only 60% of their capacity utilised. It just concerns me that that statement is there. I think you have a good case, so as not to shoot ourselves in the foot as you said earlier, but I don't think it helps to make an assertion that—

Jonson Cox: I can only plead: I have arrived. I am managing the survival of a company that has nearly fallen over. I think my team have made that with good arguments but I don't wish to go any further in putting that argument forward.

David Brewer: Can I just say that the threat that we see is not from low carbon technologies, it is not from the late development of CCS for example, it is not from an expansion in nuclear, it is not from renewables, it is from the free ride that unabated gas is going to have under the present scenario as we see it. It is that that will drive coal burn low and will prevent investment in coal-fired plant. Why would you invest in coal-fired plant and have to do a lot of these things when you can invest in unabated gas plant? That is the threat, not from the low carbon technologies.

Q235 Albert Owen: On that point, what you say in your own sense is that there is an unfair advantage that unabated gas has, but as you will know the title of our inquiry is "security and independence". What you are saying is that makes us less secure in this future, a second dash for gas that is less secure. You are not sure about the Norwegian thing but you are talking in general about imports from other countries

making us less secure than the resource of coal that we have.

Jonson Cox: Less secure and less independent.

Sir Robert Smith*:* But in the short-term lower carbon.

Jonson Cox: In the short-term lower carbon, I guess, is a corollary of that, but we are dealing with generation facilities that last 40 to 50 years and I am sure you would take the view in setting the policy to support the right decisions being made for a 40-year time frame, not for a few years. I understand how critical it is to get us down to a lower CO_2 emission.

Q236 Albert Owen: Before that intervention, what I was going to draw the argument onto was: Dr Chapman, you mentioned the fact that to have the baseload we need to have either fossil or nuclear, and obviously the plans for the UK nuclear industry is to replace like for like, the older ones, so are you saying we need a major expansion in coal-fired in the short-term?

Dr Jeff Chapman: Again, it is very difficult to predict what the mix will be, but whatever happens in nuclear it can't be flexible like fossil. We don't know what the penetration of renewables will be but what we do know is that fossil will be needed to complement renewables. Indeed, the amount of renewables that can come on stream to a large extent will depend upon the amount of flexibility that is provided by fossil fuels. So fossil fuels will have to be there whether it is coal or gas. So we inevitably face a future towards this Energy & Climate Change Committee's target of decarbonising by 2030, where we must have a large proportion of the output based on fossil fuels and it will have to be decarbonised. So the compelling argument is that we have to develop CCS on both gas and coal and we have to get on with it as quickly as possible so that we know what we are doing, and we drive down those costs and equip ourselves to supply a massive export market.

Q237 Sir Robert Smith: Is there any potential that CCS will become a flexible operation? Because my understanding is that for a CCS plant to work efficiently, the term used, "baseload always on" rather than—

Dr Jeff Chapman: Yes, I was hoping you would ask that question because it is true that the first plants that come on stream will look more like baseload. Generally the first plants that you build of any kind of fossil fuel plant go on baseload, because you have just invested a whole lot of money and you want to recover that money as quickly as possible. That has been true of both coal and gas-fired power stations in the past. They have gone on the bars as baseload and later on they have slipped down the merit order, which is fine.

The other thing about CCS is that it is an industrial process and it will prefer to run under steady, state conditions as much as possible. So we have to find ways of engineering into the system the flexibility that we already enjoy with fossil fuels, but that is not the first requirement. The first requirement is get some CCS power plant on the bars and then start looking at how we can make it flexible. It is a matter of process engineering. It can be done. There are various ways that it can be done. For example, with the hydrogen production I was telling you about before, we can store intermediate hydrogen. There is, for example, under Billingham, a store of 800 tonne of hydrogen. Not many people know that. It is stored in salt domes, and there are other salt domes in the country. It is limited but it can be done. In other ways, in post-combustion capture you can store reactant and there are ways. Unit sizes can be made such that you can turn the whole plant on and off. So it is an engineering problem that is there to be solved.

Q238 Laura Sandys: I would like to come back to Mr Cox's point. One of the things that you are saying, and making a strong case about, is that we need to ensure that we have coal capacity into the future and that there is this interregnum period where we have problems, and that that in some ways offers us the opportunity to invest in CCS but also to ensure that we have long-term independence of supply. At the same time you say we have only 25 years' coal reserves in the UK. So are we not building a technology that will in the future be extremely dependent on imports from countries where insecurity and price volatility will create some problems?

Jonson Cox: I hope I did not mislead you. The 25 years was my reference to taking UK Coal PLC—we represent about 40% of the UK industry—what we have. I fully understand the point but were it only 25 years, your point—

Q239 Laura Sandys: Are you not just looking for a short-term subsidy rather than building in long-term security and independence?

Jonson Cox: Can I comment on this: while I am absolutely not arguing for a subsidy. I am asking not to be penalised by a subsidy given to other technologies. The 25 years is: under current run technology and the current low mining technology, which is evolving—if we reopen a mine it will be under a completely different technology—does not exploit that reserve as efficiently as new investment could do, so that would extend the 25 years. Having been in a survival state, this company has not gone out to look for further reserves and of course there are further reserves in the UK we could exploit. I was merely making the point on the 25 years that that is just what we have today in our books, but it has a considerably longer term potential.

Q240 Laura Sandys: All I am saying is that if we are building and supporting technology that will subsequently become extremely dependent on imports, I think that is an interesting point; not necessarily to dismiss it but it is an interesting issue about what sort of technologies we are wanting.

Jonson Cox: It is a very good point and I would like to put some more evidence in, if we may, about the length, taking some projections about technology of the reserve.

David Brewer: This country has very substantial coal reserves. We having something like 3.3 billion tonnes in identified, named prospects, and there is something like 700 million tonnes of coal that can be extracted

from the surface economically. There are environmental challenges in doing so, but it is there and it is available and it can be extracted economically. Of the rest, it may be that under current world coal prices, investment in sinking new deep mines is not impossible. We have an example at Margam in South Wales. The steel company Tata is looking very seriously at opening a new underground coalmine. That is a special case because it is coking coal and therefore the world prices are higher, but the world prices for steam coal are pretty high, as they are for all fossil fuels, and there are very significant reserves of coal left in this country. I said that we were increasing output now and we expect it to get to 20 million tonne a year and to maintain that level for many years.

Dr Jeff Chapman: I would like to say I still think it is worthwhile investing in developing this technology in the UK for coal or gas, not the least because of the export potential that it gives us. Coal has proven itself over the years on international markets to be generally a quite reliable resource. So we would probably expect to be importing coal for quite a long time to come, and then it is down to the gentlemen on my left and right to be competitive in that market. That is over to them.

Q241 Dan Byles: I am aware we are very short of time. I am a bit concerned, Mr Brewer, about something you just said there. Are you suggesting that if we do end up with CCS working and a new generation of coal-fired power stations that you would expect the majority of the domestic coal to be coming from surface mines rather than deep mines?

David Brewer: The majority of domestic coal comes from surface mines now—

Dan Byles: I mean going forward with extra exploration, getting on board—

David Brewer:—and has done for some years. Going forward, we are in a competitive market. If there is a market for our products there, producers will produce according to their own abilities and their own costs in competition with each other, but either way whether the coal is produced from deep mines or from surface mines or, as is most likely, some combination of the two, going forward for many decades, then what it will be doing is replacing fossil fuel imported from elsewhere.

Q242 Dan Byles: Just coming back to the investment challenge that UK Coal have, I mean I have visited Dormil a number of times. I have been down and seen the operations. It is fascinating I have to say. So carbon floor price is an issue. Although you dismissed it a bit, the uncertainty over CCS must be a bit of an issue because at the moment we don't know whether CCS will ever be a long-term viable competitor. I know that we had a discussion that it could do but it is not yet the case that it is in production anywhere in the world commercially. There must be some uncertainty going forward over how much you invest in coal, if we don't know if coal-fired power stations are going to be built in the country or not. Charles Hendry is on record telling this Committee that if CCS does not work there will be no new coal-fired power stations built in this country.

Jonson Cox: I think this comes back to my concept of an option price. There are two cycles for investment in coal as I see it. There is a three to five year cycle of reinvestment in existing mines or mines that can be accessed—I mentioned the one at Harworth of 40 million tonne—where the investment cycles open new power with a three to five year cycle. I see that as a cycle that we could go through and make the investment that would secure us production into the 2020s, on the basis of current prices if we did not have the carbon floor price. That is the real problem, the level of it and the disadvantage to the UK.

Dan Byles: That remains the No. 1 stumbling block.

Jonson Cox: That is number one. That would buy us the three to five year option to be able to secure future coal output. I think you are absolutely right when you take the longer term investment decision of opening new deep mining. That is a 10 to 20 year investment cycle, and that certainly would not be made absent CCS or another exploitative technology of which there are others put before it.

Q243 Dan Byles: Very briefly on that: underground gasification. That is something that has been mentioned as another possible outlet. What are the economics of that? Is that significantly more expensive?

Jonson Cox: To be honest, we are not at the stage of fully understanding that. We are receiving inquiries and interest from people who wish to do that. We are looking at it. I will put into the Committee what we know so far about it.

Dan Byles*:* Yes, that would be helpful.

Jonson Cox: I apologise, my role in the short-term in the industry is to try to get what we have working okay.

Dan Byles*:* Yes, of course. Okay, I know we are short of time.

Q244 Chair: You talked about gas once or twice. From the point of view of people concerned about decarbonising electricity generation, what is wrong with another dash for gas?

David Brewer: Because all it does is make some reduction if it is at the expense of coal-fired power. What it does is make some reduction to CO_2 in the short-term. It does not get you where you need to be in the longer term. So there are two risks—well, multiple risks—there are security of supply risks, in our view, to an overdependence on gas, but secondly there is a risk of long-term carbon lock in. I don't have a problem with gas. What I do have is a problem that says, "You have to have CCS on coal but not on gas" because that is not a level playing field.

Q245 Chair: Suppose we have emissions performance standards, for example, on any kind of fossil fuel generation that might be introduced progressively tighter so you don't destroy all the existing assets straight away, but by 2025 you would not criticise a policy that was based on an even playing field between coal and gas, assuming

hopefully CCS might be available for both at that time?

David Brewer: It depends on the level at which you set your EPS because if you set it at a level that is the Government's initial level, it requires CCS on part of a coal-fired plant but not on gas. If you tighten it gradually, the risk is that over time you will end up by requiring CCS on the whole of a new coal-fired power plant but only on half of a new gas-fired plant. So again why would you build coal rather than gas, unless you had an absolutely clear signal that in the future there was going to be no fossil fuel without total CCS by sometime in the 2030s?

Q246 Chair: Yes, I mean you could have that signal but is there not also the possibility that you could have this progressively tightening EPS for both coal and gas but, because of your concerns about security, you can reserve some capacity, which might be coal, which would only be brought in when needed?

David Brewer: Yes, and I think that expresses itself through the existing coal-fired fleet. We are not expecting the existing coal-fired fleet to continue to run on baseload. What we want to avoid is this transition from old coal to new coal, at which the existing fleet just finds itself closed without an adequate replacement.

Q247 Chair: In answering questions, you will soon be competing with the Prime Minister in the Chamber but we have one more topic that Robert is going to deal with.

Sir Robert Smith*:* Just very quickly. The threat of the large combustion plant directive and the emissions directive, how serious a threat are they?

David Brewer*:* How serious a threat?

Sir Robert Smith*:* Yes.

David Brewer*:* Well it depends where you are. They are not a serious threat in Germany because in Germany the large coal and lignite powered plants are investing, and have invested, to meet the requirements of both of those directives. It is only a threat, a greater threat, in this country because certain other policy instruments are in play, which make investment in the existing coal-fired fleet very difficult to justify compared to Germany, say.

Q248 Sir Robert Smith*:* You mentioned in your submission from Coal Pro that the industrial emissions directive was being interpreted flexibly by the UK Government. How are they being flexible?

David Brewer*:* Yes. In the negotiations over the IED itself, the UK Government and Defra did a good job for the generating industry, at least in managing to get built into the IED maximum flexibilities, of which there are two, basically speaking. One is an opt-in/opt-out alternative, so if you opt out of meeting the requirements of the directive you can continue to operate until 2023. The other flexibility is a Transitional National Plan, which gets you beyond 2015 and through to 2020 before you close. That doesn't apply just to coal-fired power plants, there is some gas plant that will need to invest in NOx abatement immediately. As I understand it, the view of the UK is that you don't have to decide to meet the new emission limits required by the Industrial Emissions Directive. You can go into the Transitional National Plan but you can swap between one and the other, right through until 2020 and then come out at the other end. There is another provision in that you can continue operating, via that Transitional National Plan, beyond that period at a very low level of 1,500 hours a year, which sounds a low level, but that is 60 days, 60 plus days.

The Transitional National Plan has to be ratified by the Commission. Defra seems to be taking the view that the directive does not say you can do this but it doesn't say you can't either, so they seem to be interpreting it that you can have this flexibility, which delays the investment decision that is necessary. It delays the time at which it might need to be taken, but when they put that National Plan to the Commission for ratification, the Commission might say, "We didn't mean this at all. You are going beyond the spirit of the thing here", in which case that will mean earlier and more closures than might otherwise be the case. Does that make sense?

Q249 Sir Robert Smith*:* Just finally, phase 3 of the EU ETS?

David Brewer*:* Yes, well the EU ETS is a shadow price at the moment; the carbon price. Allowances are issued for free but there is a cost because they are traded at the margin. So I think generators are building the shadow cost into their decisions, but from 2013 that becomes real money in that the allowances are going to have to be purchased. So that is a real cost; pound notes as opposed to some kind of shadow cost. Looking here at the existing opt in/out plans, under the LCPD, which will continue until the end of 2015, if they have to shell out real money from 2013 they might decide it is not worth doing so and again you will get earlier closures.

Dr Jeff Chapman*:* The Treasury's auctions allowances in the EU ETS, and is also granting itself, through the carbon floor price tax, a contract for differences between the price of allowances and the fixed price. So it gives itself a fabulously stable income derived from fossil fuels, which is sufficiently high to be able to pay for any programmes involved in support of CCS.

Sir Robert Smith*:* If it were not for the fact there was a huge deficit.

Dr Jeff Chapman*:* Well—

Chair*:* Thank you very much for coming in and giving us your evidence. It is very helpful to us.

Tuesday 28 June 2011

Members present:

Mr Tim Yeo (Chair)

Barry Gardiner
Dr Phillip Lee
Christopher Pincher
John Robertson
Laura Sandys
Sir Robert Smith
Dr AlanWhitehead

Examination of Witnesses

Witnesses: **Nick Wye**, Spokesperson, Gas Forum, **Chris Hunt**, Director General, UK Petroleum Industry Association, and **David Odling**, Energy Policy Manager, Oil & Gas UK, gave evidence.

Q250 Chair: Good morning and welcome to the Committee and our inquiry, which has been going on for a little while now. You may have seen some of the previous evidence that has been given both orally and in writing. Could I start off by talking about oil stocks, which in this country are held by the industry rather than some sort of national account? Do you think that is a good idea from the point of view of energy security?
Chris Hunt: I could start by answering this, Mr Yeo. No, certainly, for the 14 years I have been in UKPIA, we have been campaigning for an agency to manage that on behalf of the UK, which is a very similar system to that deployed across most of the EU. The agency will bring a benefit of slightly lower costs, but that is not the whole reason. It is centrally managed in a transparent way, rather than in individual member companies, where it tends to be washed up in day-to-day business, hard to identify. Transparency is a big issue.
Secondly, at some point, we will lose the derogation we enjoy through our North Sea enterprise, which actually reduces our obligation under EU rules to 67.5 days from 90. That will go and it will incur somewhere between £4 billion to £5 billion of increased storage costs, which we feel an agency is better placed to manage and an agency can make decisions on a strategic basis on behalf of the nation.

Q251 Chair: The £4 billion to £5 billion is the extra amount of capital tied up in the extra stocks, is it?
Chris Hunt: It would be tied up in terms of not just the additional capital in the stocks, but the actual building of storage itself as well. We think that is far better managed by a central agency. The agency can decide whether it wants to build new storage, what that storage will be built for, and moreover, where it is built. For the whole sector, it will be a clear and transparent way of managing a national resource. It is not a commercial company resource.

Q252 Chair: It is not a great time to be suggesting public expenditure on a project like this, is it?
Chris Hunt: This will be completely self-funding, so it will not be drawing on the public purse at all. It will be a transfer really from the individual amounts that individual companies are catering for into a central agency. There will still be a form of charge from the agency to the obligated companies to manage that situation.
Chair: Hang on. You said it was going to cost an extra 5 billion.
Chris Hunt: The extra 5 billion is the increase in storage, which will come anyway because of the loss of the derogation.
Chair: The companies will have made the Government an interest-free loan for that purpose.
Chris Hunt: The agency will be able to source its own funding, we think; it will be an AAA-rated organisation as it is in the rest of Europe.

Q253 Chair: Won't the Treasury rules say that comes under public borrowing?
Chris Hunt: We believe not. We have put a proposal in jointly with DECC that should be released to Ministers shortly, which shows how that particular hurdle can be overcome so it does not offend Treasury rules.

Q254 Chair: Do you envisage all the stocks in the future being held by this agency?
Chris Hunt: Eventually, yes.

Q255 Chair: How long do you think we are going to keep our exemption as a producer from the 90-day requirement?
Chris Hunt: Figures vary. Probably David, who represents North Sea, will bear that out. Projections as to when the North Sea decline in production will actually trigger a nullification of our reduction, our derogation of EU rules, are unclear, but any time from 2018 onwards, which relatively is round the corner.

Q256 Chair: Is that your view?
David Odling: Chairman, I am not sufficiently familiar with how the detailed rules work on the stocking, but it seems a reasonable assumption—some time later this decade.

Q257 Chair: For the moment, is our exemption still justified by the circumstances?
Chris Hunt: Yes.

Q258 Chair: If we did have an agency managing the stocks, how do you think it would actually work?
Chris Hunt: The agency would, in fact, take due cognisance of the overall UK obligation to the EU and then to the IEA, which supersedes it. The agency would set in place plans for how it wants to manage that stock through things called tickets or physical

stock. It could then go on to the open market to buy tickets or to manage physical stock, and its running and operational costs would form the basis of a re-charge to those supplying into the market. The agency, in effect, cannot lose, but needs to be managed efficiently and effectively to be any good.

Q259 Chair: Would most of this extra stock be physically held or is it in some sort of futures contract?
Chris Hunt: It would be entirely a matter for discussion between the agency and Government. At the moment, there is a fair proportion held in what has formed as tickets, but increasingly as we go forward that market is going to become increasingly tight, particularly in terms of what we term "Cat 2" products, which are diesel and aviation fuel. There might well be a call, when it is agency managed, to have more in physical stock. In fact, that is one of the benefits of an agency looking at this whole issue on behalf of the nation rather than an individual company.

Q260 Chair: What are the circumstances under which any of that stock is released?
Chris Hunt: As now, it will be released either by instruction of the IEA, as has happened only this week, or by UK Government putting up a case for release to manage out the short-term UK disadvantage.

Q261 Chair: In the second instance, what will be the circumstances under which the UK Government might put up such a case?
Chris Hunt: If, for example, we had a significant and long-term refinery outage or some sort of breakdown in the infrastructure, there might well be a requirement to do that.

Q262 John Robertson: To move on to the refineries, that last comment you made about a long-term refinery outage is interesting, yet we are selling off our refineries, aren't we?
Chris Hunt: Certainly, four of the eight operational refineries have been placed on the market for sale. Two of those are in the end stages of completion for successful sale. That is the Shell refinery in the north-west of England, Stanlow, which is going to an Indian company called Essar, and the Pembrokeshire refinery operated by Chevron, which will be sold to Valero. The two other refineries up for sale are Milford Haven, operated currently by Murco, and the Total-operated Lindsey refinery up on the Humberside.

Q263 John Robertson: This comes from a position back in the 1970s when we had 18 refineries. You talked about storage earlier as well. Are refineries not used for storage of fuel?
Chris Hunt: Yes. Obviously, refineries have a fairly significant storage of both crude oil and finished products. Over the years—bearing in mind we have been operating our current compulsory stock-holding obligation for many years—part of the storage they have will be taken up by national strategic stock.
John Robertson: We are selling off storage so we can build new stuff. This is what you are telling me.
Chris Hunt: We have not actually sold off any storage as yet.
John Robertson: Well, we had 18 refineries at one time and now we are down to eight, soon to be four.
Chris Hunt: The 18 refineries have been closed for a number of reasons. If you look at the overall refinery output, in fact it has gone up since the 1970s, so the eight operational refineries have increased capacity.
John Robertson: Storage could be there if we want it, but it is just that we do not want it.
Chris Hunt: Storage of the 18 would have gone.

Q264 John Robertson: Let us move on a wee bit. The actual refinery and product that we are producing does not meet the UK's needs. Why?
Chris Hunt: The refining capacity in the UK, in terms of capacity, meets UK demand, but unfortunately not in the exact product mix we need. We, in common with Europe, all the European—

Q265 John Robertson: That is not what the Deloitte report said, is it?
Chris Hunt: Because of the lay-out configuration of refineries put down some 30-plus years ago, we in common with Europe produce effectively too much petrol for our UK demand and too little diesel and aviation fuel. Again in common with Europe, we would export surplus petrol to the United States and we will be importing diesel. Some diesel and aviation fuel may come back.

Q266 John Robertson: As we said, as we get closer to a stage where our stock starts to deplete, we will be importing all this expensive fuel, particularly aviation fuel, and we will not be putting anything else back in the market. Why are we so short-sighted in this? Why has the business in this country not thought ahead?
Chris Hunt: The business has thought ahead, but we must recognise why there are four out of eight of our refineries up for sale.

Q267 John Robertson: Is it just short-term profit? Is that what we are really talking about?
Chris Hunt: No, it is a long-term view taken by integrated oil companies that the particular issues you have in Europe and the UK, in terms of profitability, return on investment, and your future view of where this market is going, mean that if you are a global company, there are probably more exciting areas in which to invest your funds.
What it also means is an opportunity for other companies like the Essars and the Valeros with a different business model to come in and buy those assets and operate them under a different business plan.

Q268 John Robertson: The Deloitte report recommended that the Government should determine the minimum level of refining capacity that should be maintained as an insurance against market breakdown. Do you have a view on that?

Chris Hunt: My view, which we have expressed to Government repeatedly, is that Government needs to have some sort of policy framework for refineries. We are kind of seen in the downstream part of the oil business as invisible, and we are invisible, I think, simply because we do such a good job; we very rarely let the consumer down at all. North Sea and my colleagues from North Sea—it is far sexier than the refining and marketing part of the business. Consequently, we tend to be airbrushed out a bit from the future energy scenarios.

Q269 John Robertson: We have let the country down in diesel and gas oil and aviation fuel, haven't we? I have the figures here, and the amount coming from abroad would suggest—why are we not in that? Netherlands is 26% of diesel and gas oil. Why are we not doing that?

Chris Hunt: I dispute that we are letting the country down, because we have not seen massive queues at petrol filling stations for diesel, nor are we letting down the aviation industry.

Q270 John Robertson: That leads me to my last question. In 2000, there were fuel protests and some refineries were blockaded by truck drivers. That has serious knock-on effects for fuel availability and there was a stampede to try to get stuff. Is there a risk that that could happen again, and what has the industry done to try to stop it happening again?

Chris Hunt: The possibility of some attempted mass blockade of refineries and terminals is in the hands of those who might want to do that. As I say, I cannot categorically say they would not make that attempt again. What has happened since the 2000 blockades is that the industry and Government have worked very closely together.

We now have in place—we have had for some time—something called the national emergency plan for fuels, which is jointly between the industry, Government, police and every other affected agency to manage a whole range of scenarios where this might happen. Principally, it has been looking at things like access roads to refineries and terminals, and has had close collaboration with the police to keep them open. In fact, in the last year, there have been a couple of attempts to blockade, particularly down at the Coryton refinery in Essex. The police have immediately been on the case. In fact, the police were very proactive and went to visit some of those claiming to launch these campaigns and had a quiet word in their shell-like and said it was probably not in their best interests to carry that forward. We are in a far better position than 2000. As Baldrick would say, "We have a cunning plan" and we will—

John Robertson: Well, we will not ask what it is. Keep it secret.

Q271 Sir Robert Smith: I remind the Committee of my entry in the Register of Members' Interests as relevant to this inquiry as a shareholder in Shell, also Vice Chair of the All Party Group, the Offshore Oil and Gas Industry, where the secretariat is provided by Oil & Gas UK.

On the refinery thing, it has always struck me with briefings on refinery that all the money is made before it gets to the refinery. Would anyone build a new refinery in the UK?

Chris Hunt: I could give an opinion: probably unlikely. If you look at where all the investment in all the new refining projects is going worldwide, it is India, China and the Middle East, because those are the growing and expanding markets. Our market is fairly flat and will probably decline with new measures to reduce the carbon footprint of transport. Therefore, if you invest your money, would you be doing it in the EU or particularly the UK? The answer is probably not, but what we need to do, for the eight operational refineries we have, is attract future inward investment. It is significant. We reckon at least three projects in the UK at £500 million apiece are needed to improve that situation with diesel and aviation fuel. We still need to attract that and that is why we are saying to Government, "You do need to have a policy framework that covers refining and, quite frankly, stops this burden of pressure where we have UK-only CO_2 policies like the carbon reduction commitment and the renewable heat incentive". If that had gone through in its original form, it would have completely wiped out the entire refining margin for the UK, which affected UK refineries only against the EU. Then you look at the raft of EU regulations like the reduction for refineries and other heavy industry; that again is disadvantaging EU refining versus global, and we are in a global business. We have to be very conscious that first, if we are creating UK-only policy, that is going to affect refining and other energy-intensive industry and, secondly, on the EU scenario, if we are developing further carbon reduction policy versus the world, that we are in a global business, and you disadvantage those very valuable and important assets from a strategic point of view quite greatly.

Q272 Sir Robert Smith: How is the dialogue with Government on those concerns?

Chris Hunt: We have a very good relationship with our Energy Minister and that part of DECC. Personally, I think that there is a tension where you have the environmental and climate change part of Government in with energy, because there is always a tension between one and the other. Our relationship with that part of Government is fine. We do have some fair and frank exchanges of views with other parts of Government on where this policy is going on climate change. Again, we must emphasise that we are never looking for favours or advantage, but really for a level playing field for UK refining.

Q273 Sir Robert Smith: On the upstream side, the UK became a net importer of gas in 2004 and oil in 2005. Has that caused any security problems?

David Odling: In terms of energy security, do you mean?

Sir Robert Smith: Yes.

David Odling: So far, no, particularly on the gas side. The world gas market has changed dramatically over the last four to five years. We have seen a huge increase in the availability of gas reserves and a huge increase in particular in international trading of gas.

Mainly, gas is a regional fuel, but there is a growing trade in inter-regional trade.
On the oil side, clearly the oil market has been tighter than the gas market of late, but there have not been physical shortages. The market has responded. Of course, one of our biggest overseas providers of oil is Norway, which is the nearest major producer. We and Norway are the two big oil producers in Europe. Nobody else comes near us. Clearly, their production is more than ours, but they are a very significant supplier to this country.

Q274 Sir Robert Smith: From a security point of view, not having our own domestic production is not necessarily a risk, but it is the loss of economic benefit, balance of trade and jobs?
David Odling: Yes, our view very much is that it is the economic losses and the consequences of that, which there is a degree of inevitability about, but in terms of energy security we do not think it has moved the picture hugely.
Nick Wye: Certainly, on the gas side—I represent the Gas Forum, which is where the main interest of the association is—quite clearly the UK has responded, and responded in fairly good time to decline in the UKCS in so far as we have spent roughly, I think, about £5 billion on infrastructure in the last five years. In terms of the actual capacity, I believe, of import capacity, we have invested this money to allow us to import a maximum of 140 bcm a year, which compares to annual demand of around about 90 to 100bcm, so our import capability far exceeds our annual demand, so clearly the market has recognised—
Sir Robert Smith: The physical, structural input capability, but you obviously have to have gas—
Nick Wye: Yes, the commodity to follow. In the last year, if you look at the breakdown of where the gas has come from, the numbers are from Norway, 24 bcm, and this is against a total demand of about 90 to 100 bcm; LNG, 17 bcm. The year before we had 6 bcm from LNG, so it showed a marked increase in LNG importation—thanks probably due a lot to the fact of US discovery of shale, which has been very helpful to the UK—and also 9 bcm from the interconnector from Russia, from Holland and elsewhere.
We have responded in terms of infrastructure and the market has responded in terms of commodity, so we seem to be doing okay.
David Odling: Just to add to that, I would say that we now have the most diversified gas supply in Western Europe in this country.

Q275 Sir Robert Smith: We still have an estimated 24 billion barrels of oil equivalent of our own to potentially produce. What sort of investment would be needed to benefit from all that reserve?
David Odling: Currently we spend roughly £10 capital for each barrel we recover, so a very simple sum tells you that is £240 billion in today's money. Having said that, it is inevitable that future resources are going to be more difficult to recover than current resources. That trend, of course, has happened over the last 30 years. Quite where that will take us, who knows? But today's figure is capital roughly £10 per barrel.

Q276 Sir Robert Smith: When it comes to investment, obviously we have already taken evidence from you on the budget impact as you see it on investment. One of the key things you emphasised was that it was not just so much the tax but the shock and unpredictability of the tax that means that for future investment there will be more risk built in to decision-making. Is there anything in the way the Government approaches tax changes that could reduce that risk profile for the UK?
David Odling: Given that we have a unique tax system, and clearly it is a very sensitive matter as far as investment is concerned, we would certainly favour the kind of model they have in the Netherlands, which is that the special tax regime that applies to us is not changed without warning, but is changed as a result of discussions with the industry to see what is going to work best for both parties in terms of the national exchequer and the industry. I think it is the "without warning" side that is extremely damaging.

Q277 Sir Robert Smith: Is there any downside with warnings that people could be tempted to make—is there any risk? Treasury are always very frightened of sharing their thoughts in case investors can suddenly—
David Odling: Which is the worst, to share your thoughts and negotiate a deal on the one hand, or just to spring a surprise on the other when all the signals before the surprise was sprung indicated that no such thing was going to happen? We think that the second of those is far worse than the first.

Q278 Sir Robert Smith: If you can get rid of the surprise element, you can then have a constructive negotiation?
David Odling: Which is what we are trying to enter into now, of course, in the aftermath of what happened; to see what could be done to alleviate some of the consequences of that. Unfortunately, what that move did—going back to the physical side of it, the amount—is that it more than negated all the previous administration's towards the end arrangements over difficult fields, high pressure, high temperature fields and so on that had been put in place. They were just wiped out completely by the move.

Q279 Sir Robert Smith: So movement on the field alliances will, at the margins, make a—
David Odling: Potentially we think that is a very useful area, plus of course, as I think is well known, resolving the difficulties over the taxation of decommissioning. It is difficult now to separate those. Frankly, the whole package needs sorting out. Fortunately the Treasury has agreed, and therefore we are into detailed discussions with them to try to resolve this whole tangle, because it needs to be resolved.

Q280 Dr Lee: Mr Odling, you said that so far security had not been impaired by becoming a net importer of gas and oil. Putting aside our close

relationship with Norway—I note you were once employed by a Norwegian organisation; I think we are very fortunate to have that relationship—let's go to a doom and gloom situation, a globalised world in July 1914. Judging by economic indicators at that point, no one anticipated the conflagrations to come. At that point, the British people's perception of oil and gas security, energy security is, "What do we own ourselves?" That is the man in the street, "Do we have enough oil and gas? Do we have enough power?" As I said, we did not predict it last time around, so why should we predict it next time around? If we go down the path of protectionism with a nationalistic, looking after ourselves type of approach, which one could foresee developing at the moment, in Europe for sure, do we have energy security in the way that the layman in the street would understand it?

David Odling: It is a fairly complicated answer. Two things: in my lifetime at least, the biggest threat to the economy and energy supplies in this country came from a mining strike, and that was entirely internal. That was back in the 1970s. Interestingly, if you go back to the First World War, after what happened in the general strike, that was internal. The great thing, surely, is that international trade has been transformed in the last 50 years and we have seen markets opened for almost everything you care to name. Not just energy—energy came later—but even in other essentials like, say, food and clothing, with the result that we can move goods around the world in a way that was never before possible.

I think the crucial thing there is that both the suppliers and the consumers get into a position of interdependency. In other words, suppliers are looking for the revenue as much as the consumers are looking for the goods, and we see that in the energy markets, so our view is that politically we should do everything we can to maintain the best relationships possible with supplier countries, and that is true as a nation and it is true as the European Union. The European Union after all is an even bigger importer of fuels energy than we are; oil, gas, coal and so on.

Secondly, in pursuing those relationships, we should remove as many barriers to free trade as are physically possible, and then you create optionality, diversity and security of energy supplies or anything. Food or clothing again—same thing—will come from diversity and that diversity supports our own production.

Q281 Dr Lee: But that is predicated on the suppliers continuing to not need the oil and gas themselves, so if you have a developing Middle East growing significantly in economic terms—China of course always plays a part—there is a possibility you will get to a point where they will say, "No, we don't have anything to sell", or they may choose to engage in some sort of economic warfare; a sense of, "Right, we are going to retain our resources, what we have, because we know in time that that will do you harm". I know that it all sounds a bit scary to be talking in these terms but I am not convinced at the moment that the type of security that the people want is necessarily the type of energy security that we are talking about. Do you understand what I am trying to say? I do not think people fully understand. They think, "Oh yes, we have oil; we have gas", but in fact they will not have any concept of the fact of what proportion of it relies upon retaining good relationships with foreign partners.

Nick Wye: Relations are important, no doubt. Our relationship with Norway and our relationship with Qatar were important in terms of ensuring we had the facilities built in the UK with pipeline or energy-receiving terminals. At the same time, you understand that there is essentially a glut of gas. There are the traditional countries still supplying gas, but there are a lot of new countries coming to the market, such as Australia, Brazil and the Caspian Sea. There is an excess of supply, and there isn't the market locally and there will never be the market locally to satisfy that supply, so as long as we have the ability to signal our need, which is essentially the market, and the ability to move the gas from A to B, which is either through a pipeline or through LNG, I would suggest that security is pretty safe, mainly because of diversity of supply in where we can obtain gas in the future.

Chris Hunt: Can I just interject? These are very interesting questions, and I recall that the last IEA World Energy Outlook said there are 1,354 billion barrels of oil available, which is the equivalent of 45 years' worth at 2009 consumption rates. As we often say in UKPIA, oil is not running out, so you needn't rush on our behalf. From my perspective, the security of supply issue is that at the moment we can process through our refineries crude oil from 120 different sources. We use a lot of North Sea but we can process from 120 different sources. That gives you an enormous amount of supply robustness. If, unfortunately, through policy or lack of commitment from Government to the refining sector you lose a lot of that capacity, you are then in exactly the situation you are talking about. You are reliant upon the former Soviet Union and the Middle East more and more for finished products to come into the UK and I think that, if you repeat some scenarios of a major conflagration, it will put you in a more difficult position than if you were refining your own product from 120 different sources.

Nick Wye: There is a similar issue with gas in so far as, as you probably know, there are a variety of qualities of gas throughout the world. In the UK we have different quality parameters compared to mainland Europe; for example, the LNG that comes in is fairly rich gas, so it has to be treated, and that is treated at the terminal level. They bllast it with nitrogen to bring it down to the quality level we require. Going forward, it may be more of an issue if we are importing more gas, particularly pipeline gas, let's say, from Russia. There may be issues in relation to making sure the quality of that gas is appropriate for usage in the UK. Historically, the UK approach has been very much a polluter pays approach, so at the LNG terminals, the LNG companies are the ones investing in those process facilities.

If you are looking at the interconnector, there are many parties who bring gas through the interconnector, many capacity holders, all with different economic drivers. It might make sense to consider a more centralised approach to ensuring that

the quality from the interconnector is sufficient for UK consumption. I know that there have been very occasional issues with quality coming through the interconnector and- Fluxys, the operator of the pipeline on the Belgian side, has said- on a couple of occasions they have had to run their linepack, the stock level, right down to ensure that they could supply the UK with the gas that is required. That may become a bit more of an issue, particularly in terms of pipeline gas, in the future, but LNG is kind of sorted because the regasification terminals already have the processing plants in place.

Q282 Barry Gardiner: Mr Odling, in your submission for Oil & Gas UK you said that you would prefer to be building gas-fired power stations rather than renewable plant. That may be no surprise, but given that we have about 24 GW of gas at the moment and another 24 either under construction or with consent, what further emissions reductions are possible by replacing coal-fired power with new gas, and why do you believe that it is preferable, given the UK's renewables targets, to be building that gas plant instead of renewables?

David Odling: To answer your first question, we ran some calculations based upon evidence that is available publicly, and in round numbers, if you replaced all the power generated currently by coal and oil with gas—there is very little oil, of course—the reduction in CO_2 emissions per year would amount to 50 million tonnes. There would also be concomitant reductions in sulphur dioxide emissions, nitrous oxide, particle matter and so on, and various other pollutants, so you get not just the CO_2 gain but also air quality gains of a very significant order.

Why would you want to build when we have the renewables target? One of the things we also said in the submission was that we thought it might have been better if that target had been a low carbon target, rather than necessarily specifically a renewables target. But accepting the policy as it is, it seems to us there are several things. First, the renewables are going to have some sort of backup anyway. If you take wind, the best that wind has done so far in this country, on an annual availability, is about 30%. On some years it has been down in the 20s. That should rise with offshore wind, unless there are severe reliability problems, but let us set those aside, so we might get up to, say, 35% availability. Nonetheless that still means that it is going to have to be backed up for 65% of the time, which actually of course is a lot more than the 35%.

We are going to have to build both, aren't we? Or at least it seems to me, on a very simple arithmetic, that we are going to have to build both. It also seems to us much less risky in the first instance to build the gas, because it has financial advantages and it has delivery advantages. It will not strain the supply chain to anything like the same extent. We are going to need the plant anyway. It has these benefits in terms of emissions, on top of which it will buy time to allow some of these new technologies to have the necessary research and development funding put into them, so we can find out what actually is likely to work and, therefore, how we might look at things in the longer term, whereas, at the moment, we seem to be making a commitment that is extremely testing financially and from the point of view of physical delivery. One of the things that worries us most is that there will be competition for supply chain resources and, in particular, human beings, qualified engineers and so on. Where are all the marine surveyors going to come from?

Q283 Barry Gardiner: Mr Odling, you are, in a sense, repeating the Committee's own fears, from a previous inquiry, as I am sure you will know. Let me ask you this, in pursuit of what you just said: do you believe that there will come a point where perforce, like it or not, the Government will have to renege on those targets?

David Odling: We think it is going to be extremely difficult to meet the 2020 renewable energy target.

Barry Gardiner: That is what you said in your last answer. I am asking you a further question.

David Odling: Forgive me. I am not sure it is for us to pronounce on that. I think that is something, if I may say, for the Government to decide.

Barry Gardiner: It will be for Government to decide. I am asking you for your opinion. As a person in your position, it would be strange if you did not have an opinion on such matters.

David Odling: We certainly think we are going to miss that target, and miss it by an appreciable margin.

Q284 Barry Gardiner: Thank you very much. You have obviously seen the Energy and Climate Change Committee's reports. You will know that they said, and I quote, "There is no role for investment in coal plant without full carbon capture and storage to come on the system beyond 2020, and only a limited role for unabated gas plant. That is, for example, running at low load factors in balancing intermittent generation. If there were to be investment in either form of unabated fossil fuel capacity for baseload generation, the required sector decarbonisation would not be achieved". Do you disagree with that?

David Odling: It comes back to this question of developing new technology. It seems to us that there is a bit of an assumption there that carbon capture and storage at power station scale is going to be made to work. We are still only—

Barry Gardiner: Sorry, no, the quote actually talked about how if it was unabated then it would be incompatible with reaching the low carbon targets.

David Odling: That may well be true, but surely that is not the only consideration, because the Government has three interlocking overall objectives, which are to reduce emissions, to secure supplies, and to do it all in an affordable way that keeps the economy competitive. That particular quote was, if I may say so, only looking at one of those three overall objectives. The question in my mind is, how do you tie all those three objectives together? To come back to my point, it is almost assuming that carbon capture and storage could be made to work. Well, maybe it can, but we don't know yet and we don't know how long it is going to take, and we don't know how much funding it is going to take.

Q285 Barry Gardiner: Let's stick to the question that I put. I understand there are other factors here, but I want your opinion on this. If the sector were to go on and build unabated CCGT plant, do you accept that beyond 2020 that is incompatible with meeting the CO_2 target, the reduction in emissions?
David Odling: If those are the calculations that the Committee have done, then so be it. That is obviously the correct answer.

Q286 Barry Gardiner: In that case, if that is the correct answer, and given the scepticism that you have just expressed about the possibility of carbon capture and storage being fitted to CCGT and working, how could you justify as a sector continuing with the 24 GW that is in the pipeline to be built, which is currently going to be built in unabated form?
David Odling: The crucial question, the point there, is the date 2020. That surely is the nub of it.
Barry Gardiner: You said you agreed with me.
David Odling: Yes, but will carbon capture and storage be ready by 2020? That is the big question in my mind. It may well be ready, but I think by 2020, in a commercial sense, it is most unlikely.

Q287 Barry Gardiner: When do you expect it to be available?
David Odling: Well into the 2020s; it could even be 2030. The timing issue is crucial there.
Nick Wye: I think I would agree with that. In terms of your question about CO_2 emissions, and in view of what David said, the Government's own research, carried out by Redpoint as part of the EMR, said that if you replaced all the currently existing coal plants with CCGT, the levels of carbon emissions would be 30% lower compared to 1990 levels. It is unabated, so it is a fairly significant contribution to reduction in CO_2 reduction. Beyond that, of course we have the potential for CCS. At the moment it is untested, the science is untested and the economics are untested, so we have to wait and see, but there is hope that that will be possible.

Q288 Barry Gardiner: Of course, key to that, and key to the role that the Energy and Climate Change Committee sees gas playing as a balancing fuel within the electricity sector, will be the capacity to deliver CCS that is in itself flexible in being able to be ramped up and closed down at short notice. What evidence do you have, or do you have evidence that would show it is not possible to have such flexibility in CCS plant?
Nick Wye: I have no evidence either way, to be honest, as regards CCS.
David Odling: I think a lot depends on the exact technology that comes out of the research and development. I don't pretend to be an expert, but currently they use a thing called an amine absorber. The one thing that characterises all big plant, frankly—it does not matter whether it is a power station, a chemical plant or whatever—is that it much prefers to run a constant load, just like a motorcar. You are better off steadily driving up the motorway than you are stuck in the traffic of London or Manchester.

Q289 Barry Gardiner: Finally, going back in some respects to the first question that I asked, you argued in your submission that it would be cheaper to invest in new gas plant rather than renewables. Given the constraints that we have just talked about and therefore the need to have those plants at least compatible with the retrospective fitting of CCS technology, and ultimately with the fitting of that CCS technology, and given the cost that will be involved, can you still make the same claim that it would ultimately be cheaper, in the long run, than renewable technology?
David Odling: The figures that we have run on this, Chairman, are that round three offshore wind developments are costed at roundly £100 billion in capital for 25 GW of capacity. The same capacity in gas-fired power would cost between £12 billion and £15 billion, that sort of order, so there is an awful lot of money out there in the difference between the two. I think the question we were fundamentally raising in our reply, though, was that the programme that has been set involves so many different new developments on a very big scale, all happening at the same time, which has huge financial implications. It has huge technical implications and it has huge implementation—actual physical delivery—implications. That really is the point we are coming from. We listed eight major factors in our response to you where we are trying to make really substantial changes to the energy systems of this country. It is a question of risk and optionality, and what we were trying to say was that we think this is the lower risk route, which also keeps options open, depending on how technology develops, because the crucial unknown is the development of new technology. We just do not know how some of these things are going to develop, and we need time, it needs money and it needs space in order for these things to happen.

Q290 Christopher Pincher: My question has been partially answered by Barry's last question, but you mentioned, Mr Odling, that there is a technological challenge with CCS, but isn't there also an economic one, in that, as I understand it, if CCS is applied to gas-fired stations, it effectively makes it much more difficult for them to be dialled up and dialled down to meet peaking demand? I think that is an economic and a technical problem. As a result, we are turning them into nuclear baseload-style stations, and doesn't that then place an even greater risk on reliance on intermittent technologies to provide peak capacity?
David Odling: As I think I was trying to explain in answer to the previous question, we just don't know yet exactly how these things will operate in practice. I don't pretend to be an expert on absorption of CO_2 from power station chimneys. All we do know is that complex plant tends not to enjoy variable load. It prefers constant load, and I was trying to make the point that generally that is true of all the machinery and plant and so on. So it remains to be seen, but I have no great expertise in that technology and much will depend on how things evolve during the course of the experimental period that we are going into.

Q291 Sir Robert Smith: Two quick things. One is that in the optimistic scenario, pre-combustion CCS producing hydrogen and burning hydrogen in a gas plant should potentially provide that flexible response that actually works, because you can buffer the fuel, but it was just more on this challenge of meeting the three targets for Government. It seems that going to gas early instead of coal is a quick win, but the worry is that in the long run, without a massive CCS retrofit, you will not achieve the emissions targets. But if the renewables and other technologies take off, will those gas plants have paid back? The worry people have is that once you have the gas, the incentive to get the other low emissions may disappear, but if you run those gas plants for a short period of years, will they repay their investment, even though they still have more life in them?

David Odling: We are now getting into power station economics and power station financing, which again is a big area, and clearly the power generators are really the people to answer those questions. But again, what struck us was that if we were going to build the gas now, let's get on with it, for that very point, because then you have a chance of getting the capital back, and we are probably going to need those gas-fired power stations anyway, given the sheer amount of conventional capacity that will have to be retired in the next 12 or so years; coal, oil, even early gas, and of course a lot of nuclear, and we have to keep the lights on—security of supply. If the renewables programme takes longer than planned, and that is what we believe to be the case, then in order to do all those other things we are going to need those gas-fired stations anyway. I accept entirely that there is a risk, but there are very considerable risks in what we are doing now. It is a question of which is the lower risk, balancing all those different competing interests.

Nick Wye: We have a pretty competitive market in the UK and investment is done on the back of that. As long as the framework is clear and the policy is clear, private companies will make investments on that basis, and one would assume that being fairly astute individuals, they would ensure the returns they get cover the costs and give them a profit margin. As long as it is clear where we are going, you can leave it to private industry to determine whether or not they should build a power station. In the very short term it is clear we do need additional generation pretty quickly. We have something like 19 GW coming off in the next 10 years or less—actually, it may be less than 10 years—and that is essentially replaced by the new build CCGT. I think 12 GW is being constructed now and there is a potential for another 12 GW, I think, in various stages of development. There is a very short-term need, but longer term, as long as the framework is clear, as long as the policy is clear, I think the market will decide whether or not it is economic to build more.

Q292 Laura Sandys: We are talking very much in terms of free trade, of an open market, when one starts to look at potential politicisation, potential protectionism that in many ways could create shocks within the system. I think there is nothing more illustrative of that than, in many ways, pipeline policy, and the investment and the political investment in the development of pipelines. Mr Odling, you said in your submission that the Nord Stream pipeline between Russia and Germany would greatly improve the security of European gas supplies. That would not be necessarily what I would think if I was sitting in Poland. Why do you believe that is crucial, or that it contributes an important part of our energy security?

David Odling: Clearly, it is a substantial increase in pipeline capacity between Russia, as a very large supplier of gas, and Western Europe, and considering the interaction that did occur a few years ago was the result of a spat between Ukraine and Russia, and we all know the consequences of that, fortunately it has been patched up and relations seem to be on a much better footing than for some time, maybe not as good as we would like. Clearly, the addition of a capacity of 55 billion cubic metres per year, which is what the total capacity of Nord Stream will be when it is fully commissioned, is a very significant piece of infrastructure enhancing security of supply in Western Europe. If you are in Poland, I accept entirely that it is a different matter, but on the other hand, Poland has a separate Russian pipeline passing through it, which incidentally throughout the Ukrainian dispute continued to flow at maximum capacity. Sometimes that gets overlooked.

Q293 Laura Sandys: But do you feel that there is the possibility—these are captured markets in many ways, when you have pipelines going from point A to point B. There is certainly quite a lot of friction; you mention the Ukraine in particular. Do you not see that certain elements of the infrastructure can be politicised and, certainly, if there was a very cold winter in Russia, we would actually end up being very much subject to their internal politics and that, when you continually talk about this expanding diversified market, there are certain shocks, or potential shocks, within that diversified market that might increase pricing? Again, affordability is part of our energy security as well as access.

David Odling: But surely an increase in diversity is exactly what we need to get security, and Nord Stream increase diversity.

Nick Wye: There are two things I would add to that. Nord Stream is a commercial pipeline. It is underpinned by commercial contracts. It is not a political pipeline, so that in itself should be heartening. Secondly, and I agree with David, the more capacity you have in relation to gas coming from mainly Russia of course, which supplies the west, the more likely you are to get more gas-to-gas pricing. As you know, a lot of contracts in Europe are oil indexed. If you have more spare capacity, suppliers will want to use that capacity and obviously profit from the utilisation of the pipeline. It is more likely to lead to gas-to-gas pricing, which of course we have in the UK, and therefore, hopefully, we should attract that therms of gas we need to start up our boilers.

Q294 Laura Sandys: If you are talking about the diversification of pipelines and access to gas, would you not start to look at the Nabucco gas pipeline? Do you believe that it will actually come to fruition, and

do you think that there should be political investment in speeding up the pipeline?

David Odling: I was in the audience, Chairman, when you took evidence from Professor Jonathan Stern and two others a few weeks ago. Professor Stern probably knows more about gas from the former Soviet Union and so on than any of the rest of us. If I remember rightly, his answer was that he did not think there would be a pipeline, whether Nabucco or something else, from that part of the world to Central Europe before the 2020s, and I defer to his far superior knowledge in these matters.

Nick Wye: It is a very long pipeline and a very expensive pipeline, and to date I believe it has not done anything via commercial contracts. So in the short term, no; in the longer term, I really cannot answer the question.

Q295 Dr Lee: With the German Government's recent decision about nuclear, in terms of capacity, and on the presumption that they are not going to be getting that power from wind farms, and it is between 20% and 25% of their usage, is there a problem? I envisage this Nord Stream pipe coming down and the Germans saying, "Right, we need a bit more of that. We need a bit more of that because we no longer have nuclear power". Eventually, it is not going to provide the diversity you refer to, if that was the case.

Nick Wye: I understand. I have read elsewhere that the likelihood is that Germany will require an extra 16 bcm of gas to support the build up of CCGT, to account for the loss of nuclear, but Nord Stream itself carries 55 bcm, so there is a fair amount of space in that pipe to supply onwards.

David Odling: Interestingly, the most recent figures I saw on what has happened since the seven power stations were shut show that gas demand has not changed at all in Germany, but what has gone up is coal demand.

Q296 Christopher Pincher: There seems to be general consensus that gas storage capacity is inadequate. You mentioned Professor Stern. When he came before the Committee a few weeks ago he said that through a constellation of unusual events—he was referring to the very cold winter at the end of last year and the start of this year—the UK came close to major gas supply problems, adding, "I would say, we have been lucky". Can you say just how bad you think our gas storage situation is, if it is bad?

Nick Wye: In terms of figures—I will not bore you with the figures—we have built quite a bit recently; we have built 1 bcm in the last five years and there is a lot more storage slated. Who knows how much is going to come, but there are a lot more projects out there. I think numbers in excess of 5 bcm should double our current capacity, so there is potential for additional storage. I believe other individuals have given evidence, particularly those with storage interests, and have talked about the problems in relation to building storage, in particular the seasonal spreads and issues relating to planning, and so on. There are a number of issues out there but there are a number of projects that could be built. Whether they will be built depends on the economics. I think it is fair to say there is a general view that we do need more storage, and on that basis one would assume that the market would respond as it has responded in the last five years, and some of these projects will be built. The other thing to be aware of is that there is a major project being built in Holland called Bergermeer, the size of which I believe is greater than our total storage capacity in the UK. That facility is only 20 km away from the BBL pipeline, which is the interconnector pipeline between Holland and the UK, so even though physically it may be argued that currently we don't have enough storage, we may have in the future. We will also have access to storage from, for example, Bergermeer, which will be a third party access facility, so we don't necessarily need to look purely in the UK. We can look a bit more broadly at facilities that can support UK flexibility.

David Odling: I have heard that statement—that we came within a whisker and so on and so forth—yet if you look at the records of what happened in the market during that period, there is no evidence that the market was reacting as if we were about to hit a crisis. There was none at all, so I am a bit puzzled by some of those statements. Clearly, demand was very high, and 2010 as a year recorded nine of the 10 highest days of gas demand ever in this country; three were in January and six were in December, yet the market seemed to take it pretty much in its stride. There were a few ripples here and there but they were soon sorted out, so I am a bit puzzled by some of those statements along the lines that we came within a day or whatever of disaster.

Q297 Christopher Pincher: Do you agree with the Energy Minister when he said—I think, he was speaking to clause 79 of the Energy Bill—that we do need more gas storage, or do you think that the market will always provide and that there isn't a problem?

David Odling: We are on record, including in our reply to you, that we foresee a need for more gas storage, but we also think that the market should do it, and the market slowly is doing it. But don't discount what has happened in the LNG world; LNG has started arriving in this country in very considerable quantities, and what is more, it has shown enormous resilience and flexibility. We have suddenly had—pipelines tend to flow more steadily—this very significant transformation, and to a degree LNG is a kind of buffer because you always have stocks in the tanks at the reception terminals, so in part it can act a bit like storage.

Q298 Christopher Pincher: You said the market is reacting. I have a list of about a dozen consented facilities for gas storage. Some are onshore and some are offshore. Of those, Centrica, who are going to provide 0.6 bcm in an offshore facility, are not planning any activity in 2011. The plan is on hold. Eni, I understand, have gone cold on their reservoir, which has 4.6 bcm, and there are technical challenges that InfraStrata is facing in its salt reservoir, which would offer 1 bcm, so it seems that perhaps the market is not moving as quickly as you think it might to provide gas storage capacity.

David Odling: It has been moving slowly, I acknowledge that, but there has been no evidence that to date we have needed more than we have. It would be nice and comfortable to feel that we have more but there are projects happening. Our view, which I think we also put in our evidence to you—we certainly did to DECC in the electricity market forum—is that the type of storage that is more likely to be needed in future is the quick-in, quick-out type of storage, the salt cavity, rather than the big quasi-strategic offshore field of 3 billion, 4 billion, 5 billion cubic metres. We think that the economics of something like that are probably extremely difficult.

Q299 Christopher Pincher: You pre-empted my next question, which was, do you think we have the balance right between those porous reservoirs, which act like a sponge—you pump gas in and you only get a proportion of it out—and reservoirs that have more capacity to push the gas out themselves; salt caverns, for example? Do you think we have the balance right between them?
David Odling: Certainly on the list we have of those that are either under development or which have planning consent, the predominance is salt cavity.
Christopher Pincher: So you think the balance is right?
David Odling: Yes, we think this is right. Yes, because we think it is going to be the quick-in, quick-out type of storage that is more likely to be needed in future.

Q300 Christopher Pincher: One final question. Do you think that the Government should establish—you talked about it earlier on with respect to petroleum—a stock-handling agency with respect to gas? Would that be a sensible move?
Nick Wye: I can't really see the need for it. If you are talking about public service obligations, you kind of mean withholding gas in storage. We do a bit anyway. National Grid does contract for some storage to assist. It is called operating margins for emergency rundowns. We do a little bit of that, if you like, but if you are looking further afield more widely and imposing PSOs on the market, I think they would probably undermine the market. They are more likely to crush the spreads and less likely to underpin investment in these facilities. Ultimately, we have facilities built on the back of the market. We have a number of facilities looking as though at least some will come on stream on the back of our current arrangements. PSOs tend to be used in markets that are illiquid, where there is no ability to buy flexibility. Anyone can buy flexibility. We have a very active NBP, so I don't think it is actually required in the UK, unlike perhaps somewhere in Spain, where it has been used for many years and where they don't have a very liquid trading market.
David Odling: The costs will be absolutely astronomical. There was a calculation about three years ago at European level, and what the calculation did was take the 90-day IEA oil stocks across the EU27, turn that into money and then convert it back into stored gas. How much gas would you have for that amount of money in relation to demand? So 90 days' oil came out at something like 2 or 2½ days' worth of gas. The numbers would be enormous.

Q301 Dr Whitehead: The EU third energy package was designed to free up the market, make it more liberal and flexible, allegedly to add to collective EU energy security; how would that play in the UK?
Nick Wye: I think, in terms of the UK itself, we don't need to do too much because we are pretty market-focused already. I think it will help in relation to the continent. We keep talking about the need to be able to move gas from A to B, across borders, and certainly the third package is focusing on opening up these markets. They are very slowly opening up and there seems to be a bit of a wind behind them now. The hope is that the third package will be the final step towards encouraging opening up of the continental markets, which in itself should aid security in the UK, allowing us to access gas from the east to the west through pipelines that are open to third-party access and across borders and countries as well.

Q302 Dr Whitehead: I think you mentioned in your written evidence that there is potential for gas flowing into the UK to be of different quality from what we are used to. I assume that relates to what we are adapted for in the UK and what imperfections are tenable as far as UK gas supply is concerned. The interconnectors in the UK were originally designed as outward interconnectors, I believe, so a flow of gas in, or equally in as well as out, could lead to those quality issues, could it not?
Nick Wye: I mentioned earlier that we do import. We are importing gas from the continent now, and I mentioned before there have been a couple of occasions where Fluxys mentioned that they had issues in relation to their own systems supporting the export of gas through the interconnector into the UK. As we state in our evidence, we think the Government should look seriously at quality issues and consider whether or not something needs to be done more centrally in relation to sorting out quality issues before they get into the UK market. It is a problem for the pipes, comingled pipes, where you have more than one shipper/supplier moving gas, because not every single party is a physical party. A few of those parties are traders. They have no interest in the physical commodity, so it may need a push to encourage the proper processing plant to be built to ensure that quality is maintained.

Q303 Dr Whitehead: This is a rather ingenuous question: at which end?
Nick Wye: I don't think it really matters as long as it is done one end or the other. I guess it would be easier at our end, wouldn't it, because it is on our land, but it does not really matter.

Q304 Dr Whitehead: How serious is that as an issue and who might do that? I presume it has to be done one end or the other and has to be reliable.
Nick Wye: Yes. The problem is our problem rather than the continent's problem because we are importing their gas. Clearly it is our problem, something we need to resolve. At the moment it is not a big problem,

but as we become more import dependent it probably will become a bigger problem. I can't say when and I can't say how much of a problem it will become, but I know there is work going on in the EU about gas quality and how to harmonise gas quality. It is just something you need to be aware of. I think historically we have looked at it in the UK. I know Ofgem did some work a few years ago looking at where the costs should be imposed to build such facilities and, as I said earlier, the conclusion was, the polluter must pay, which is fine—I say "it is fine", they may not agree—in so far as you are talking about a single provider of gas through a singly owned, let's say, LNG terminal, where the gas can be properly identified. It belongs to this company and therefore they should pay for the processing. But when you are talking about a pipeline with many players involved, it is far more difficult to identify who should pick up the cost for building the necessary facilities.

Q305 Dr Whitehead: So we invite them to send gas to us; we scrub it at this end, we charge them?
Nick Wye: No I think they probably wouldn't swallow that. I think we need to look at—I hate to use the word "socialisation" because that is a dreadful word—some way of sharing the cost, probably at our end, in relation to making sure the gas quality is appropriate for our own consumption.

Q306 Dr Whitehead: Just a minor thought on that. If they were required to contribute to the scrubbing of their own gas for importation into the UK, presumably you would be rather reluctant to import gas into the UK, might send it somewhere else?
Nick Wye: Certainly. I think that is probably a fair conclusion. Additional cost isn't attractive, is it?
Dr Whitehead: So therefore we will have to pay for it ourselves?
Nick Wye: I think it is probably a more reasonable way to look at it, yes.
David Odling: Also if I could just add, you say "scrubbing". It is not really scrubbing in a sense; it is that the quality band in the continent is wider than ours. If you go outside our band, which some of their gas may do, it has to be treated to bring it back into our band, so that is a job for us, I am afraid.

Q307 Dr Whitehead: Yes, and what sort of cost is that?
David Odling: The only figure I have ever seen, which I think came from National Grid about three or four years ago, was something like £250 million; something of that order. It did sound—
Dr Whitehead: That is a one-off investment in—
David Odling: One-off investment, and then you have a bit of running cost, of course.
Dr Whitehead: Right.
David Odling: But amortised over 40 years. At the time, £250 million struck everybody else as an extremely large sum, but even if it were £250 million amortised over 30 to 40 years, with the volume of gas that you are talking about, you would hardly even notice.
Dr Whitehead: It is certainly a lot cheaper than changing every boiler in the country.
David Odling: It is hugely cheaper.
Nick Wye: I think I saw a figure at 0.1 pence per therm to an average household bill, something like that.

Q308 Dr Whitehead: Right. But presumably this is something that cannot really be put off, or should not be put off, i.e. we do it?
Nick Wye: Yes, you don't want to wait until it is too late, certainly, so I think there is a push that something needs to be done in the near future.
David Odling: It would be very unfortunate—to go back to the question over here—if on one of those extremely cold days in December, Fluxys had suddenly said, "Terribly sorry, chaps, got to stop", and so suddenly 30 or 40 cubic metres a day did not turn up.
Chair: Thank you very much for your time this morning. We covered some useful ground.

Examination of Witnesses

Witnesses: **David Loughman**, VP Commercial, Europe, Shell, **John MacArthur**, Vice President CO_2 Policy, Shell, **Peter Mather**, Regional Vice President, Europe and Head of Country, UK, BP, and **Steve Jenkins**, CEO of Nautical Petroleum and Chairman of the Oil and Gas Independents Association, gave evidence.

Q309 Chair: Good morning and welcome to the Committee. I think most of you heard most of the previous session, the first three witnesses.
The UK became a net importer of gas in 2004; oil in 2005. It does not seem to have caused any security problems so far. Is there anything inherently more secure about oil and gas produced here, compared with imports?
Peter Mather: Shall I take that first? I would agree with a lot of the points made in the previous session. I think the issue here is about diversity of supplies rather than energy independence. It is important that, clearly, the indigenous supplies of the UK are fed and watered, encouraged and prolonged as much as possible, but we clearly have to look at storage, we have to look at interconnectivity with Europe, and we have to look generally at the conditions that make an efficient market. There are lots of issues around energy security. You can't defy gravity, as far as the North Sea is concerned, but clearly there are things that we are all trying to do to prolong its life.

Q310 Chair: We have been told that the recoverable reserves, oil and gas, on the UK continental shelf may be 24 billion barrels of oil equivalent. How much is it going to cost to get that out?
Peter Mather: That will depend on a number of different things; obviously, the technology breakthroughs, and I think all of us here are deeply involved in trying to push the frontiers on technology.

It will depend on the fiscal rates, but obviously on the availability of the rocks as well. We are personally, as BP, committed to investing around £10 billion over the next five years in the North Sea. That is just one company. I am sure Shell and others will be looking at similar investment profiles. We are committed to doing our bit but, as I say, some things are out of our hands in terms of the geology, fiscal rates and clearly the availability of the technology required to get to the more difficult areas.

David Loughman: This technology point is very critical. I think in our industry we have constantly underestimated the technologies that can be developed over time. I would make another point, which is that in that 24 billion there will be some larger discoveries, but a lot of it will be made up of the typical portfolio of smaller fields that is the natural outcome of a typical geological basin, and the issue of infrastructure availability becomes just as important as the capital cost. Having the infrastructure available—we spent a great deal of money in maintaining that infrastructure, and will continue to do so—for those small fields to be pulled through into the supply chain is a very critical issue, not just for the UK but for many of the mature basin areas in the North Sea.

Q311 Chair: We were also told that changes in the supplementary charge on oil and gas, announced in the Budget this year, could cut investment in the UK continental shelf. Have any of your companies actually cancelled any projects as a result of that announcement?

David Loughman: We are evaluating the portfolio at the moment and looking at it in the context of the change. I think that the challenge will be particularly for the fields that I was just talking about; the smaller accumulations, the more difficult geological accumulations where I think, the point David Odling was making earlier, that with special incentives being negated, the challenges for some of those fields are now quite significant. The other issue, as of course has already been mentioned, is the relative impact on gas, which is for the moment not attracting the same price as oil, and the impact on gas development, particularly small gas developments, will remain to be seen.

Peter Mather: I am not going to sit here and tell you that we welcome a tax increase, obviously. It is actually the case that none of the immediate projects that we have coming off the blocks now will be stopped as result of the tax increase. Clearly we need to look very hard at the viability of some others. I completely agree with what my colleague from Shell said. I think there is another issue that we need to be very careful about: if the oil price comes back down again, we need to ensure that the Government sticks to its pledge to reconsider the additional taxation, because while prices are a little bit higher than they have been, clearly they could well come down, and I think this level of taxation at significantly low oil prices would be very bad for the North Sea.

Q312 Chair: Since the justification for the tax increase as far as I can remember was to protect petrol consumers, presumably if the oil price came down, it would not be difficult to persuade the Government to relax the regime.

Steve Jenkins: I hope it wouldn't. But there have been projects that have been delayed, especially the smaller projects and the more difficult oil, HPHT, which benefited from the field allowances, and those have been put under closer scrutiny. It is very difficult to turn off a project that has been the subject of long-term planning. Cycles are, from exploration to development, something like eight years, so if decisions have been made to go ahead with a project, you cannot pull it easily. What is going to happen in the next couple of years is really critical, so there may not be any immediate effects, but in the next couple of years, one will see that projects that were scheduled to be developed will not go ahead.

Q313 Sir Robert Smith: Isn't one of the concerns that by definition there have been less attractive returns on the investment, and the worry is that some of the more mature, larger hubs will start to become uneconomic sooner than they should have, or that there is not enough incentive to do infill investment to keep those hubs productive, and without those hubs, all these other small fields will be lost for ever?

Steve Jenkins: That is correct. I think post the tax change there are 20 fields, maybe, of which their decommissioning has been hastened by between one and five years. You are right, Sir Robert. Once the infrastructure is gone, it is gone. There will be no facilities that we can add the smaller fields on to, which are going to be the future of the North Sea and that would go towards the 24 billion barrels. Because the infrastructure was just not there and these fields were not economic on their own.

David Loughman: I think the point was made earlier that given the complexity of this and the predictability, it is so important to have a dialogue about fiscal change, and I think one understands that when all the prices are moving upwards the Government will of course want to look at that. It really is a situation—the sort of complexities that my colleagues have described—to have a dialogue and discuss what can be done, because the immediacy is a challenge to all of these issues.

Q314 Sir Robert Smith: So it is very important that these discussions that are going on now about how the trigger will be changed on the way down and what other incentives in field allowances could mitigate the worst impacts of the tax increase are a constructive dialogue.

Peter Mather: They are very important indeed.

Q315 Sir Robert Smith: And that is about jobs and future tax revenue and future balance of payments, even if it may not be so much about security.

David Loughman: I think there is a component that links to security of supply. You mentioned the relationship with Norway earlier; we mentioned the relationship with the Netherlands, and of course the Netherlands has, in the Groningen field, Europe's biggest gas field, what is essentially a large storage facility that is important to us. In that we are active in our own oil and gas industry, I think it does two things

for us. One is that it shows that we are interested in oil and gas and that we are keen to work on developing the resources that we have. That sends certain signals to our key suppliers. And it also, in a general commercial relationship, gives us some bargaining power in terms of managing the various contacts with all of the suppliers that are going to contribute to our security of supply. I would agree that it does have an element of contribution to security of supply.

Q316 Dr Whitehead: As the oil production from the UKCS decreases, we know we will have to increase physical storage capacity, and we talked about that a bit earlier today—the question of derogation of energy and so on. One hundred per cent of oil stocks are held by industry for reserve stocks. Is that a similar profile to the situation elsewhere in Europe? How do other European countries deal with this in terms of who holds what stocks?

John MacArthur: In terms of specific corollaries with other European nations, I don't have that information to hand. I would be happy to supply it, but going back to the earlier statements, I think the UKPIA position on the National Agency and much of the conversation we had earlier was something that, from a Shell perspective, we believe is certainly worth exploring.

I think there is another part to this that has not been discussed yet, which is that we were looking through the lens of a traditional liquid fuel supply and oil from a transportation perspective and so on, and of course we do have the emergence of biofuels, which will have an increasingly important part to play in the energy fuel mix globally, particularly in the UK, which has, I think, about 20% of its biofuels domestically sourced. But it does give you that diversity of energy and liquid fuels. There are some 20 different countries that supply us biofuels from around the world, so I think the refining discussions and the structural discussions are not only that oil gives you liquid fuel security but there is also an important part for biofuels as well.

Q317 Dr Whitehead: One of the things that has been suggested by Deloitte is that because of the way in which UK stocks are held by industry, it may be more convenient and cheaper for, they say, a higher proportion of stocks to be held abroad if companies find it cheaper, instead of building new storage in the UK. How would that contribute to the UK's energy independence and energy security?

John MacArthur: The UK's security of supply, as we heard earlier on fuels, is dependent on imports in some regards. That is the nature of equilibrium in free markets globally, which brings a great deal of security of supply but also security of demand with our partners as well. There is a surplus of refining capacity in the world, and as I said before, you could bring biofuels into the mix as well, which gives you more diversity in that supply. But having a domestic refining infrastructure or storage does not necessarily make it cheaper for you. As long as we have those security of supply and demand relationships, as we heard earlier—for example, gas in the Groningen field in the north of the Netherlands, where I used to work, getting the gas in and out of storage at rates of many millions of metres cubed per day—those technologies are variable and the interconnectedness of storage, as you say, is certainly something that we shouldn't only see within the UK context but more as being the core of the discussion about interconnectedness with our partners in Europe.

Peter Mather: I would support that. To answer your original question, I think the model for stocks in Europe varies a little bit, but it is fair to say that on the whole there is a bit more state involvement than in the UK. I think the proposal, which was well-aired earlier on so I won't go back over it, for the agency-type arrangement for oil stocks in the UK is eminently sensible. It seems administratively more efficient and simpler, but I think the point here, certainly on oil, is that it is an incredibly fungible, liquid market, and while we need to look at the economics of increased oil storage in the UK, were the derogation to go away, it is not something that one should fear too much because it is so easy to transport liquid fuels around north-west Europe. There is a very well-established system of not only refineries but import terminals in the Thames and tanker capacity, and obviously refining capacity at the mouth of the Rhine and other places.

Q318 Dr Whitehead: But if I am abroad, meaning in another European country, and I have a pile of oil sitting within my national borders, I may count that as my reserve supply. Meanwhile, we have counted that as our reserve supply in the UK because it is held abroad. Wouldn't that lead to double-counting?

Peter Mather: That wouldn't be very sensible; no, I agree.

Q319 Dr Whitehead: I appreciate that it wouldn't be very sensible, but isn't that rather a basic problem with this suggestion that UK supplies might be kept "abroad"?

Peter Mather: I think, if it is double-counted, that is wrong. I completely agree with you on that, but one has to look at the hierarchy at national and EU level and obviously IEA level stocks and make sure we are not double-counting.

Q320 Dr Whitehead: What would happen if they decided they wanted it at the same time?

Peter Mather: I think that would have to be clearly delineated under IEA rules in terms of pecking orders, priorities, discharge rates and beneficiaries.

Q321 Dr Whitehead: It is not at the moment, though, is it?

Peter Mather: I would have to get back to you on the exact system, but I don't believe there is a lot of double-counting.

Q322 Dr Whitehead: As far as resilience of supply within the UK is concerned, in the event of, say, further protests and demonstrations at fuel depots, we heard earlier that police had had a word with some people who might be protesting. That does not strike me necessarily as leading to full resilience. What is

your view in terms of future resilience of UK supplies in the event of protests such as we saw previously?

Peter Mather: Having lived through and personally been very involved in a couple of these situations over the last few years, when the Secretary of State at the time called us in to account for the potential supply disruption at the forecourts, we are only too aware of the possibility, obviously, of industrial action. I think there are a number of things that are important here, and keeping a good relationship between you and your haulier is vital. Maintaining both as a company and at a national basis a good infrastructure in terms of refining and terminalling is important, and obviously the UK has a large number of onshore pipelines for oil products too, which are very helpful, plus, of course, making sure that the UK is well-connected—going back to my earlier point—to the other markets of north-west Europe. It comes back to the point about diversity; ingress points, storage on land and refining capacity.

Q323 Dr Whitehead: I was going to ask you briefly about pipelines as you mentioned them. Certainly, in my constituency, you cannot move for signs in various nice parts of the country, saying, "Here's a pipeline". How resilient might that make the system, and does industry or anyone else have any intention of extending that pipeline network?

Peter Mather: Personally, I'm not aware that we are involved in any expansion projects because, as I said, the combination of pipeline capacity plus storage capacity, haulage capacity in terms of road tax, and refining capacity is deemed sufficient and has proved itself robust during a number of crises over recent years.

John MacArthur: From a Shell perspective, I think the point is that the UK oil industry has proven itself to be very resilient over many years. Of course there was Buncefield in 2005, which is a good example of probably the most significant loss of capacity in recent times. We had to reorganise and respond, and I think we did that. One example, describing what we did with the pipelines, is that we had to increase jet fuel supplies from the southern pipeline down to the airports. It wasn't without impacts. There were some flights rescheduled at airports, but considering the disruption—we redistributed the truck fleets; increased it through other terminals—there is flexibility, adaptability and diversity of different sources. Equally, diversity of infrastructure and different ways to move fuels around it is critical. We are talking about the resilience of the system; we are also a retailer and we have just bought 254 new service stations, and we would not do that if we did not believe that we would have security of supply to our customers as well.

Q324 Sir Robert Smith: Does that mean you now make money in service stations?

John MacArthur: Of course, but how much is really always the question, isn't it?

Q325 Barry Gardiner: Perhaps you could very briefly describe how the oil price is determined and then say what the role of each of your companies is in determining those prices.

David Loughman: Maybe I could say the role we play in determining the oil price in the short term is minimal. I think our company owns on a proprietary, equity basis something like 1% of proved oil reserves around the world, and since it is a very deep, liquid and open market, you can see that we have relatively little influence on it in the short term. In the longer term, although our companies, by international standards compared with national oil companies, are relatively small, we still have a leadership in technology, and our ability to lead the way into new areas, deeper hydrocarbons, more complex hydrocarbon accumulations, is of course in the longer term a way of mitigating long-term price evolution by bringing in new supplies and accessing new areas. That might not be very helpful in the short term, but I think it is the honest truth. Like everyone else, I am wondering where the oil price is going to go tomorrow or the day after, as a commercial manager in Europe.

Q326 Barry Gardiner: The first half of my question to you was to explain to the Committee how the oil price is determined. I appreciate that you have said that you as a company have virtually no impact, certainly in the short term, on how it is determined, but can you tell us, therefore, how it is?

Peter Mather: To be perfectly frank, the oil price is set by supply and demand. I don't want to be facetious, but it really is. Supply and demand have many influences. Demand is influenced obviously by economic activity, and part of the reason for the recent increase to the oil price has been the economic recovery that we have seen in the United States and to a certain extent in Europe. Of course, China has generally fuelled a more buoyant oil market for several years as a large purchaser, and clearly the emerging economies suffered less in the recession than the OECD did. On the demand side, you are really looking at economic activity.

On the supply side, it is clearly world events. Oil is fundamentally geopolitical, and world events, whether they are uprisings in the Middle East or other supply disruptions, clearly have an enormous effect. OPEC is talked about a lot. Clearly, there is a group of countries that meet, and it is fair to say that the specific influence of OPEC is probably less than it used to be.

In summary, I think supply and demand on the whole wins through, certainly in the long term. There are short-term—

Q327 Barry Gardiner: On the index of pre-tax fuel prices—this is taken from *Quarterly Energy Prices* put out by DECC—how would you explain the spike that occurred in 2008–09 in light of what you have said about demand, and given that this was the beginning of the recession? I would have thought that you needed to tell me something about the basic costs of production and then overlay the other market factors that you have been talking about, but so far I have not heard that from you. How would you explain that in light of what you said about the demands coming into the market and affecting price, given that

this was a period when the world went into recession? Are you going to say that because the world goes into recession, suddenly the risk became greater and that is what pushed the price up? I do not understand that.
Peter Mather: I cannot remember the specific circumstances, but if I remember correctly, I think obviously we still had virtually all Iraqi production off the market, which is now coming back on to the market. Unfortunately, that has been offset somewhat by Libyan production coming off the market—
Barry Gardiner: Sorry, I didn't catch the first thing that you said.
Peter Mather: One of the features of that period on the supply side is that we were effectively getting virtually no production from Iraq, which is potentially one of the biggest exporters of oil, so I think that was a factor for the price increase. If I remember rightly, the Chinese were continuing to buy heavily during that period. The recession had not hit them as hard as it hit the OECD markets of the US and Europe. I think there were supply disruptions and I think there was still an awful lot of demand from Asia, if I remember rightly. I would have to look back at the exact circumstances.

Q328 Barry Gardiner: I would be grateful if you would, and actually supply the Committee of your analysis of just why it was that there was such a peak during that period, and then if you could justify that analysis against the statement that you made to the Committee about supply and demand.
Peter Mather: I am pleased to do that.

Q329 Barry Gardiner: The Government said in its response to this inquiry that exposure to volatile prices is the greatest risk to energy security. If that is the case, what more can be done to mitigate that risk? From what you have said, remarkably little.
Peter Mather: If we are talking about oil, with oil and gas there are similar issues.

Q330 Barry Gardiner: They say oil. You say oil and gas have similar issues?
Peter Mather: Let's talk about oil.
David Loughman: Maybe I can talk about gas.

Q331 Barry Gardiner: Shell's submission to the Committee made it very clear that they believed there was quite a distinction between oil and gas volatility, but you say they are similar.
Peter Mather: Yes. There are similar underlying factors, coming back to supply and demand, but I will leave my colleague to talk about gas, which has generally, as was said earlier, been very robust despite the coldest winter for a long time—200 years or something—last winter. On the oil side, last year actually saw a drop in volatility of oil prices. It has obviously come back up a little bit recently, but you have to look at the long term in terms of volatility, and if you look at oil price volatility in the long term, it has been relatively lower than many other commodities and has been something that people have been able to invest around. Of course, in terms of the consumer, one has to remember that the majority of the price at the pump is actually taken by the Government in the form of tax revenues.

Q332 Barry Gardiner: Let me just come back to the point of the question, which was what more can be done to mitigate the risk? I was suggesting in light of your earlier remarks that it might be remarkably little. Is it remarkably little, or are there real steps that Government can take to mitigate the risk of oil price volatility?
Peter Mather: In terms of Government, I think that what Government can do is be supportive of the industry, whether it is indigenous industry or companies investing overseas, to ensure that we all bring as many supplies on to the market as we possibly can, not only in the case of the companies here ensuring that we can continue to make the North Sea a fertile and productive area from an oil point of view, but also, as the Government does, support us in our endeavours in other countries around the world, because the key thing is bringing more supplies on to the market. That is what is—

Q333 Barry Gardiner: Mr Mather, forgive me if it was Mr Loughman who said this at the beginning, but one of you, I think, said that your proportion of the oil—
David Loughman:—that we own as an equity company.
Barry Gardiner: Did you say that the proportion was minuscule?
David Loughman: Yes, indeed, as a percentage of the total crude oil that is owned in the world.

Q334 Barry Gardiner: How is helping you to bring as much of that minuscule amount on to the market as possible really going to affect the stability of oil prices and therefore mitigate, given that you said effectively, "This is supply and demand; we are takers of a price"? How is it actually going to help us to stabilise the situation and provide that security?
Peter Mather: Because I think the marginal price for any commodity often sets the price, so even though between the oil majors I don't know what the percentage is—maybe it is 5% of world supply—that can be the marginal price setter, particularly given that in the case of the companies here, I think a lot of our investments are actually outside the OPEC area, so therefore they provide healthy competition, if that is the right word, to OPEC suppliers, but it is around marginal economics. I think there is one more thing that Governments can do—

Q335 Barry Gardiner: I am happy to come back to that, but at the beginning, the impression was that there was nothing you could do that determined the price, but now you are saying that your supply on to the market can actually be the determining factor.
David Loughman: Because it is the marginal barrel. It is the point I made about longer term, technological evolution.
Barry Gardiner: But you will admit there is a tension here between the answer to my original question, which was, "It is supply and demand; this is the market. We have a minuscule amount, and actually we

don't influence it", and the view that is now coming out that says, "Actually, we can be the price-setting determinant"?

Peter Mather: If you removed the activities that companies like us are involved with in places like the North Sea or the Gulf of Mexico or Angola or wherever, you would see a significant rise in the price of oil. The point is, structurally, we are price takers. Structurally, the longer term economics of oil and gas is supply and demand, but we are part of the supply equation. We are not—

Q336 Barry Gardiner: What you are saying, in effect, is that you have a determining effect in reducing what would otherwise be a much higher price of oil. Is that correct?

Peter Mather: I think it is quite hard, with respect, to put it that simply, because there are so many other factors involved, but yes, I think other supplies of which we are all part, and certainly non-OPEC supplies, are an important part of the oil equation, yes.

Q337 Barry Gardiner: I now feel much better informed but none the wiser, I have to say. I will move on. The UK price rises in 2005–06 came, we understand, from a lack of import and storage infrastructure. The UK now has a greater level of import capacity. Do you think that that has reduced the risk of a similar price spike happening in the future?

David Loughman: Are you talking about gas now?

Barry Gardiner: Did I say oil? Yes, gas.

David Loughman: You didn't, sorry. I think if one reflects on the import capacity of the UK, which I believe is between 125% and 130% of the total demand in the UK at the moment, it is clearly a major step forward in determining security of supply. To go back to your earlier question about what we can do in terms of developing gas security of supply on that basis, which in turn tends to modulate price both in the short term and long term, I think it is very much about making efforts to diversify that supply base out there in the world. I think a key thing to understand about the global resource base of gas is that it is growing. We have this mental model that we are running out of hydrocarbons, but in fact the IEA statistics show that on a global basis we have added to reserves, when you look at production globally, every year since we recorded this in the early 1970s.

Q338 Barry Gardiner: Is that conventional gas?

David Loughman: Yes. It includes unconventional resources coming in as well. I am talking about total resources.

Q339 Barry Gardiner: Does that same claim apply if you limit it to conventional gas?

David Loughman: Yes, it does. What we are seeing is a resource base of gas that is also diversifying in terms of the countries that own the gas. We have seen, of course, the significant development of Qatar that was mentioned earlier. I think the UK is importing today from ten countries, and I think, for us, to develop the relationships that were described earlier with a wider range of gas suppliers and see what can be done to encourage them to bring gas to the market is in our interests long term. That is something we can do to increase the availability and diversity of gas supply. Of course, as you say, regarding the introduction of unconventional so-called gas—gas in tight reservoirs, coal-bed methane and so on—is probably, in terms of ultimate, recoverable reserves, the estimates are something of the same order as conventional gas, taking us up towards very large numbers; 800 trillion cubic metres. If all of that was to be recovered, it would mean some 250 years of supply at current global demand levels, which is, I think, impressive. From the suppliers' point of view, the whole debate around security of demand becomes very important. At what point do we get an opportunity to bring our gas to the market? And there is competition from the suppliers' side. I think it is in our interests to work and build a dialogue with those suppliers, exactly as I think we have done with Norway and some others. I think the dialogue with Russia would be very important as well, and other former Soviet Union countries.

John MacArthur: The diversity and source of gas is one element. The other one is the type of product you get from gas. This is where we do have a role to play in bringing technology into the market. David mentioned Qatar. This year we started our gas-to-liquid plant, which will be fully up and running in 2012, and that provides enough gas oil, which can power buses and taxis, and has been done in London, which would fill over some 160,000 cars per day. If you look at those different products and technology as well, it helps you in all these diversity of supply situations.

Q340 Barry Gardiner: You talked about the growth of hydrocarbons futures. In the peak oil debate, therefore, do you believe that we are before the peak? How do you think peak oil relates to the higher prices that we have experienced over the last few years.

David Loughman: That is a very complex question. Being a geologist, I get the peak oil question very often. To be honest, I don't know, and what I often talk about are unknown unknowns, which I accept is an easy way out, but there are new basins, oil discoveries, being made in, for example, the deep subsalt play in Brazil. One of the two basins that have fully been explored in Brazil—there are several others that have yet to be—has the possibility of transforming our view of the crude oil output from that country. Being a geologist, I tend to be optimistic that we can do that again in other places and we can access, as we are doing already, unconventional resources that are very large, in the form of oil sands, for example. It is an evasive answer, I agree, but I am not sure about peak oil. I would not like to say when it is.

Q341 Barry Gardiner: Relating that part of my question to the other part of it, given the indeterminacy, you would say that considerations of peak oil should not be playing into price?

David Loughman: Of course, the price will also depend on people's perceptions. They may not have

the same perception as I do, so they may take their position in the market accordingly.

Peter Mather: In the history of the oil price, this is not a desperately high oil price in real terms, so it is not as if we are in a panic situation about future oil supply. David is right; it has always been a discussion between the economists and the geologists. In some ways at the moment there is a bit of agreement between the two of them, because there are unconventional supplies now being made available by the geologists that the economists feel can be developed at existing prices. When I joined this industry, the North Sea was going to have run out by now, so I am a firm believer that the hydrocarbons are there. It is just a question of technological breakthrough and choices about where we go in the world to explore.

David Loughman: Globally, I think we are very far, given the resource base I described, from peak gas. It will be very important for China to make decarbonisation efforts, as we all know, and a lot of that will be around the issues we were describing earlier in terms of gas back out of coal. That is an area where we are working with the Chinese, for example, and other companies to find ways of enabling that to happen, given that China's gas resources are largely unconventional.

Q342 Barry Gardiner: Mr MacArthur, as the CO_2 man in Shell, if, as Mr Mather and Mr Loughman believe, those hydrocarbons are there, should we be getting them out of the ground and burning them up?

John MacArthur: Thank you for the question. I think the two issues that were described earlier are economics and technology. In a world that needs more energy but less CO_2, those become even more important considerations. You have to create the right carbon price signal to make sure that you can encourage something like CCS, and on the technology—carbon capture and storage or offshore wind—that needs that carbon price signal, at least to bring it to maturity. There shouldn't be an ongoing thing, but we need to accelerate those things to try to hit the kinds of targets that we're attempting to achieve and set the pace globally in the UK.

Q343 Sir Robert Smith: Moving on from that, setting the pace, should you be building more gas-fired power stations?

John MacArthur: If you have that carbon price signal, you will find that all power emitters who are involved in the EU Emissions Trading Scheme, which is an exemplar for the world—there are 11,000 emitters involved—as the cap comes down will have to invest in carbon capture and storage. I believe that wise companies who are building these gas-fired power stations are thinking of the outcomes of that carbon price signal. That is why it is really important that we make sure there is robust pricing that people know is going to be here in future so they will invest in third party tie-ins in their facilities when they are making the decisions now, so they can retrofit easily when they need to, or, when we build later on in the future, there is a clear case for doing so.

David Loughman: I think the CO_2 emissions piece is about targets and setting milestones in the future, but it is also recognising that it is very short-term game, and the shape of the overall CO_2 emissions envelope—the value in terms of climate change effects in getting the CO_2 that would otherwise be up there out early—is very important in terms of the total challenge, so therefore, "What can I do tomorrow?" is very much about getting CCGT capacity in place. As we discussed earlier, the advantages of that in terms of old coal are, I think, well known and understood.

Q344 Sir Robert Smith: Do you accept the Climate Change Committee's view that unless the gas was abated by 2020, we would then not meet our rather strict targets on emissions?

John MacArthur: That is a bit of a simultaneous equation. I don't have numbers in my head of specifically what would happen. I am quite positive. I believe that with gas we have that transition. The dash for gas has been mentioned before. I think we do have a dash for gas. It is important to dash for us to meet the objectives we have set out, but it is not only for the power sector to reduce those emissions. It is also in road transport and biofuels, which, I repeat, are an absolutely crucial part of reaching those 2020 targets, as well as energy efficiency as well. The behavioural side is a challenge for everyone. I have a hybrid car. Public transport; there is a long way to go there, but I think we are on the right track.

Q345 Sir Robert Smith: You said the emissions trading scheme was am exemplar. It may be in terms of its structure and scope, but in terms of its pricing, is it not failing to send strong enough signals?

John MacArthur: That is another question I welcome. In terms of the price signal, we have had quite unusual circumstances over the last few years, and all markets have been impacted to some extent by the change in the growth patterns in the OECD and so on. What we recommend is that in the next phase of ETS, there is a balanced reduction of available credits, so you have set aside some credits, which will give some more stability to that price. We also believe that post-2020, in the next phase, we should have an auction reserve price as well, because although we have seen some of the reductions that have been achieved because of the financial situation in the last few years, there has been a reduction in emissions as well. Connie Hedegaard talked about, between 2008 and 2010, an 8% reduction, but it was still a learning period, and we did not expect, I would suspect, that degree of change in a relatively short period, but setting aside allowances is something we should move quickly on. The EU should take positive action there to make sure we retain that really important carbon price signal.

David Loughman: If we go back to CCS, I think one can see it as an essential technology from a global perspective, particularly going back to China and the current build-up of coal-fired power generation, which will need to be retrofitted to have a material effect on global CO_2 emissions. It is very important, given that the CCS will be retrofitted as some point beyond 2020, to have the pilot projects that are going on at

the moment, so I think, from our perspective—the Longannet project in Scotland, the work that is going on in Norway at the technology centre in Mongstad—to indeed find out in detail and research some of the challenges that we face with CCS is very critical, but I have no doubt that in the long-term solution to 2050, CCS, as the Intergovernmental Panel on Climate Change have said, will be critical to the 2050 carbon future.

Q346 Sir Robert Smith: But it is important that we also have it for gas as well as coal.
David Loughman: Correct, yes. I think what you have to do is look at two things. Firstly, what is the cost per megawatt hour of electricity in terms of your CO_2 capture? If you look at that for gas and coal, although you get less CO_2 of course, the actual cost of capture of CO_2 per MWh produced by gas and coal is relatively similar, and that is what you are interested in. The key thing is that you have less CO_2 per megawatt hour, and therefore you need less storage space, less compression, less of everything down the value chain for gas.

Q347 Sir Robert Smith: Do you see it being commercially viable by 2020?
Peter Mather: Perhaps I could just jump in. You have two companies here that have probably led the way on CCS. It is very difficult. We are all in various projects at the top of the learning curve, trying to get down it as fast as we can. If you want my personal view, I think 2020 is a bit premature. I think we are going to be looking at more like 2025 or 2030 before we have scale for CCS and real economic viability.
Can I also put a little bit of a plug in for the ETS? I think it is very easy to dismiss it. It is very early days for this market. Again, it is to a certain extent driven by fundamentals, and economic activity in Europe has been low. It would be interesting to see how it responds to a pick-up in economic activity, but one of the reasons why the price has been low is economic activity. Clearly, as we go through each of the phases and we tighten it a little bit each time, I think it is going to become a much more credible and robust price signal. For example, at BP, we don't use the current ETS price in our projects. We use $40 per tonne for all our investments for carbon, so everything has to be robust, factoring that in. We are anticipating higher levels further down the road.

Q348 Barry Gardiner: I would just say that we were told, after the first stage of ETS, "We know we have got it wrong but we have quite deliberately had to start the market off," and now we are at the second phase where we are told, "But now we are going to get it right." Now you are telling us, "Well, maybe some time in the future it will be got right."
Peter Mather: Your point is well made, but I repeat that we are not factoring in the current price on our projects.
Barry Gardiner: No, I take that point.
Peter Mather: We are looking ahead to a tighter regime, which I think is important.

Q349 Barry Gardiner: Yes. I want to move briefly to the transport sector. Do you think it is fair to say that because of the lack of diversity of fuels in the transport sector, it is less resilient and more prone to supply disruption and price increases than other parts of the energy system?
Peter Mather: We talked earlier, didn't we, about what I believe to be the robustness of the liquid transport fuels infrastructure in the UK. We talked about it in the context of industrial action. I would also echo what John said about biofuels. Again, you are looking at two companies here who are at the forefront of investment in biofuels. We have invested an awful lot over the last few years in—

Q350 Barry Gardiner: How quickly do you think that will happen, that there will be a wholesale transfer from petrol and diesel through to biofuels and electric vehicles?
Peter Mather: Our prediction or extrapolation, if you like, from today on biofuels—obviously there are various targets for the immediate future; 2020, which is basically the 10% coming out of the Fuels Quality Directive and the Renewable Energy Directive—is that we see, possibly in the UK, 30% being achievable by 2025–30, and on a global basis, biofuels are the fastest-growing of the transport fuels.

Q351 Barry Gardiner: I would be interested to know whether Mr MacArthur feels that that is justifiable in terms of the World Bank's report on emissions levels for biofuels when you consider the opportunity costs of land use.
John MacArthur: The first point I would like to make to address that question is that this is an area where we are putting in a lot of effort together with Governments. The UK Government particularly has been strong in supporting transparency. You can go on the Department for Transport website and see the sources of all the different biofuels, and it is not one size; there are many different types. There is good and there is less good. Sugar cane ethanol, for example, is some 70% less emission-intensive, so I think it is really important that we get that.
Barry Gardiner: Not if you consider the alternative land use.
John MacArthur: That is where we are working together with Governments and other organisations. It is really important that we get these parts of the argument clear.

Q352 Barry Gardiner: What do you believe the role of Government should be in facilitating the transition here to alternative transportation fuels? Let me phrase that more provocatively: is the Government doing enough to switch people over to electric cars?
John MacArthur: In terms of being able to switch people over to full electric cars rather than hybrid, I think it is something that will take quite some time. If you have 900 million cars in the world, 50 million per year—
Barry Gardiner: No, I was talking about the UK.
John MacArthur: Within the UK stock it would also take considerable time to completely change over your car stock. That is why biofuels are so essential. Even

then, I think there will be a mosaic, a variety, of different kinds of vehicles and different kinds of fuel, so whether it is biofuels and hybrids, whether it is liquefied natural gas and shipping, whether it is bio jet fuels, it is not as simple as just swapping over to electric cars. I think there is also the well-to-wire or well-to-wheels—the full value chain; you may switch over to an electric car, but then where does your electricity come from? Is it coming from a coal-fired plant? Is it coming from a gas-fired plant? These things all work together.

Q353 Barry Gardiner: Indeed they do, but you will have seen the figures that say that even if the electricity does come from non-renewable energy, it is still going to be less pollutant than a petrol engine. Would you not agree that moving to electric vehicles is actually one of the best ways to decarbonise the transport sector?

John MacArthur: We think electric vehicles have a very important role to play if we look at the broad picture. In that interim period, we think that biofuels are an absolutely vital transition.

Barry Gardiner: I would never have guessed.

Peter Mather: There is a sequencing here, and you do have to look at the impact that can be made from energy efficiency, hybrids and biofuels. I think that is bringing down the emissions curve quite substantially. If you then plug into a dirty or still relatively carbon-rich grid, you really lose all those benefits, so I think it is a sequencing thing. There is an awful lot that can be done with the internal combustion engine before you then look at a future for electric vehicles further down the road, so I think I would agree with the point.

Chair: Time presses a bit, and I have not taken part in that exchange because I have a declared interest in a second generation biofuels company.

Q354 Laura Sandys: My concern is that we would compromise food security for energy security, and that doesn't really help us very much. I would like to move to the international perspective. Obviously Shell and BP operate on an international level. What do you consider the biggest threats and challenges to energy security in the international political spectrum, and what risk impact of the price on both oil and gas would you place in relation to what I would call political security? Very briefly.

Peter Mather: That is a massive question. I will help my colleagues out by going first. I think, as I said before, oil and gas are fundamentally geopolitical. I noted you raised the issue of Nabucco earlier. Maybe we can use that as a very short case study, because we are very involved in that whole discussion of a southern corridor. What you have there is the potential of gas imports into Europe through a southern corridor from Turkmenistan, Azerbaijan, Kurdistan and potentially, further down the road, from Jordan and Syria and other places like that, so you have a logic of demand in Europe and supply, not much of it yet available, but certainly not far off.

What is holding that up at the moment is politics and economics, frankly, so clearly a lot of the countries in that area need to sort out agreements between themselves so that they are prepared to trade and have flows of hydrocarbons between their countries, and we welcome the progress made between Turkey and Azerbaijan recently, for example. It is also economics. I am sure, as citizens, we would all love to have a massive, great big pipeline bringing all these supplies right to our front door; maybe not quite to our front door, but into Western Europe. Of course, the issue is who pays for that? It cannot be purely on the shoulders of producers like us to foot the bill for an oversized pipeline. Equally, there is option value in having an oversized pipeline. The industry and Government and the various infrastructure owners need to come to some sort of arrangement in these situations so that energy security is ultimately delivered, which is the goal.

David Loughman: Yes. If I talk about gas in general, again it goes back to the point about the distribution of reserves, which I think every region in the world, in the recent IEA report, shows to have similar levels of available gas resources. We expect the growth in the number of LNG-exporting nations to double over the next five to ten years, and that is something that we should be encouraging, because that is the fundamental mitigant to supply stoppages or challenges in any given area.

Q355 Laura Sandys: Yes, but you are giving me a narrative of how the international market works and needs to work. What do you see as the long-term risks, whether that is political instability, protectionism or the politicisation of energy? Having worked in the Caucasus, I have seen certain elements of that. This is not a clear, free market as we would like to look at it from turning on the heater back here in the UK. How do you cost that?

David Loughman: Something I am very conscious of because I work with it a lot in Europe, which I think could be an issue, is what we clumsily call above-ground non-technical risk, but it is basically the acceptability of having oil and gas facilities, particularly if they are designed for export, that are acceptable to growing local communities and other stakeholders who sit around that gas facility—it might equally apply to oil—who do not directly benefit from it. As you broaden the number of suppliers and go into different places, that challenge becomes ever greater. In our projects, that is just as important as managing the commercial impact on the economics of the project.

If I take the example of Norway, Norway has been going through a political discussion in the last few years as to what its role as a gas and oil exporter should be, given that a lot of its CO_2 emissions come from that sector, and I am pleased to say that on Friday, the Oil Minister of Norway, having listened to many advocates from the UK, among others of their customer nations, took the view in their White Paper published on Friday that the oil and gas export industry in Norway should be an important contribution to global security of energy supply going forward.

Q356 Laura Sandys: Yes. I wouldn't say that Norway would put a political risk premium on their role or their contribution, but when we start to look at

the opportunities and the needs, when you start to look at development exploration in the Arctic—you also experience it in Nigeria; BP is in Venezuela—there are a lot of differences. You are working in difficult areas; terrorism, pipeline exposure to terrorism, all of these issues. What we are trying to get to is where you see the biggest risks, and what sort of impact is there on UK energy costs? What premium do you put on political insecurity?

Peter Mather: I think it is very hard to put a number on it. If you look at energy supplies over their history, they have been remarkably robust. Think how many political perturbations we have had in the Middle East and elsewhere. We had a Cold War and Russia remained a very reliable supplier. Ultimately, you need matched needs between suppliers and consumers, therefore contracts need to be good. Relationships have to be good. I think the role of Governments in facilitating commercial agreements between willing parties in the energy industry is massively important, whether it is—

Q357 Laura Sandys: The legal framework is absolutely critical, sure.

Peter Mather: Whether it is the legal framework, political support—

Laura Sandys: And the transparency of that legal framework.

Peter Mather: Yes. Contractually sound arrangements between willing buyers and sellers. All of these things are important. It comes back to a point, I think, that has been a theme here, which is diversity. It is terribly important that we are all talking to a number of different energy suppliers, and indeed consumers, so that the world can ride out the inevitable discontinuities that there will be. Libya is a case in point at the moment, but actually, in the overall scheme of things, the world, as far as oil supply is concerned, is riding out that particular crisis reasonably well.

David Loughman: If we look at the Arctic—I was in the Arctic two weeks ago on the Russian-Norwegian border—I think the message there is that we can manage the technological aspects, but what will be very important is co-operation between the Arctic nations and others, particularly in setting the standards and setting up international response mechanisms, the response to technical issues or spills, so that we have that in place and it is organised at an Arctic level. You saw that in the conversations between the Norwegians and Russians.

Q358 Laura Sandys: You would not invest in the Arctic unless there was a clarity of legal framework, and contractual and, in many ways, territorial clarity?

David Loughman: Yes. For example, the Russian-Norwegian border area has recently been resolved by Medvedev and the Norwegian Government, and that has opened up a vast new area for exploration. That is, on the Norwegian side, about the size of Central Europe. On Friday, the Norwegian Minister said we will move fast to open up this area for exploration but in very close co-operation with our Russian colleagues over the border. I think that is a good example of what you are describing.

Peter Mather: There is a lot to learn and a lot of care has to be taken before these areas can be opened up. In many ways, the world will need to make some of those choices with us, but our job is to make sure that where we do go, we do it in the safest and most responsible way.

David Loughman: In fact, the first steps in the process that I have just described are the environmental and other impact assessments, and in fact Norway already has a policy of no emissions in Arctic waters at all, so that has been in dialogue with the other Arctic nations.

Chair: Thank you very much. This has been a very helpful and interesting session. There may be one or two points we want to follow up in writing as well. We will be in touch about that. Thank you.

Tuesday 5 July 2011

Members present:

Sir Robert Smith (Chair)

Ian Lavery	Christopher Pincher
Dr Phillip Lee	John Roberston
Albert Owen	Dr Alan Whitehead

Examination of Witnesses

Witnesses: **Dr Simon Harrison CEng FIET**, Chair, Institution of Engineering and Technology (IET) Energy Policy Panel, and Mott MacDonald, **Duncan Botting MIEE**, IET Energy Policy Panel, and Scottish European Green Energy Centre, and **Professor Roger Kemp FREng CEng FIET**, Royal Academy of Engineering's Engineering Policy Committee, IET Energy Policy Panel, and University of Lancaster, gave evidence.

Q359 Chair: Welcome to the inquiry and thanks very much for agreeing to give evidence. Don't start with opening statements, but if you could just give your name and position for the record, starting on the left.
Duncan Botting: Duncan Botting, representing the IET today.
Dr Harrison: Simon Harrison, also representing the IET.
Professor Kemp: Roger Kemp, representing, I think, both the IET and the Royal Academy of Engineering.

Q360 Chair: Thank you. To open up, maybe you can outline what you see as the main threats to UK energy security both now and during the transition to a low-carbon energy system. Who would like to start?
Dr Harrison: We come to this as independent professional engineers; we all have different corporate hats, but we put those to one side for today. We are representing our professional institutions and they, together, have a membership of most of the professional engineers operating in the UK. We hope that what we are going to bring is engineering-informed evidence to assist you in your deliberations. There are a number of key thoughts that may be worth bringing out at the beginning before delving into the questions that you have suggested.
The first is the need for a systems approach, and we mean that in the very widest sense. As engineers, we think naturally about systems and we think about the consequences over here for something that you do over there, and how to arrange things so that that happens predictably and reliably. That is hard to do in a world that is complicated by a wide range of other factors, but when you are thinking about moving to a low-carbon economy and all the complexities that that involves for the energy system, everything becomes a lot more integrated and the need for real systems—thinking across Government, across the industry, industry structures that support that type of systems thinking and, indeed, across our own professions there is a challenge for us as well—is key to being able to deliver an overall low-carbon energy solution. We recognise all the difficulties and complexities of that, but it is the systems angle that I think you will hear coming again and again from today.
We mentioned in our evidence other areas that we think are very important but are often overlooked: using less, being more efficient about energy use. Energy security improves for every little bit of energy less that you have to use. The emphasis on using less energy is just as important to security as it is to all the climate change arguments. Skills and the role of professionals is very much a key theme for us. One characteristic of where we are going in energy is optimisation across a mass of sources and uses of energy, each of which has its own particular characteristics. Even if you take an individual dwelling house, it has a different building fabric maybe from the one next door; it has different thermal properties; it has different patterns of use; it has different levels of wealth among its inhabitants. Each of those is a system by itself that cannot be treated in the same way. Even two apparently similar houses, one next door to the other, need to be thought about differently. The skill requirement to deliver the right solution for each circumstance is quite significant and we do not have anything like that in anything like enough quantity at the moment.
Similarly, when you send people in to do the physical installation, those skills are short, too. It is very easy to show—there is plenty of evidence—that the wrong installation techniques applied to energy efficiency technologies mean that they fall far short of reaching their potential. There is a lot of emphasis on skills and on people—we come to this as engineers doing technical things, but, from a systems point of view, the people are a key part of the system; people as users. If people do not buy into or understand their role in a low-carbon secure energy economy, they are not going to be able to allow us to optimise the use of energy and the mix of energy in the way that we would otherwise want to. Maybe it is a slightly surprising little list there, but we think that those are, if you like, the key factors in thinking effectively about this. From that, we think there are quite a lot of lessons for all of us, including Government, in how to move forward. In our replies to the questions, we hope we will address those.

Q361 Chair: Thanks very much for that opening. Do you think overall the Government have a sufficient comprehension of the systems approach needed and what you have identified?
Dr Harrison: No. Would you like to join, Roger?
Professor Kemp: I think one of the problems we see is that Government is not a unified whole. If you look back, for example, at the eco-towns initiative organised by the previous Administration there was a

general view among the engineering profession that that was wholly misguided in the fact that it did not take a broad view of energy use. You could get a proposal that appeared satisfactory by the standards of the eco-towns programme, but that did not have any means of having renewable transport to work, so that it would just increase the amount of road traffic. There were a number of issues like that where we felt that there had not been a sufficiently broad view across not just the Government Department that was looking at that particular activity, but also integrated with all the other departments that have an impact in that area.

Q362 Chair: Would that be an argument for DECC having a more over-arching view?

Dr Harrison: Potentially yes and, as engineers, the term we keep coming back to is one of systems authority; in other words, the small group of people who are responsible in an engineering sense for making sure that a system is delivered to do whatever it is supposed to do. In Government there are some big barriers to that because of the departmental boundaries, but there is an organisation within the Treasury, Infrastructure UK, which seems to us to potentially have some of the potential to develop into a systems authority, if only the other relevant Departments—and it is not just DECC, but DCLG and DfT and others—buy into that as well so that we see the emergence of somebody in Government with a responsibility and a competence for looking across the whole piece.

Q363 Chair: One of the concerns you have highlighted in terms of complexities of the system is cyber-security. How much more of a threat is cyber-security to the stability of the system?

Duncan Botting: I think that in all these areas—you can look across the whole telecommunications environment—cyber-security is an issue, specifically to the energy domain. It has a number of different aspects because a lot of what we are talking about is legacy infrastructure and it will still be in place for a good long time to come yet. Therefore, legacy standards apply for some time to come. The new security measures that have been put in place as we move forward are indeed stronger than those that were there before. Cyber-security, I think, is an issue to be concerned about. But, from a systems approach, it can be reduced and mitigated if the systems activity is taken into account. A lot of the problems come in the interfaces between different standards and there are often loopholes in these areas that need a broad view as to how everything plugs together. I think it is no bigger threat than a lot of other risks that we face, but it is one that we should focus on in a systems approach, rather than just saying, "A new standard will fix everything".

Dr Harrison: Security is a systems property. Making your smart meter secure is not the same as making the energy system secure, for example. You need to think about it all as a piece.

Q364 Chair: But do you think that, in a democracy, with multiple pressures on Government and the complexities of delivering so many different services, it is realistic? People have talked for generations about ending the silos, joining up Government—it is often talked about—but how realistic is it to achieve it?

Professor Kemp: Could I talk about systems authorities? We are not looking for a group that is going to be something like an old Soviet-style Energy Ministry, but far more a group of specialists. In the same way with mobile phones, there have to be international standards that make sure that your phone uses the same data protocols so it will work equally well in Taiwan as in South-East London. One needs the same sort of joined-up thinking. So it is not a question of saying, "We want to make an over-arching management structure", but an over-arching and all-pervasive technical structure so that people can think through the implications of what they're doing; although what they will eventually be doing will be managed within their existing structures.

Duncan Botting: If I just give you an example, 30 years ago nobody sat down and drew up and designed the internet as we use it today. In exactly the same way, the energy system is not going to be sat down and designed to be delivered in a specific way. It will evolve through a number of toolboxes that will be used and people are creative in the way that they use those toolboxes. To be honest with you, most of what we are seeing is the policy frameworks, which allow a systems approach to evolve, being the barriers rather than necessarily the systems themselves. Therefore, it requires people not only to deliver technical systems, but frameworks of policy that are coherent between each other's area: DECC, Defra and so on; the interface between the built environment and active network management for distribution of it. With the interconnection there, it is sometimes not clear how the policy is connected between the two.

Dr Harrison: For us, one of the challenges is that there has been a progressive degradation of engineering capability within the DNA of the Civil Service and there are not many people in the Civil Service who can take this kind of view of potential policy as it is being developed. The engineering input to policy seems to us to be very important. I think there is a view that says, "Well, we will get the engineers to deliver the policy when we decide what it is going to be", which you might say inevitably seems to us to be the wrong answer because there is a very large engineering dimension shaping what a credible policy should be.

Professor Kemp: Could I use the example of electric vehicles? There is a policy at the moment that favours electric vehicles. There is also a policy that favours heat pumps in homes and converting more homes to electric heating. The latter policy probably will mean that we will need renewable generation in winter of a greater capacity than renewable generation in summer, so that we are likely to find surplus renewable energy in summer. Now, rather than using electric vehicles, which will take the same amount of energy pretty well all the way through the year, one could say for certain categories it is probably better to go to hydrogen. Looked at purely as a vehicle, hydrogen is probably less efficient than going via battery route, but if you have spare renewable energy that you do not know what else to do with in summer, it is probably better

to make that into hydrogen then; you can store it, whereas you cannot easily store electricity, to use in HGVs throughout the winter. So this is, if you like, joined-up thinking between the generation side of things, the transport side of things and also the domestic heating and housing side of things. If you just take each as an individual silo, or whatever else one wishes to call it, those linkages are not going to be visible.

Chair: We are coming later to transport.

Q365 Ian Lavery: Just a number of points on the flexibility in dealing with intermittency. There seems to be a lot of ambiguity about nuclear, about gas, about coal and capturing storage and flexibility. In the written evidence from the IET, it was suggested that nuclear power is relatively inflexible. I am just wondering whether this is because it is technically not possible to flex the output of a nuclear plant, or is this as a result of economic flex.

Dr Harrison: It is a bit of both. At a purely engineering level, if you are cycling the output of a nuclear power station up and down you are putting the key materials of that nuclear power station through thermal stress cycles, which will limit its life. So you are having a direct impact on effectively the long-term value of that nuclear power station. From the economic side, the marginal cost of producing a unit of electricity from a nuclear power station is close to zero. Almost all the cost is fixed once you have built it and got it operating, so it makes sense to generate as much as possible from that nuclear power station. There is some experience in France of using nuclear power stations to load follow, so adjusting their outputs as the load varies. That is because they have such a large proportion of nuclear in their generation mix that they have had to learn to accommodate it, but it is not particularly sensible to try to do it from either an economic or a technical perspective. At the margin, there may be some room; but if you have the option of flexing a nuclear power station or turning off a wind farm, it is better to turn off the wind farm. Better still, find another source of use for the electricity from that wind farm: for example, use it to make hydrogen or some other purpose.

Q366 Ian Lavery: Also in your written evidence it suggests that coal with carbon capture and storage would be relatively inflexible as well. Are there any realistic prospects for improving the level of flexibility provided by future coal and gas plants with carbon capture and storage?

Dr Harrison: It is a more complex question than at first appearance perhaps. The coal plant we have in the UK currently was mostly built to be inflexible, but was re-engineered to be flexible post-privatisation. If you were to build a new coal plant today, you would want very high-efficiency coal plants, no doubt, that would use advanced super-critical or ultra-supercritical technologies. Those technologies are inherently pretty inflexible. Forgetting the carbon capture and storage equipment for a minute, if you simply build a new state-of-the-art coal-fired power station it is likely to be pretty inflexible. Moving to the CCS equipment, the short answer is we do not know because nobody has ever built one. There is some work that suggests that CCS will have some flexibility in terms of the CCS equipment itself. There are quite a few engineers who have quite serious practical concerns with that in terms of the stability of catalysts and such like. So we do not really know. One option, of course, if you happen to have a coal plant that was flexible and a CCS plant that was inflexible, would be to turn the CCS plant off when you wanted to flex and those options are potentially available. With gas, the unknowns are even more so because nobody has ever gone down the route of trying to build a CCS plant for gas. It is more difficult than coal because the carbon is more dilute in the flue gas volumes.

Q367 Ian Lavery: In your report I think you say that advanced coal CCS is a key component of the future energy mix. It didn't mention gas, as such. It would appear as if coal was a better option than gas. What are the pros and cons of coal versus gas with CCS?

Dr Harrison: With coal, per unit of carbon sequestered, you will pay less for the CCS because with coal plant the carbon is relatively concentrated in the exhaust gas stream. So it is, relatively speaking, an easier job to remove it. With gas-fired plant, combined cycle gas-fired plants, it is an efficient plant anyway. The carbon intensity of the process is that much less. The amount of carbon per unit of flue gas is much smaller, so the costs of extracting are going to be higher. There is no reason in theory why it cannot be done.

Q368 Ian Lavery: So you believe that coal will be cheaper than gas with CCS?

Dr Harrison: Well, that depends on the relative prices of the coal and the gas.

Ian Lavery: The process?

Dr Harrison: The CCS plant that you fit on the back of a coal plant per unit of carbon extracted will be cheaper for coal than it will be for gas. But, of course, the coal-fired power station is rather more expensive to build than the gas-fired power station and you have very different fuel costs and fuel cost volatility. So the overall picture is not obvious because it will primarily depend on the gas price.

Q369 Ian Lavery: Turning slightly to the intermittency with wind power, how much wind power can the current electricity system accommodate before intermittency begins to pose a problem for balance of supply and demand?

Dr Harrison: We had a long discussion about this one. I think the short answer is nobody quite knows yet. We are in a learning-by-doing phase. Nowhere in the world is quite the same. You can point to examples in Denmark or Germany or somewhere that say they have x% wind power and they manage to cope with it, but they are very different power systems. Most of the European power systems are very strongly interconnected to each other, whereas the GB power system is pretty close to being islanded, so it has different characteristics. Also, how much wind can be accommodated on the system will depend on what

else you do to the system; so if you, at the same time, advance a programme of smart grids, you produce a lot of controllable demand, you end up with a whole lot of options to be able to manage the intermittency of wind, which will then allow you to accommodate more of it on the power system. So the answer is it depends on a wide range of things.

Duncan Botting: It comes back to the systems approach again—

Dr Harrison: It does, yes.

Duncan Botting:—because if you only look at generation and ignore effectively the network transmission and distribution and the demand side, I think National Grid identified that originally they were quite happy to accept up to around 20% wind intermittency on the network without too much challenge, but as soon as it went over 20%, that was a major issue for them. It was almost a flip-flop situation where other things had to be done to mitigate the intermittency. So, in terms of the question of how much can you have, it depends on how much are you willing to do to the rest of the system to allow more wind to be added.

Professor Kemp: If you introduced at the same time a large fleet of electric vehicles with battery chargers that could be controlled by a central smart grid of some description, it would probably allow you to put more wind on to the system because when the wind dropped or disappeared you could phase back the battery chargers and tell them to take less energy. So you could match it that way. There is also the stability issue of exactly how you control this, so you do not end up with fairly violent load swings when you get a demand from the central system into smart loads. But, as we have said, this is an area where, frankly, I do not think anybody really knows and we will be trying it, I suppose.

Dr Harrison: Well, we are learning by doing, but the important thing is I think that there is an environment created where that learning can take place effectively rather than being constrained by silo thinking. I think that is the key point.

Duncan Botting: I point to a couple of things that are in place today; things like the Low Carbon Network Fund, which is allowing us to trial things on a reasonably large scale and understand some of the consequences of some of these different systems approaches. I think that is key for us to be able to understand the learning by doing, but also identify what are the most cost-effective solutions that will roll out generally. So £0.5 billion sounds a lot of money, but when you get to large-scale demonstration of deployment, the Low Carbon Network Fund is constrained by what it can do because those figures are nowhere close to the sort of level of the £200 billion investment over the next 10 years that we need for the network itself or the energy system itself; so generation, transmission and distribution. I think we probably promote more learning-by-doing-type of projects where we have an increased Low Carbon Network Fund type activity.

Q370 Dr Lee: Moving on to the climate change question and the resilience of our infrastructure in this country. What do you see as the major threats posed to that?

Dr Harrison: Well, you framed the question widely: infrastructure as a whole. We were part of this report, which I think many of you might have seen, by Engineering the Future, which looked across all the different strands of infrastructure and examined the interdependencies between them and produced what I think was quite a comprehensive piece of analysis to help explore those. In the case of energy, while energy underpins almost all the other infrastructures, energy itself is probably a bit less vulnerable than some of the others. We tend to, as engineers, think about from the energy perspective, "This is stuff that you have to learn how to deal with, but we'll get on with it".

Where I think co-ordination is needed is in looking at the interdependencies across energy and the other infrastructures and that's an area where, again, I think Infrastructure UK is doing some interesting work. That should very much be supported because it is this cross-co-ordination that is needed so that one can understand, "Well, okay, if a bridge gets washed away, what about the water pipe, the medium-voltage distribution cable and the telecoms cable that was attached to it and what is the impact of that event on a wider area?" We can try and explore that a bit now if you like, but I think the subject is quite well dealt with in this report.

Q371 Dr Lee: In terms of the threats to environment change, to what extent do you think we are doing a good job of mitigating those threats?

Dr Harrison: In terms of design criteria for siting of power stations and suchlike, I think people are taking a careful view of such things. National Grid is much more aware now of siting substations away from areas of flood risk. So I think those kinds of issues are being dealt with.

Q372 Dr Lee: You say that energy itself is less at risk than other parts of infrastructure in this country. Why do you say that?

Dr Harrison: I was part of the group that looked at energy as part of this piece of work and when we started to think about all the complexities of the problems we are trying to solve in energy at the moment, the type of items that we ended up putting on our list as being vulnerable to climate change seemed very much second order. For example, specify transformers for greater temperature rise, which is easy to do; make sure that your overhead lines are designed so that the maximum sag is for a hotter summer day than we are planning at the moment. It is not difficult stuff and all of it is widely done elsewhere in the world. There is a lot of expertise in the UK in engineering this kind of equipment internationally as well.

Q373 Dr Lee: An even broader question, if that is at all possible, about strategic thinking in Government. My impression so far, after a few months of being here, is that there is an absence of strategic thinking. Often the defence is, "We are on a five-year political cycle, so we can't do strategy, Phillip". This is one example. One could look at behavioural change,

patterns of behaviour in healthcare and social care, ageing and all those other things. Do you think that Britain does strategic thinking well in Government and if not, why not? If you were to do one thing to try and improve that, in comparison to some of our near neighbours who seem to be able to build railways and build airports and generally make strategic decisions more easily, how would you change it? What would you do?

Professor Kemp: As part of my history, I spent a few years in Paris as project director for the consortium that built Eurostar and so I saw quite a lot of the French way of working. I had the impression there that for things like the TGV programme it wasn't a sudden, "Let's build a TGV line". It was part of a long, "Here's a 30-year programme. This is how we are going to do it. This is where we're going to feed the energy from". I think part of that—and I'm afraid this comes back to something that Simon was saying earlier—is the type of recruitment that is used for parts of the French Civil Service; that it is quite normal for senior civil servants to be from the École Polytechnique, which is primarily an engineering university, and to have discussions with civil servants where they can challenge engineers and where they understand the detail of some of the engineering that we have been talking about. That is quite different, I think, to the situation that exists—

Dr Lee: So what you are saying is we have too many historians, lawyers and PPE graduates? Is that what you are saying?

Professor Kemp: I couldn't have expressed it more succinctly.

Q374 Dr Lee: Looking at this, I just get the impression it is just another example of how we don't do it right in this country. I have not read this document, but I suspect that document is a valuable read in terms of looking at the challenges that we are going to have to deal with in this particular area. But I wonder whether that document will ever be read and implemented and that is my concern.

Duncan Botting: I think it truly does come back to the fact that we tend to break problems down and distribute the problem and not necessarily look at the interfaces between the problems that we are distributing when it comes together. So in terms of strategic thinking across a whole piece, like the systems approach activity, I think others have a better system for providing that framework to operate.

Q375 Dr Lee: So the final question is what would you do? Would you create some sort of department for strategy or some way of bringing the strands together and saying, "Right, we need to do this over here. For instance, for this, you need to have science and engineering graduates coming through; so there needs to be an interface with education. You need to have an understanding of energy markets. You need to have a geopolitical view. So the foreign policy has to fit in, the defence policy has to fit in, the foreign policy has to fit in". I mean, the whole thing is all connected, so I just—

Duncan Botting: UK Infrastructure is one of the reasons that we highlighted them as a possible surrogate for this activity because, to be honest with you, they have done some great work at multi-disciplinary policy.

Q376 Dr Lee: How big is this unit? Are we talking two or three people?

Dr Harrison: It is a fairly small number of people.

Duncan Botting: Very small. I think the problem is that a lot of it is based on a lot of academic activity and there are not sufficient people with the engineering back-up to provide that competence within UK Infrastructure. So I think the strengthening of that sort of area with professional engineers who can have that dialogue with the scientists and with the industrialists is key for us to getting a complete strategic view of things.

Dr Harrison: But also not just that thing sitting in isolation in the Treasury but, as we said before, the buy-in from everyone else; also the other Departments having sufficient engineering capacity to have an intelligent dialogue with it and with others so that, as in France, there are enough people who can have the conversation and there is a level of mutual understanding as to what things mean.

Professor Kemp: There is also a problem in that it is assumed that science and engineering are somehow the same and, particularly in the climate change area, they are not. Science basically says, "We need to reduce carbon dioxide", and that is the end of their output. It then goes into an engineering phase, saying, "How on earth do you do it", which is the engineering strategy type of discussion. Then finally you have the, "Okay, we know what we are going to do. Now do it". I think the existing Civil Service understands that bit. The science bit they understand. But the engineering, "How do we do it? Do we do it by electric vehicles? Do we do it by hydrogen? Do we do it by this", doesn't feel to me like something that is done as part of the mainstream Civil Service.

Chair: If we can move on to doing it with transport.

Q377 Albert Owen: Yes. You have touched on things, Professor Kemp, but I just wanted, first of all, to ask the three of you a more general question. Do you think the UK can meet its long-term carbon reduction target without the electrification of surface transport?

Professor Kemp: No. Basically domestic transport as a whole is about a quarter of our total CO_2 emissions. If you roll in international flights and bunker fuel for stuff we are importing from the Far East, that obviously gets a larger number. So if we want to make an 80% reduction, transport certainly has to take at least its fair share. I used to think transport was one of the more difficult areas to decarbonise until I started looking at domestic heating.

Albert Owen: That comes later.

Professor Kemp: Then you realise transport is nowhere near as bad as some other areas. So I think that if we are serious about the 80%, then we basically have to take at least 80% of the carbon out of transport as well. We can't assume that it has a free ride.

Dr Harrison: But, having said that, electric is one solution. This is all part of the systems argument. You

have hydrogen options. You potentially have biofuels options.

Q378 Albert Owen: That was my next question, anticipated. Is it a mix? Do we move from fossil fuel to hybrids to use of biofuels and then electricity or do we make a quantum leap to begin?

Professor Kemp: I think it depends also on what else happens. If we decide we are going to be serious about using electricity and heat pumps for domestic heating, then that suggests that there are going to be times of the year and times of the day when we are going to have unused low-carbon generation capacity. Now, storing electricity is very expensive; a minimum of, say, £300 a kilowatt hour. Storing that energy as hydrogen, as biogas—as something else—is probably a far more attractive way to go. So it looks to me as though, if we want to go with electric heating in homes and decarbonising transport, the route of just going for electric vehicles is probably not the right one. If we were taking transport as it stands, which is what we did in the Academy when we produced this book on electric vehicles—there we were just looking at vehicles, we weren't trying to integrate it with the whole energy system—there it seems to make more sense to look just at battery vehicles.

Dr Harrison: So it is another example of systems again.

Duncan Botting: If you take that on board, one of the barriers to delivering what Professor Kemp has just identified is the network and the support capability to deliver and manage that whole emphasis of having EVs in place to take advantage of the renewables when they are not being utilised. If you don't do the smart grid aspects, the whole systems approach falls down yet again.

Q379 Albert Owen: I am going to move on to that, but I just want to push you a little bit. Don't you see a rural/urban divide here—electricity and vehicles in the cities and in the large towns, but it will be more difficult in the urban areas—and do you not think biofuels and hydrocarbons have to play a bigger role to play there?

Professor Kemp: I think you are probably right; particularly hybrid vehicles where you might have a 40 or 50-mile range that you can get by plugging in and then, if you want to go beyond that range, you can use whatever biofuels there are. If you look at the statistics of the number of miles people do a day, most people go relatively short distances, even those living in the country. So if they have an electric grid, it is relatively easy to recharge for the relatively short journeys; but for longer trips, then probably hybrids of some sort, plug-in hybrids, make a lot of sense.

Dr Harrison: One of the key constraints on all this is the availability of biofuels and they are, at the moment at least, a precious resource. One of the system decisions will be about how they should be allocated and whether it is for say ground transport or aviation is a subject that hasn't run its course yet, I don't think. There are, of course, technical opportunities that may exist in the future to produce biofuels on a rather larger scale—for example, through seaweed and suchlike—that one can't rely on in setting policy at the moment, but may become available.

Duncan Botting: I think we will come back to the point anyway but in terms of the view of this divide between urban and rural, one of the major problems is the urban area for providing sufficient capacity to be able to provide that intensity of energy in one place. So if you have 100,000 spread across the UK, it is not a bad problem; but if they are in one town it is—

Q380 Albert Owen: Before I move on to the sort of grid systems, smart grids and smart metering, I was fascinated with what you said, Professor Kemp, about the planning in France on the TGV. Here we are going into High Speed 2 and we are all talking about the destruction of the countryside—which is a big issue, and I am not saying that—but we are not talking about the long-term future of peak oil and moving from diesel to electrification of trains and that is an area we need to. Do you agree with me there is not enough dialogue about it? It makes a greener argument for high-speed trains as well if we talk about electrification of the whole network, rather than just destruction of the countryside.

Professor Kemp: Yes. At present, the appendix on environmental impact of High Speed 2 in the documents on their website describes moving passengers from aeroplanes to trains as being one of the key environmental benefits, but that in fact is only about 6% total of population on the trains. The other 94% will either be people moving off existing trains, which are more energy efficient, or people making journeys they would not have made before. Obviously it is better, from the energy point of view, to stay at home rather than to make a journey. So it is rather difficult to see the energy justification for that particular project, unless there is a very large amount of otherwise unused renewables, but I think all the work we have done in the institution suggests that that is unlikely.

Q381 Albert Owen: But you alluded to the fact that in France there was more joined-up thinking between the various Government Departments and civil servants.

Professor Kemp: Well, going in not speaking brilliant French—I spent four or five years working there—there did appear to be much greater understanding, partly because they came from the same backgrounds. My senior managers were from places like École Polytechnique, which was the same as the senior managers in the generating companies and the railway authority, which is also the same as the people within the Civil Service. So there did seem to be this view that you take very senior, very competent engineers and put them, not in little boxes saying, "Engineer: feed problem when required", but put them seriously into the policy-making part of the state infrastructure.

Q382 Albert Owen: It is a good point that you have made on several occasions. Going to the Royal Academy of Engineering now and the planned smart grid, smart metering system that we have, you suggest that this will not make a significant impact if the fleet

of electrical vehicles would be insufficient, the planned assumptions that we have now from Government.

Professor Kemp: At present, there isn't really a plan. There is a plan for smart meters and the bit that is fairly clear is that people will no longer go round to homes to read meters. It will be done remotely. There is also the assumption that you will be able to change your supplier at the click of a mouse, rather than having to fill in lots of forms, and that, at some stage in the future, this will send signals out to people to say, "Electricity is cheap now, because the tide is going out and the tidal barrage is generating", or, "The wind has started blowing", or, "The sun has started shining", or whatever, "therefore, it would be a good time to charge your electric vehicle or switch on your domestic water heater", or something. What goes beyond that, I don't think anybody has really drawn out and we find this a bit surprising. As engineers, we would expect to look at the overall objectives of the smart grid and then say, "Well, now let us put some bits of smart meter on to that", rather than saying, "Let's build a smart meter and work really hard at that and then decide how it is supposed to be used within the overall scheme of things". So it does seem to us to be back to front.

Q383 Albert Owen: A final point on energy security. Do you think this puts us at risk in the future if we don't do as you are suggesting, Professor Kemp, and have this grid; not concentrating just on the metering, but on the bigger picture?

Professor Kemp: I think it depends how much we are prepared to trade off low carbon versus security; that if you want perfect security, you have a lot of coal-fired power stations with very big coal tips next to them and it is relatively easy then to guarantee security. It is much more challenging if you are saying, "We want to go down this route. So we close all the coal-fired power stations. We only operate things with CCS and we move in that direction, Oh, and we want security as well". I think it becomes a whole lot more challenging and, again, like most things in life, I think it depends how much you are prepared to pay. If one says, "Well, we will have a large number of gas turbine power stations just sat there waiting in case there is another fortnight when the wind doesn't blow", that will give us security but at a price I suspect we wouldn't be prepared to pay.

Q384 Albert Owen: A final, final point, I am sorry, just on the issue of the electric cars themselves and the R&D that goes into that. Isn't it the case now that most of the companies in the UK are doing their R& D outside anyway and Britain is not in the forefront of it? As engineers, what is your view on that?

Professor Kemp: It is interesting. I used to think that, partly because at one time I worked for a car company which is no longer doing what it used to do. But there is an awful lot of work in companies like Ricardo, which are involved in detailed powertrain development, so it is not the bits that are totally visible. There is no badge on the front of your car that says "Ricardo", but it may well be quite a lot of the kit that went into it was designed there. For quite a lot of vehicles, even those built in mainland Europe, you find that the engine or part of the drive train was probably built within the UK. So I think there is quite a lot of UK business; not the big spectacular building large fleets of cars in the same way it might have been 20 or 30 years ago.

Duncan Botting: I would say that you only have to look at F1 and the number of teams that are residing in the UK because of the innovative R&D capability that is here. Where we lack the capability is in the mass production area, which is taking it on from just R&D to mass roll-out.

Dr Harrison: But it does bring you back to the skills point, the whole STEM agenda, and the flakiness of the engineering pathway through university and the number of people wanting to do it and suchlike. It is a big skills problem affecting our industry and the deliverability of climate change targets. So there are some really great things going on here, but the base that should be supporting those into the future is rather eroded and that is, I know, a big area of concern for the IET.

Q385 Christopher Pincher: I think, Chairman, it is time that we talked about heat. I know this is going to interest you particularly, Professor Kent. You have been waiting for this one. The evidence from the IET and also, I think, from the Royal Academy of Engineering suggested that transferring heating from fossil fuels to electricity would have, "A profound effect on the electricity system, potentially doubling electricity demand." Now, if we want to decarbonise heating, is there any way of doing that other than going through electricity?

Professor Kemp: It is difficult and I think this is one of those areas where I have to say it is work in progress. Last year the Academy produced a report on electric vehicles. We were hoping this year we would produce a similar report on heat and in fact, it is taking rather longer than we had expected because it does seem to be rather more complicated than most of us thought.

Q386 Christopher Pincher: What makes it complex?

Professor Kemp: Heat is a problem. If you look at cars, there are a number of major companies—Nissan, Jaguar, Renault, whomsoever—that you think of as being big car companies that can influence the way things go. If you look at heat, there are a number of boiler companies that basically just make boilers. They do not do complete heating systems, and heating systems, particularly domestic ones, tend to be built by relatively small groups of heating engineers fairly low down in the skill agenda and there isn't this sort of overall integration in the same way there is with cars.

Q387 Christopher Pincher: So there are no professional engineers in Worcester Bosch is what you are saying?

Professor Kemp: There will be in Bosch, yes, certainly, and I have seen some really good papers written by Bosch about particular heat pumps and about particular activities, but that is designing one

component. If you want Bosch to come in and really take your house apart and decide how best to save energy in your house, it would cost an awful lot and I would suspect they would not want to be going around doing that to a lot of domestic properties. They can afford to do it to big commercial properties, but it is quite difficult to see how you are going to look at a whole row of houses that are, as Simon said earlier, probably slightly different—with different lifestyle patterns, different heating demands—and then try and work out how it is best to make each more energy efficient.

There are some things that are no-brainers; improving the efficiency of the insulation in the roof is obviously a good one, if you have a roof and if you can get at it. If you have rooms in the roof, as a lot of Victorian houses have, then life becomes more difficult. It makes sense to put in cavity wall insulation, again if the house can accommodate it. Beyond that, it is quite difficult to know where you go: double-glazing, yes, good idea; draft prevention, yes; but go too far down that route and you might find you get dampness problems unless, at the same time, you have done things to the damp-proofness of the house. So it is quite difficult to look at houses in general and come up with a generic solution and it very much requires somebody who understands all the problems, looking at a particular house or group of houses and saying, "This is how we propose to deal with them".

Dr Harrison: Well, maybe even looking at a whole city because you end up potentially with district solution options. You have the option in some cities of inter-seasonal heat storage. There are all sorts of things that potentially you could do, but it does become bespoke to a set of circumstances.

Duncan Botting: I think the Europeans have exactly the same issue. I mean, only last week the Smart Cities Initiative was launched and this is about the interface between the built environment and all of the technology that we can throw at it to solve some of these issues. That is probably one of the greatest examples of a systems approach coming together, because the city environment is one where all of these problems come together. The issue about Europe is most people live in apartment blocks, so they do not have roofs for their own areas. There is a huge problem with infrastructure as to how you retrofit solutions and one size doesn't fit all is the basic answer. I think there is an issue around assuming that you can take just one technology, like heat pumps, and suddenly all of your problems in heating are solved, which is probably not the case.

Q388 Christopher Pincher: Do you think that not just changing infrastructure but changing people by giving them more information through smart metering, for example, or through alternative and more attractive tariffs is a way of reducing heating CO_2 emissions?

Duncan Botting: I think all of the demonstrations that have been done so far have been quite short term in duration, but those that have gone on further than the normal sort of three-month trial period have indicated that people sort of get fed up with the novelty factor and their traits and their behavioural activities kick back in. There is a certain amount you can do about behavioural change and the way that you can deliver information for people to make decisions. One example I tend to give is, in the smart metering domain, we are giving people in-house displays to understand what their energy consumption is. If we had done the same in the automobile, with the energy management system that we now have under the bonnet, we would have a head-up display on the windscreen with so much information that the driver would not be able to see the road. The difference between the two is one is effectively automated and the other is requiring people to interact in a way that you would hope will deliver the outcome.

Q389 Christopher Pincher: So people are recidivists, they get bored with smart metering, and properties are all different, so changing the infrastructure is challenging and complex. Where have your research and your thoughts landed in respect of reducing emissions?

Professor Kemp: Well, there is one very politically unacceptable thing to say, probably, which is to make energy as a whole horrendously expensive and then it will encourage a lot of behaviours, rather different behaviours. If you think of energy as not just something that, "Oh, it is nice to save it because it probably helps the planet", but something that, "It makes a real hole in your budget if you don't", it would encourage a set of very different behaviours. But that, of course, would bring rather different problems with it.

This again is one of those questions where there is not an answer that says, "This is the solution for everything". It will involve improving the physical condition of the buildings, in particular insulation. It will involve changing to heat pumps, electric heating, where it is sensible and where it is a building with the right type of local environment to do it and also where there is lifestyle, because heat pumps are fine as long as you want a steady background heat all day. Someone like me who is in perhaps for a few hours at night and my wife is out working during the day as well, we come in and we want the heating on, we turn it off again the next morning, and we go out. The heat pump would not suit that lifestyle particularly well.

It depends very much on where you are, what you are doing as to what makes sense and the big challenge is to get heating engineers who are genuine engineers, not basically plumbers with a relabelled van, who can look sensibly at buildings and say, "This is the right solution for this particular building". I think that is going to be one of the really big challenges.

Dr Harrison: I think it is going to be a huge challenge; but then also, at local authority level, at city level, it is about having engineering capacity to think about what the problems and opportunities are and how to enable action at that level to make the difference that is needed. At the moment there is really hardly any capacity to do that, with very few shining exceptions. The well-known example in Woking is one of them.

Duncan Botting: In terms of answering your question, "What will we do", I think the key is that it is a portfolio approach and there is a prioritisation

of portfolio activity that you can do. The biggest-win solutions would start at the top, trailing down to the less short-term type activity, and for the majority of issues, we are talking about not new build, but retrofit. Therefore, one of the key aspects that we need to understand in the learning-by-doing piece is how do we do the retrofit rapidly and the cost-effective element. That is where I think some of the things like Smart Cities initiatives will start to pay off because we will start to be learning by doing very rapidly.

Q390 Christopher Pincher: What are your top three wins? Is Smart Cities one of them?

Duncan Botting: Smart Cities is certainly going to drive economies of scale because there is a very concentrated effort in a very small space basically. Also manufacturers and industry will be coming together to look at how they can drive down costs if they are solutions that are winners. Whether you have district heating, CHP, micro-CHP, heat pumps—all these are detail issues, but that is where the problem is. It is not in the big picture issue.

Q391 Christopher Pincher: So accepting that these are complex but also accepting that, as part of our drive to decarbonise heat, we all have to shift in some degree to using electricity, does that present any energy security implications for us; that greater reliance on electricity or the shift away from carbon heating?

Duncan Botting: I think we are almost moving on to the distributive energy discussion here, because the energy security and energy reliance has mainly been focused on centralised generation with large-scale transmission and distribution. I think we will be moving towards now an environment where embedded generation that is distributed will play a part in local balancing and local supply and demand activities. So we will have a hybrid system that has both centralised and distributed architectures sitting within this, which could improve resilience because you are no longer dependent on one single source of centralised sort of delivery and if your one or two lines break then you lose a lot of people.

Q392 Christopher Pincher: But in terms of international energy security, we will be relying on more gas or more oil, both of which we import more of.

Dr Harrison: Well, that will depend on your mix. If you were to move to essentially an electric world with electric transport and electric heating, then essentially you are substituting gas and oil for something else. What that something else was would need to be thought about, but I would have thought that nuclear would play a role in it; coal with CCS would play a role in it; gas with CCS would probably play a role in it and more renewables. You are kind of shifting the problem. You are getting a bit less dependent on Libya and Iraq and suchlike, but you are potentially becoming more dependent on having an energy system that is very well integrated and controlled so that you can manage all these very complex balances between demand and supply that would then result.

Chair: Just exploring "distributed" a bit further, Alan.

Q393 Dr Whitehead: Yes, the answers this morning are leading very handily into the questions. On the question of distributed and community-style generation—you have touched on both—we have discussed the question of the potential security benefits of distributed energy in terms of giving a wider number of sources. But what are the particular risks and problems associated with a much larger amount of distributed energy, particularly electricity, coming forward? Obviously some of them relate to the question of how you balance that locally, but what sort of system and how secure might it be where you are balancing locally and/or managing, as it were, supplies on occasion from that distributed energy on to the grid? How secure might that look and what particular issues would relate to the development on a wide scale of that sort of energy economy?

Duncan Botting: I think you have hit it on the nail in that there is a chicken and egg problem here. The resilience of distributed architecture is only there once you have a lot of things in place at the same time. Therefore, the work that has to go on for the distribution grid to be able to support the embedded generation and the way that it interacts to the transmission grid as well, in terms of its balancing act that it is now doing, requires the grid, which is basically not designed to work like this at the moment, to transition into a different mode. You can't do this overnight. It is not possible to do overnight, but the more that we invest in sort of the centralised model, the more inertia we have for thinking that the only way for cost-effective delivery is to put more effort into a centralised model. So the chicken and the egg is when do you invest what seems like a stranded asset in terms of the distribution architecture, but leads to a situation that we know well from the web, where people find hugely creative different ways of utilising that once the infrastructure is in place. But we would never have based our business models on that as a benefit before the event.

There is a real issue around the prioritisation of how we see benefits being delivered, and the business models have to change to allow a cost-effective delivery of the distributed architecture that you are referring to. If we do not do that, we will continue to have a top-down approach of centralised transmission and distribution and what we will have is a range of problems that become larger and larger for the central control system in terms of the way it is able to manage the entirety of the problem. Not only that, the resilience gets worse as you increase in size; one big thing, if that goes down, you lose possibly the whole country. In a distributed architecture, you may only lose a small community.

Q394 Dr Whitehead: But the implication of what you are saying is that the development of a distributed energy system or a grid system that could manage a large amount of distributed energy is essentially a public good and may well not be invested in by those people who might benefit and use that system. Therefore, other considerations might come to the fore about how that may be developed; for example, the two-waying of district networks is not an obvious

point of heavy investment for those people that are likely to invest in the system currently. Is that a fair—

Duncan Botting: Yes. I find it quite strange that we are comfortable to assist and promote generation technologies that would not happen unless we gave incentives and capabilities to deliver, but we do not seem happy to do the same in relation to the very system that we require for getting that generation to the end users or vice versa.

Dr Harrison: I think there are signs of progress. You know, we have the Low Carbon Network Fund, as Duncan mentioned, and that is causing some of the exploratory work to now be done, at least by the more progressive distribution companies. I think it is also significant that Ofgem, the regulator, has moved quite a long way in terms of its thinking about the future. But, culturally, Ofgem is uncomfortable with pre-investment in assets whose short-term use is not clear, and the trouble with this is you have to do quite a lot of that to enable everything else to happen.

Q395 Dr Whitehead: One of the things that has been said about distributed generation is that it hides demand from the central grid system and, therefore, reduces overall demand within the system. A report recently from National Grid about system resilience in 2020 looked at what the overall demand in the system might look like if you have a combination of interconnectors, distributed energy and indeed some storage. It seemed to suggest that that would cause a substantially lower amount of future capacity to be needed to be built into the system by a factor of about 15%. Is that something that, overall, you would consider would lead to greater energy security? Alternatively, is it something that, as you have said earlier, would require such a lot of initial engineering as to be rather difficult to achieve, so for greater energy security we might as well carry on building large amounts of additional power stations that will not run very often but at least we will know they are there should we start worrying on a cold winter evening?

Duncan Botting: I think you are absolutely right. I think the report you refer to was a good piece of work and it indicates that, again, it is a systems approach that is paying the dividends. Unless you have the interconnection, unless you have the distributive architecture, unless you have the ability to play with different portfolio mixes of generation, it is impossible to deliver the benefits in terms of the reduction of capital expenditure that you would need otherwise, but no one company has that ability to put that in their business case. They can't take it to the board and say, "These are all our benefits".

Chair: Thank you very much. I should remind the Committee and the witnesses of my entry in the Register of Members' Interests as a shareholder in Shell, which has been relevant to this inquiry. But I would like to thank you for your evidence and the joined-up nature of the evidence that you gave us, which is most helpful.

Examination of Witnesses

Witnesses: **Anne-Sophie Corbeau**, Senior Gas Expert, International Energy Agency, **Katinka Barysch**, Deputy Director, Centre for European Reform, **Brigadier (rtd) Tony Ling CBE**, Director, LPD Strategic Risk Ltd, and **Peter Kaznacheev**, Managing Partner, Khaznah Strategies Ltd, gave evidence.

Q396 Chair: Thank you very much for agreeing to give evidence to us today. For the record, could you introduce yourselves with your names and positions, starting with Ms Barysch?

Katinka Barysch: Katinka Barysch.

Brigadier Ling: I am Tony Ling of LPD Strategic Risk.

Anne-Sophie Corbeau: Anne-Sophie Corbeau from the IEA.

Peter Kaznacheev: I am Peter Kaznacheev, Khaznah Strategies.

Chair: Maybe we could start on questions on the EU and energy security, particularly if you have to leave quite soon.

Katinka Barysch: I have until 12 pm.

Q397 Chair: To what extent do you think the UK's energy security is all tied up with EU energy security?

Katinka Barysch: Sorry, I didn't hear that.

Chair: How tied up is the UK's future energy security with that of the EU?

Katinka Barysch: Inasmuch as we are building an integrated European energy market, of course the United Kingdom has a big stake in the EU succeeding. Also, if you look around the world, where energy security challenges come from emerging markets and unstable regions, of course these are challenges that would be much easier addressed as part of a European Union rather than 27 small or mid-sized countries all trying to achieve their own global energy security goals.

Q398 Chair: Are there any other views on that?

Anne-Sophie Corbeau: I am going to stick to the gas markets because I am a senior gas analyst. I think you can't look at the UK or Europe alone. The UK imports gas during the winter in order to meet its peak demand and during the summer it is exporting gas. Because there is a lot of gas coming from Norway and because of importing LNG, the United Kingdom has effectively become a transit country for gas to the wider Continental European market. So you have to look at both together.

Q399 Chair: How does the EU approach energy security? Does it have a—

Brigadier Ling: At the moment it is a little siloed, but efforts are beginning to be put out. There is a European committee and a thematic network on critical national infrastructure. It has only met a couple of times, but there is a realisation at this stage that there is a threat and I think that is the first thing,

the most important. There are still issues on having a collective European risk assessment right across the board and also the challenge of international inter-country cross-border interoperability of security systems so that a threat in one country can be recognised and picked up electronically in another. So we have a bit of a way to go as far as Europe is concerned.

NATO has a pipeline security planning committee. It is beginning to take a real interest and later on this year NATO is planning some desktop exercises that will allow representatives from all the countries to play out various scenarios and I think this is a move forward. OSCE is also now doing some work here and there was a recent conference in Vienna to try and understand different countries' views and where they see the risk. So, in summary, a long way to go but at least the various organisations are beginning to grasp that there is a problem that has to be managed.

Q400 Chair: We will come a bit more on to pipelines, but I just wondered, in terms of the way the EU is going, how the Lisbon Treaty feeds in. Does it help or hinder this more strategic view?

Katinka Barysch: Let me perhaps take a step back. Until the Lisbon Treaty, the EU did not have any original competence in energy. So its energy policy was more a patchwork of derived competencies from other fields, most notably the single market, which is where the EU energy policy originated. The objective of a single energy market was to deliver secure and cheap energy to consumers and to give them choice. The other energy objectives, climate change objectives and the energy security field were only tacked on relatively recently, so this is a new policy field. It is now only with the Lisbon Treaty that there is some original competence. Now, the Lisbon Treaty is still in the implementation phase and especially when it comes to two areas, the common foreign policy, the establishment of the European External Action Service, and the idea that various European policy fields should be integrated, which is a big part of the Lisbon Treaty. These are still very much in the implementation phase, so it is far too early for me to say whether this is going to work.

Energy security for the European Union until now has mainly meant gas security because oil is a tangible commodity. Yes, we had some problems with cascading power outages in the European Union; but our big formative experiences were the gas crises of 2006 and 2009 where, all of a sudden, we realised that we are dependent on each other and that we couldn't help each other as much as we wanted to because the physical interconnectors between national markets just weren't there. This is where the energy security agenda really took a big step forward because solidarity became very loud.

What you are seeing at the moment is that the European Union is still driving that agenda. This is very much a twofold agenda: firstly, the resilience of the internal European gas market through interconnections, through new storage capacities, through the new energy security, gas security regulations, which sets a new standard, and secondly, the diversification agenda where you see the European Union for the first time trying to pursue something like an energy foreign policy. Nabucco is a big part of that endeavour, but obviously not the only part.

The risk here is that the European Union is trying to address yesterday's problems. Because the fundamentals of the global gas market have changed, the European Union is in a very different position vis-à-vis its main suppliers than it was a few years ago. So, again, a rapid rethinking would be necessary here, but on the basis of a policy that is still very much at the formative stages.

Q401 Chair: Do you have a view on that?

Anne-Sophie Corbeau: I think I would share your views, indeed. I would add that, in terms of gas security, one crucial element is information and the data. Honestly, when it comes to the OECD countries, we have good information in terms of supply, demand, import and so on, but, in terms of non-OECD countries, we are blind. We have no monthly data. We have annual data one year later or an estimate. When you are looking at the global energy market and looking at the fact that we have a lot of non-OECD countries that are becoming LNG importers, this is causing a problem. In terms of energy export, we have no idea. Even Australia, which is an OECD country, has relatively poor data in terms of LNG exports. But now we have three Latin American countries, two Middle East countries, we have China importing LNG—information from China you can get back from special requests—you have also India and you are going to get a bunch of South Asian countries that are going to become LNG importers. So the market is changing very fast and information is really crucial and we don't have the same quality of information that is available for the whole market.

Q402 Chair: Just one more on the Lisbon Treaty. How much are we out of phase 2? The Lisbon Treaty was about also introducing more market-based approaches and the UK had gone ahead with a much more market-based approach than the rest of the EU. Now there is an attempt to open up the rest of the EU market. How much does that now maybe contradict trying to take big strategic decisions?

Katinka Barysch: That is the big question and I don't have an answer for you, but this is exactly the right question because we are still pursuing a market-based approach and the Commission, until recently, argued quite happily that a single European energy market would help us to fulfil the other two goals in terms of climate change and energy security as well. It has now transpired, for example, that just by unbundling and national liberalisation of energy markets, we ended up with a virtual energy market, but the physical interconnections between markets that we require for European markets simply didn't get built. So here the Commission is now changing tack and taking a more industrial policy approach, putting together the system operators to these new bodies and trying to work them out, where strategic pieces of infrastructure are needed for the European market that perhaps market incentives alone would not finance.

So you have two, in many ways, conflicting policy trends here at the moment and, to my mind, that is the

big debate at the moment in Europe. The question is asked whether the European Commission, by making top-down decisions or trying to enforce top-down decisions, is locking in the wrong decisions and the energy companies are obviously very much against the EU playing too big a role in infrastructure; the EU playing too big a role also in energy foreign policy. You see the debate surrounding the Caspian Development Corporation. The EU suggested that European companies should set up a buying consortium to make us look more interesting to Turkmen and other gas suppliers. This is something that the energy industry has not welcomed at all. So that is an ongoing battle.

Q403 Christopher Pincher: I would like to focus particularly on the issue of pipelines and I should say I am a member of the all-party parliamentary group on Azerbaijan. There are a number of important energy projects going on in Europe at the moment and three particularly important gas pipelines. First, the South Stream pipeline, which Alexey Miller of Gazprom has described as "an incipient construction"; secondly, the Nabucco pipeline that you have also mentioned, which I think was announced a couple of weeks ago as being now two years beyond the completion time; and, thirdly, North Stream, which is much closer to completion. I wonder what your views are on those three pipelines and their importance to the UK's energy security.

Peter Kaznacheev: I think generally the importance of pipelines has been exaggerated. We are in the age when pipeline transportation of gas is becoming less significant due to LNG. I think that I would agree with the previous comments of Ms Barysch about the EU fighting yesterday's battles, in a sense. I think that Russia, in its attempts to persist about some pipeline projects, especially South Stream, is also fighting yesterday's battles. I call it a chicken game, where Russia is trying to see whether the EU and the consortium of countries in the Nabucco project would call it off and, if it does, then Russia can, with dignity, do the same because it is not in Russia's interests. Anyway, whichever way you look at it, I don't think it is in Russia's interests to pursue the South Stream project. I have my doubts as well about the Nabucco project, due to the greater importance of LNG in Europe and the increase of shale gas capacity. I think, in terms of costs, clearly we have seen that LNG has an advantage in terms of diversification as well. So I think a lot of the pipeline projects of the pre-crisis era, the pre-LNG and the pre-shale gas era will be reviewed by both sides.

Q404 Christopher Pincher: If I can ask you then, do you think it has a different implication for European Union energy security as opposed to UK energy security? The EU has, I think, three major suppliers. They are Russia, Algeria and Norway, in that order of supply. Now, would Nabucco, for example, have an implication for Europe's energy security that would be beneficial because it would diversify the supply mechanism?

Peter Kaznacheev: I would hate to be provocative, but I would say that Europe is already terribly secure in terms of its energy suppliers because if you look at the situation, let us say, 20 or 25 years ago, 70% of Europe's imports of gas were from the former Soviet Union. Today it is only 40%, and I would argue, from everything that we have seen, Europe's dependence on Russia's gas will decline, not increase, for a variety of reasons that I already mentioned, LNG and so on. So I think that Europe is quite secure in terms of becoming more diverse and the development of the spot market will do further good to Europe. If you are asking me about the UK, I would say that, first of all, the UK is not dependent on Russian gas in practical matters, if you look at percentages. It does import some gas, but not much, and it comes from Norway. So the same concerns that apply to Russia, in Eastern Europe and Central Europe and so on, are not really relevant to the UK. So I think that, frankly, the discussions about the pipeline or pipelines are not really of great relevance to the United Kingdom.

Katinka Barysch: May I present a slightly different view here? The EU as such, of course, does not have a diversification problem, but there are some Member States that are 100% dependent on one single energy company and that is Gazprom. Even if that company wasn't a Russian state-controlled monopoly but a Swiss energy company, I would be very concerned to get all my gas from just one single company. What Nabucco would do is it would single-handedly reduce the—because Nabucco goes through the Central and East European countries that are most dependent on Russia and, because of the dependence, are blackmailable and because of that ability of Russia to blackmail these countries and to play shenanigans in their energy market, it is creating so much division within the European Union. If Nabucco gets built, it feeds into those energy markets.

Also, unbundling is meaningless in an energy market where you only have one supplier. For the first time, you would have something resembling gas trading in these countries because Nabucco is planned in a way that it has lots of entry and exit points and it is reversible in its flows. It would increase the energy security of those countries that need it most. Of course, the United Kingdom will be a bigger gas exporter in the future, but let me make one point about the UK's approach to European energy policy. What perhaps does not work so well is British Ministers turning up in Brussels and just pursuing one single agenda, which is that of market liberalisation. Occasionally, it would help if British Ministers—and they have done that increasingly now in recent times—speak also in the interests of their European partners. What countries such as Poland or Bulgaria or Slovakia care about is to reduce their dependence on Russia and they are increasingly also willing to make their own investments in that.

So it is right that the UK supports the Nabucco project, as it does. At the moment Nabucco, as you mentioned, does not make much progress. This is to be expected in an environment where we have almost unprecedented uncertainty about the trends in European gas demand. Nabucco, as an empty piece of infrastructure, was always going to be extremely difficult to get off the ground. But I see Nabucco almost as a public good because it would really

address the heart of the European energy security problem. Although it will only ship in 5% of total European gas demand, it would reduce the vulnerability of those countries that need it most.

Anne-Sophie Corbeau: Can I offer a slightly different perspective again? I think that, first of all, when you are looking at volumes and when you are looking at future imports, there is already a lot of pipeline infrastructure. But I would agree with Ms Barysch on the fact that there is a clear east and west division that was very apparent when we had the disruption of gas supplies in 2009. Why? In Western Europe you had almost no problem and in France you could really well manage; whereas the UK noticed that markets were functioning very well indeed because you saw your storage depleting very fast, but that was just a sign that markets were working very well because the pricing signal was directing gas towards Europe.

But in Eastern European countries, some customers were disrupted. Some people did not have gas for heating in Bulgaria, for example. This is where the lack of interconnection between the different markets became very apparent and, on top of that, the lack of the possibility to reverse the pipeline flow. It is possible, but people had never done that. In order to reverse the gas flow, for example, from Germany to the Czech Republic and then to Slovakia, it took them about 15 days. The same thing from Greece, which was able to import some LNG towards Bulgaria; it took them some two weeks in order to get the contract in place. So it is a question of having the agreement in place and having also the infrastructure and the knowledge on how to reverse the pipeline flows. So that is one point.

In terms of the three pipelines that you have mentioned, North Stream is already pretty much there: it is going to arrive at the end of this year. It is going certainly to provide more capacity towards Northern Europe. Whether it is providing more gas, this is still the question mark. Are we going to see the gas that is currently flowing through Poland for the Czech Republic and Slovakia reported on North Stream or are we getting additional volumes? That is the key question and when you are looking at the transit contracts for Slovakia, it is an open question mark because we foresee a decrease of the transit volumes for Slovakia and the Czech Republic. So it is not certain at first stage that we will get additional gas from North Stream.

When you are looking at South Stream, yes, South Stream has been in competition with Nabucco for quite a long time; I mean, 63 bcm. That is quite interesting because when you are adding up the capacity of North Stream and South Stream, you are getting exactly the capacity of transit for Ukraine, so I will let you draw the conclusions.

Q405 Christopher Pincher: Do you think that North Stream has the capacity to segment the gas market east and west, so you have western provision going through North Stream, but Russia could then have much more control of imports over its southern neighbours?

Anne-Sophie Corbeau: North Stream is really dedicated to the northern part. It is meant to supply Germany, but there are also some pipelines being built towards the Czech Republic and also, of course, towards all the Western European markets. When you are looking at the companies that have signed long-term contracts to use the gas from North Stream, these are essentially Western European companies. South Stream is a much different issue and a much different problem, but I would like to go to Nabucco because it is very curious that people tend to focus on "Nabucco, Nabucco, Nabucco".

Nabucco is not the only pipeline in the southern corridor. There are other pipelines as well that are under discussion. The difference between Nabucco and these other pipelines is that these pipelines start from Turkey. This is, for example, the Trans-Adriatic pipeline and also the ITGI, part of which is already built. The part from Turkey to Greece is already built. We need to add the second part from Greece to Italy. These three pipelines are looking at exactly the same sort of supply: Azeri gas. Shah Deniz Phase II, which is the first stage of incremental Caspian gas supply, will now arrive by 2017. The amount of gas that is foreseen will be enough to feed either TAP or ITGI, but will not be able to meet the total feed capacity of Nabucco, which at the maximum will be 25 or even 31 bcm. So for the big Nabucco, not for the first stages—you need additional gas. It has been the same problem for the past, what, 6 years.

Q406 Christopher Pincher: So you say there are other pipelines in the vicinity. Mr Kaznacheev has made his view fairly clear, I think.

Anne-Sophie Corbeau: Sorry, I have difficulties to hear you.

Christopher Pincher: Sorry, I will speak up. I think Mr Kaznacheev has made his point fairly clear that Nabucco and other pipelines are unnecessary. Do you think that Nabucco is going to be built?

Peter Kaznacheev: I personally think it won't, if you ask me. I agree with Ms Corbeau with regards to the other alternative pipelines. I think that in the pipeline world, especially today, small is beautiful. The shorter pipelines are cheaper. Gas can be redirected one way or another. They can be adjusted to carry LNG gas and so on and so forth. So the grand projects of the pre-crisis era and the pre-LNG era such as Nabucco and South Stream are really a relic of the past, I think, and neither of them will go ahead.

North Stream, if you ask me, well, it is going ahead; but whether it is a good idea for Russia, for example, I would say definitely not. That was a big mistake to build this pipeline, because all it will do is it will redirect the same volumes of gas. Think about it, because as Ms Corbeau said, there is unlikely to be an increase of overall gas export from Russia for one simple reason: Russia doesn't have the capacity. So it will transport the same gas, just via a different route. What good does it do to Russia, or Europe for that matter? Strategically, nothing. Instead, Russia should have focused on catching up with the rest of the world and developing LNG, and yes, pipelines to China; both things that they are busy doing right now, but it is a bit too late.

Anne-Sophie Corbeau: Can I just continue on Nabucco and the suppliers because I think it is quite

important, also from the perspective of the suppliers. Originally there had been a lot of sources talked about regarding Nabucco. Azeri has always been the first source. Then we have been seeing Iraq, which is very challenging and honestly, looking at Iraq, the gas is going to go first to the domestic market. Then Turkmenistan; I am sorry to say Turkmenistan gas is going east to China. While Europe was discussing in committees the possibility to get Turkmen gas, in 2009—in three years; the agreement was signed in 2006—the Chinese had 7,000 kilometres of pipeline up and running, which is being expanded. The Chinese signed two transit agreements for Uzbekistan and Kazakhstan. They built the whole pipeline. They had the agreement with Turkmenistan and, of course, they have provided some money, because one thing is very important when you are talking to Turkmenistan—I was there two years ago and discussing with the Minister—is that you bring the pipeline to the border. This is why the CDC and building the trans-Caspian route is so important. When looking at all the sources of supply for Nabucco, there is Iran, but Iran, again, is a net importer; so it is not going to be so easy.

Q407 Christopher Pincher: So your view is that the pipelines are going to be built eastwards but Nabucco is not going to be built? Is that your view?

Anne-Sophie Corbeau: I would have more confidence in ITGI or TAP getting some gas because they are smaller. The problem for Nabucco is that it is a big pipeline and you need to find enough gas; otherwise, from the Azerbaijan point of view, we are going to support the first construction costs of the small Nabucco—let us say 8 to 16 bcm—and we have enough gas to feed that pipeline. Then the expansion, which costs nothing, is going to benefit the other suppliers, but the initial costs are going to be borne by Azeri and this is not something that we are keen to see.

Katinka Barysch: The Shah Deniz consortium hope to have offers from all three southern corridor pipelines by October so then we should know more. Nabucco is much further ahead in its regulatory stages. It is the only one of these pipelines that has an inter-governmental agreement, which is a very important step. TAP has the problem that it is currently planned to go through Albania and not everybody who was involved in the pipeline is happy with this. Also, in terms of its regulatory development, it is the furthest behind. ITGI has, of course, made some progress but the problem with ITGI is it is not easily scalable.

This is the first link between the European Union gas market, which is massive, and Caspian gas and you want that link to be scalable because otherwise the producers in those areas will never take us seriously. The Turkmen are always signalling to the European Union, "Why don't you become a bit more like the Chinese? Build that pipeline, offer us a massive supply contract, throw in a strategic partnership, build some hospitals and provide the finance", which is what the Chinese did in one big package.

Now, the European Union obviously does not work that way. But the Turkmen have become a bit more conciliatory lately because they are not particularly happy with the energy partnership they have with the Chinese at the moment. Firstly, that pipeline is running far, far below capacity because China is not buying as much gas as the Turkmen were hoping. Secondly, the Chinese are even tougher customers than the Russians when it comes to price negotiations. The Turkmen had the very real experience that their energy relationship with Russia improved massively as soon as they had an alternative buyer for their gas and they were no longer 100% dependent on just one outlet for their gas exports.

They would now very much like to have even more flexibility in their energy relationships. So they are signalling to the Europeans that they would be willing to look at a European gas outlet. But if we are dithering and we say, "This is never going to come to anything and the trans-Caspian problem is so difficult and we are just going to build a very small pipeline", then, of course, the Turkmen will not make the political investment that would be necessary to get a trans-Caspian link built because this is something that would leave the Russians very unhappy. I am not saying the Turkmen will always be unwilling to do that but they will obviously not make that political investment for a—

Q408 Christopher Pincher: So your view, unlike Mr Kaznacheev, is that big is beautiful, as opposed to small is beautiful, with respect to Nabucco?

Katinka Barysch: Scalable is something that would convince me. The problem with ITGI, I understand, is that it is not that easily scalable.

Christopher Pincher: Shall I just finish with one last question, Mr Chairman? We have talked a bit about Nabucco and South Stream, but the biggest supplier to the UK is Norway. I wonder how Norway fits into the gas supply picture. Do you see any issues for Britain with supply from Norway?

Chair: No views.

Q409 Dr Whitehead: We have concentrated on gas supply and gas pipelines across Europe and also the UK. Are there, to any degree, similar issues relating to European electricity interconnectors? I appreciate it is quite a different landscape and does not relate to Russia and so on, but the extent to which European electricity interconnection leads to greater European energy security and the extent to which the relative absence of electricity interconnection as far as the UK and other European countries is concerned perhaps leads to less energy security as far as the UK electricity supply is concerned. Do you have either information or thoughts on the extent of what we hear generally is a relatively high degree of interconnection between most European countries and what sort of electricity interconnection might look comparable as far as the UK is concerned, or is that not an issue?

Katinka Barysch: Is everybody looking at me? Okay. The electricity infrastructure challenge—and I am not an expert here, so I am going to give you just an observer's view—seems to me, in a way, much more complex than the gas challenge because there is the issue of security of supply, but there is perhaps the much bigger issues of integrating renewables on a

massive scale into the European grid. These two issues together present a very, very complex infrastructure challenge where renewables are obviously often generated in places that are very far from demand centres and where you will, of course, have to have more international interconnections; for example, to get North Sea wind power or Mediterranean solar power into core European markets. So I think, on the one hand, these international lines will increase energy security but, on the other hand, I also see them as a challenge because the European market will become much more complex and much more integrated and you will really have to ask a power specialist how the resilience of such a massive grid would have to be improved.

Q410 Albert Owen: You have dealt with most of the points that I wanted to ask about. Between you, you paint a very worrying scenario for energy security for the UK, but I will try and unpick it. First of all, we heard that there is no need for the pipelines from Russia and so on because we are getting LNG from other sources, but those sources are not very stable at the moment. We see issues in the Middle East and North Africa and then you were stumped when my colleague Christopher asked about Norway. But if Russia turns off the gas and if the situation in the Middle East and North Africa is as it is, then we are very reliant on Norwegian gas. Doesn't that put us in a very difficult position for energy security, those pipeline failures?

Anne-Sophie Corbeau: One thing I did not agree about with Mr Kaznacheev is that, yes there is plenty of LNG around. Yes, for the moment we are very fortunate that there is plenty of LNG around and the UK benefited a lot from the recent increase in capacity. We saw 25% increase in LNG trade last year; never seen and don't expect to see it again. Now where is your LNG going to come from? Australia. There were six final investment decisions taken over the past two years; four in Australia, one in Indonesia and one in Papua New Guinea. So they are all in the same area; far, far away from the UK and from Europe in general. Where are they going? India, China and Japan, because Japan needs to replace its existing contracts. What few people have realised is that Japan currently imports a lot of gas from Indonesia, Malaysia and Brunei. These LNG supplies are going to go down because in these countries domestic demand is growing so fast that it is, "Domestic demand first and then we export what we can". So Japanese people and companies in general have been anticipating these declines of their traditional supplies by securing additional supplies from new markets and this is Australia. Additionally came Fukushima. We have recently done medium-term forecasts for supply and demand in the world and it is showing that, between Japan, China, Asia-Pacific, a few bcm going to the Middle East, Latin America and so on, there is less LNG going to Europe by 2016.

Peter Kaznacheev: Less LNG?

Anne-Sophie Corbeau: Less LNG.

Peter Kaznacheev: How is that possible? You just said Australia is coming on stream in terms of LNG. Australia is expected to become the biggest producer of LNG.

Anne-Sophie Corbeau: No, not the biggest.

Peter Kaznacheev: In the forecast that I saw it is surpassing Qatar at some point in the future.

Anne-Sophie Corbeau: 2020.

Peter **Kaznacheev:** All right. But, nonetheless, there is more LNG. The US, after the shale-gas revolution, needs far less LNG than it used to. So there is spare capacity there as well and there is Russia. It is very slowly developing, yes, but still a great potential for LNG and it is now emphasising that.

Anne-Sophie Corbeau: There is great potential but not in the medium term.

Q411 Albert Owen: Can I interject? I am sure you can have this conversation in another place and at another time. It is an important one, but I just want to get back to the energy security of the United Kingdom, the principal thing, and the links to Russia. You have dealt with most of the issues but with Russia, which has a very big land mass, if its domestic market was to increase, does that present a threat to the United Kingdom and energy security?

Peter Kaznacheev: The United Kingdom does not buy much Russian gas, so I do not see how it could possibly present—

Q412 Albert Owen: It is important in the winter period for us. It is our capacity—

Peter Kaznacheev: Marginally. I think the emergence of LNG, which we have discussed, can easily offset that risk. Again, the Russian domestic market is not liberalised. Gazprom is still reliant on exports to Europe and it is going to last for quite a while. I would say the essential thing is that I think there is a misunderstanding. In reality Russia is far more dependent on Europe as its customer than Europe, and specifically the United Kingdom, is dependent on Russia. So we are looking really at a very unequal relationship here where Russia has great problems: undeveloped LNG, lack of pipeline to China, all the things that I mentioned and more; illiberalised local market; all those problems for Gazprom, but not for Europe.

Katinka Barysch: I would venture that if there was another gas crisis of the magnitude of 2009 that the UK might well be affected. There is still very limited gas storage in this country. What we saw in the gas crisis is that price signals did not work—usually what you would expect in the market is that gas flows when prices are high. We did not have the physical interconnectors; since the market signals were not working properly, countries were holding on to their gas. Unless there is real progress and we are seeing progress towards a European gas market, it might well be that the UK would be affected if there was another Russian crisis. But, as I said, the new gas security regulation is a priority for the European Union at the moment. They are driving the interconnector issue. I totally agree with you that Russia is trying to adjust

to the new realities. Russia has realised that it has not done itself a favour through the Ukrainian gas crisis, so it will probably do its utmost to avoid another disruption of that magnitude. But still there is a strong case to be made to drive the European gas market forward for security reasons and that does include, to my mind, the United Kingdom.

Q413 Chair: Brigadier Ling, do you have a view on this?

Brigadier Ling: It is much easier to protect a pipeline coming from, more or less, our backyard than it would be for LNG being carried through troubled waters. That is assuming that the security exposure remains about the same. The security success of BTC and SCP shows that this can be done with goodwill between Governments and proper consultation.

Q414 Dr Whitehead: On the subject of LNG, indeed we have seen the successful emergence of LNG and the potential of the US exporting shale gas rather than being a net importer in the future, which then leads to the question of the six world choke points as far as oil and LNG flows are concerned. Roughly speaking those are Hormuz, Malacca, Suez, Bab el-Mandab, Bosphorus—no alternative to going through the Bosphorus—Panama Canal, obviously, not fit for purpose you might say. So to what extent are those choke points likely to constitute any sort of major issue for UK energy security in the future?

Anne-Sophie Corbeau: If I may start, I think Qatar is one of your main suppliers, so if Qatar is disrupted then everybody in the world is in trouble because right now about one quarter of total LNG capacity is located in Qatar. So because we also have some markets such as Japan and Korea that have no other option to importing LNG, the world will be in trouble and some countries will be extremely stressed. I have never done a scenario where you will not have Qatar any more but, honestly, that would be extremely difficult to replace.

The second potential difficulty for the UK would be the Suez Canal. We looked at that at the IEA because, when there were the events in Egypt, we were looking at the fact that that is about 40 billion cubic meters transiting through the Suez Canal, mostly coming from Qatar and going to Europe. So that could be an additional issue. It is not the fact that the gas would not eventually come to Europe. It is more the fact that it would take about 15 more days to arrive in Europe. Knowing that the current costs for LNG shippers are about, I think, $100,000 per day, that means some additional cost and, because there is also some tightness in terms of shipping, there would be a pressure on prices. So that will be more a pricing issue than a tightness issue.

Q415 Dr Whitehead: Presumably if at any one stage one choke point is choked, as it were, then that is a pricing issue. More than one, presumably, is a different dimension?

Anne-Sophie Corbeau: Yes.

Q416 Dr Whitehead: I know this is getting us into apocalyptic territory, but your view is that a disruption in one choke point would not unbalance world energy flows to such an extent to provide a security issue but might provide a price issue.

Anne-Sophie Corbeau: Disruption in Qatar would definitely create a lot of stress in the current market situation because it would be extremely difficult to replace all that gas. This is about 100 billion cubic metres. This is only 3% of total world consumption, but it is about 25% of total LNG trade. So this is extremely important. That would be difficult to replace, even with Russian gas, Norwegian gas and so on at a maximum. Disruption through the Suez Canal would be easier to manage but would have a price impact.

Q417 Dr Whitehead: But, as we say, there are pipelines everywhere. There are pipelines across Saudi Arabia, for example.

Anne-Sophie Corbeau: You need time in order to build pipelines. We hope that by the time the issue arises with Qatar—I mean there is the Bosphorus Strait—we would find a diplomatic solution in the world other than to have to build a pipeline, which takes a few years.

Peter Kaznacheev: Can I ask a question? Do you think that the disruption of a pipeline would be more dangerous or less dangerous than disruption of one LNG source of equal magnitude?

Anne-Sophie Corbeau: It depends which market you are looking at.

Peter Kaznacheev: But in my view LNG at least provides flexibility. If you import LNG you can switch whereas if you import through a pipeline, clearly you cannot switch right away. So it is a different magnitude of security risk.

Anne-Sophie Corbeau: If you are Japan it is a bit difficult to switch. You can definitely not switch to pipeline for the moment and, because there is not that much spare LNG capacity available, you would need to import more LNG from other sources which will then deplete—we are having a private conversation again. I am sorry.

Q418 Chair: Shall we bring in Brigadier Ling?

Brigadier Ling: It is probably worth mentioning about issues of prevention and trying to keep choke points open; clearly the first thing is good intelligence and good diplomacy but also a deterrent from a collective, NATO or whatever, organisation would be suitable. As far as the Straits of Hormuz are concerned, the most important thing is to develop redundancy, I would have thought. There are thoughts about not just Qatar gas but Saudi oil being able to be taken directly to the Red Sea; also Iraqi oil and gas going through Jordan. They are all points for the future; redundancy and resilience. The other aspect on the choke points and I don't know whether you want to touch on piracy in a moment, is the bottom end of the Red Sea and Bab el-Mandab.

Q419 Dr Whitehead: You have anticipated exactly the next question that I wanted to come to very briefly. Obviously, we hear an enormous amount on piracy and its intractability in terms of its relation to the increasing sophistication of equipment and the conjunction of that sophistication and failed states and, therefore, the relative impunity with which piracy can be carried out landside, as it were. Is that a real issue in terms of future security—

Brigadier Ling: Yes.

Dr Whitehead:—or is it something that we are shocked by but is, shall we say, a pinprick on world supplies generally?

Brigadier Ling: Piracy is getting worse, and we have talked particularly about the Somali case, mainly because international crime have been able to see that this is a revenue-earning opportunity. So it is getting a lot worse. Also, as you mentioned, there is relative impunity for those carrying out the crimes. The loss or the capture of the Sirius Star, the big Aramco cargo ship; the cargo was worth $100 million and they paid $3 million ransom. There have been at least eight other tankers taken. Just look at the revenue that is going into criminal pockets. This threat is now spreading into the Indian Ocean and it is attractive. It started life in the Malacca Straits. It might be back there. There is the whole West Africa issue of piracy. So yes, I think it is something we need to grasp.

The other issue, of course, is that there is less naval protection than there has been in the past with the shrinking of not only the Royal Navy but other navies. So protection of shipping lanes is becoming more and more problematic. The issue of jurisdiction and governance at sea, as you know, has been well aired. The pirates are just allowed to go off if they are captured. This is an issue for jurisdiction throughout the world, particularly in the west; but different standards, different countries.

The other issue is increased use of private military companies and putting armed guards on ships. Now, that is a problem for the oil and gas industry, obviously. Understandably, they do not like having weapons on board. So the idea of what amounts to private navies set up—and this is the whole PMC development of private military companies—is an inevitable consequence of cutting down on our armed forces and NATO's forces.

Q420 Chair: I think the Foreign Affairs Committee has been looking at the piracy issue. Did they not get evidence that those ships that comply with all the advice on how to approach the area do not get pirated? It is the ones that ignore it.

Brigadier Ling: Absolutely. You may have come across the evidence from the piracy inquiry; the minutes of the House of Commons FCO inquiry of 22 June. That is exactly one of the conclusions that they reached. There is something called the ISPS, the International Shipping and Port Security, which is part of the SOLAS, which is the Safety of Life at Sea regulations. Indeed, if cargo ships behave as required and follow out the good management processes then statistics show they have less chance of being captured.

Q421 Dr Whitehead: You have mentioned in terms of piracy that this is a potentially real longer-term issue and that indeed the question of having oil tankers doubling up as battle ships is not necessarily the best way forward. Is it your view that some form of international safe passage, possibly electronically monitored, is the issue? We have a combination of the world's most intractable choke points and piracy reasonably adjacent, shall we say. Does that create a particular additional imperative or is it something that maybe can be managed by other means?

Brigadier Ling: If you are implying some sort of monitoring system where we are aware of authorities—presumably the NATO task force involved in this—that has much more control and know who is doing what, yes that would certainly help. But I think much more important than that is that there should be some form of deterrent to make it unattractive for criminals to carry out this action. What that might be would have to be debated legally and it is not really for me to come up with ideas but I think that is the top priority; proper jurisdiction at sea.

Q422 Christopher Pincher: Can we talk briefly about oil stocks and the International Energy Agency? About two weeks ago, for the third time in its, something like, 40-year history, the IEA released oil stocks into the market to offset the effects of oil supply disruption from Libya. Something like 60 million barrels-worth, I think, have been released, 3 million of which come from the UK. Given that the IEA's own assessment of oil stocks for the UK suggests that the UK has 476 days-worth of oil imports in stock, I wonder if you believe that that stock-draw decision was necessary.

Anne-Sophie Corbeau: Don't ask me to comment on that.

Chair: We have no experts on that.

Q423 Christopher Pincher: Can I ask another question that perhaps you will be able to help us with? Do you think that the decision that the IEA took was motivated because of supply disruption issues or would you think the decision was perhaps a political decision based upon price?

Peter Kaznacheev: I would say the latter because fears of disruptions of supply are usually part of market psychology rather than reality and relate to anxiety that exists in the market and influences the price greatly. If you look at alternatives to Libya, the increase in production of oil in the US, I believe, was estimated to be greater than the entire production of Libya. We have additional oil that will be coming from Iraq in the future. We have greater oil production in Africa and then, longer term, we have the Arctic. So we may worry and the IEA may worry about oil price fluctuations; they happen all the time. But in the long term, if you look at supply rather than market anxiety and politics, I think it is fairly secure.

Q424 Christopher Pincher: On that basis, if you think that supply and politics were the reasons for the decision, not a decision based simply around

disruption, do you think that the IEA's decision will have long-term implications to oil producers because they now see a different motivation for a stock drawdown other than a disruption to supply?

Peter Kaznacheev: I don't think it will have a terribly large effect long-term; I don't think so. I think other forces will be at play that are more important than the IEA's decision, but that is my view.

Q425 Chair: One last area we wanted to quickly explore was the role of UK energy companies working overseas in terms of their security in some of the countries they are operating in and how that may impact on our security. Do you have any views?

Brigadier Ling: Yes, and you are talking about the people. Obviously the main priority of any oil company working abroad is to make sure its staff is safe but it extends rather further than that and goes into the whole litigation area. For a company working abroad on, say, a big project like BTC or like the Tangguh gas project in Papua, it is more than just the safety of the employees. It is the safety and understanding of the local community, in particular, that they are working with, often in fairly undeveloped parts of the world. Companies that understand the role that the community has to play have a terrific benefit. It is a question of keeping the communities as well as employees safe. I am probably going a little beyond your question, but many of the big projects rely on the host Governments—Indonesia, Georgia or Nigeria or wherever it might be—to protect the project and that is something that is probably agreed, what their role in protecting the project, as a key national point, is. It is often these host Governments that provide a bigger threat to the community than anyone because of abuse and the traditional mistreatment of people out in the areas where the company might be operating. All these sorts of things need managing.

Q426 Chair: Should we be insisting that our companies play a role in ensuring that human rights are not abused, to achieve their own energy security?

Brigadier Ling: Absolutely. Yes, I think this is a fundamental role of a multi-national company, helped by home Governments. It is important that major companies address this issue right up front with their hosts. Often it is better not to couch it in the emotional phrase "human rights" because that has developed a bad meaning with some of the countries we work in. However, the various protocols, and particularly the Voluntary Principles on Security and Human Rights, were an initiative that came from the last Government early on. It is an operational rather than aspirational set of principles that allows companies or guides companies in their engagement with host Governments to try and improve their association with their communities. That is a very important point. I could talk more about that. I think most major companies are using this now as one of the pillars of their security protocols.

Q427 Chair: Just one other thing on our own security. Are we too tough in this country in our own regulations, such as for refineries, that we end up undermining our security by forcing investors to go elsewhere?

Brigadier Ling: I am probably the wrong guy to ask but, as far as UK security is concerned, no, I don't think we are. We put this very solid security system in place during the Provisional IRA threat and, frankly, I think it is as good as you are going to get anywhere. I do not think it is over the top. There may be a slight relaxing of standards, I am not sure. But, as you know, critical points have been designated by the Security Service and they inspect and ensure that standards are retained. I think this is probably right. Situations change; threats go up and down; who knows what is round the corner. But I think to bring down our level of security for the Grangemouth and St Fergus terminals and those sorts of high-risk places would be a big mistake.

Q428 Chair: On a wider market, though, maybe when it comes to environmental regulations on refineries, are we undermining our own security by forcing more production overseas?

Peter Kaznacheev: I would say that generally there is such a trend because there is a global competition for where international oil and gas companies will bring their capital to invest. In terms of UK energy security, if you think about the crucial element of UK energy security which is reliance on its own production, how did the UK manage to sustain indigenous production at such a high level, still being the leader of indigenous production in the EU? I am not talking about Norway because it is not EU. It is because of mid-cap and smaller oil and gas companies coming here, investing their money in high technological exploration and getting into reserves that were previously considered non-commercial. Now, think about the bulk of burdens that they are facing, such as we have seen; the increase in taxation, regulation and all sorts of requirements.

I am not trying to undermine the importance of security. I am just trying to say, think about the overall situation that they are facing and the alternatives that they have to bring their money elsewhere and, therefore, explore less in this country. I was reading in *The Telegraph* yesterday, I think, that there was a comment made by the Chairman of this Committee about the situation with RWE, which is another illustration of this trend; companies which want to pull out of the country rather than stay in the country. I think that could potentially undermine. As to which part of the balance you have to emphasise, whether it is through taxation or through reduced regulation or through changing regulatory requirements to make them more efficient, I do not have an answer. But generally I would say, in the big scheme of things, the UK is facing tough competition and it will be unfortunate if major and mid-cap companies start leaving this country.

Q429 Chair: Thank you very much. One last comment?

Brigadier Ling: I would be amiss if I did not answer one of the questions you asked the last panel about cyber-security; very quickly. It is probably the major security risk now facing Europe in particular, because

Europe is not faced with the other issues. You just have to look at the various worms that get a lot of publicity that can bring down a system, destroy a SCADA pipeline instantly. That is apart from theft of commercial information and all the other issues. It is big and it is right out there.

Chair: If anything else occurs to any of you later, we can always take written submissions following this meeting, but I would like to thank you all for your evidence and your help with our inquiry and adjourn the Committee.

Tuesday 19 July 2011

Members present:

Mr Tim Yeo (Chair)

Barry Gardiner	Laura Sandys
Albert Owen	Sir Robert Smith
Christopher Pincher	Dr Alan Whitehead

Examination of Witnesses

Witnesses: **Charles Hendry MP**, Minister of State, Department of Energy and Climate Change, **Emily Bourne,** Deputy Head of Team, Transmission Access, Department of Energy and Climate Change, and **Chris Barton,** Head, International Energy Security, Department of Energy and Climate Change, gave evidence.

Q430 Chair: Good morning and thank you for coming again to see us. We seem to be meeting quite a lot at the moment but then there is quite a lot going on and this is our last opportunity for a few weeks to have a conversation in public. Can I start by asking how the Department defines energy security?
Charles Hendry: It is a combination of matters. It includes the resilience of our energy supplies, inevitably now it includes low carbon issues and it includes an affordability aspect. In the same way as your Committee has taken a very wide-ranging approach to the issue of energy security, then similarly within the Department we do as well.

Q431 Chair: Where do you see the biggest threats coming from?
Charles Hendry: I think it depends if you mean in terms of the availability of, for example, imported gas or if whether you mean the ability to generate. My concern on the generation side is we clearly have a very significant amount of capacity coming out of commission in the middle of this decade and thereafter. We lose a third of our coal capacity in five years' time, we lose most of our nuclear in the course of this decade and the early 2020s, and therefore there is a real challenge to replace that and that is what EMR has been about.
In terms of the sources of supply, then we have been keen to diversify those. I think the last Government made good progress in terms of the development of the LNG terminals, the additional pipeline, the Langeled pipeline to Norway. That has all been an important part of that process but it is certainly not the end of the story.

Q432 Chair: Do you think that our system here in the UK is resilient enough to withstand threats that might come in the form of external shocks, might be internal disruptions, might be the long-term trends you have referred to?
Charles Hendry: I think more needs to be done. Good work has been done but certainly this is an area where you can never be complacent. If you look at the recent winters where there has been a challenge, those have been the consequence of unpredictable external shocks. It was the freezing up of the Langeled pipeline, it was the troubles in the Middle East and the interruptions that created to supply or the threat of interruptions, it was the Russia-Ukraine dispute a few years before, and therefore we have to have a system that is able to withstand multiple shocks rather than simply an individual shock. The process that we go through is to try and make sure that we are able to do that. In our modelling we look at if a number of different things happened at once would we still have, for example, the gas that is necessary to keep our industries working and our homes warm.

Q433 Chair: The question of price is one that often comes up. Does the fact that we still have a significant, although not as much as we used to have, amount of oil and gas produced from our own waters give us any price protection or does it mean in practice consumers in this country are still completely exposed to movements in world oil and gas prices that are completely outside the Government's control?
Charles Hendry: It has strangely resulted in us being more exposed than other countries. Because we had the ability, historically, to bring out additional sources of our own domestic gas and oil as required, we have been more reliant on the spot market than other countries. We have seen much less use in the United Kingdom of long-term contracts. We are keen to see more of those develop now but historically we haven't had that many of them. As a consequence to that we have seen greater spikes in this country than you get in other countries. In addition to that, if you look at what has happened in France with the policy over some decades of a commitment to nuclear, one has seen much greater price stability as a result of a reduced reliance on imported fossil fuels than we have inevitably seen in the United Kingdom. I think it has to be one of the drivers of policy now that we would need to try and protect consumers against those spikes.

Q434 Laura Sandys: How do you measure whether energy security is improving or worsening? You have outlined three key issues: resilience, low carbon and affordability. How do you measure where we are and what progress we are making?
Charles Hendry: The factual assessment every year is carried out for the annual *Security of Supply Report* that we publish jointly with Ofgem. That was last published in November 2010 and so will be published again in the autumn of this year, and that is a factual assessment of where we are across the energy portfolio and spectrum. In addition to that we have now committed to an annual energy statement, which is more focused on the policies and what we are going

to be doing about the challenges that have been highlighted. So we have both a factual assessment and the ability to respond from a policy perspective.

Q435 Laura Sandys: The energy system consists of interdependency, interconnection. How do you keep track of those particular policies and target areas that affect other areas of the system, for example how a policy to support greater use of renewables impacts on the need to update the electricity system? It is one integrated system and anything that fails within that system will have a knock-on impact. Do you believe that you have the complex modelling and the Department is on top of that complex modelling enough to see where there is a threat to that resilience?
Charles Hendry: I think we have two aspects. One is evidence gathering where we exhaustively look for evidence, be it from commercial players or from academics or others in the sector about where they see the risks of different policy directives. In addition to that we do our own modelling, or we buy in modelling support as well. We are constantly looking for ways to improve that. We constantly learn from experience so that when we get, for example, last winter up to Christmas, the coldest winter for 100 years, the system proved itself relatively resilient in that period, remarkably so in fact. Had we had a very cold January, February and March we would have had other lessons to learn from that process, but we do constantly learn from experience as well as we go through the process.

Q436 Laura Sandys: For example, will your next annual report have different indices to the previous one? Is your learning being translated into the publication and the assessment of energy security?
Charles Hendry: These are evolving documents in that we have to take account of the world as it is and so that has to look at both our own domestic situation and international issues. As those change then clearly we have to monitor it in a different way. We have a variety of teams. We have the international team that is looking at the longer term security of supply and where resources may be coming from, and we have our commercial team. We have a number of teams but security of supply is so written through the core of everything that the Department does that I think everybody who works for us within the Department recognises the critical nature of ensuring it.

Q437 Laura Sandys: One of my concerns is whether the other Departments within Government understand the impacts and the input that they can make to energy security. Do you feel that you get full co-operation? The issue about the change in taxation that the Treasury announced seemed to be a little bit of a shock for your Department. Do you feel that there is full co-operation and understanding that this is a national security issue, not just the responsibility of DECC?
Charles Hendry: I think one of the most important changes there is that this issue is now looked at by the National Security Council. We have a national security strategy that has been written, which reports into the NSC. That is a cross-departmental paper and approach. Ministers from all the relevant Government Departments feed into that process, so for the first time we do have a cross-departmental way of dealing with that. That is also done with the International Energy Committee, which is an official-led group across Government Departments, to try and make sure that those energy issues are addressed. One of the other changes that was made was specifically to have within the Foreign Office a Minister with energy responsibility: Lord Howell, who has decades of experience in this sector, has again made sure that within one of the most important Departments there is a Minister who directly addresses these matters.

Q438 Laura Sandys: I have to say that the National Security Council is quite opaque in the sense of not a lot of communication of what they are doing comes certainly in front of parliamentarians. Would you push them to be a little bit more explicit about how they are looking at energy security from a national perspective?
Charles Hendry: I think inevitably the work of the National Security Council is and should be opaque. It is dealing with issues that one can't discuss in open forum. Clearly that goes alongside a freedom of information approach and therefore documents and issues that can be published will be, and inevitably should be, but nevertheless there are some things that have to be done in private. I think everybody would accept that is appropriate.

Q439 Christopher Pincher: Minister, the Government is introducing supply side measures to affect energy efficiency and security, but this Committee has also heard about new technologies that can affect the demand side, consumer behaviour. We have heard about electric vehicles, heat pumps, smart metering, but their success depends very much upon take-up, upon whether they are attractive to consumers and whether they understand them. I wonder has there been any DECC social research to determine whether these new technologies are attractive to people?
Charles Hendry: We are, through the market reform process, dealing with demand side response in a way that has not been done before. There are, as you say, a number of those technologies. There are others as well that can be part of that process. We are looking at the additional role that interconnectors can play because we recognise as well that that is a useful balancing mechanism within the structure. We are trying to look at it in the most comprehensive way, but what we are seeking to do through the capacity mechanism is to encourage the development of those that are going to be most effective at the least cost to consumers. This is not an area where Government should be rigid. It is not an area where Government should seek to narrow down the technological focus, so ideas that can come forward should be able to be part of that process. Part of that will be done on a straightforward commercial basis. The voltage optimisation, for example, which we have used very effectively in DECC, that is done on a commercial basis; individual businesses, Government Departments taking part in that process. As part of

our smart meter rollout, however, we are looking at a communications package so that people understand the benefits that they can bring, because that is an area where the benefits will only genuinely be achieved if the consumers change their consumption patterns. Education is an integral part of the success of it.

Q440 Christopher Pincher: How much emphasis are you going to place on that? Steve Edwards of the Energy Networks Association said to this Committee that the ENA have gone through some stakeholder engagement and asked this kind of question about new technologies. They asked, "What do you know about smart meters? What do you think about ground source heat pumps?" He says they just don't have a clue what is going on. Clearly, public engagement and understanding at this point in time seems to be pretty low. How much emphasis are you going to place upon those educational measures to raise awareness?

Charles Hendry: It depends on the specific technology that we are looking at. For smart metering there will need to be a communication programme. I think we have to move forward. We are speeding up the process, we have brought it forward certainly by a year already, but we also need to carry consumers with us. A core part of this programme is going to be our engagement with consumers because they have to be comfortable that smart meters will be of benefit to them and it is not going to be involving any invasion of their privacy, it is not going to involve loss of their data. There is a balance that needs to be struck in that respect.

I think that the ENA's research is probably right that there is so far a greater understanding of the problem and the challenges than there is, within individual households, of the solutions that can be part of that process. I have described it before as enthusiasm with confusion. People want to do more but then every time they open a newspaper it is saying, "Well, this is what you must be having" and then they open something else and it says, "Well, don't do that, do this". There is inevitably a tendency that people will sit back and say, "Well, I will wait and see what everybody else is doing and then I will follow when I can see a greater clear way forward". So involvement of the consumers is absolutely essential to this.

Q441 Christopher Pincher: So there is some confusion out there among consumers; you accept that. You are introducing, I think, four trials to encourage take-up of the Green Deal, so they are carrots. Have you considered introducing any sticks alongside those carrots, such as encouraging people, making people obliged to introduce energy efficiency measures in their homes? Will that clear up some of the confusion?

Charles Hendry: In the private rental sector we have said that we will use compulsion. We hope it can be done through a voluntary approach but if that doesn't work then we will look at requiring people by law to improve it. I think in so many of these areas when one starts going down the route of compulsion you start to lose that debate with the consumers. The programme for energy efficiency in Australia was stopped in its tracks because the consumers lost faith in it and people had been killed in the process of installing the energy efficiency measures in a way that they were not competent to do. In Holland, the rollout of smart meters was stopped in its tracks because of lack of public confidence. My instincts in this are always to see what we can do more to stimulate consumer interest and demand so that we have consumer pull coming through rather than forcing it to happen. But there will be areas where regulations are also relevant; the role of building regulations, for example. In so many of these areas, if it is a new build property it is going to be much easier and cheaper to install those energy efficiency measures and micro-generation measures at construction rather than looking to retrofit them later. There is a role for carrot and stick, but I think if we go too much down the route of stick then it makes it more difficult to get the degree of consumer buy-in that is necessary.

Q442 Christopher Pincher: Just one last question, related to the point you made about the possibility of compulsion in the private rented sector. What defines private rented sector? Are we talking about big landlords here or are we talking about some individual who wants to rent out their house for six months while they are abroad?

Charles Hendry: At this stage we are saying that we hope the voluntarist approach will work. The focus will inevitably be on the larger landlords, but nevertheless we do believe that this is something to which tenants should be entitled. They should be able to have warm homes and not having to pay a fortune to keep them warm and so that applies across the housing stock in general. But at this stage we have not framed the legislation. We are saying that we would give it to the middle of this decade and beyond to see how that voluntarist approach is working and then to see what additional powers may be necessary.

Q443 Sir Robert Smith: I have been taking part in Warm Homes Week for many years now, trying to promote energy efficiency. There does seem to be still a big challenge in terms of, as you say, the consumer knowing what to do. Part of that is obviously the supplier of equipment is often more comfortable supplying the equipment they are used to. When condensing boilers came in, quite often people were told, "You don't want that newfangled device. You want the one that I can service". That has changed now. Do you think there is any read-across from the digital switchover for television? Does there need to be more of a public education, public champion coming from an organisation, such as Digital UK did for digital switchover?

Charles Hendry: I think there is a fundamental difference between them, which is that for digital switchover there was one solution that was necessary for every household and if they didn't switch over they were going to lose their television pictures, whereas for energy efficiency what is right for a house in your constituency may be different from a house in mine. Therefore, there is going to be a very significant difference between what is going to be recommended according to the nature of the housing stock, the age of the housing stock, the type of it and the location.

There is a much more localist approach that is necessary as part of that process.
What we did see with condensing boilers was that because of the regulation that was involved in that, the take-up went up extremely sharply indeed, much more sharply than were it left to a voluntarist principle. We see, for example, on the take-up of roof insulation, that even though the payback period for that is only a year or so, still the majority of homes are not properly insulated in their roofs, and many do not have proper cavity wall insulation. Again, the payback for that is a couple of years. Even the things that bring very immediate, quick benefits at a small outlay from the consumer tend not to get done. We have the No. 10 nudge unit, which helps us on how to move people's opinions so that they can try and look at this in a different way, but we do need I think—one of the advantages of the approach of the Green Deal is that there will be a significant number of trusted suppliers coming into this area and saying, "We can help in this area" and we hope that will start to transform it.

Q444 Sir Robert Smith: It does seem to be the trusted supplier, because the cavity wall insulation is still suffering a bit from people who remember "World in Action" probably 30 years ago on the problems of damp coming into the houses. We still have people resisting that intrusion into their house when they would actually benefit from it.
Charles Hendry: I think that there will be different consumer responses to different technologies. The cavity wall insulation, probably because it is usually non-intrusive, is going to be something that most people will be prepared to see done. I think it will be more difficult to persuade people about the role of solid wall insulation if that has to be on the inside of their homes or their cupboards have to come out and will they fit when they go back afterwards. There are issues that we don't minimise in terms of getting consumer acceptance in those areas, but then in terms of what we have to achieve this has to be the low-lying fruit. If we look at the cheapest mass low carbon technology, which is nuclear, the best price that we can see for that is £40 per megawatt hour. Most forms of energy efficiency are much cheaper to deliver than that is, so it is absolutely right that we should be looking at the costs of different approaches and trying to drive that forward in a more determined way.

Q445 Barry Gardiner: Minister, the local low voltage grids are going to experience a doubling of peak time flow and consequent real problems because of the onset of electric vehicles and heat pumps and so on. You said in the White Paper that you have estimated £110 billion only is needed to be spent on new electricity generation, transmission and distribution, but we have some doubts as to whether that assessment includes the costs associated with the strengthening of the distribution network to deal with those additional items like electric vehicles. Does it?
Charles Hendry: The £110 billion does not include the local networks. The £110 billion basically looks at the new generating plant that is necessary and the new grid infrastructure that is going to be required to bring them on stream. There is a figure of £200 billion by 2025, which is more generally the need for investment in the energy infrastructure. That includes gas networks that are not part of EMR and also the DNOs as well, because we do recognise that this is a multiple factor of pressure on the local networks. Therefore, significant investment is going to be required in that. Demand management can do some of it, but we are going to need a significant upgrading of our local networks.

Q446 Barry Gardiner: What price tag do you put on that upgrading of the local networks? Can you clarify whether out of the additional 90 billion between the 110 and the 200 overall, which is for energy as a whole, that is included in the 200 even or whether it is additional to that?
Charles Hendry: It is quite hard to quantify because at this stage we don't know what the rollout, for example, of electric vehicles will be. We don't know what the rollout of ground and air source heat pumps.

Q447 Barry Gardiner: I assume, Minister, that your Department has projected a number of different scenarios and perhaps you could give us the figures that are associated with those different scenarios.
Charles Hendry: I would be grateful if I can write to you on that because I don't have that immediately to hand.
Barry Gardiner: Absolutely, of course.
Charles Hendry: Clearly, it depends on the take-up of those. It depends to some extent on where they are because the network is much more robust in some parts of the country than others. There are a range of different outcomes that could be considered as part of that.

Q448 Barry Gardiner: Yes, if you could do that and then again just specify whether it is additional to the 200, that would be really helpful.
Charles Hendry: Yes.

Q449 Barry Gardiner: Thank you. To what extent do the Government's proposals on smart meters and smart grids take into account the functionality that will be needed to manage electrical vehicle charging?
Charles Hendry: What I have been absolutely clear about in trying to speed up the smart meter programme is that in doing so we should still future-proof it. At this stage, we do not know the full range of usage that it can be used for, but we should not be closing down options. Part of the purpose of this is to get the benefit of electric vehicles.

Q450 Barry Gardiner: But that doesn't sit terribly well with having brought forward the targets for delivering the smart meters. On the one hand you are saying, "Let's get it right rather than get it soon" but on the other hand you have actually brought forward those targets for delivering smart meters, haven't you?
Charles Hendry: No, I think it is entirely compatible. For example, we are saying that in terms of the role that smart meters can play there is likely to be a position in due course where we may want to have

water meters as part of that process, so let's not stipulate a technology now that would rule that out. What we are looking at is how one has an all-embracing technological approach. We have multiple work streams that are going on in all the individual elements. We have much more detail coming out in the next few weeks on where we have achieved agreement with industry on many of those factors. Part of the whole thinking of why we should be going down the route of smart meters and smart grids is to facilitate the rollout of electric vehicles because we want them to be able to be charged up when there is extra capacity in the system, that is overnight. We want them to be able to be used as a store for electricity where additional electricity can be downloaded from them at peak times in the morning. They are in their own right a very important part of the balancing mechanism.

Q451 Barry Gardiner: What is DECC doing to ensure that the potential impacts of climate change are factored into the investment plans of the electricity network?
Charles Hendry: Rather than going for a sector specific target for reducing carbon emissions, we have a national one. We have, as you will be aware, gone further than many people expected in terms of the fourth carbon budget in setting a cap at 1,950 million tonnes of carbon. I think that the drivers for that will then be largely commercial so that we have things like the carbon floor price, we have CRC—

Q452 Barry Gardiner: Sorry, I think we are at cross purposes, perhaps, here. What I am thinking of is more, in those investment plans have you factored in changes that will come about perhaps as a result of climate change such as increased use of air conditioning?
Charles Hendry: Yes, and one of the reasons why we are still showing a commitment to solar is that there is a very direct read-across between solar power at its peak in the summer and the growing demand as we would anticipate it for air conditioning. We see that there are areas where the rollout of new technologies can be very helpful to meeting the new demands that are going to be there as well.

Q453 Barry Gardiner: Sorry, Minister, to interrupt you again, but your focus seems to be more on the new technologies, whereas the focus that I am trying to observe here is more on the capacity of the infrastructure and the grid to cope with perhaps those increased demands.
Charles Hendry: Certainly, we recognise that electricity demand will probably double over the course of these next four decades to 2050. That reflects the growing use of electricity in heating and powering heat pumps, the growing use of electric vehicles, so that is a consequence of our decarbonising objectives. We need that electricity done in a low carbon way and we also need to find ways of managing demand more effectively. So, shifting demand smartly is a part of that process; smart grid is a part of that process; interconnectors are part of that process.

Q454 Barry Gardiner: Indeed. Just so I am clear here—I am not trying to put words in your mouth—in that doubling that you have projected of electricity demand between now and 2050, you have included all the reasonably foreseeable elements that will come about as a result of a change in climate? Whether that may be increased wet spells, increased cold spells, increased warm spells, you have factored all that into that projection of doubling of electricity demand?
Charles Hendry: Yes, we have. I will ask Emily to come in on that as well, but also we are very heavily guided in this work by the Committee on Climate Change. They have been doing a lot of work, which we clearly respond to and which has been invaluable to us in addressing those issues.
Emily Bourne: The doubling of electricity demand that we are looking at to 2050 comes about from the work we did on the 2050 pathways where we looked at various different scenarios to reach the decarbonisation trajectory to 2050. That obviously includes assumptions of decarbonisation being different within different sectors, but within that we did look at projected demand going forwards within the DECC scenarios. I am not sure what account they specifically take of changing weather conditions but I am sure that is factored into those assumptions.

Q455 Barry Gardiner: You are not sure what it is, but you are sure it is? That is less than comforting.
Emily Bourne: They take account of the DECC projections for future demand, so we would have to check to what extent that covers weather patterns.
Barry Gardiner: Perhaps you could let us know the specifics of that as well. Thanks.

Q456 Sir Robert Smith: Could you also check the resilience of the system to the impacts of predicted climate change? The French found that when you get warm summers your nuclear power stations can't get so much cooling water. You have more demand but you can't actually run them. How much is the system being tested against actual climate change impacts in that direct way?
Charles Hendry: I think that also emphasises why we are keen to have a balanced portfolio. The reliance that the French have on nuclear gives them limited scope around about it as most of the rest of their electricity comes from hydro sources. Clearly, that is going to be less available in the summer than in some of the spring months. What we would expect to have is a range of different technologies that enhance our resilience in times of extreme weather conditions, be that very hot summer weather or very, very cold winter weather.

Q457 Dr Whitehead: Could I take the question of projected levels of electricity demand up to 2050 just a little bit further? The Department's updated electricity projections suggest that up to and beyond 2025 electricity demand looks like it will be fairly static. What is the point at which your view is that this very substantially greater electricity demand really starts to take off? We have the end point of 2050 maybe doubling and maybe getting on to 2030 almost static demand. How does that relate to the

question of the long-term availability of plant and other arrangements in order to deal with that likely increase?

Charles Hendry: Again it comes back to we need to look at the individual technologies as part of that process. The rollout of electric vehicles will move up in the course of this decade, but it will be in the course of the 2020s, and particularly in the 2030s when we need to substantially decarbonise ground transportation, that that will then become a very serious demander of energy. The role of renewable heat, and therefore of heat pumps, will be growing strongly in this decade but more strongly thereafter. The boundaries of what is achievable through energy efficiency, we would expect that will start to tail off as we go through the 2020s. The Green Deal is heavily focused on achieving a great deal in the course of this decade of a great step up from what has been historically the case in terms of energy efficiency, but there comes a natural barrier where one can't, at a reasonable cost, go a great deal further. That is the point at which we then switch from being able to offset increasing demand with energy efficiencies and that is when we would expect, post 2025, to see significant growth in demand.

Q458 Dr Whitehead: Indeed. Thinking about electricity supply in the mid-2020s, the Climate Change Committee, in bringing forward its fourth budget, very strongly indicated that it felt that there was no serious role for unabated gas post the early 2020s. My understanding would be that unabated gas might only be used under those circumstances for very brief peak interventions and not for base load or mid load. Do you accept that suggestion in terms of your planning for those sorts of capacity requirements through the 2020s?

Charles Hendry: I think we have to be careful that we don't stifle the necessary investment in new gas, which we do need to see. If we look at the scale of the challenge, then we know that new nuclear will only be just beginning to come on stream if all goes well at the end of the decade. We know that the huge potential for marine and tidal technologies will be in the 2020s rather than before then. We know that carbon capture and storage will only be by the end of the decade showing its potential rather than resulting in new large-scale plants. We know that offshore wind will be growing through this decade but great potential into the 2020s. But the timeframe at which we are facing a crunch comes earlier. We have at the moment a good capacity margin, about 18% capacity margin. We expect that to be dropping to under half, to less than 8% by the end of the decade. We have a crunch coming and the technology that is best equipped for dealing with that, where the plant can be built quickly, where the fuel we know is currently broadly available, is gas. If people feel they are expected to turn off their gas plants by 2025, they are not going to invest.

What we are trying to do through the Emissions Performance Standard—and I have always been clear that the EPS should be a driver for investment rather than something that cuts it off—is saying let's look at a sensible environment that will encourage some investment in gas but people will know that there comes a point, by looking at how we will grandfather the existing arrangements, perhaps for 20 years subject to final decision, that then they know what the timescale is either where they would then be having to move that plant on to an occasional operating basis or when they would have to apply CCS to it. It is also why we have said that the CCS competition should include gas because in terms of the long-term interests of the United Kingdom finding a technology that enables us to continue to use hydrocarbons such as gas in a low carbon way, that is going to be an important part of the mix. I think what we are trying to do is to find the right balance between mechanisms that will drive investment in the necessary technology, and to have protections in there to make sure we don't get too locked into a higher carbon technology, but also make sure that we are on a constant downward progression in terms of our carbon emissions.

Q459 Dr Whitehead: So the EPS has been designed specifically to exclude gas?

Charles Hendry: Well, it has been designed in the early years to exclude gas and we are proposing that it should be set at 450 grams per kilowatt hour. That means that a new coal plant would have to have some degree of CCS and we don't in any case envisage any new unabated coal in this country. We do need some additional gas, but we also recognise that, as the Committee on Climate Change has said, we need to be decarbonising electricity generation around 2030, soon thereafter. Therefore, this is a way of giving us the security of supply that we are going to need in the shorter term, but also making sure that by limiting the time when that can work in an unabated way we will be reducing the carbon emissions over time.

Q460 Dr Whitehead: What is the point at which you envisage perhaps strengthening or even applying an EPS to gas, particularly in view of the previous discussion we had about the increased demand for electricity in the 2030s?

Charles Hendry: We have said that anything that is consented before 2015 the Emissions Performance Standard would not apply to, and then they could expect a 20-year, perhaps, grandfathering position. That is still subject to a final decision, but that is the sort of range that we are looking at. It does mean that any new gas plant would need to be operational with CCS by the mid-2030s at the absolute latest, possibly even earlier than that. We think that gives a sufficiently strong signal to investors to bring forward new gas plant because at the moment we have quite a lot of consented gas plant that is simply not being built because the outlook is not clear enough. We recognise that we will have to have some more in the mix, but we don't want to get it out of kilter in terms of where the direction of travel is for decarbonisation.

Q461 Dr Whitehead: So perhaps 15 to 20 gigawatts of installed capacity of gas grandfathered for 20 years, unabated until 2035?

Charles Hendry: Well, 15, 20, I am not going to speculate on whether that is the right issue. The situation at the moment is that grounds for consent

can also look at whether the disbenefits outweigh the benefits. If it were then considered that we were seeing too much gas coming on to the system, then that would be grounds for saying that we don't need to be seeing more consents to be granted. We have not set a figure for what that is but clearly we do not want to reach a situation where it is more difficult to see the rollout of other low carbon technologies and renewable technologies because of too much gas in the system. We need more gas but we don't need to see a massive dash for gas.

Q462 Chair: I would like to be constructive here, but isn't what you have just said actually going to create, firstly, a dash for gas in the next four years because that is the one where you get freedom from the EPS and, secondly, then you say if we get too much we will change the rules? That is what has caused so much dismay with solar, that because admittedly a decision made in the last Parliament set the tariffs for solar at a rate that was clearly unsustainable, we had this huge dash and lots of clever people in the City dreaming up schemes to invest in solar power. Isn't there a danger now we are going to make the same mistake with gas? We will have a huge amount of new gas and suddenly think, "Oh, gosh, all this stuff is grandfathered until 2035, there is no way we can get anywhere near our targets because we've got this massive amount of unabated gas".
Charles Hendry: There are a number of different factors that come into that. First of all, yes, we need more gas in the system. We will have a crisis if we don't secure more investment in gas, but then we have to do that in a way that is not at odds with our decarbonisation requirements in the fourth carbon budget and the subsequent ones in due course. Inevitably, there is some finessing that is required in this process. The key to it is predictability for investors. We are not talking about saying, "Now you have built that gas plant I am afraid you have to turn it off early" but if we do see a significant rush in the direction of gas, which at the moment I don't see, but if we do start to see that coming forward in a way that is greater than anticipated then of course we will have to moderate it because otherwise we will not be able to meet our decarbonisation objectives.

Q463 Chair: How will that moderation be achieved at that point?
Charles Hendry: It can either be done through the Emissions Performance Standard that also we have in there, which has to be factored in; a carbon price, which will be impacting on the economic viability of gas plants. There are different measures that can be used there, but our security of supply requires more gas at this stage and we have to try and manage that in a way that is not in conflict with our decarbonisation objectives.

Q464 Dr Whitehead: If we have this perhaps 10 to 15 gigawatts of installed gas grandfathered for 20 years prior to 2015, and then another lot of gas produced after 2015 subject to an EPS level that does not affect them, also presumably grandfathered for another 20 years, why would anybody take any interest at all in undertaking a gas-based CCS demonstration plant?
Charles Hendry: Because we have given a very clear signal that we would expect an EPS to apply to gas in due course and the time that it will take to—

Q465 Dr Whitehead: In 30 years' time?
Charles Hendry: We are talking certainly in the 2020s and 2030s there is going to be—if you look, this is not just in terms of the United Kingdom, this is something that is of global importance. We have companies here that are global leaders in this area, who are very keen indeed to invest in gas CCS and to take forward the development of that technology. We have given a very clear signal that we would expect the emissions from gas plant to be constrained in the course of the 2030s so that that works in terms of trying to meet what the CCC has said about decarbonising electricity. The assumptions that you make about 2015 are pure speculation—that we have a very tight EPS post 2015. There is tremendous scope for flexibility, but what we have sought to do is to create the right environment in which people are prepared to invest now in a way that is necessary for our security of supply but not to do that in a way that jeopardises our low carbon objectives.

Q466 Dr Whitehead: Forgive me, if there is no signal now at all that anybody investing in gas plant prior to 2015 will have any sort of EPS applied to them, that anybody investing after 2015, and I presume up to 2020 or so, will have an EPS that will clearly not affect them under any realistic circumstances, which means they are then perhaps grandfathered to 2040, what kind of a signal is that? It is getting on for being no signal at all, isn't it?
Charles Hendry: The second part of that is total speculation and not based on anything that we have considered, discussed or imagined. We can't at this stage say what the regime will be post 2015. The other element that needs to be factored into this is the element of market reform, which are the contracts for difference for low carbon technologies. Investors will be looking at the relative balance and benefits of different technologies and if they can see a more attractive rate of return coming through the CFDs that are available for low carbon technologies, then that would moderate investment in gas. This is not an absolute science inevitably because what we are seeking to do, rather than Government regulating this and Government stipulating that we want this number of gas power stations, this number of nuclear, this volume of tidal, which we believe is overly regulated and overly centralised, is trying to create a structure in which the market will operate and deliver the solutions that both secure our energy security concerns and also achieve what we are trying to do in terms of decarbonisation.

Q467 Dr Whitehead: Are you going to in any way relate timing of signals to availability of CCS second, third, fourth demonstration projects? What is the sort of timing you are thinking about that those projects are likely to be underway and demonstrating what we trust they will demonstrate? Is that the point at which

you might consider further signals as far as EPS are concerned because of the availability of that technology in a proven capacity basis?

Charles Hendry: Part of the purpose of the CCS pilots is to identify, first of all, if it is technically possible, which our assumptions are that it will be because the individual parts of the process have been established so far but they have not been put together at scale, but also more critically what is the cost of that and what that then does in terms of the cost of delivering low carbon technologies. We have made clear in the EMR that the contracts for difference will be available for hydrocarbon plants with CCS, so that is another way in which we can encourage the development of it. In terms of the timescale of it, we are still working to finalise the details of the first plant, which is at Longannet, a retrofit coal plant, post combustion technology. Then we are looking at a range of different plants. Some of those, for example one of the gas projects, would be able to come on stream in the middle part of this decade or soon thereafter. Some of the other technologies are further out and would be before the end of the decade. What we have committed to is four plants operational by 2020, but they don't need all to be working on the same timescale.

Q468 Chair: Have you got the funding for that?

Charles Hendry: Have we got—

Chair: Funding for the four plants?

Charles Hendry: We are still discussing the arrangements with the Treasury. What we are looking at is the right balance between support per unit of electricity generated with CCS and the need for upfront funding. We are looking at how that can link in as well to the European New Entrants Reserve 300 project, which would give upfront funding. Clearly, there is a need for upfront funding in those areas, which we are keen to work alongside.

Q469 Chair: I don't want to sound too cynical, but given the Treasury's recent record I am not sure that outside investors will be entirely convinced that their priority is to develop low carbon sources of electricity generation. Therefore, if we can't really say where the funding is coming from and it still depends on the goodwill of some future Treasury Minister, coupled with the fact about five minutes ago you said we might change the rules on EPSs after 2015 for gas, I think we have a complete mass of uncertainty that will do a lot to damage investor confidence.

Charles Hendry: I think what we have sought to do is give exactly the opposite, to provide clarity to investors. People who are building gas plant now will understand that they are going to have a grandfathered period before an EPS would be imposed. That is clear. We are not looking at anything that would be retrospective that would change that once people have gone ahead with those investment decisions and made them.

What we inherited was a proposed levy. That would have been only payable per unit of output, so the companies taking forward the additional CCS projects would have had to carry every bit of the risk. In the event that it did not work and did not generate the electricity that they had anticipated, they would be liable for all of those costs without any support from the Government. We moved away from the levy and we are looking at how one then provides a mixture of support per unit of output and also upfront. I think what we have also recognised is that the funding upfront is going to be important, but it doesn't absolutely need to be clear from when you launch the project. The existing Pilot One scheme set up by the last Government said, "Yes, there will be some funding available" but it was not until the last budget that it was confirmed how much money would be available. That was £1 billion, and the rest of that had all been done without any understanding whatsoever of how much money would be available or how it would be paid.

I think we have the right policy drivers in place. We have more interest in Britain in taking forward CCS than in any country in Europe. Seven of the schemes coming forward for the European NER 300 are out of the United Kingdom. That is over a third of the projects in Europe and I think that reflects as well the engagement that we have with industry on these matters.

Q470 Chair: But as far as the UK funding is concerned, when we had £1 billion in the end how many consortia decided to bid for it?

Charles Hendry: The £1 billion was only allocated after there was a change of Government, by which time we were down to one bidder.

Q471 Barry Gardiner: Minister, I just want to press the Chairman's original question here because the question was, is this not going to cause disquiet in the markets and uncertainty in the investing community? You said you thought we had the right structure in place because we would be encouraging gas to come in, and then you moved to talk about CCS. What you didn't tackle was what happens after the first gas comes on stream. What happens in that middle period when more are in the planning pipeline, when more investors are looking to make those investments, spending considerable sums of money doing their feasibility studies, doing all their pre-delivery stage, and suddenly you pull the rug from under their feet? That is what is causing the concern. That is what is going to cause mayhem in the investor community.

Charles Hendry: The response to what we have been saying in these areas and to the EMR last week from industry has been extraordinarily positive. They have broadly welcomed the additional clarity that we have provided. They think that we are putting in place a structure that will attract investment, and that applies both to the existing players and to people who we would like to see coming in as new entrants. The response that we have had from industry is saying that we are giving the clarity that they want. This is not something where a Secretary of State or a Minister five after me—given the normal turnover rate of Ministers—wakes up one morning and says, "We must stop this this morning". We would see this evolving and it would be quite clear in order to meet our carbon objectives whether tightening is going to

be necessary and that would happen over time. There is a legal requirement to consult.

Q472 Barry Gardiner: It did not happen that way with solar, did it?

Charles Hendry: I will respond to that in just a moment, but industry itself is going to be looking across the portfolio and they will be looking at how the contract for difference will work. They will be looking at whether they want to bid into the capacity mechanism. There are a number of different drivers in here that will stimulate investment, which I think will ensure that we do have a balanced portfolio and do it in a way that meets our energy security.

The issue that we faced on large-scale solar was that the calculations made by the previous Administration assumed that there would not be a single facility of more than 50 kilowatts anywhere in the country before 2013. In the last couple of weeks three of over a megawatt have opened, so those calculations were massively flawed. We understand why, because the cost of solar has come down much faster than people anticipated. I am not making a political comment but I am simply reflecting the fact that it was wrong. The consequence of that was that the entire budget would be swallowed up by large-scale solar and there would have been nothing left for small-scale solar and for schools and churches and homes and community projects. We took a decision it was right to do it.

I think the other question we have to ask is, is it right for your constituents, less well-off constituents, to be paying a surcharge on their electricity bills for multimillionaire investors to get a 15% return that is not available to ordinary members of the public? Now, that is a decision that we made that this was a regressive policy. It was not achieving its objectives and it was right to stop it. We made that decision. We can now focus it back on micro-generation as it was originally intended to be and to receive many more household schemes and community schemes coming forward.

Q473 Sir Robert Smith: I should remind the Committee of my interest in the Register of Members' Interests as a shareholder in Shell and other oil and gas interests. Was the gist of your argument really that the EPS is a sort of backstop but the stronger driver is the carbon price and the market mechanisms?

Charles Hendry: I think backstop is one way of describing it. The key driver will be the market reform measures, but we also wanted people to be in no doubt that we do see an absolute limit on what is appropriate levels of emissions. My view has always been that Britain can set a lead in this area and what I think we will now find is that other countries in Europe are looking to say what is the appropriate level of an EPS for them, because people can say, "We know what it is going to be in the United Kingdom so we can invest with clarity in that area", whereas they do not know what it is going to be in other economies in Europe. I think this will actually be a driver for investment.

Q474 Sir Robert Smith: The first pilot CCS project, what is the next milestone that we can judge if it is coming on stream?

Charles Hendry: There are very detailed discussions that have been going on. We are looking at some additional FEED work, so the cost of engineering and design work, in terms of whether what we are seeking to take forward is achievable. It is a very ambitious project. There is a tremendous amount of detail. Much of that is not between Government and industry; it is between the industry partners themselves and which parts of that chain will take on the liability. If they invest in a sequestration scheme that ultimately is not used for very long, is that the liability of the people responsible for the sequestration or the people running the power plant? There are very, very complex legal issues, which we are doing everything that we can to address and resolve.

Q475 Sir Robert Smith: On the security of sources of energy, how important are the gas pipeline projects around Europe to our energy security?

Charles Hendry: Absolutely critical. What we saw when the Russia-Ukraine dispute was on is that even though we were physically almost as far away as we could be in Europe from where that dispute was happening, the gas was essentially transiting through the United Kingdom. It was coming in through one interconnector and it was going straight out through another, 26 million cubic metres a day coming through one, 25 million cubic metres a day going out through another. That is the way in which our market operates, but what it showed us is that we can't be insulated from an event that is a long way away. One of the bits of evidence that I was disappointed by was in terms of the engagement that we have with the EU and suggested that we are not engaging with some of our Central European counterparts on energy security. We have, in fact, been extremely robust in support of the Hungarian Presidency and the Polish Presidency on the steps that they are taking, both in terms of electricity connectors and gas interconnectors.

Q476 Sir Robert Smith: Yes. The pipelines now will be able to flow both ways at the eastern part of Europe, which will make even more pressure possibly on our supplies?

Charles Hendry: Yes, there is a requirement that most pipelines will have to work two ways. There will be some exemptions where it is a particular local nature, but it is part of opening up the market in Europe and making it a more fluid market. We very strongly support the work that the Commission has been doing on this and the focus on energy security.

Q477 Sir Robert Smith: In the early days of some interconnections the market here got very confused as to why, having built a pipeline, no gas was flowing into the country. Is it crucial to these pipelines and these interconnections working that we have some kind of coherent market mechanisms across Europe?

Charles Hendry: There needs to be greater coherence, but at the same time there are issues that need to be done domestically. That is why we are taking powers in the Energy Bill to put a greater obligation on the suppliers that they can meet demand in times of extreme demand and that we believe will actually ensure that this system works more clearly to our

advantage. While we did see the market working as it should do last year and the molecules were following the money, we need to be certain, if we see a prolonged cold winter, that our own energy security issues have the right attention and prevalence.

Q478 Sir Robert Smith: Is the Government supportive of the Nabucco project to bring Caspian gas to Europe?
Charles Hendry: Yes, we are supportive of a southern corridor more generally. We think that there is a case for an additional route for bringing Russian gas into the European market that avoids the constraints in the Ukraine. Nord Stream does part of that; South Stream would do part of that as well. But Nabucco is important for what it does in opening up the Azeri gas, the Turkmenistan gas, the gas from Kurdistan and from elsewhere and finding a way of bringing that into the European market as well. We believe it should be market driven. We don't believe this is something that should be given huge amounts of European funding, but we do certainly see a very strong case for a southern corridor.

Q479 Sir Robert Smith: Do you see any timeline when it might actually physically exist?
Charles Hendry: A target of 2020 is talked about. We are seeing a number of different options on the Nabucco project being explored and so it remains to be seen which of those gathers most commercial favour. Certainly, we are very supportive indeed of the Commission's work to try and bring forward that investment.

Q480 Sir Robert Smith: Do you think some more incremental and smaller projects might be more realistic?
Charles Hendry: It is not just one big project that is necessary. I think what we are keen to see, and again this is driven by the Commission and European policy, is a more integrated network of pipes. That inevitably means that there is less scope for countries facing interruptions of supply.

Q481 Sir Robert Smith: Earlier we touched on the fact that while our own production may not protect us from prices abroad, if we are talking about pipelines bringing gas here does the Government still have a commitment that we might as well maximise our own production as part of our security?
Charles Hendry: Very much so. We believe it is absolutely in our national interest that we should do. In terms of our dependency at the moment, at the moment 35% of our gas is imported. We expect that to rise to perhaps 50% plus by 2020. In oil terms it is 17% imported at the moment. We expect that perhaps to rise to 50% by 2020 as well. The more that we can get out of that there is a real national gain. Sir Ian Wood, who I think is an icon in the Scottish oil and gas industry, has said the difference from policies that maximise and optimise returns is between an additional 11 billion barrels and an additional 24 billion barrels. That 13 billion barrel equivalent is worth £1 trillion to the British economy. We have an absolute vested interest in seeing that development coming forward, but it is a very different nature of exploration now. These are smaller finds, they are more challenging, quite a lot of those are in deep water, and so the nature in which the basin is evolving has to be recognised as well.

Q482 Albert Owen: Are you concerned, Minister, by Russia's use of energy as a tool for foreign policy?
Charles Hendry: I think that when I look at the German experience over 40 years, even right the way through the Cold War, every contract that they ever had on gas supply was honoured. I think the Ukraine-Russia issue was different, that what it showed would then be a normalisation of relations between Russia and Ukraine. There needed to be a separating of the domestic Ukraine gas issues from the transit gas issues that had become blurred in that process. There needed to be a normalisation of the market price for gas in Ukraine, and that is all happening. There is also a much more constructive relationship between the current Ukraine Government and the Russian Government. We need to recognise this is a global area. We see Russia as an important trading partner. It is very, very small; we get less than 1% of our gas from Russia. That will increase slightly but it is not going to be our most important partner. But it enhances the need for extra security provisions, more storage, more long-term contracts as we become more dependent more generally on imports.

Q483 Albert Owen: We only get 1%, so are we exaggerating? In this country there has been a lot of hype abut the importance of Russia. You mentioned the Ukraine and you say that was a one-off, but that could happen again. Are we just exaggerating the whole situation?
Charles Hendry: I think that we saw the impact of an interruption across the whole of Europe and that we are not immune from that even if we are remote from where the problem is. We recognise that there is a challenge there. The Nord Stream pipeline, which will be coming on stream later this year, will be part of the solution to that, to bring a lot of additional gas into Germany and Northern Europe more generally. There are measures that we can take to ensure that our security of supply is enhanced as we become more dependent on imports. Norway I would expect to continue to be our most important gas trading partner. We have had discussions with the Norwegian Government about an additional pipeline. The LNG terminals, the long-term contract that we have seen Centrica negotiate with Qatar, is an important part of that process as well. There are many additional markets that are coming on stream in this area. The global market for gas is changing dramatically. In Iraq every year they are now discovering more gas than in the whole of the North Sea in total. Australia by 2020 will be probably the world's largest gas exporter through LNG terminals. This is a very fast changing picture.

Q484 Albert Owen: How does the UK use diplomacy with Russia in any sense? Do we use, for example, the UK Trade & Investment arm?

Charles Hendry: We do, but they often have different purposes. The commercial sale of gas is not impacted by UKTI in the same way as the coal that we import from Russia. We buy more coal from Russia than from anybody else, but that is on a straightforward commercial basis. Some of the role of UKTI is to try and ensure that the opportunities for British companies in Russia are fully developed. It is clear that there is an interest in having international expertise coming in in the development of the Yamal Peninsula, in some of the additional hard to reach areas, that the expertise that British companies have in that area is going to be important as part of that process.

Q485 Albert Owen: An example of that was BP more recently?
Charles Hendry: BP more recently, the work that Shell is doing on a continuing basis, and also alongside that the incredibly valuable role that British companies can play in dealing with some of the challenges such as flaring, such as the rather old gas pipeline infrastructure that is in Russia and how that can be maintained more effectively.

Q486 Albert Owen: Forgive me, how is this helping our energy security if it is only 1% in the long run on gas?
Charles Hendry: Because we have an interest when there is going to be greater global demand for gas to ensure that more gas is coming into the market more generally. What we have seen in just the last year is the likelihood of a much greater demand for gas in Japan, understandably with Fukushima leading to the nuclear programme there being put on hold, much greater demand for gas in Germany as a result of their decision to bring forward the closure of their nuclear plants, the decision in Italy not to have new nuclear and, therefore, greater reliance probably on gas there. We are seeing growing demand for gas before you even bring into that—

Q487 Albert Owen: It is more price than security?
Charles Hendry: It is both. We are also seeing the dramatic growth of demand for gas in China simply because of the economic rate of growth. The outlook for gas, although it continues to look benign, is more challenging than it was a year ago.
Chris Barton: May I add just a couple of points? First of all, in terms of why Russia matters to us from an energy security perspective, I think in particular two ways. One, in terms of the direct supply, as we have said, while less than 2% probably comes directly to the UK it still affects us indirectly in that we get significant supplies from Europe and, therefore, one removed, if there is a disruption to supply to Europe then that has an impact on us and, indeed, can lead to the situation where we are having to supply Europe. Secondly is in terms of the investment. Russia, being a very major gas producer, it is very much in our interests that it is developing both its gas and its oilfields to help meet global demand.
I would also add, if I may, in terms of our engagement, you asked about the political engagement with Russia. As well as the involvement through the UKTI, we also have direct contacts. As energy ministries we have a UK-Russia energy dialogue that meets every year or two at ministerial level. At official level we have an MOU Committee that meets at least once a year, which covers energy issues, including also the energy efficiency side and development of renewables, partly reflecting the fact that if Russia uses—

Q488 Albert Owen: But that is not unique to Russia. That relationship is not unique to Russia. You get it with all the big players.
Chris Barton: Yes, we do it with a number of big players, but certainly Russia is one of the key countries with whom we engage in that way. We do have a variety of engagements and, of course, the Foreign Office, both in post and here, has close engagement, so in regular contact and discussion with them. One other avenue I would mention is through the EU. There is an EU-Russia energy dialogue and one of the committees under that looking at market developments is co-chaired by us, by the UK, so we do have a number of avenues through which we can engage constructively with the Russians.

Q489 Christopher Pincher: Sticking with the subject of gas, you have clearly outlined the importance of it to Britain. If we are not dashing for gas, then we are certainly jogging towards it at quite a fast pace. But the experts that we have had before us in this Committee—Mark Hanafin from Centrica, Professor Stern from the OIES, Mark Rigby from Stag Energy—have all raised a concern about gas storage and that we don't have enough of it. We have something like four times less gas storage than our major European competitors. Why is that? Why do we not have more gas storage, given that our natural reserves are depleting?
Charles Hendry: Partly because we had those natural reserves historically. It used to be the case that if we needed additional gas we would simply pump out a bit more more quickly from our own reserves. What I think my criticism of the past Government had been was that we did not see that emerging more quickly and respond to it more rapidly at the time. We currently have, I think, seven large gas storage facilities with about 4.5 billion cubic metres of gas storage capacity. If one looks at the ones that are under construction, that is another billion cubic metres. If you look at the ones that are consented, that is a doubling of that again. If one then looks at the ones that are pre-planning but under consideration, that would increase fourfold from where we are the total availability of gas storage. There is significant potential here, but at the moment the real challenge is that the economics do not add up. The difference between the price at which they would buy gas and then be able to resell it later doesn't justify the nature of the investment in many cases. So through the changes we are bringing in the Energy Bill we would hope that one of the consequences for that is to make a stronger case for gas storage.

Q490 Christopher Pincher: I was talking with Mark Rigby of Stag a few weeks ago and he acknowledged

that there is a potential for increased storage but between the idea and the reality, as you have evidenced, falls the shadow. He made clear to me that he believes there is a hiatus in those companies like ENI's appetite to build increased gas storage capacity, so unless the Government is prepared to take some action it would appear that that doubling of storage capacity is not going to happen. What specific measures do you think the Government can undertake and should undertake to encourage that building of capacity?

Charles Hendry: Our approach at the moment is to say that Government should create a framework and we leave it for industry to decide how it wants to meet that. We do not want to be prescriptive and going down the route of a strategic gas reserve, of Government essentially running this itself and deciding when it should buy gas and when it should sell gas. What we are looking at is the new structure that will come in place through the Energy Bill and then there are a number of ways in which they can meet that. I would hope that gas storage would be part of that process but greater long-term contracts is going to be part of that process, so guaranteed flows through the LNG terminals and through pipelines as well, all of that is part of a more balanced approach and enhances our security. We are a trading nation in gas and therefore what we saw last winter was, as the international price rose, we were taking less out of storage and indeed we were being able to adapt according to the circumstances at the time. So there is a market here. We want to see additional investment in gas storage but we believe by leaving it to industry to decide what is the best balance between storage, long-term contracts, interruptible contracts, all of that will provide a more robust approach than simply a stipulation for more storage. But we are seeing gradually, not as fast as I would like but gradually, some additional storage brought on stream and we will obviously watch it very carefully.

Q491 Christopher Pincher: What is the timeline for that gradual increase in storage capacity? Have you modelled this to work out where we are going to be in four years' time when, as you have suggested, there will be a start of the gas crunch?

Charles Hendry: It is slow to build. It depends on the technology. One that I visited recently is an old salt cabin and it took seven years to dissolve the salt in order to create the space for the new storage facility in Humberside. So there is a physical time it takes to build the different plants. Different approaches take different lengths of time so it is not a uniform length of time and it is difficult to achieve much in the course of this Parliament. It would need to be under construction already to be open by 2015, but we are constantly in discussion with companies like ENI that their Deborah field off East Anglia would double our gas storage facility on its own.

Q492 Christopher Pincher: Somewhere at 4.6 bcm, but as I understand it they appear to have colder feet now than they had perhaps a year ago.

Charles Hendry: They made a preliminary decision that they want to take it further but they have not made the final investment decision. We are in regular contact with them. I am due to meet Mr Formica, who is the Head of ENI here, in due course just to see if there are more things that we can do to try and encourage that investment decision.

Chris Barton: May I just add as well, I think generally when we are looking at storage it is important to see that there is storage in the context of a variety of measures of encouraging resilience. In particular, I think in this context we would emphasise the huge growth in LNG imports capacity within the UK. So storage has a very important role to play but it is not the only means of resilience. We have a variety of pipelines, we have the LNG, we have the storage, we have UK Continental Shelf production, we have demand side response, so we have a variety of different approaches; the key is to be developing them all. That said, we are very keen not to be, and we are not, complacent that everything is sorted at the moment. That is part of the reason why we have taken, or are hoping to take powers through the Energy Bill to sharpen the incentives on gas suppliers to ensure that they have adequate supply but then leave it to them to judge exactly what the best way of guaranteeing that security is.

Q493 Christopher Pincher: I take your point that LNG equals resilience but it doesn't necessarily equal security because it has to come from somewhere else and if you can't control the somewhere else then you don't have such a handle on your energy security as you might otherwise have.

Chris Barton: I think that is one of the reasons why we are very keen to develop as liquid a gas market regionally and internationally as we can, which comes back to the Russia question: the more resilience of supply and the greater diversity of supply to the global gas market, the more confident we can be that the LNG market will be able to supply.

Q494 Albert Owen: I wanted to pick up on these points that my colleague has just made now. I can remember not so long ago a very robust Shadow Energy Minister making statements in the House of Commons, that I agreed totally with, about the lack of storage and that the Government was short-sighted. The answer I have heard from a very diligent Energy Minister today is slightly different and I just want to pursue particularly on Qatar and the supply of LNG. The answer from the previous Government was that the Norwegian pipeline was coming on stream, that we were going into LNG. That is the situation today but there are still risks there and I am a little concerned that you are just leaving it to the market and leaving to industry whereas when you were a Shadow Minister, Minister, you used to say that the Government should be doing more. What has changed?

Charles Hendry: The Government is doing more, so we have delivered on that. First of all we are making this change in the Energy Bill, which will put a much higher cost on suppliers if they fail to meet their supply obligations. So we have significantly changed that, or it is being changed already, Ofgem is taking

through the necessary regulatory changes to make that a reality.

Q495 Albert Owen: So these external factors are very real?
Charles Hendry: They are very real. But we also recognise that the Government at the highest level should be doing more to secure long-term contracts. I have been critical of the past regime that whereas you would see Chancellor Merkel signing off a German gas contract, you would see President Sarkozy signing off a French one, we would send the British Ambassador along, who is a very fine person—

Q496 Albert Owen: But the Qatar deal is long term.
Charles Hendry: It was signed when the Prime Minister was in Qatar. So we have said that this is now a matter where it should be done at the highest level, led by the Prime Minister. These are matters of national security and getting in place those greater long-term contracts is going to be part of this process. So I think what we have done is we have tightened up on the requirement, much higher penalties will be coming through for industry if they fail to have adequate provision and, secondly, a much greater focus by Government on those supply contracts.

Q497 Albert Owen: But do you not agree—I have referred to your previous statements—that you are now saying that the role of Government on storage is slightly diminished to what you thought it was before?
Charles Hendry: What I said is that my preference is for solutions whereby the market operates but if the market doesn't provide us with the security of supply that we need then we will need to find additional measures that will address that.

Q498 Albert Owen: I don't think that is any different to what was previously said. I was in agreement with you then, and I am in agreement with you now.
Charles Hendry: I am not sure where that leads us.
Albert Owen: To an agreement.
Charles Hendry: May I also say that I was delighted that you were in agreement with us last night and you were, indeed, the only Labour MP who voted with us for the National Policy Statement, so thank you very much for that.

Q499 Dr Whitehead: That means I wasn't one of the Labour MPs. On the question of the market, we have heard that a consideration of gas storage could well be that, within essentially a free-ish energy market in Europe people could take the option that they would undertake gas storage for the UK elsewhere in Europe and then bring it back under the interconnector. I assume the same principle applies the other way around, that other of our European partners could decide that they wish to provide their storage in UK resources. Who would count what as counting towards whose energy security under those circumstances and might there be the possibility of double counting under those circumstances?
Charles Hendry: It is a European requirement that there should be open access to the storage facilities and a company cannot, unless it gets a particular exemption, build a storage that is only for its own usage; it has to make it more generally available. Those could indeed be to companies elsewhere in Europe. I am much more comfortable about gas storage at my end of the pipeline rather than at somebody else's end of the pipeline. I know it is more likely to be available to us when we need it and so that is why we put the focus on trying to get a better structure in place in that area. But this is an area where there is a fully functioning market and the price determines whether it flows into storage or flows out of storage. In the course of last winter, we did see times when it justified putting more into storage, even at times when it was very cold weather indeed, because the price differential justified that investment. I think when I look at the German market one of the things that I find attractive there is that the huge scale of the German storage system, because they don't have their own natural gas supplies, means that they are in a better position to buy cheap gas in the summer and to sell it in the winter and therefore that balances out the price as far as German consumers are concerned. But we are very long way off being able to be in a position to do that.

Q500 Sir Robert Smith: Just a nice easy question now. Briefly, how does DECC expect the global oil supply and demand will change in the next two decades?
Charles Hendry: You don't get easier than that, do you? We recognise that the demand for oil is going to remain high for the next couple of decades. We will be very significantly dependent on hydrocarbons more generally, even with the best ambitions with which we have moving in a low carbon direction. We are seeing additional sources of supply being found, that there is significant exploration work. We are also seeing countries like Saudi Arabia looking at a major nuclear programme so it can preserve its oil reserves for export rather than for its own domestic use, because at the moment it uses a lot of its oil for that electricity generation and it wants to move away from that. Therefore that will make more available more generally. We are finding, through different technology, that reserves that would have been unimaginably hard to reach a few years ago are now more achievable, so the ability to find more reserves to bring them into the market has enhanced. We are seeing some diversification in terms of the countries that have the oil reserves of their own demand and we will see a gradual move away from it.
I think one of the most important things that the International Energy Agency said in their annual energy report last year was that the gain for the consumer comes in managing demand so we bring it down before the peak. If demand doesn't come down until after the peak then the consumer is going to have to pay a higher price because of the imbalance between supply and demand, but if we can start to get it on a downward progression at an earlier stage then the consumer benefits.

Q501 Sir Robert Smith: Is there not a sense that we must be in a fairly tight situation, that even with a fairly global recession the price is still peaking and

spiking and hitting up and that really supply and demand is fairly tight?

Charles Hendry: There is inevitably in that a recognition of uncertainty. There is no doubt that there are very few countries that can increase output in a way that will meet extra demand. Saudi Arabia, foremost among them, has the world's largest reserves by far. Some of the countries that are within OPEC have very limited scope. Venezuela and Angola don't have much scope for increasing their output, but Saudi Arabia can absolutely and has said that it will increase output to ensure that demand is met and has done so. I don't think this is about an actual shortage but I think it does recognise that there are sensitivities in the market about the vulnerability of some of the countries involved.

Q502 Sir Robert Smith: Your recent call for evidence on crude oil supply and demand, has it had any impact on Government policies or contingency plans?

Charles Hendry: We have recently taken a decision on a strategic reserve release in order to try to reduce the pressure, and that was done on an international basis. We are constantly looking for evidence—and I will ask Chris Barton to come in on this as well—for where those constraints may be developing elsewhere around the world, where the demand is going to be growing fast.

Chris Barton: Just to add, I think the work we did seeking views on the future oil supply really reiterated for us the importance of pressing on with the main planks of our policy, dealing with the future of oil supply, recognising that most projections are for oil demand to be increasing swiftly, even under low carbon scenarios, and oil supply to certainly face constraints. We need to be looking to constrain our own demand for oil. We need to be trying to encourage development of low carbon alternatives internationally, and that includes being more energy efficient and crucially, I think, trying to reduce subsidies. The latest figure was over £300 billion a year is spent globally on subsidising consumption of fossil fuels, which is batty from all sorts of directions. We want to encourage investment and also to promote a more effective energy market, which we do through enhanced producer-consumer dialogue encouraging greater transparency. So there are a number of measures that we need to take but I think there is no getting away from it that the long-term answer has to be reducing demand for oil. Improving market functioning, improving investment all helps but it is not going to get away from the basic fact that oil demand increases at current rates cannot continue in the most likely scenarios.

Q503 Sir Robert Smith: So did the Treasury get sight of this information when it decided to switch tax from consumption to production?

Chris Barton: Yes, we have been generally engaged with them on all our oil market issues. In terms of our response to the call for evidence, we have engaged with them. I have learnt it is bad for my career prospects if I talk about individual Treasury decisions but certainly they are aware, and we work very closely with them on market issues.

Charles Hendry: I think there was also an urgency in a very rural constituency like your own, where people have to have cars and are really feeling the pain of the high prices, to try to do something to mitigate that. The approach of finding that elsewhere within the energy sector I think is something that is understandable, particularly given the way in which the prices have increased since the original investment decisions were made.

Q504 Laura Sandys: When one starts to look then at oil stocks and the impact of the new EU directive, which will bring us in line with other Member States and in line with the IEA requirements on stock requirements, do you see this as a positive measure that will assist with price volatility and some of the potential shocks and threats in the oil market?

Charles Hendry: We think our approach has worked. We have higher oil stocks than we historically had but we are very different from many other nations because we do obviously have significant oil reserves of our own. So I think that has to be taken into account in the way in which one looks at it. I can certainly understand that if you are a country without any of your own natural oil assets then a structure for greater security of supply is important, but I think one has to recognise that for a number of states in the EU, Britain foremost among them, we do have our own reserves, which are a different part to that equation.

Q505 Laura Sandys: But what do you think is the value of, for example, the IEA's stockdraw recently? What it did was it lowered the price for one week, or 10 days, and then the price just spiked again. Do you see it as an effective price mechanism or is it just there as a sort of sellotape that people feel is a security rather than the actual reality of security?

Charles Hendry: It is a combination of things. First of all, it was designed to show to the markets that governments were not neutral about this, governments did believe that prices were higher than they needed to be and should be and therefore we wanted to put some downward pressure on it. We also wanted to show support for the very strong leadership that Saudi Arabia gave at the OPEC meeting, where they said that they would be increasing their own production, and we wanted to show that there were areas where we could support that. So, for example, part of the shortage is in light crude, of which Saudi doesn't have a huge amount because much of that comes from Libya. So the focus of the stock release was on light crude and it was very much to complement the decisions that Saudi Arabia and some of the others had taken that we felt deserved recognition and support.

Q506 Laura Sandys: Do you think the Department has the capacity to, in many ways, participate in that sort of gaming when one is talking about hedging from one form of oil to another, supporting countries such as you say, Saudi Arabia? Do you have the capacity to do that in the sense of the expertise?

Charles Hendry: We certainly have the expertise. There is global expertise in these areas, and this was done very much as a joined-up global initiative, where this was done by a number of countries at the same time to try and ensure it had the desired effect.
Chris Barton: If I may just add, the IEA stock release system is very much designed for short-term supply issues and that is precisely how it was used in this context, in recognition that Saudi had increased—

Q507 Laura Sandys: Supply rather than price?
Chris Barton: Yes, it is explicitly not directly about trying to impact price, although clearly supply interruptions have an impact on price, but the primary driver is filling a short-term reduction in supply, recognising that Saudi had agreed that it was going to increase production but it would take a little bit of time for that to come into effect so the IEA stock release was helping with that. It certainly is not trying to game the system at all and, just to emphasise, this is not about trying to choose a particular price. It is rather wanting to make sure that if there is a short-term disruption to the supply of the oil market that we can use stock releases to meet that, and that it is agreed internationally, so the IEA stock release was agreed among all the IEA members.
The other point, if I may, just in terms of price. It is immensely difficult to say exactly what impact it has on price because, of course, 105 other things change after you do it, but our internal economic advice has been that their central estimate is that it will still have lowered price compared to what it otherwise would have been. There is uncertainty inevitably around that but the fact that some prices went up again does not mean that there was not an impact on price although, as I say, that was not the primary driver.

Q508 Laura Sandys: When you start to look at the UK's compulsory oil stocks, do you feel that they should be held by the public sector or the private sector?
Charles Hendry: Our approach to this is we don't believe it is the role of Government to be holding stocks.

Q509 Laura Sandys: Unlike other EU states?
Charles Hendry: Unlike others, yes. We have traditionally had a less interventionist approach in this area. We believe that we have a market structure that has worked here, which has delivered long-term security for us. Nothing we have seen persuades us that industry is not the right people to deal with this.

Q510 Chair: I think we are now over the time that you kindly offered to give us. There was one other matter that we were going raise that perhaps we might write to you about but we want to respect your wish to be away at 10.30am.
Charles Hendry: If you wish to raise it then—I may regret having said that.
Chair: No. It is a very innocent one. I wouldn't press it otherwise.

Q511 Barry Gardiner: Minister, we have heard this morning quite a bit on the radio about nudge theory in the Government. The National Emergency Plan for Fuel deals with how the downstream oil industry and the Government need to respond in an emergency. Does the plan contain proposals for how you will prevent public panic buying and how you will communicate with them to do that, and is nudge theory involved?
Charles Hendry: Sorry, what was the last part? Is nudge theory—
Barry Gardiner: Is nudge theory involved? That was a throwaway.
Charles Hendry: I think on issues as central to our national security interests as the availability of oil stock, I wouldn't leave that to nudge theory. Nudge theory, I think, has a very important contribution to make in attitudes towards energy efficiency, towards smart metering, micro-generation and many of those other things, but this is an area where clearer Government leadership is required.
Our first stage is to work very closely with the industry in terms of the availability of stocks and distribution network to make sure that it is robust and resilient. That is ongoing work that happens at all times. If we see international pressures or other pressures then clearly we address those immediately to make sure that we have the focus of attention that is necessary for taking that forward. Part of that process would also, absolutely, be consumer engagement, because a difficulty in supply could easily become a crisis if people decided to react in a way that was not necessary. So, for example, we have a massive fuel reserve in our vehicles and petrol stations, which traditionally are only kept half full. People drive around with their tanks almost empty assuming that the price must drop at any moment and then have to fill up reluctantly at the most expensive petrol station around. So we have some additional fuel storage space that can be used but part of the process would be that if we see an emergency coming then we do need to try and manage that in the most effective way, and of course that is part of the process.

Q512 Barry Gardiner: The MOU that was agreed after the 2000 fuel blockade, do you think that that will prevent such protests from disrupting supplies in future?
Charles Hendry: We hope it makes the system more resilient, that we are constantly vigilant. That was one set of issues that arose then; there can be others that could create a difficulty in the future. So part of the purpose of the plan is to be as comprehensive as possible, to involve all relevant Government Departments in a very structured way and to try and make sure that we are always looking forward and we try to avoid the emergencies happening rather than having to respond to them as they emerge.
Chair: Thank you very much indeed for your time again this morning and we look forward to seeing you again before very long.

Written evidence

Memorandum submitted by the Department of Energy and Climate Change

Introduction

1. The challenge for energy security over the medium and longer-term is significant. As indigenous resources decline, the UK is increasingly dependent on fossil fuel imports, leaving us more exposed to risks from rising global demand, limitations on production, supply constraints and price volatility.

2. Over the coming decade, UK production of oil and gas will continue to be in decline and our dependency on global LNG markets will increase. On oil in particular, we have seen recent increased levels and volatility of oil prices and there is clearly a risk that this will continue. Meanwhile, global pressures from increased demand, investment uncertainties and supply constraints pose major risks in the longer term.

3. At the same time, many power stations will close as they come to the end of their lives or are forced to close due to environmental legislation. By 2018, 16 power stations representing approximately 19GW generating capacity will close—that is around 25% of British electricity generating capacity. Further, the shift to low carbon generating technology, such as wind, which is intermittent, brings challenges

4. Therefore, we must take action to reduce our long term dependence on imported fossil fuels and reduce the risk of locking ourselves into a high carbon future where we are reliant, in global competition with others, on uncertain and potentially volatile supplies.

5. We are therefore acting in four key areas:

(i) *Maximising economic recovery of indigenous reserves*

We have policies in place to maximise economic recovery of our indigenous hydrocarbon reserves. Some 20 billion barrels (perhaps more) remain, around 3.5 billion of them in the deepwater areas West of Shetland. In our latest (26th) offshore licensing round, we have offered 144 new oil and gas licences covering 268 blocks.

(ii) *Reducing our demand for energy*

Reducing demand is often the most economically efficient way of reducing emissions; whether from appliances, lighting, houses or businesses. The Green Deal will provide household and business energy efficiency improvements at no up-front cost, with consumers repaying through the savings they make on their energy bills and the roll-out of smart meters will enable consumers to optimise their electricity and gas demand".

(iii) *Ensuring we have a strong, resilient market and infrastructure, through*

- Electricity market reform to ensure that the right long-term signals are in place to enable cost-effective investment in all forms of low-carbon generation while maintaining security of supply and the best possible deal for consumers;
- Gas market reform—improving our resilience to low probability/high impact events;
- Creating a Green Investment Bank to fund the scaling up and deployment of green technology and clean energy projects;
- Building import infrastructure to ensure resilient access to global energy markets, particularly for gas, oil and electricity;
- Developing a smart grid; and
- Institutional Reform, including reform of OFGEM.

(iv) *Influencing other countries*

- Where we are reliant on imports we need to manage that dependency through constructive bilateral relationships and international institutions, further diversifying our imports to reduce our reliance on individual markets, and supporting long-term contracts;
- Internationally promote low carbon growth, encourage necessary transitional investment in oil and gas production, promote more reliable supply of energy and enhance price stability; and
- Pursue the liberalisation of EU and global energy markets.

Immediate Challenges

6. These are central challenges in the long-term. However the Government is also focused on delivering the day-to-day resilience of our energy infrastructure. We live in an uncertain world, and the Government stands ready to meet immediate challenges—such as major climatic events, civil disturbance or terrorism. This is illustrated by recent developments in Japan and in the MENA region (the Middle East and North Africa).

7. The Secretary of State has asked the Chief Nuclear Inspector to submit an interim report by mid-May on lessons from the emerging nuclear crisis in Japan, with a final report within 6 months. The Secretary of State has also confirmed that the Government will consider the Nuclear National Policy Statements (part of the planning consents regime) in light of these developments, before proceeding with the ratification process. Safety is the Government's top priority.7.

8. Recent social unrest in the MENA region has put upward pressure on oil prices, due to market perceptions of an increased risk to supply, but with only limited disruption to global supplies, and no physical impact in the UK. If physical supplies were significantly affected, the UK is a member of the IEA's emergency response mechanism, whereby substantial strategic oil stocks can be released to make up a shortfall in the market; and we also have a National Emergency Plan for Fuel to help manage any domestic impacts.

9. Gas production was not affected during the uprisings in Tunisia or Egypt, and (as this Memorandum is prepared) has not been affected in any Gulf countries. Libyan gas exports have been suspended, but meanwhile Russia has increased exports to Italy, the country most affected, to make up the shortfall. The Japanese nuclear crisis could also impact global gas markets, through increased demand for imports of LNG (Liquefied Natural Gas) to offset reduced availability of nuclear generating capacity.

10. These developments underline the importance of a diverse mix of energy types and fuels, and of diverse sourcing of the fuels in an open, liquid and competitive market. This is further discussed below, in the response to Q.7.

Responses to specific questions

Q1. *How resilient is the UK energy system to future changes in fossil fuel and uranium prices?*

11. Resilience to future changes in fossil fuel and uranium prices is taken to mean the extent to which such changes are likely to feed through into higher energy prices (for electricity, heating, transport) and /or risk supply disruption.[1]

Uranium Prices

12. If global demand significantly affected the price of uranium, it would only have a limited effect on the cost of electricity generation as uranium represents a much smaller part of the cost of electricity in nuclear power stations than the fuel for other forms of electricity generation. This was illustrated in 2007 when the spot price for uranium moved from the very low levels it had been for almost two decades to record highs and then subsequently fell back. Since raw uranium only makes up a small proportion (around 1.5%) of total nuclear generation costs, the movement had little effect on overall nuclear costs.

13. In addition, we are confident of our ability to source uranium, now and in the future. Deposits of uranium are widely dispersed across a number of countries. Potential sources include countries that we do not currently rely on for fossil fuels and there are considerable resources available in OECD countries which can help spread the supply risk that could be associated with a particular fuel or region of the world. For example, over 40% of the Uranium supplied to EU utilities in 2009 was supplied from Australia and Canada alone.[2]

14. The OECD's Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA) have stated that, regardless of the role that nuclear energy ultimately plays in meeting rising electricity demand, the uranium resource base is more than adequate to meet projected requirements. The Euratom Supply Agency has expressed confidence that there are sufficient identified uranium resources to meet the current demand for about 100 years.[3]

Fossil Fuel Prices

15. Fossil fuel price increases could come about for a variety of reasons, for example, sudden increases in demand (eg due to cold weather increasing heating demand), supply interruptions or, in the long-term as a result of lack of investment.

16. The risk of interruptions to physical supplies will depend on what the driver is for the changes in prices. Changes in prices *per se* do not imply a risk to physical security, as has been shown in the recent oil price rises caused by unrest in North Africa and Middle East. In response to a shock, commercial operators and the IEA might be expected to act to mitigate the impact of the shock. Markets can respond to prices in the long-run in a number of ways, for example by attempting to alter the efficiency with which they use the fuel (eg using more fuel efficient vehicles if oil prices rose), switching to the most competitive energy source, and investing in new supply sources.

[1] Within Northern Ireland, energy policy is devolved. Depending on the context, this Memorandum refers to the UK or to GB.

[2] Euratom Supply Agency—Annual Report 2009, published 2010 http://ec.europa.eu/euratom/ar/last.pdf

[3] Justification of Practices Involving Ionising Radiation Regulations 2004, October 2010. http://www.decc.gov.uk/assets/decc/What%20we%20do/UK%20energy%20supply/Energy%20mix/Nuclear/newnuclear/667-decision-ap1000-nuclear-reactor.pdf (page 41)

Short-term price shocks

17. *Oil*: To mitigate oil price shocks, oil-producing countries can expand production to increase the amount of oil available to the market, putting downward pressure on the price. For example, Saudi Arabia has recently made a number of announcements of its plans to increase production capacity following unrest in North Africa and the Middle East. In addition, IEA members and EU member states have access to precautionary oil stocks equivalent to 145 days of net imports for IEA, 121 days consumption for EU. On unanimous agreement, these stocks can be made available to the market to offset the supply short fall.

18. *Gas*: Gas markets at present have a significant amount of production and transportation capacity relative to demand, and reductions in supplies from one source can be made up by increasing production flows from elsewhere, using stocks, and demand-side response. UK currently has sufficient import capacity alone to meet 150% of annual demand, though more will be needed in the future to replace declining domestic production and to provide resilience to unexpected outages and the increased demand from prolonged cold spells. As European and global markets become increasingly integrated then the market's ability to respond to shocks will improve, benefiting the UK. Implementation of the EU Gas Security of Supply Regulation, which came into force in December 2010 will also improve the resilience of member states, and the EU as a whole, to gas supply disruptions. The Government is also proposing further improvements with measures in the current Energy Bill to reduce the likelihood of a Gas Supply Emergency, and its duration and/or severity, should one occur.

19. *Coal*: A reduction in supplies from a particular source will tend to raise prices, incentivising increased supply from other sources of coal (production and stocks) and demand-side response. Since 2002, electricity generation has accounted for over 80% of UK coal consumption.[4] At the end of December 2010, stocks held at UK electricity generators were about 13.4 million tonnes (provisional estimate),[5] or approximately enough for all 23GW of transmission-connected coal generation capacity[6] to generate continuously at full capacity for about 63 days.[7] In terms of demand-side response, generators may switch to gas generation (depending on gas and carbon prices).

Sustained Price Increases

20. Should fossil fuel prices significantly and sustainably rise then, all other things being equal, there is expected to be significant impacts on electricity wholesale prices.[8] Changes in wholesale prices would be expected to lead to increases in retail prices (at least in the long-run).

21. We could also expect average retail bills for gas and electricity to rise too in this case, although the extent of bill rises would be offset to some degree in a number of ways. A range of Government policies aimed at reducing energy consumption and moving to more sustainable sources of energy would be expected to help shield consumers from increases in fossil fuel prices by reducing the demand for fossil fuel. Additionally, there is scope for consumers to reduce their energy consumption and, by creating greater incentives for investment in renewable energy sources, the subsidy requirement for these sources to achieve our renewables targets will reduce.

Q2. *How sensitive is the UK's energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?*

Electricity Networks (transmission and distribution)

22. Failure to put electricity network infrastructure in place will, immediately or over time, reduce the reliability of energy systems, with potentially damaging consequences for the local, regional and national communities and economies.

23. Lack of sufficiently robust electricity networks can cause or contribute to large scale blackouts. Such infrastructure projects often have long lead times and/or cater for longer-term needs, based on careful forward planning by energy companies; failure to put them in place may reduce future reliability.

24. Whilst the existing network needs to be maintained and upgraded to safeguard ongoing supply and accommodate new generation, it will also need to respond to the expected increases in demand due to the development of new housing and business premises as well as technological shifts such as the greater electrification of transport and heating. Electricity networks need to evolve on an ongoing basis to ensure a reliable supply of energy is maintained.

25. Ofgem estimates that around £32 billion needs to be spent on pipes and wires in the next 10 years to secure supplies for consumers and to move to a low carbon economy. This is a doubling of the rate of

[4] DECC monthly statistics, February 2011.

[5] DECC monthly statistics, February 2011. On average, from 1995 to December 2010, stocks at electricity generators over the course of a year peak in October (14.5 million tonnes on average), and are at their lowest in March (10.8 million tonnes), and stocks have never fallen below 6.2 million tonnes in any month since January 1995.

[6] DUKES 2010, Table 5.7.

[7] Based on an average generation per tonne of coal of 2.6GWh. In practice, it is unlikely that coal generation will run continuously at full capacity, and that generators will not have added to stocks at all since October.

[8] Electricity prices will be determined by the cost of the marginal sources of supply. This is often gas, or coal, power stations.

investment from the previous 20 years. In order to attract efficient investment, Ofgem's new performance based RIIO model for price controls rewards companies that innovate and run their networks to better meet the needs of consumers and network users. It does this by setting longer eight-year price controls, offering incentives focused on delivering results, and expanding the £500 million Low Carbon Network Fund to further encourage the development of smarter grids.

26. Beyond 2020, distribution networks are likely to need to expand and be reinforced to deal with growing demand, especially from electric vehicles and heat. The development of smart grids will also be important in working alongside traditional reinforcement to help manage network limitations and reduce the pressure on new infrastructure requirements.

Electricity Storage and Other Technologies

27. Storage, including pumped-storage plants such as Dinorwig and Festiniog, plays a small but vital role in meeting short-term surges in demand. In the future, storage has potential to play an even larger role in the management of the system carried out by the system operator, and in managing day to day fluctuations in generation and demand, particularly around intermittent output from renewables. A variety of technologies are in development to fill this role, though at present are not commercially viable.

28. The system operator currently procures the services it needs on a technology neutral, least cost basis, where storage must compete against other technologies which can provide the same services. The system operator will continue this approach as its requirements for reserve and other ancillary services grow up to 2020.

29. A similar process is present more broadly in the market, where storage must compete against investment in other technologies (such as conventional generation plant) that can provide energy. The case for investment in storage is likely to increase with greater volatility, which would come about with sharpening of cash out and increased levels of wind generation.

30. As part of the Electricity Market Reform consultation a Capacity Mechanism has been proposed which would be designed to ensure there is sufficient investment to guarantee resource adequacy. The starting principle of any such intervention is that it be technology neutral. So whilst storage may form part of this package, it will need to be considered alongside other technologies which would provide resource such as demand response, conventional generation, and interconnection.

Gas networks

31. A lack of investment in the gas network would put constraints on the system operator's ability to accept gas into the network, or transport gas within the network, and risk interrupting customers. For example, planning approval granted in December 2010 for a Pressure Reduction Installation at Tirley, Gloucestershire, will enable a 25% (around 5 bcm/pa) increase in capacity on the Felindre to Tirley pipeline (which transports gas from the Milford Haven LNG terminals), when the facility is operational.

32. The GB gas transmission network achieved 100% reliability in 2009/10. Despite record demand during winter 2009/10, it was necessary to interrupt only one interruptible customer[9] supplied directly from the National Transmission System (NTS) on a single occasion, and no firm customers.[10] National Grid's Transmission network reliability was 99.9999% for Distribution Networks.

33. In the future, investment may be required to accommodate changes in the level and profile of demand for gas: for example, to take account of energy efficiency measures, of electrification of heating, of the role of gas-powered generators providing flexible back-up to wind generation, and of the potential for bio-methane grid injection.

34. Information relating to forward planning for the gas transmission networks is set out in detail in National Grid's Ten Year Statement.[11] As for electricity, Ofgem's new eight-year price control review process offers incentives focused on delivering results, innovation and efficiency.

Gas Storage

35. Storage is one means of managing seasonal fluctuations in gas demand—as are flexibilities to modulate imports (via LNG and pipeline) and production from the UK Continental Shelf. Storage is also one option for dealing with short-term demand fluctuations or supply disruptions, which the UK may be further exposed to as it becomes increasingly import-dependent. Storage will also become increasingly important as the contribution from wind to power generation increases, when gas-fired generators are expected to provide firm back-up for wind intermittency.

[9] An interruptible contract may be signed by gas consumers where the relevant transporter and/or supplier has the ability to ask a consumer to reduce its off-takes. These contracts allow the transporter and/or supplier to disconnect the consumer (in or out of an emergency) in order to manage demand on the system. Consumers may sign these contracts in return for reduced rates on their gas supply.

[10] A firm customers is one with a non-interruptible gas supply contract. These customers cannot be requested to reduce their demand or have their demand curtailed except for following the announcement of stage 3 or greater of an emergency.

[11] National Grid Ten Year Statement: http://www.nationalgrid.com/uk/Gas/TYS/

36. At present there are nine commercial gas storage facilities in GB. Four new facilities are under construction, and another 16 proposed storage facilities, nine with planning consents in place.[12] Independent modelling,[13] commissioned by DECC, has shown that, in the short to medium term, the GB market is resilient to a wide-range of potential shocks. Additionally, the growth of a large and flexible LNG market, together with surplus import capacity, allows the GB market to access "virtual" gas storage through commercial arbitrage opportunities. The continued liberalisation of EU markets will allow this opportunity to expand. However, the report did identify certain scenarios, with a low but non-negligible probability, that could lead to supply disruption and/or high wholesale prices. In the current Energy Bill, the Government has therefore proposed new powers for Ofgem to make changes that would improve our resilience to such events, and which would help underpin commercial demand for additional supply infrastructure, including gas storage facilities.

Q3. *What impact could increased levels of electrification of the transport and heat sectors have on energy security?*

37. At a national scale the levels of electrification anticipated by 2020 will not have a significant impact on demand. Up to 2020, and for some years beyond, the main impact of electrification of heat and transport on security of supply is likely to be at the local level. Electric vehicles and heat pumps place a significant new demand on the network which, where clusters of installations occur, may exceed the capacity of the distribution system on a localised basis. Where clustering of installations does occur, reinforcement to the network, or management of demand, for example to stagger charging of vehicles on a particular street, will be necessary.

38. In March 2011 DECC published its revised 2050 Pathways Analysis.[14] Dependent on the choices of the user for how energy will be supplied in 2050, the Calculator shows that high electrification of demand can trigger significant challenges for electricity back-up, demand shifting and/or interconnection requirements with the European mainland, as well as a potential doubling of electricity demand.

39. The Electricity Market Reform consultation has made proposals for ensuring the market framework enables sufficient generation capacity to be developed, while remaining consistent with our long-term climate change targets and ensuring the best value possible for electricity consumers. Government is also working with Ofgem to ensure that we have the right investment framework in the distribution networks in the longer term to cope with future challenges such as electrification, and to enable network capacity to increase at the appropriate rate. It will also be important to develop smarter grids to help manage network constraints in the period of transition to greater electrification, especially where reinforcement is not feasible in the timescales allowed. Roll out of smart meters will be an important first step in enabling optimised charging, for example through the development of time-of-use tariffs. It will be important to ensure that local network operators can input into the use of demand management as a resource.

Q4. *To what extent does the UK's future energy security rely on the success of energy efficiency schemes?*

40. Actions to improve the energy efficiency of our homes and businesses make an important, cost-effective contribution to each of our energy policy objectives, including energy security. Through minimising overall demand for energy, energy efficiency will also minimise the total volume of fuel imports required, and sessen the need for new generating plant.

41. It is estimated that in 2020, post 2007 Energy White Paper policies to improve energy efficiency will have led to an overall reduction in domestic[15] final user energy demand of roughly 9% from "business as usual". This roughly equates to 12.7 million tonnes of oil equivalent (mtoe). Of this, electricity demand in 2020 will be reduced by some 55.7 TWh (4.8 mtoe, 14%), mostly through improvements in the energy efficiency of appliances and lighting. This will be of key importance for delivering our 2020 renewable energy targets.

42. It is important to note that many of the key energy efficiency measures we undertake today, such as loft and wall insulation, should last for many decades, thus contributing to our energy security objectives to 2050 and beyond.

Q5. *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?*

43. Some efforts to reduce emissions will enhance security: specifically, efficiency improvements, demand reduction and increased deployment of micro-generation. Equally, diversifying our energy sources and switching to naturally abundant renewable sources also reduces risk, and particularly our reliance on imported fossil fuels.

44. However some renewable sources are intermittent, which, for electricity generation, means we may still need back-up capacity (or additional demand-side response) to augment pumped storage. The Electricity Market Reform Project has consulted on whether a capacity payment mechanism is necessary to provide sufficient

[12] National Grid Ten Year Statement: http://www.nationalgrid.com/uk/Gas/TYS/

[13] GB Gas Security of Supply and Options for Improvement: A report to Department of Energy and Climate Change (Pöyry Energy Consulting, March 2010).

[14] www.decc.gov.uk/2050

[15] Excluding international aviation.

incentive for the market to ensure such generation is in place when we need it, while still meeting our emissions reduction targets.

Q6. *What would be the implications for energy security of a second dash-for-gas?*

45. A second dash-for-gas is interpreted as meaning a large increase in gas-fired power stations above currently projected levels. This scenario would impact on both gas and electricity markets.

Electricity Market

46. For the electricity market, so long as generators could access sufficient gas at reasonable prices, electricity security could be maintained since gas-fired power stations are able to increase output flexibly to meet any sudden peaks in demand. Indeed, gas-fired power stations are expected to play a significant role in the transition to a low-carbon economy, in particular, by providing back-up to intermittent renewable generation. However, one key effect would be to place an increased proportion of our generation capacity at the mercy of global gas markets; in particular the price and availability of gas supplies. As domestic production declines this represents a growing risk to electricity security to the extent that it is dependent on gas. Furthermore, in the longer-term, to be consistent with our climate change objectives, a growing proportion of any gas-fired generators would need to be replaced by lower-carbon forms of generation. The Electricity Market Reform consultation has set out a number of proposals aimed at ensuring the GB electricity market provides sufficient generation capacity to maintain electricity security, while being consistent with our climate change targets.

Gas Market

47. The impact on gas supply security as a result of increased gas demand will depend on a number of factors, such as whether GB transportation and supply capacity will be sufficient to meet the increase in demand, what arrangements the market has made to deliver the gas to GB, and whether any particular issues arise around system balancing.

Transportation capacity

48. It is important to note that an increase in gas-powered electricity generation would not come as a surprise to the gas market; particularly to shippers, whose role it is to source gas for their customers' demand, and gas transporters, whose role it is to transport that gas to sources of demand. This is because:

(a) there are several stages to bringing forward a new CCGT, such as project development, planning permission and construction, which together would take a number of years; and

(b) if the gas is to be transported through a network, then both network capacity and a connection to the network will be required. National Grid is required to make best use of existing capacity and to consider whether some unsold capacity can be substituted to other exit points. If additional gas transmission capacity is required, National Grid is obliged to make exit capacity available within 38 months from receiving signals from the exit capacity mechanism. National Grid is also required to prepare an annual statement for each of the succeeding ten years that will forecast the use and likely developments of the pipeline system. Together, these form a robust set of arrangements to allow for the delivery of sufficient transportation capacity.

Supply capacity and market balancing

49. In order to receive gas, the power station would need to make arrangements with a supplier in order to offtake the gas, which in turn would need to arrange with a shipper for that that gas to be available, including that entry capacity (such as import and storage capacity) is available. Again the lead times for delivering gas-fired power stations to the market would give the market some time to prepare for any additions to gas demand.

50. However, if gas demand were to increase rapidly, due to a rapid growth in power generation demand, and, for whatever reason, there had been an insufficient market response to provide sufficient gas supply capacity, then it is possible that the security of supply position may be impacted.

51. In 2010 DECC published three reports from Pöyry Energy Consulting which formed a thorough assessment of GB's security of gas supply; amongst other things these included sensitivity analysis, in which gas demand was assumed to increase significantly (for a number of reasons) in the medium-term. The analysis showed that large GB demand increases would not of themselves cause security of supply problems,[16] and that the market would remain resilient to a range of shocks. However, the reports identified some scenarios, with a low but non-negligible probability, that could lead to high prices and/or supply disruptions.

52. There are already strong incentives for shippers to match their input and offtake of gas into the gas network (and thereby ensure enough supply capacity is available), and these incentives are being sharpened further still through changes proposed in the current Energy Bill. The Bill proposes to give Ofgem a new power to sharpen financial incentives on gas market participants to meet their contractual supply obligations during a Gas Supply Emergency. In turn, these should also sharpen incentives to avoid a Gas Supply Emergency

[16] That is, supply would still be sufficient to meet demand even during a severe winter.

occurring by, for example, underpinning commercial demand for additional supply infrastructure (including gas storage facilities), as well as encouraging demand side measures such as more interruptible contracts.

System balancing

53. Ofgem previously assessed the balancing implications for the gas network of large gas demand from the electricity sector. At that time Ofgem judged that the balancing arrangements were adequate. Ofgem keeps these matters under close review, especially in the light of the potential impact that additional wind generation may have on the volatility of gas demand.

Q7. *How exposed is the UK's energy security of supply to international events?*

54. We assess the greatest risk to energy security to be volatile oil prices. However, this is not an issue for the UK alone—oil is an internationally traded commodity, with prices derived from the global market. Prices have been rising recently, in part due to increased global demand as economies recover from the recession. The recent social unrest in the Middle East and North Africa has further increased prices due to market perceptions of an increased risk to supply, but there has been only limited disruption to global supplies, and no physical impact in the UK. Wider social unrest would almost certainly increase market prices, but it would not necessarily impact physical supplies significantly. If physical supplies were significantly affected, the UK is a member of the IEA's emergency response mechanism whereby substantial strategic oil stocks can be released to make up a shortfall in the market and we also have a National Emergency Plan for Fuel to help manage any domestic impacts. Through the International Energy Forum we also work closely with oil producers, some of which can increase supplies to make up for shortfalls elsewhere.

55. Indigenous production currently meets around two thirds of UK primary energy demand. As UK fossil fuel production has declined, our former self-sufficiency has been replaced by increasing reliance on (net) imports, though to varying degrees depending on the fuel (coal, oil, gas). Imports of each come from a wide range of countries. By 2020, on central projections overall net annual energy import dependency is set to rise to over 40%, with a rise from just under 20% to nearly 50% for oil and just under 40% to just over 50% for gas. However, increased imports do not necessarily equate to reduced energy security, as the UK's experience of reliable supply from a diverse range of countries, sources and supply routes over many years generally shows. Furthermore energy prices—for oil and coal and increasingly also for gas—are set at a global level, even for domestic production.

56. The global gas situation is at present relatively benign (in large part due to global recession and the exploitation of new "unconventional gas" reserves in the United States), but could face challenges in the short term (eg if the Japanese market reacts to the closure of part of its nuclear generation fleet by importing additional gas from the LNG market that would otherwise have come to the GB market), and in the medium term should there be global underinvestment and /or supply constraints.

57. Supplies to the UK can also be affected by more local or regional issues, eg pipeline failures relating to supply from Norway, or disruptions to supplies from Russia to mainland Europe. However we have a diverse range of import sources, including UK Continental Shelf, pipeline from Norway and EU, LNG from a wide variety of sources and countries (including Algeria, Australia, Egypt, Qatar, Trinidad & Tobago), and withdrawal from storage. This has helped to ensure that gas disruptions on mainland Europe in recent years have not affected UK physical supplies, although there has been some price impact. Recent and forthcoming implementation of European legislation (eg Gas Security of Supply Regulation and the "Third Package" of energy market liberalisation) are making the UK and Europe even more resilient.

58. The Government has implemented a range of policies to address the risks. Domestically the UK is reducing the need for oil and gas imports—notably by maximising UK production and promoting low carbon alternatives such as electric vehicles, biofuels, CCS and fuel efficiency. Meanwhile, measures in the current Energy Bill are designed to improve the GB gas market's resilience to high impact/low probability events, by improving the interface with international markets during a gas supply emergency.

59. Internationally, the Government is working to:

- encourage investment in oil and gas production;
- promote more reliable supply of energy, through more efficient markets, stronger bilateral links and robust energy response arrangements;
- enhance price stability, through increasing transparency, shared analysis of energy and financial markets, and enhanced producer-consumer dialogue; and
- reduce demand, by supporting low carbon growth internationally.

Q8. *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?*

60. The Coalition Government has made Energy Security a priority, and is making vital reforms to our energy markets to ensure the UK has security of energy supply consistent with our climate change targets. We

do not believe that any further interventions are necessary, but we keep our energy security outlook under constant review.

Q9. *Are there any other issues relating to the security of the UK's energy supply that you think the Committee should be aware of?*

61. Emergencies, whether caused by natural hazards, accidents or terrorism, also have the potential to disrupt energy supplies. Although outside the scope of the present Inquiry, there is cross-government work underway, including by DECC, to improve how we prepare for such events.

March 2011

Supplementary memorandum submitted by the Department of Energy and Climate Change

Responses to Questions in the Committee's Letter of 19 July

Q.1: *With reference to Barry Gardiner's questions on the upgrade of electricity distribution networks. Please could you provide estimations of the costs associated with upgrade work to electricity distribution networks that will be needed up to 2020 (if necessary, under different scenarios) and specify whether these costs are included in, or are additional to, the £200 billion total investment to the energy system that DECC has said will be needed by 2020?*

The figure of £200 billion came from Ofgem's "Project Discovery" Energy Market Scenarios, published in October 2009,[17] and was Ofgem's estimate of the cumulative investment required in energy infrastructure to 2020 in their "Green Transition" and "Green Stimulus" scenarios. "Energy infrastructure" includes electricity generation, transmission and distribution, renewable heat, energy efficiency, smart meters, gas storage and LNG terminals and selective catalytic reduction (SCR) technology.[18]

The Green Transition and Green Stimulus scenarios factored in an increase in electricity demand due to heat pumps and electric vehicles. Ofgem's Project Discovery estimated that, in these scenarios, around an additional £40 billion of investment would be needed for electricity transmission and distribution by 2020.

The Smart Grids Forum, chaired jointly by DECC and Ofgem, and with a membership including network companies, has embarked on a programme of work to develop, a set of credible assumptions and scenarios to build consensus on the demands that networks are likely to have to meet, until 2030, in terms of the uptake of electric vehicles, heat pumps and distributed generation.

This will provide guidance to network companies on the preparation of well, justified business cases to underpin their business plans in the next Distribution Price Control Review period, which starts in 2015. I anticipate that the scenarios will be published in the first half of 2012.

Q.2: *In response to questions from Barry Gardiner and Sir Robert Smith you offered to provide further information regarding the assumptions underpinning DECC modelling and whether these take account climate change impacts. Please could you clarify what consideration is given to the potential impacts of climate change when thinking about the future of the UK's energy system? This is both in terms of changes in demand (for example increased use of air conditioning) and in terms of the physical resilience of infrastructure (for example resilience to heatwaves or flooding events)*

As I mentioned in my response to Q454, our modelling has been guided by advice from the Committee on Climate Change.

The impacts of climate change on weather have been factored into the calculation of typical heat demand in DECC's 2050 calculator. But they have not been reflected elsewhere. We are in talks with the MET Office's Hadley Centre to see if they can provide predictions of other aspects of future weather for use in our modelling.

The risks to infrastructure posed by natural hazards (including heat-waves and major flooding) are assessed annually with the Cabinet Office as part of the National Risk Assessment ("NRA") process. The Energy Sector Resilience Plan takes the NRA as its starting point. The "Sector Resilience Plans for Critical Infrastructure 2010–11" is on the Cabinet Office website.[19]

To date this work has focused on electricity substations where the electricity network companies have worked together with Ofgem, under the auspices of the Energy Networks Association, to produce an Engineering Technical Report "Resilience to Flooding of Grid and Primary Substations" ("ETR138"). ETR138 presents a risk-based methodology that provides guidance on how to improve the resilience of electricity substations to flooding to a level that is acceptable to customers, Ofgem and Government, taking account of a cost/benefit assessment for each site The major substation sites at risk of flooding have been identified; and a remedial work programme is in hand, focused initially on those sites with the greatest risk. The work is not expected to be completed until 2022; there will be residual, though reducing, risk during the period until then.

[17] http://www.ofgem.gov.uk/Markets/WhlMkts/Discovery/Documents1/Discovery_ Scenarios_ ConDoc_ FI NAL pdf

[18] Separate DECC analysis shows that around £75 billion could be needed in new electricity generation capacity by 2020.

[19] at: http://www.cabinetoffice.qov.uk/sites/default/files/resources/sector-resilience-plan-2011.pdf.

We are working with energy companies to understand the potential implications of hotter drier summers on the physical resilience of energy infrastructure. Meanwhile, by January 2012 the current Climate Change Risk Assessment work, led by DEFRA, will draw together evidence and analysis which will enable DECC better to understand the level of risk posed by climate change to the energy sector.

Q.3: *You mentioned that DECC carries out modelling to investigate how resilient the UK energy system is to multiple disruptions. Please could you provide the Committee with more information about this stress testing process, such as what is measured by this modelling work, how often it is carried out and by whom and whether the results are ever published?*

I mentioned in my reply to Q432 that we need a system that is able to withstand multiple shocks rather than simply an individual shock.

Such shocks will typically involve a combination of high demand, together with one or more stresses on the supply side.

In relation to electricity, analytical work, both in-house and by consultants, on the implications of interruptible renewables for our security of electricity supply, has strongly informed the Department's Electricity Market Reform White Paper (CM 8099, July 2011). That includes the current follow-up on the design of a capacity mechanism—which is taking into account the potential coincidence of high demand with low availability of interruptible renewables, together with other stresses on the "capacity margin".

As an example in the gas sector, I refer the Committee to a consultancy report for my Department, which I published last year: "GB Gas Security of Supply & Options for Improvement", by Pöyry Energy Consulting.[20] That assessed security of gas supply against various stress tests, including multiple shocks. It work has informed the development of policy, including the gas provision in the current Energy Bill, and Ofgem's current "Significant Code Review" on security of gas supply.

There is no rigid timetable for such in-depth formal analyses. Rather, we conduct specific in-depth work as and when that is judged appropriate. The judgement whether and when to do this is informed by more routine work on security of energy supply.

This includes the annual "Statutory Security of Supply Report" to Parliament, jointly by DECC and Ofgem. The first such report[21] was published last November; the next one will be published in the autumn.

In addition, the UK Government is required by the EU Security of Gas Supply Regulation (944/2010) to carry out a risk assessment every two years. This must include a number of stress tests, including an assessment of the ability of gas supply infrastructure capacity to meet total gas demand, at times of exceptionally high demand, in the event of disruption of the single largest piece of infrastructure. It must also assess whether arrangements are in place to ensure that the requirements under the Regulation, that households remain supplied with gas during periods of extreme demand or infrastructure losses, have been met. The first of these risk assessments is due to be published in the autumn.

More generally, and quite apart from these specific exercises, my Department keeps this issue under constant review.

Q.4: *You mentioned that energy security is a theme that runs through the work of the whole department. However, the Committee understands that there are also individual teams within DECC who have specific responsibility for leading on energy security work. Please could you provide further information on where energy security, at both the domestic and international level, sits within the DECC organisational structure?*

As I mentioned in response to Q430, the Department takes a very wide-ranging approach to the issue of energy security, which includes low carbon issues and affordability as well as resilience.

Reflecting this, management oversight responsibility for domestic and international security of supply, as well as resilience issues, has now been brought together under a single Director (Grade 3).

This will ensure a sharp focus on a range of issues that are increasingly important and challenging as we become increasingly import-dependent, and while at the same time our own indigenous energy supply sectors are undergoing major transformation to meet the challenges of the 21 century—the provision of secure, sustainable and affordable energy.

[20] See my Parliamentary Written Answer of 13 July 2010; "Official Report", cols.652W-653W. The report is on the DECC web-site at
http://www.decc.gov.uk/en/content/cms/meeting_energy/markets/gas markets/gas markets.aspx

[21] http://www.decc.gov.uk/en/content/cms/meeting_energy/en_security/sec_supply_rep/sec_supply_rep.aspx

Q.5: *Many other EU Member States have recognised the national aspects of strategic oil stocks, and manage them through an independent stockholding agency. The Committee has been told that the creation of such an independent agency-self-funded by industry—could lead to greater control in an emergency. It has also been argued that such an agency would save money as it would be able to take advantage of lower financing costs than the individual companies that make up the industry. What is the Government's view on these proposals?*

In my response to Q509 I mentioned that we have traditionally had a less interventionist approach in this area than some other EU Member States. We have nevertheless been reviewing our future approach to holding oil stocks, working closely with industry stakeholders.

We have excluded options based on publicly-owned stocks, given the inconsistency with our priority to reduce the budget deficit. However, there is

scope for a policy and regulatory framework that would enable obligated companies to design and implement an industry owned and operated central stockholding agency. Industry has indicated that this would be a more efficient way for them to hold stocks as the UK becomes more dependent on imports.

We continue to explore further with industry stakeholders an industry owned and operated agency option, with the intention to consult next year

Our highest priority remains to meet our international oil stocking obligations, and to have stocks available for use in an emergency—as in 2005, in response to Hurricane Katrina, and this June, in response to the disruption in Libya.

Q.6: *Barry Gardiner asked you if the National Emergency Plan for Fuel contains proposals for how the Government will prevent panic buying during a fuel supply emergency. You acknowledged that there would be some engagement with consumers, but we seek more details about this aspect of the plan and how you think it will work in practice*

The National Emergency Plan for Fuel (NEP-F) is DECC's plan for managing significant disruptions to road fuel supplies. It was developed in consultation with key stakeholders in Central Government Departments, the Devolved Administrations, Industry, Government Offices, the emergency services and local resilience planners.

The NEP-F would only be implemented in the event of an emergency where the availability of fuels was likely to be significantly affected, The NEP-F identifies how the resources of the downstream oil industry and the Government can be utilised in an emergency to protect human life, alleviate suffering, and support critical supply chains. The plan contains a variety of approaches and tools that can deployed in the event of a significant disruption to fuel supplies, be it at a regional or national level and as a result of a variety of possible causes, either local, national or international.

Clear and accurate communication will form a valuable part of industry and Government's response to a supply disruption. This can play an important role in both dispelling unfounded rumours as well as encouraging sensible and proportionate public behaviour in the event of an actual disruption. Government, the industry and relevant third parties all have a role to play and the communication plan that supports the NEP-F is designed to ensure that co-ordinated and consistent messages are deployed. Whilst we recognise that public concerns may lead certain individuals to buy fuel they do not need, we believe that clear information about the actual status of a supply disruption event, as well as advice on rational purchasing and a reminder that excessive purchasing can create wider social problems, will contribute to an effective overall response. More direct intervention in the market by Government remains an option, through a number of tools in the plan, if circumstances require.

August 2011

Memorandum submitted by the Confederation of UK Coal Producers

1. Closure of Existing Coal-Fired Power Stations

1.1 Of the 28GW of existing coal-fired plant, 8GW will close by the end of 2015 because it has been opted-out of the requirements of the Large Combustion Plant Directive (LCPD).

1.2 Because carbon allowances under the European Union Emissions Trading Scheme (EU ETS) will have to be purchased with effect from the commencement of Phase 3 of the Scheme in 2013, CoalPro believes that some of this plant may close before the end of 2015. Such premature closures will increase the risks to security of supply in the period 2013–15.

1.3 The remaining 20GW of coal-fired plant will have to invest in additional abatement equipment, particularly for NOx, to meet the requirements of the Industrial Emissions Directive (IED) if it is to continue to operate after the end of 2023. CoalPro is concerned that the uncertainties are such that it will be very difficult to take major investment decisions in respect of this 20GW of plant. If most of this plant closes, the risks to security of supply in the mid-2020s could be severe.

1.4 The provisions of the IED contain certain flexibilities. These are complex. CoalPro understands that the UK Government is taking a liberal interpretation of these flexibilities. However, this may be subject to challenge. If the Government's interpretation cannot be sustained, this may lead to more, and earlier closures than anticipated.

2. Construction of New Coal-Fired Capacity

2.1 The Government has made it clear that no new coal-fired capacity will be constructed unless at least partially equipped with carbon capture and storage (CCS). At the same time, the Government will fund, either directly or through a levy on electricity consumers, up to four demonstration CCS equipped power stations. The policy of the previous Government has been continued in this respect.

2.2 A competition, initiated by the previous Government for the first such demonstration plant is now moving to a conclusion. CoalPro understands that there is only one remaining entrant in the competition. The invitation to participate in a competition for the remaining three demonstration plants has elicited an encouraging response with nine applications. However, the Government has opened up this competition to gas-fired plant and two of the applications are for such plant. There is no certainty, therefore, that the funded demonstration programme will lead to the construction of four new coal-fired plant.

2.3 Whilst the competition process has resulted in an encouraging initial response, CoalPro is concerned that other Government measures pose major risks to the demonstration programme. If there is no relief from carbon price support for the abated element of such demonstration plant, there is no incentive whatsoever to invest in such plant as opposed to the alternative of investing in unabated gas plant. Furthermore, the lack of any relief from carbon price support in respect of the unabated portion of such demonstration plant will considerably limit the incentive to invest in such plant compared with the alternative of investing in unabated gas-fired plant.

3. Transition from Existing to New Coal-Fired Plant

3.1 CoalPro considers that the combination of the risk that more existing coal-fired plant will close, and that such closures may take place earlier than anticipated, as a result of the LCPD and the IED on the one hand, and the limited incentive to invest in new, CCS equipped coal-fired plant on the other may result in very little coal-fired generation capacity being available in the mid 2020s.

3.2 CoalPro believes that the transition from existing to new coal-fired plant needs to be very carefully managed. If not, the low level of coal-fired capacity in total that is likely to emerge in the mid 2020s may pose severe security of supply risks in a number of respects.

4. Overdependence on Gas

4.1 The expansion of renewable generation capacity between now and the mid 2020s offers superficial security of supply benefits in that the UK will not be dependent for this element of electricity generation on imported supplies of fossil fuel or uranium. However, renewable generation is intermittent and unreliable by nature and cannot supply electricity on demand. In particular, there is no guarantee that electricity from renewable sources will be available to meet demand at peak periods.

4.2 CoalPro recognises that some new nuclear plant will be constructed between now and the mid 2020s. However, this is likely to do no more, by that time, than replace nuclear capacity that will close. Whilst the new generation of nuclear capacity will be more flexible that the existing fleet, it will not be capable of rapidly ramping up and down to meet peak loads.

4.3 If there is very little coal-fired plant available in the mid 2020s, CoalPro considers that this combination of circumstances will lead to a massive overdependence on gas-fired plant at certain times. CoalPro invites the Committee to consider the scenario of a cold, still winter day in the mid 2020s. Renewable generation, whatever the level of capacity, will effectively be zero. Nuclear generation will provide some electricity but will not be able to respond to peak demands. At peak periods on such days, therefore, reliance on gas for electricity supplies could be as much as 80%.

4.4 Such conditions are hardly unknown. They occur at least once every winter and usually more often than that. In long, cold winters such as those experienced over the last two years, they may occur for several days at a time. If little coal-fired capacity is available, CoalPro considers that the overdependence on gas poses unacceptable security of supply risks to electricity generation at the same time that industrial, commercial and residential demand for gas will be at its highest.

4.5 Apart from risks to security of supply, such an over-reliance on unabated gas-fired plant will lead to long-term carbon lock-in making it difficult to achieve longer-term carbon reduction requirements for 2030 and 2050.

4.6 The security of supply and carbon lock-in risks will be correspondingly greater to the extent that electricity replaces fossil fuel used for transport and heat.

5. Effect on UK Coal Production

5.1 Coal production in the UK is a growth industry. Output has increased over the last three years and exceeded 18 million tonnes in 2010. CoalPro believes that, with ongoing investment in new and replacement mining capacity, the reserve base is sufficient to attain an output of 20 million tonnes a year and to maintain that level for many years. Some 90% of UK coal output is supplied to the electricity generation industry.

5.2 Investment lead times in the industry are long. If there is a perceived risk that the demand for coal in the mid 2020s may be less than that necessary to sustain an output of 20 million tonnes a year, bearing in mind that the industry's customers will not wish to completely forego the import option, then investment will be at risk.

5.3 The UK's deep mines require periodic tranches of investment to access new areas of reserves if output is to be maintained. The investment decision cannot be delayed. There is a point of no return beyond which investment to access new areas of reserves cannot be completed in time. If investment decisions are not taken in time, then closure is inevitable.

5.4 Decisions on new investment at all of the UK's deep mines will need to be taken in the next few years, in some cases imminently. Without some confidence that there will be an adequate market in the 2020s, the risks are such that the investment will not take place resulting in premature closures. Similar, but less acute considerations apply in respect of surface mining capacity.

5.5 There is a real risk, therefore, that the growth in UK coal output will be brought to a halt, followed by a decline. Investment will be stifled and employment will fall. UK coal production will be replaced by imported gas or, if the market for coal proves to be higher than is feared, by imported coal. Overall security of energy supplies will be adversely affected and the influence of a significant indigenous source of energy in mitigating fossil fuel price increases will be lost.

6. Overall Security of Supply

6.1 CoalPro considers that security of supply is best assured by having a diverse portfolio of sources available. This is particularly the case for electricity generation and particularly so at periods of peak demand. These considerations will become even more important as decarbonised electricity replaces fossil fuels used for transport and heat.

6.2 All forms of energy supply have advantages and disadvantages which do not need to be repeated here. Coal has particular security of supply advantages in that it is abundantly available, including from UK sources, and can be transported and stored by flexible, low risk means. An energy portfolio without a significant contribution from coal is thus inevitably a higher risk portfolio.

6.3 UK coal production has been increasing in recent years and the opportunity is there for it to increase further. Market uncertainties risk sending this into reverse. This will result in fuel produced in the UK being replaced by imported fuel, gas or coal, with the effect of reducing overall security of supply.

March 2011

Supplementary memorandum submitted by the Confederation of UK Coal Producers

1. *Can you explain why a carbon price floor would have a worse impact on coal than gas?*

Coal is a more carbon-rich fuel than gas. Moreover, new gas-fired plant operates at higher efficiency levels than the existing, ageing, coal-fired fleet. Hence for a given level of electricity generated, CO_2 emissions from burning coal are, very roughly, double those from burning gas. As the carbon price floor is related, albeit imperfectly (for further comment, see below), to CO_2 emissions, the cost of the floor per unit of electricity generated is, very roughly, double that for an existing coal-fired plant compared with a new gas-fired plant.

This problem would, in part, be addressed if the existing fleet of coal-fired power stations were to be replaced by new, higher efficiency coal-fired plant, as is being done virtually everywhere else in the world. The UK Government has stated, as a matter of policy, that no new coal-fired plant will be built without at least a proportion of CCS. The UK has therefore completely foregone, uniquely so, the option of reducing CO_2 emissions by replacing existing, relatively low efficiency coal-fired plant by new, higher efficiency coal-fired plant. Indeed, because of the energy penalty associated with CCS, it only really makes sense to fit, or retrofit, CCS to new, high efficiency plant.

What makes matters worse are the mechanics proposed for applying the carbon price floor to coal. This is based on assessing the CO_2 emissions from coal on a calorific value (cv) (or heat basis), and then converting this to a rate per tonne of coal. However, the average cv or heat content of coals used to do this is some 15% higher than the average heat content of coals used for electricity generation, thus imposing an additional penalty for coal. Even worse, the average heat value for imported coals (and hence the related CO_2 emissions) is higher than that of UK produced coals, so the use of a single per tonne factor for all coal discriminates against UK coals. The use of a rate based on heat content rather than a per tonne rate would resolve these problems and is the basis for accounting for CO_2 emissions under the EU ETS. CoalPro is in discussion with HMRC

on this issue. HMRC seem to be favourably disposed towards our arguments but, if these arguments do not prevail, coal in general, and UK coals in particular, will be further discriminated against.

It should be noted that the carbon price floor for gas is expressed in terms of heat content.

It should also be noted that, with an increasing carbon price, unabated coal-fired plant will be the marginal price-setting plant. This will result in windfall gains for existing nuclear, for existing and new gas plant, and to the extent that the value of ROCS is not correspondingly reduced, for renewables.

2. *Unlike gas, coal is easily stockpiled, so why is reliance on coal imports such a bad thing?*

First, domestically produced coal can be stockpiled just as easily as imported coal, and there is thus no security of supply argument favouring imported versus UK produced coal.

On the wider question, it is not a "bad" thing to relay on importing anything. In fact, provided the rest of the world is prepared to fund the UK infinitely and indefinitely, we could fulfil Napoleon's insult and become entirely a nation of shopkeepers!

In other words, the arguments are economic. It is not a "bad" thing to rely on coal imports per se, but it is surely a "better" thing to produce coal in the UK provided we can do so competitively, which we can. If we import coal, we export jobs and other economic benefits. If we produce coal in the UK, we retain employment and capture the other economic benefits.

3. *Russian coal accounts for approximately one third of the UK's total coal consumption—should we be concerned about coal imports from Russia?*

No, other than the economic arguments set out in the answer to 2. When Russian coal was first imported into the UK, there were some quality issues. However, Russia has developed into a reliable supplier both as to volume and quality.

The Russian supply chain is relatively complex. The coal has to be transported an average of 4000km to Baltic or White Sea ports. These ports are relatively small and coal is shipped therefore in relatively small vessels. It might be argued, for example, that in a long, cold winter in Russia, with heavy snowfall, and frozen seas at the ports, there is a greater security of supply risk with Russian coal than with imports from other sources or UK produced coal, but the difference is one of degree rather than kind.

To summarise, a concern about coal imports from Russia would relate more to geopolitical than logistical issues. Thus far, and unlike gas, there has been no such issue with Russian coal.

4. *How does the price of imported coal compare to that produced domestically?*

The price of coal, from whatever source, is determined by a fully competitive market. UK coals are priced to ensure that they are competitive in that market. If the international price falls, then UK producers will reduce their prices to ensure they remain competitive. Equally, if the international price rises, UK producers will take advantage of this to the extent that they are able to do so.

Generally speaking, UK coals are sold on a medium to long-term contract basis. In a rising market, as has been and continues to be the case, UK produced coal will tend to be, on average, slightly cheaper than imported coals as these contracts run their course. When they fall due for renewal, the new contract price will recognise any increase in the international price.

The benefit, in price terms, of a significant volume of UK produced coal is that it will exert downward pressure on the international price. Whilst the UK is a small producer in global terms, the volume is still significant in relation to the North West European market. Its availability thus exerts downward pressure on the price of imported coal delivered into North West Europe. In particular, it will tend to reduce the volatility of the NW Europe import price.

5. *How does the volatility in the price of coal compare to that of gas?*

Apart from an extreme price spike in 2008, when the international price, briefly, peaked at over $200 per tonne, at a time when there were similar price spikes for all other internationally traded commodities, the price of coal bas been on a steadily rising trend since 2002, without excessive volatility.

The Committee should seek information from other sources on price trends of gas in recent years. It has undoubtedly been rising (and indeed has remained high at over 50p per therm currently). I suspect it has been more volatile than the coal price, with seasonal variations rather greater than for coal prices, but this would need checking with other sources.

6. *How flexible would a power plant fitted with CCS be in comparison to a standard non-CCS plant, and what could the impact of this be on the security of the system?*

I am not an expert on CCS. However, one of the purposes of the UK and European demonstration programmes is to assess CCS plant under a range of operating conditions, including operation at varying load factors.

It is worthy of note that when the existing fleet of coal-fired capacity was constructed in the 1970s and 1980s, it was built to operate on base load. The plant operators have learned to operate it flexibly since then.

7. *What are the relative volumes of CO_2 produced in coal—and gas-fired power generation—as well as major industries—and what do these different levels mean for the cost of CCS and the volume of storage required?*

Very roughly, coal-fired power plant produces about twice as much CO_2 as gas-fired plant per unit of electricity generated. Whilst I am not an expert on CCS, my understanding is that, all other thing being equal, including the fuel price (they never are!), the cost of CCS on a gas-fired power plant will be less than that on a coal-fired power plant per unit of electricity generated, but more per tonne of CO_2 abated.

I have no information on the volumes of CO_2 produced by other industries.

As far as the volume of storage required, my understanding is that in depleted oil and gas reservoirs and in saline aquifers, the UK has more than adequate storage capacity for all large UK point sources taken together for perhaps many decades, but this statement needs checking with other sources.

8. *What is the UK's available capacity to store CO_2, and what is the estimated cost to build the infrastructure necessary to transport the CO_2 to storage locations?*

I am not an expert on CCS but my understanding is that the UK has a huge potential available capacity to store CO_2. I do not have information on the cost of the transport infrastructure.

9. *Will potential operators be willing to store CO_2 without indemnity against potential future CO_2—leakage?*

I am not competent to answer this question.

July 2011

Memorandum submitted by the Carbon Capture & Storage Association

Introduction

The Carbon Capture & Storage Association (CCSA) welcomes this opportunity to respond to the Energy and Climate Change Committee's call for evidence, "the UK's Energy Supply: security or independence?"

The CCSA brings together a wide range of specialist companies across the spectrum of CCS technology, as well as a variety of support services to the energy sector. The Association exists to represent the interests of its members in promoting the business of Carbon Capture and Storage (CCS) and to assist policy developments in the UK, EU and internationally towards a long term regulatory framework for CCS, as a means of abating carbon dioxide emissions and combating climate change.

Executive Summary

1. Fossil fuels provide over 70% of the UK's electricity supply and are likely to continue to play a major role in the UK electricity sector, at least in the short and medium terms.

2. However, their associated emissions represent a major source of CO_2, an important greenhouse gas. Carbon capture and storage (CCS) is a key technology that enables fossil fuels to become a low carbon source of electricity through the permanent geological storage of associated CO_2 emissions.

3. Electricity from fossil fuels is not subject to the intermittency of renewables, nor the inflexibility of nuclear, so they are an important tool for enabling generators to be able to meet variations in demand.

4. Pre-combustion capture CCS technology provides a cost-effective and low-carbon method of generating hydrogen from coal or gas. The "Hydrogen Economy", in particular when applied to the transport and heating sectors, offers the opportunity to diversify fuel sources and reduce UK reliance on imported oil and gas.

5. There is a risk that if Government CCS policy does not provide adequate support or incentive, and with the current effective moratorium on unabated coal and planned closures under the Large Combustion Plant Directive, the UK will be increasingly reliant on gas for its electricity.

6. Fossil fuels with CCS will allow the UK to maintain a diversity of fuel and energy sources. Specifically, abated coal plant would reduce the UK's exposure to gas price volatility, while supporting the low-carbon agenda.

7. CCS infrastructure projects are capital-intensive and will compete for capital with alternative investments. Fiscal, policy and regulatory uncertainty will inhibit investor confidence in funding CCS projects. Any new risks imposed by the authorities may deter investment and increase costs to the consumer.

8. It is important to note that according to the IEA and the EU, tackling climate change without CCS will be much more expensive. The development of CCS could also deliver substantial economic growth in the UK's green economy.

9. The CCSA is concerned that CCS deployment is not advancing as quickly as necessary. This will compromise the UK's ability to have secure, low-carbon electricity supplies. We eagerly await the conclusions of the Electricity Market Reform consultation which we hope and expect will contain the elements necessary to ensure CCS deployment and UK energy security—but only if properly implemented.

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

10. The CCSA only offers comments on the resilience of the UK energy system to changes in fossil fuel prices.

11. Fossil fuels provide over 70% (coal 25.8%, gas 47.7%)[22] of the UK's electricity supply and will continue to provide a significant proportion in the short to medium term. In the face of declining North Sea gas output, and the closure by 2015 of approximately 9000 MW of coal-fired plant due to the Large Combustion Plant Directive, the UK will become increasingly reliant on imported gas for electricity generation, as well as for domestic heating purposes.

12. Existing legislation requires all new coal fired power plant to be built with 300MW of CCS and, without appropriate support for CCS, there is a risk that *no* new coal plant will be built. If there are to be new coal plants built, it is likely that they will be parts of projects 2–4 of the CCS demonstration programme, although note that at least 1 of these will be gas. Clearly, a reduction in coal plant means the UK will become more reliant on imported gas.

13. Norwegian gas supplies are unlikely to be able to meet the gap created by increasing demand for gas and declining UK North Sea output, meaning the UK could become increasingly exposed to price volatility and potential geopolitical volatility in gas supplies.

14. Coal power plant, with CCS, will diversify the UK's fossil fuel requirement, increasing security of supply. In the face of rising gas prices, the UK's still significant coal reserves could provide added energy security. Therefore it is of paramount importance that CCS is rapidly deployed so that coal can provide cost-effective, low-carbon electricity for the UK.

15. While their overall use as a proportion of the energy mix may decline over time, it is important to keep fossil fuels in the UK's energy mix as—unlike nuclear—they offer a flexible source of electricity generation and, unlike wind, tidal or solar—are not intermittent. Fossil fuels therefore play a key role in ensuring that the UK's electricity supply can meet demand. When combined with Carbon Capture and Storage, the continued use of fossil fuels is fully compatible with the low carbon energy agenda.

16. Enhanced Hydrocarbon Recovery using captured CO_2 could be used to extend the productive lifetime of UK oil and gas reserves and can mitigate rising oil and gas prices, reduce dependence on imported oil and continue to provide North Sea jobs, prosperity and revenue as well as permanently storing CO_2.

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

17. Timely investment in the CCS industry is key to its wide spread deployment. Indecision in the critical near-term commercial scale demonstration of CCS and "first of a kind" implementation phases caused by near-term legislative, regulatory and policy uncertainty will delay investment and impair industry's ability to meet Government goals.

18. Without pre-empting the outcome of the Electricity Market Reform (EMR), we are concerned that it does not properly address these investment concerns. The most significant risk is that the reform package militates against fossil fuels, especially coal fired generation, with consequent impact on supply security.

19. Infrastructure projects are capital-intensive and will compete for capital with alternative investments. Hence any support provided must be structured to ensure that equity investors find them attractive. New risks imposed by the authorities may deter investment. It is also essential, if low cost to consumers is sought, to ensure that the project can be structured to allow a sizeable proportion of the capital involved to be provided by debt rather than relying solely on equity.

20. The EMR package will be good for mature technologies operating on a business-as-usual basis. CCS is neither mature nor is it business-as-usual. Demonstration projects incur considerable first-of-a-kind costs which the EMR cannot be expected to cover. These "FOAK" costs break down into two parts: early-stage or emerging

[22] DECC, UK Fuel Mix, disclosure period 1 April 2009—31 March 2010
http://www.decc.gov.uk/en/content/cms/statistics/fuel_mix/fuel_mix.aspx

technology costs; and infrastructure costs. There is good reason to separate these costs and provide separate support mechanisms, noting that: there is no certainty that emerging technology costs will be driven out of the system after four CCS demonstration projects; and the demonstration programme will not have provided a comprehensive geographic spread of infrastructure to free subsequent projects from further infrastructure hurdles.

21. A crucial milestone for CCS in the UK—strongly supported by the CCSA—is to ensure that Government's commitment to 4 UK demonstrations is maintained and delivered. Thereafter, the transition from CCS demonstration projects to progressively more widespread CCS deployment must be a continuous process. The operation of the electricity market around 2017–19 needs to show that CCS provides a business case for a new generation of plant. The CCSA is looking for the EMR to be a key element in the commercial deployment of CCS—thus enabling UK leadership in CCS.

22. However, CCS has not been advancing as quickly as it needs to. CCS technology is essentially proven but the policy and incentives framework is uncertain. DECC's CCS Roadmap, originally due in spring, is now due in the autumn. Without greater certainty, potential CCS investors—backed by pension funds and global money markets—will not deliver. DECC's 2050 Pathways confers on CCS playing an important role in meeting the UK's energy security needs in a low carbon way. Level 2 CCS deployment under the 2050 Pathways analysis would lead to 40 GW of installed CCS capacity by 2050. Level 4 would lead to 40 GW of installed CCS by 2039, and 86 GW by 2050. This pace of deployment under Level 4 is achievable and is similar to the peak rate at which gas CCGT was delivered in the 1990s. However, even meeting the ambitions of Level 2 which are necessary to meet Climate Change Act commitments is extremely challenging given the current trajectory.

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

23. Obviously, this development would increase overall demand for electricity. If this electricity is not derived from low-carbon sources, this will increase GHG emissions and make meeting Climate Change Act targets extremely challenging. Deployment of CCS is key to cost effective, low-carbon electricity in the UK and will support the electrification of the transport and heat sectors.

24. Potentially these developments could provide greater flexibility in fuel sources; electricity can be derived from the burning of coal or gas, whereas gas alone is currently dominant in the domestic heating sector. Thus coal with CCS would add diversity in heat sectors and increase energy security.

25. Pre-combustion CCS could be a key part of the "Hydrogen Economy", providing hydrogen—a low pollution and zero carbon fuel—for vehicles. If the UK is to have a substantial Hydrogen Economy in the future, fossil fuels with CCS will be required to economically produce the necessary large volumes of hydrogen.

26. The Hydrogen Economy, particularly when applied to the transport sector, would help to reduce the UK's reliance on imported oil. When applied to the heating sector it substitutes for imported gas.

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

27. Energy efficiency is important, but the rebound effect—where the potential benefits of efficiencies are diminished by increased consumption premised on the improved energy efficiency—will reduce its impact. Given the increasing need for electricity to meet modern consumer and industrial needs—and the extra demand from the electrification of the heating and transport sectors—energy efficiency measures alone will not provide energy security. Therefore, increased generating capacity will be required.

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*?

28. An energy mix consisting of renewables, nuclear and fossil fuels with CCS provides an excellent basis on which to meet GHG emissions reduction targets and to provide UK energy security. However if CCS is not widely adopted and supported then there is a real risk that there will be insufficient low-carbon generating capacity to meet demand as well as provide the necessary flexibility to respond to variations in demand. It is necessary to consider separately three types of capacity shortfall; these types are discussed in the following paragraphs.

29. The capacity shortage that occurs at the relatively short teatime peak of demand can be met by more interconnection, more pumped storage, demand-side reduction and open cycle gas turbines.

30. The second type of capacity shortage is that which could occur due to the difference in demand between day and night in winter—lasting, each day, for about eight hours and measuring around 20 GW. This is currently provided by older and less efficient coal power plant and gas CCGTs that are "two shifted". These units have consequentially rather modest load factors (30- 35%); this is acceptable commercially because the capital investments in these plants have been written off.

31. The third type of capacity shortage is that which could occur at periods of low wind across the whole generation system, sometimes lasting several days. If wind targets are met this shortage could measure up to 25 GW.

32. It is technically feasible for coal with CCS to provide the flexible, low-carbon capacity required to cover day-night and low-wind effects, but there need to be capacity payments to compensate for the modest load factors that are an inevitable consequence of such operating modes.

33. It should also be noted that the types of capacity shortages described above are additive in effect. Windless winter days are not uncommon.

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

34. While abated gas would be a low-carbon source of electricity, this would leave the UK highly exposed to volatility in gas prices.

35. The CCSA strongly believes that an energy policy that includes abated coal will provide diversity in fuel and energy sources, whilst also enabling reduced emissions.

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

36. Enhanced hydrocarbon recovery, made possible through the use of captured CO_2, could be used to extend the life of the UK's oil and gas reserves, helping to reduce the UK's reliance on imported fuels and thereby to reduce the impact of international events.

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?

37. The UK's energy policy is very much in flux at the moment, given the EMR, Carbon Price Floor and the EPS. This makes it difficult to answer this question with any degree of certainty. It is certainly possible that these policies *could* deliver secure, low-carbon, energy supplies. However, whether they do will depend upon the policy options chosen and how they are implemented.

38. The CCSA believes that CCS on *both* coal and gas—as part of the UK's energy mix with renewables and nuclear—will enhance UK energy security. Industry must be incentivised to ensure that CCS is delivered in a timely manner and this will only happen with credible, consistent and bankable policies.

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*?

39. Energy intensive and other industrial users are under increasingly severe pressure as electricity costs increase to meet tightening environmental legislation. This sector is a large employer and to be sustainable requires stable energy prices with minimum exposure to price shocks and regulatory driven escalation of prices.

40. Diversity of supply and appropriate infrastructure are important factors. CCS contributes to both by allowing coal generation to be maintained as part of the energy mix, minimising dependence on gas generation and by providing the anchor for CO_2 transport and disposal infrastructure, which is required by a range of industrial users in the medium term to underpin the reduction in emissions required from their operations.

The view expressed in this paper cannot be taken to represent the views of all members of the CCSA. However, they do reflect a general consensus within the Association.

Supplementary memorandum submitted from the Carbon Capture & Storage Association

1. *Can you explain why a carbon price floor would have a worse impact on coal than gas?*

The CPF proposes to remove the current exemption from Climate Change Levy for fossil fuels used to generate electricity. The rate of CCL for fossil fuels will be set according to the average carbon content of each type of fossil fuel, resulting in different carbon price support rates for gas and coal. When expressed as a price/KWh of electricity generated, the rate of CCL is approximately 2/3s higher for coal that gas (see Table 1). Capital costs for the construction of coal power plant are already higher than for gas (see Table 2). The imposition of CCL in its proposed form will increase the operating costs of coal plant, while making gas comparatively cheaper.

Table 1

INDICATIVE CARBON PRICE SUPPORT RATES FOR THE MAIN FUELS USED IN ELECTRICITY GENERATION: UNIT RATES IN ENERGY

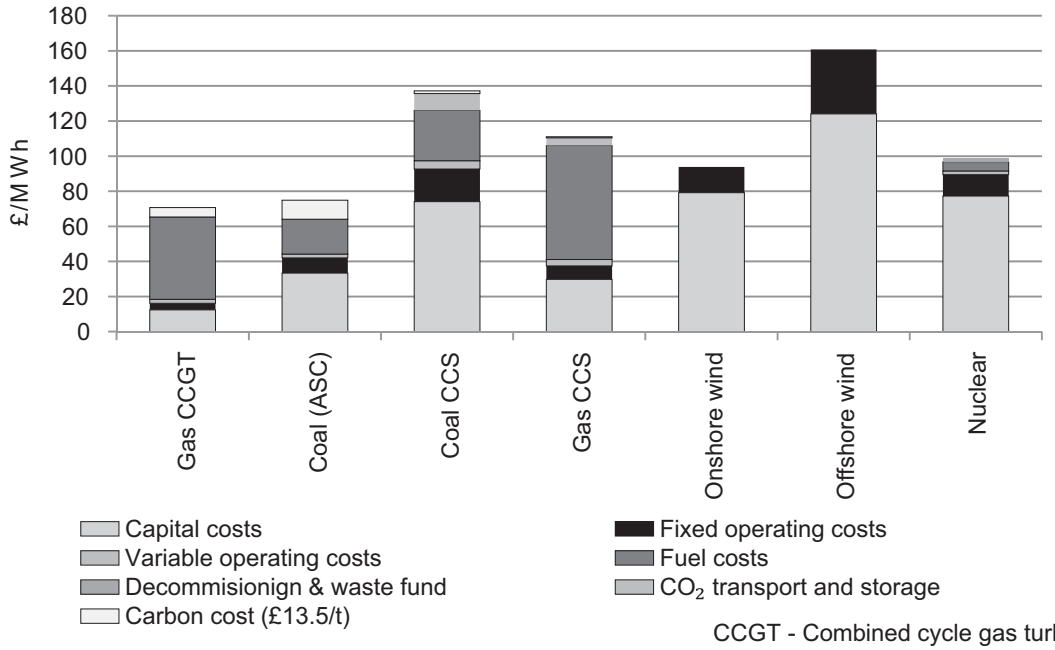
	Gas (p/KWh)	*Coal (p/KWh)*	*Fuel Oil (p/KWh)*	*Gas Oil (p/KWh)*
£1/tCO_2	0.018	0.031	0.027	0.025
£3/tCO_2	0.055	0.092	0.080	0.076
£5/tCO_2	0.092	0.154	0.133	0.126
£10/tCO_2	0.184	0.308	0.265	0.252

Source: HMT, Carbon Price Floor consultation document, 2010

Table 2

ILLUSTRATIVE LEVELISED COSTS OF A RANGE OF GENERATION TECHNOLOGIES ASSUMING CURRENT PRICES WITH 2009 PROJECT START

Chart 3.A: Illustrative levelised costs of a range of generation technologies assuming current prices with 2009 project start (£/MWh)



CCGT - Combined cycle gas turbine
ASC - Advanced super critical
CCS - Carbon capture and storage

Source: Mott MacDonald, 2010

2. *Unlike gas, coal is easily stockpiled, so why is reliance on coal imports such a bad thing?*

The ease with which coal can be stockpiled provides further reason to maintain (abated) coal as part of the UK's energy mix. Coal stockpiles can be used as a hedge against variation in fossil fuel prices, as well as the intermittency of renewables' output or (un)expected outages of nuclear plant. Reliance on coal imports is much less of an issue because of the ability to stockpile coal.

3. *Russian coal accounts for approximately one third of the UK's total coal consumption—should we be concerned about coal imports from Russia?*

No comment.

4. *How does the price of imported coal compare to that produced domestically?*

No comment.

5. *How does the volatility in the price of coal compare to that of gas?*

No comment.

6. *How flexible would a power plant fitted with CCS be in comparison to a standard non-CCS plant, and what could the impact of this be on the security of the system?*

There is an expectation that the ability of power plant fitted with CCS to operate flexibly will be tested as part of demo program, when further data will become available.

CCS has lower capital costs than other low-carbon energy generating technologies (Table 2) so the economics of operating CCS plant flexibly (ie on lower load factors) are more favourable than for other technologies.

The general issue of flexibility was covered in verbal evidence and is in the transcript.

7. *What are the relative volumes of CO_2 produced in coal-and gas-fired power generation—as well as major industries—and what do these different levels mean for the cost of CCS and the volume of storage required?*

In general CO_2 emissions from coal power are about double those of gas, as is the concentration of CO_2 in the flue gas. Because of the lower concentration the cost per tonne of capturing CO_2 from a gas power station is much higher but because of the lower emissions per unit of power output the cost per kWh is about the same, given the error band of cost estimates. It is interesting to note that in industries such as steel and cement the concentration of CO_2 in flue gas is double that of coal fired power plant and therefore, in theory, is cheaper to capture. In certain other process industries such as ammonia and natural gas processing the emissions are almost pure CO_2 and consequently the capture cost is very low indeed.

Clearly, if the CO_2 emissions from gas power are about half that of coal then the requirement for both pipeline capacity and also storage capacity will be commensurate. Of the three elements of CCS, namely capture, transport and storage, storage is anticipated to be the least cost element of the chain. Thus the impact of the greater storage requirement for coal compared to gas is likely to be a relatively unimportant determiner of the overall relative costs of CCS for the two fuels. Also, since the cost of pipeline capacity reduces considerably with diameter the cost of providing capacity for gas is not just half that for coal but will be somewhat lower depending on the specific installation.

CO_2 emissions from the energy supply sector were provisionally estimated to be 191.3 Mt in 2010. In 2010, direct CO_2 emissions from power stations were 156.2 Mt, just under a third of all CO_2 emissions. In 2010, gas usage for generation remains at historically high levels, whilst use of coal in generation has roughly halved since 1990. (Source: Decc: UK Climate Change Sustainable Development Indicator: 2010 Greenhouse Gas Emissions, Provisional Figures And 2009 Greenhouse Gas Emissions, Final Figures By Fuel Type And End-User)

In 2010, coal accounted for 28.4% of UK electricity supplied and gas 47.3% (Source: DECC, Energy Trends, March 2011). Emissions per unit of electricity supplied by major power producers from fossil fuels are estimated to have been 555 tonnes of carbon dioxide per GWh in 2010 overall; within this, emissions from electricity generated from coal (872 tonnes of carbon dioxide per GWh electricity supplied) were over two times higher than for electricity supplied by gas (364 tonnes of carbon dioxide per GWh). (Source: Decc: UK Climate Change Sustainable Development Indicator: 2010 Greenhouse Gas Emissions, Provisional Figures And 2009 Greenhouse Gas Emissions, Final Figures By Fuel Type And End-User).

Table 3

ESTIMATED ANNUAL UK GHG EMISSIONS FROM COAL AND GAS POWER PLANT

Fuel source	*GHG emissions per GWh (tonnes)*	*emissions per TWh (tonnes)*	*total emissions 2010 (tonnes)*	*total GHG emissions (Mtonnes)*
coal	872	872000	94777680	94.77768
gas	364	364000	6300200	63.9002
			total annual storage requirement (based on 2010 emissions)	**158.67788**

Assumptions: 872 tonnes CO_2 per GWh supplied electricity for coal, 364 for gas

Total generated electricity from coal (2010) 108.69 TWh; 175.55 TWh for gas

Table 3 shows the estimated annual storage requirement CO_2 for electricity generated from gas and coal. At 2010 energy mix and assuming 100% capture rate, the annual storage requirement would be 158.7 Mt CO_2. At 90% capture rate, annual storage requirement would be 142.8 Mt CO_2.

In 2010, CO_2 emissions from the industrial process sector were estimated to be 9 Mt (a reduction of around 2% compared with 2009). It is worth noting that between 1990 and 2010, emissions from this sector are provisionally estimated to have decreased by around 47% (Source: Decc: UK Climate Change Sustainable Development Indicator: 2010 Greenhouse Gas Emissions, Provisional Figures And 2009 Greenhouse Gas Emissions, Final Figures By Fuel Type And End-User). Current political efforts to "rebalance" the UK

economy, with a larger manufacturing sector, could slow this trend, or even reverse it, further increasing the importance of CCS for industrial applications.

8. *What is the UK's available capacity to store CO_2, and what is the estimated cost to build the infrastructure necessary to transport the CO_2 to storage locations?*

The most up to date reports on storage capacity are by the British Geological Survey (Industrial Carbon Dioxide Emissions And Carbon Dioxide Storage Potential In The Uk**,** October 2006) and the Scottish Government (Opportunities for CO_2 storage around Scotland—an integrated strategic research study, 2009).

As the BGS study states, "it is helpful to consider the CO_2 storage capacity of the UK and its Continental Shelf in terms of a resource pyramid that divides the total resource into three categories: *theoretical* resources, *realistic* (quantifiable) CO_2 storage potential and (clearly) *valid* CO_2 storage potential (Bradhsaw et al. (*in press*). These categories are a convenient and practical way to classify a continuum of potential in which increasing levels of confidence can be placed. The *theoretical* resource is very large because the UK Continental Shelf is very large and contains many sedimentary basins that contain potentially useful saline water-bearing reservoir rocks. However, the large parts of the UK Continental Shelf that are remote from land areas and at present do not contain identified oil and gas resources have theoretical CO_2 storage potential that is never likely to be realised. Quantifying this potential should be a low priority because of the high costs involved and because most of it will prove to be unrealistic. *Moreover it is already clear that the theoretical potential is sufficient for the UK's needs for the next few decades (see below).*

"The potential becomes somewhat more realistic in the non-hydrocarbon-bearing basins closer to shore, and significant, quantifiable and realistic in the hydrocarbon-bearing basins, particularly in the North Sea and East Irish Sea Basins. The CO_2 storage capacity in the UK's gas fields can be considered to be *realistic*, and close to the valid category and the storage capacity in the UK's oil fields can be considered to be within the *valid* category. The prime sites for geological CO_2 storage in the UK are considered to be the offshore oil and gas fields. Their realistic CO_2 storage capacity is estimated to be in excess of 7.5 Gt CO_2, of which the oilfield capacity (approximately 1.175 Gt) can be considered to fall into the valid category. There is a window of opportunity, open between now and 2030, to exploit these fields before the production wells are plugged and the infrastructure removed.

The realistic CO_2 storage capacity of the saline water-bearing parts of the Bunter Sandstone Formation in the Southern North Sea Basin is *up to* 14.25 Gt, but could be significantly less depending on how well-sealed the Bunter Sandstone proves to be. The realistic CO_2 storage capacity in structural and stratigraphic traps in the saline water-bearing parts of the Ormskirk Sandstone Formation is *up to* 0.63 Gt CO_2 —and this figure excludes any storage by dissolution and residual saturation. These two reservoirs are the only reservoirs that have been sufficiently well studied to realistically assess their CO_2 storage capacity. A further 3 Gt of potential capacity tentatively identified in the early Cainozoic sandstones of the Northern and Central North Sea Basin is not considered to be sufficiently well-defined to be included in the "realistic" category. Thus the total presently quantified realistic storage capacity of the UK and its Continental Shelf is >7.5 Gt CO_2, and could be up to 22GT CO_2. This compares to total UK CO_2 emissions of 0.575 Gt CO_2 annually, of which approximately 0.132 Gt comes from the 20 largest UK power stations. Thus the quantified realistic CO_2 storage capacity appears sufficient for the UK's medium-term needs."

The Scottish Government report concluded:

> "Scotland has an extremely large CO_2 storage resource. This is overwhelmingly in offshore saline aquifers (deeply buried porous sandstones filled with salt water) together with a few specific depleted hydrocarbon fields. The resource can easily accommodate the industrial CO_2 emissions from Scotland for the next 200 years. There is very likely to be sufficient storage to allow import of CO_2 from NE England, this equating to over 25% of future UK large industry and power CO_2 output. Preliminary indications are that Scotland's offshore CO_2 storage capacity is very important on a European scale, comparable with that of offshore Norway, and greater than Netherlands, Denmark and Germany combined."

The cost of infrastructure is very dependent upon the framework which is developed by government to support it. Right sizing pipelines for the anticipated volume of CO_2 from the outset will maximise Value for Money. Government support might, for example, be able to lead to more efficient decisions about when to rightsize pipes, or develop clusters. For example a relatively small increase in support might significantly enhance the throughput capacity of a pipeline for future capture projects. For example, internal work undertaken for DECC suggests that a typical pipeline serving multiple sources of carbon dioxide totalling 25M tonnes a year, would cost about twice that of a pipeline sized to handle the carbon dioxide from a single source of 2.5M tonnes a year. So, on the assumption that the single source pipelines costs £250 million increasing the capacity by a factor of 10 would cost an additional £250 million. It would also provide enhanced strategic and long term planning, which would provide increased certainty for investors.

In summary, support for right-sized regional CCS infrastructure could:

- minimize the overall costs to electricity customers for an expanded CCS rollout in the near future supporting the decarbonisation of the electricity sector; and

— Provide a lifeline for industrial users who emit CO_2 and who are now becoming exposed to cost penalties reducing their competitiveness

9. *Will potential operators be willing to store CO_2 without indemnity against potential future CO_2 leakage?*

Operators will not be willing to undertake a storage license agreement unless that agreement gives a clear and pre-defined mechanism for handover of liability to the State. In the UK, the government and the CCS industry have consulted together and we believe that regulation has been drawn up that is acceptable to industry whilst protecting the public good within the terms of the CCS Directive.

Under the CCS Directive, only storage sites that have a very low probability of leakage will be granted a storage licence. It is assumed that the value of the liability would closely correlate with the value of the volume of leaked CO_2 (based in EU ETS price). In a developed store, the value of the stored CO_2 could thus be many millions of Euros. It is impossible to precisely quantify this liability due to uncertainties in the future price of carbon under ETS, or even if ETS will continue beyond 2020.

The CCS Directive places the liability with the storage operator for a minimum of 20 years (however this can be reduced if it can prove to Competent Authority (CA) that the CO_2 is safely and permanently stored). Furthermore the transfer of liability to the CA will only take place after the 20 year period if the CA is satisfied that the CO_2 is effectively and safely stored. The storage operator must also contribute towards to cost of long term monitoring of the store.

A leak from a geological store is a low likelihood, but potentially high impact event. An indemnity arrangement that satisfies regulators without deterring investment is being developed. One possible model is a pooling arrangement similar to that in operation for the nuclear industry, which also faces a similar "low risk/ high impact" risk profile.

July 2011

Memorandum submitted by Stag Energy

Our memorandum consists of:

A. An Executive Summary

B. A background description of Stag Energy, which we believe qualifies us to be considered a significant expert in explaining the current barriers to UK gas storage development.

C. Brief comments on the need for additional gas storage, which aim to address Committee question 2. *How sensitive is the UK's energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?*

D. Brief comments on gas supply risks, which aim to address Committee question 7. *How exposed is the UK's energy security of supply to international events?*

E. Detailed comments on the weakness of current government gas storage policy and our proposals on what we think should be done, already made to both DECC and OFGEM, and which aim to address Committee 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?*

A. Executive Summary

1. Stag Energy's evidence is from the viewpoint of the largest new entrant stand alone storage company—ie a company with no other gas market interests. We therefore consider we are qualified as an expert both as to the reasons why new UK storage projects are not proceeding to Final Investment Decision ("FID"), and to what is needed to change this situation.

2. Stag Energy does not seek to offer an expert view as to the amount of additional gas storage required in the context of the supply risks. Nevertheless we calculate that around 5 bcm of additional storage needs to be built to meet a GB target of 30 peak day cover, which appears consistent with the NGG December 2010 Ten Statement ("TYS").

3. We do not agree that future gas imports are as secure as recent Ministerial statements made to Stag Energy in written replies to our concerns. We cite market intelligence and statements by NGG in support of this view.

4. We argue that the reality of the Government's current approach towards new gas storage is both ambivalent and not clearly thought through.

5. The general industry view is that current market forward prices do not incentivise new storage build. This is either a case of market failure to provide security, or the market is simply signalling that it is not possible to price for such a significant but rare extreme event.

6. The Government appears to have compromised on policy and chosen a new gas balancing measure that they claim will incentivise new storage against general industry advice that it will deliver nothing of the sort.

Parliamentary approval to introduce this measure is sought in the current Energy Bill (Clause 77). This invited wider debate in the House of Lords as to whether they had chosen the correct measure.

7. OFGEM are now also implementing the EU 3rd Energy Package, in which the UK Government wishes to take a lead. OFGEM proposes to "gold plate" GB storage regulations under this package. Paradoxically the "one size fits all" EU policy is quite unsuited to the GB storage market unless gas security Public Service Obligations (PSOs) are also brought into line with Europe. Implementation of the EU 3rd package will also come before Parliament later this year under the affirmation procedure.

8. Stag Energy advocates the following two changes in approach:

- The OFGEM process should be used now to establish a framework for a wide GB PSO. This is much more efficient in terms of time and removes regulatory uncertainty. However the new PSO would only be implemented if no new storage was committed to construction as a result of other Government measures now underway. This key difference between establishing a framework and its subsequent implementation has been put by Stag Energy both verbally and in writing to Ministers and their officials and OFGEM, but without response.
- A calculation of the value of security needs to capture the whole supply chain—ie society as a whole, rather than immediate gas customers. A "low margin" gas consuming activity that does not economically qualify for "protection" against gas supply failure may well be performing a vital public service. The OFGEM remit, which confines analysis to a framework where there are just gas customers who are somehow separate from the rest of society is too narrow to properly evaluate security issues.

B. Background to Stag Energy

9. Stag Energy is a private company based in Edinburgh. We are developing the Gateway 1 Gas Storage project, which is a 1.5BCM salt cavern facility located offshore in the East Irish Sea.

10. Gateway 1 has received all necessary planning and consents and has completed Front End Engineering and Design ("FEED"). Our second UK storage project, Gateway 2 has yet to apply for any consents but would add a further 1.5 BCM of storage. Both of these projects are listed in National Grid Gas December 2010 Ten Year Statement ("TYS"), and so comprise a significant part of the Government's recent public claims that up to 18 BCM of gas storage projects are under development in the UK.

11. Stag Energy is a member of the Gas Storage Operator's Group ("GSOG"). GSOG aims to speak with one voice in areas of common interest, ranging from taxation issues to regulations affecting data disclosure and access.

12. However it should be understood that there are clear differences in view between GSOG members when it comes to major policy questions depending on whether the relevant storage company is:

- An existing storage incumbent, or a new entrant which may potentially challenge an incumbent, and/or
- Part of a wider integrated gas group with other interests in the gas chain, or a stand alone storage company.

13. Stag Energy's evidence is from the viewpoint of a new entrant stand alone storage company—ie a company with no other related gas market interests.

14. Gateway 1 has reached the point where we have had extensive detailed negotiations with potential equity investors and storage capacity holders, both UK based and overseas.

15. Necessarily we have also had discussions with relevant Government Departments and the regulator OFGEM over gas storage regulation policy and licensing.

16. We therefore consider we are qualified as an expert both as to the reasons why new UK gas storage projects are not proceeding to Final Investment Decision ("FID"), and to what is needed to change this situation.

C. Need for Additional Gas Storage in GB

Q2: How sensitive is the UK's energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?

17. The policy debate as to whether GB needs more gas storage is not new. Indeed it had already featured in parliamentary debates in the late 1990s

18. Policy debate is confused by whether the UK needs any more gas storage, of what type, and what is the correct way to go about achieving this. It is a complex technical area with many different interests groups.

19. Stag Energy does not seek to offer an expert view as to the amount of additional gas storage required in the context of the supply risks we have highlighted below in Section D. We also clearly have a vested interest. So we have focused on offering advice as to what is needed to support investment in new storage, where we are expert.

20. However DECC asked our view of the amount of additional storage needed in autumn 2010.

21. We responded suggesting a 30 days peak ratio would be prudent, in conjunction with other sources of flexibility, in accordance with the EU gas security Directive.

22. Quite how this 30 day peak cover translates into an annual cover yardstick depends on the type of storage built, and therefore its deliverability characteristics, as well as its notional annual capacity.

23. Crudely, if the market were to focus on large scale inflexible reservoir storage, then a higher level of notional annual coverage would be required than with flexible salt cavern storage or pressurised tanks.

24. Stag Energy's calculation is that around 5 bcm of additional storage needs to be built to meet our 30 days peak cover target of which at least half will need to have high deliverability. We have never been advocates of matching French or German levels of annual cover, much of which is low deliverability.

25. We think this extra 5 bcm is consistent with the NGG December 2010 Ten Statement ("TYS").

26. This is a GB issue because Northern Ireland is considered to be part of the "All Ireland" energy market by the Republic and so gas storage development in Northern Ireland would be included in the Republic's PSO framework, so giving confidence to potential new investors. (See paragraphs 74 to 82 below).

D. Gas Supply Risks

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

27. Future UK gas demand is likely to prove more volatile because of increased intermittent renewables and a greater amount of gas fired generation, now even more probable post the Japanese nuclear crisis.

28. Ministers have consistently argued over the last decade, and continue to argue, that the supply side of our gas market has responded well to the challenge of increasing import-dependence. They cite the fact that GB's gas import capacity has increased by over 500 percent. Much of this, for example pipeline connections from Norway and Continental Europe as well as the major new South Hook LNG import terminal at Milford Haven, has been underpinned by long-term contracts.

29. On closer examination the picture is not nearly so robust. NGG published Transporting Britain's Energy (TBE) in July 2010.

30. Regarding Norwegian supply robustness NGG says:

- "Norway prioritises gas supply to the Continent"
- "For security planning we make the assumption that the loss of Norwegian production impacts the UK ahead of the Continent."

31. There is a wide possible range of possible Norwegian imports but with a decline setting in post 2015. The amount under long term contract is not transparent. It is also partly field specific and therefore subject to decline (Gateway estimate perhaps ~8 BCM at most, less than half, is at present is under long term contract and is therefore a "must flow" to the UK)

32. Regarding LNG supply robustness, NGG says;

- "Of all of the supply components LNG imports provide the greatest level of supply uncertainty due to numerous factors."
- "A view that most LNG imports to the UK may not be specifically contracted"

33. Stag Energy estimate less than half the LNG required on an annual basis, and shown in Figure 11, is long term contracted. The need for additional LNG supply becomes acute post 2016 as Norway falls away. Tightening of the global gas market by 2016/2017 is made even more likely as a consequence of China's postponement/possible cancelation of nuclear reactors representing 40% of global demand for nuclear reactors.

34. Regarding the interconnectors, NGG says;

- "It must be stressed that there is considerable uncertainty over future flows through both BBL and IUK due to options to flow gas to alternative markets and possible gas quality issues."

35. Stag Energy believes PSOs in most mainland EU states will remain in place, forcing supply prioritisation of these markets whatever GB price levels may signal. (see paragraph 75 below)

E. Government Policy, and Proposals Already Made by Stag Energy to Address Gas Security of Supply

Q8: 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?

36. We answer this question in three parts:

- E1. We summarise the different attitudes to gas storage amongst the various players

— E2. We explain why we believe current Government policy will not result in any significant new GB gas storage.

— E3. We set out what we have already proposed to Government and OFGEM to promote more gas storage in GB.

E1. Different attitudes to gas storage

37. Ministers may appear to agree with a consensus view that the UK requires more gas storage and it is merely a matter of how this can best be achieved.

38. However, we believe Government policy is also strongly influenced by groups opposed to increased gas storage and is rather ambivalent as a result.

39. The current position as we perceive them of the four major groups involved, on the basis of their published written evidence to the OFGEM SCR, are summarised below;

Customers

40. Large gas customers argue more storage is essential because for them a reliable gas (and electricity) supply could be a matter of business survival.

41. Domestic gas customers' appointed representatives Consumer Focus have argued against more gas storage because they perceive this would add to gas bills, but only large customers would benefit.

Market Participants

42. Gas importers, shippers and suppliers argue that recent market experience clearly demonstrates that UK gas security is more than adequate and therefore there is no need for new interventionist action to promote storage. They would wish to avoid the risk of additional costs that they may be unable to recover from the marketplace.

43. The gas storage industry puts forward inconsistent views, depending on whether it is an incumbent or a new entrant or is part of a wider group with other interests in the gas chain.

44. New entrants such as Stag Energy argue that the structure of the UK gas market is such that only direct market intervention by DECC/OFGEM will have a material effect on forcing significant levels of new storage. Other more established companies prefer to focus on tax and planning issues which would benefit their own operations.

45. Consultant reports commissioned by these different groups tend to support the views of those commissioning them.

Regulators

46. Historically OFGEM view's was supportive of the gas supply side view that security was not an issue.

47. However it changed its position post the 2008 Russian/Ukraine gas dispute. Project Discovery concluded that there is the risk of a major UK gas interruption which although of "low frequency" could be "potentially catastrophic".

48. This conclusion is surely now significantly reinforced by recent events in Japan and the Middle East. What should be done about this risk is however a matter for Government/DECC in policy terms, OFGEM being principally concerned with implementation.

49. At the EU level a gas security of supply directive requires a certain level of gas supply security but is non prescriptive as to how precisely this should be achieved. The UK government argues it is compliant with this Directive. This may be a generous interpretation, but it is unlikely any legal cases will be brought to test this assertion.

50. The general established EU approach is to have a prescriptive level of storage which gives storage operators a guaranteed potential market and so is quite different to the UK security approach post privatisation. The non-prescriptive aspect of the Directive was partly to accommodate current UK gas security policy.

51. The EU third Energy Package also affects gas storage by its "unbundling provisions. Unbundling fits well with the EU approach of guaranteed throughput for storage facilities but is less appropriate for the "merchant" storage facilities in the UK which would be very high risk in an unbundled environment.

52. These are currently being interpreted by OFGEM for UK implementation although the package will require parliamentary affirmative approval.

Government

53. The Government through DECC determines gas security policy and under Labour consistently took the view that there is no need for direct government intervention to promote gas storage.

54. The Coalition appears to remain content to let this area be driven by the market and is therefore more supportive of the views of gas shippers and suppliers and the need to avoid extra costs being placed on consumers. They are mindful of the extra costs now beginning to being placed on energy consumers as results of renewables. Gas storage costs would be small in comparison. Stag Energy has calculated that the costs of renewables (ROCs and feed in tariffs) on domestic customers are approximately 45 times those of an extra 5 bcm of new storage. Nevertheless a PSO is possibly viewed as one more burden too many, even if the customer is simply paying in other ways through higher average gas prices.

55. Both Labour and the Coalition has maintained a consistent policy of being supportive of gas storage development in removing artificial market impediments to storage in the planning and tax areas and easing the licensing regime. Historically these factors were thought to be the major impediment to gas storage rather than forward gas market prices, but currently are not material compared with the market environment.

56. The Coalition is now considering revising the gas market balancing regime to ensure that the incentives on gas shippers and suppliers are properly market reflective with regard to supply risk. The Energy Bill currently being debated in Parliament will give OFGEM extra powers to expedite this process.

57. Under Labour DECC consulted and twice rejected any new measures to promote storage, such as this gas balancing reform, so it could be argued that the Coalition is now taking some action. OFGEM have begun an implementation process under its Significant Code Review Process ("SCR").

58. But it should be noted that the Conservatives in opposition had argued that direct intervention on storage prescriptive lines, such as a PSO, was necessary to promote new storage, so, unlike renewables, the Coalition policy has changed to emphasising a market based approach.

E2. Current Government Policy will not Produce More Gas Storage

59. We argue that the Government's current approach is both ambivalent and not clearly thought through.

60. Ministers continually cite the 18BCM of existing storage projects which have not yet proceeded to financial close to be the result of a successful policy:

- Should we infer that, if few or none of these Projects proceed to financial close, then the current policy will be changed?
- If policy is changed then what storage target (size and timing) will the government use to base any change in policy?

61. Or, if the market arrangements are deemed "economically correct", and still few or none of these storage Projects proceed, then:

- Should we infer the logic of the Government's current position is that the market has correctly decided more storage is unnecessary and it is safe to run gas security risk?

62. The view held by both DECC and OFGEM appears to be that changing the gas market balancing rules will probably incentivise more storage.

63. However consultants employed by DECC under Labour twice found this balancing rules change approach to be the least effective of the measures available. (Oxera in 2008 and Poyry in 2010). It is a very complex approach, different to everywhere else in Europe, and largely untried except we believe in the very small Victorian (Australia) gas market.

64. Responses to the initial OFGEM SCR consultation generally confirm the view that changes to the balancing rules are unlikely to produce more storage. They also highlight implementation difficulties and unintended consequences.

65. Stag Energy's view is that the paramount problem remains the absence of a long term gas summer/winter differential price signal for the bulk of the potential new storage projects. Most of the current projects were initiated during the period 2005 to 2008 when this forward price signal was present, and all appear to have stalled now that this signal has disappeared.

66. It is a general industry view that changes to the balancing mechanism will not influence the forward curve significantly. This is because suppliers will find it too difficult to properly evaluate and price this new risk in the forward curve until after a supply failure event (the parallels with the 2008 banking crisis are striking).

67. There are a number of opinions as to why the GB market forward price curve differential has weakened, albeit the absolute annual average gas price has remained unchanged and comparatively high. Some pundits consider it to be a fundamental structural change signalling a lower need for storage, others that it is a temporary feature driven by the marketing practices of a limited number of large importers and the differential will reappear by 2015.

68. Forward GB gas markets are thinly traded and capable of rapid shifts in sentiment. When the differential finally reappears as a response to winter gas shortages it then may be too late for new storage to be developed.

69. Implementation of the EU 3rd energy package is taking place concomitant, but independent from, the OFGEM SCR process.

70. The Government has chosen to "take a lead in Europe" on implementation of the 3rd Energy package regarding unbundling. This appears to be based on the belief that a more competitive EU gas market enhances UK gas security, despite the presence of PSOs in mainland Europe preventing responses to price signals.

71. Consequently OFGEM's initial proposals on unbundling storage are to "gold plate" the package. They go far further than the 3rd package requires, involving potentially tight price regulation and annual auctions.

72. We think OFGEM's proposed regime fits well into the general EU environment where storage has a guaranteed throughput via PSOs and so capacity holders need to be price protected. However it is likely to prove highly toxic to the possibility of any new entrant UK merchant storage under the different UK market rules.

73. In summary, while Ministers might state they wish to see more gas storage in the UK, the renewables agenda and implementation of EU regulations appears to occupy a higher priority for DECC where there is any potential policy conflict.

E3. Measures needed to promote more gas storage in GB

74. France, Spain, the Benelux area and the Irish Republic all have mandatory levels of storage imposed on gas market participants through a PSO framework.

75. These PSOs have a direct impact on the UK market because they override market signals that may suggest for example reverse interconnector flows to the UK, and they will not change. Hence taking a lead on unbundling is unlikely to improve interconnector gas supply flexibility.

76. We recognise EU Regulation prefers "market based solutions" but we understand this to mean measures involving monopolist state or system operator roles are to be avoided. PSOs based on supplier shares obtained in competitive markets are the storage regulatory norm in mainland Europe and are interpreted as a market based solution.

77. We understand that it is the Government's view that focusing on a prescriptive level of storage through a PSO, and setting an annual target for that element, is inadvisable, because it would directly substitute one view of the appropriate mixture between the various balancing tools for the companies.

78. Ministers argue that "second guessing" the market in this way would not be cost free—for example, it would reduce the commercial incentive to construct what (on an ex ante basis) may appear to be marginally economic gas import capacity; during this winter we have seen just how valuable that capacity can be, in providing access to a benign international gas market.

79. Stag Energy's contention is that it is DECC and OFGEM who are the ones focusing on one solution. We do not see PSO and balancing changes as mutually exclusive. In fact there is a limited PSO already in place which was transferred from supplier to transporter licenses in 2007 following a DECC consultation.

80. Clearly there is a case for revisiting this PSO transfer and reassessing the scope of the existing PSO as complementary to anything that may be changed with respect to balancing rules.

81. We are mindful it will be necessary to move rapidly to a PSO should a gas supply shortage develop yet it takes some time (more than 1 year) to design a PSO under the OFGEM process, let alone finance and build a new storage facility.

82. We therefore also argue that it would be more efficient if the SCR process be used now to establish rules for a wider PSO, with no need for implementation if more storage projects are committed to construction in the meantime.

83. The point that there is a difference between establishing a framework and its subsequent implementation has been put by Stag Energy both verbally and in writing to Ministers and their officials. We have also put this point to OFGEM as part of the SCR consultation. We are therefore disappointed and that, what seems to us to be a helpful and constructive comment, so far seems to have received no acknowledgment.

84. No measure can be guaranteed to deliver 100% supply security. However, by its very nature, a PSO is guaranteed to produce a level of storage depending on how it is set and therefore is clearly more in tune with the spirit if not the legal niceties of the EU gas security directive.

85. It is also clearly the case that multiple storage projects within local GB jurisdiction deliver a better quality of security than, for example, flexible supply contracts subject to force majeure or commercial non performance, or the vagaries of international spot LNG markets.

86. We also think the value of security needs to capture the whole supply chain—ie society as a whole, rather than immediate gas customers. A "low margin" gas consuming activity may well be performing a vital public service.

87. Most major historic supply interruptions in GB have arisen from domestic infrastructure failure rather than physical availability of gas. It is difficult to see how balancing changes address this point, or how the consequent penalties can be fairly allocated to those ultimately responsible.

88. We conclude that if the SCR is to place a sole emphasis on balancing reform rather than a PSO it follows that balancing reform should be safely judged to deliver both the same level of security as a PSO, and at a lower cost. Balancing changes should not be prioritized as a sole measure if the level of security they deliver is uncertain and/or their associated costs are unclear.

March 2011

Supplementary memorandum submitted by Stag Energy

Regarding questions one, three and four, I do of course have views, but they are merely those of the informed layman, and I would defer to the views of the major suppliers and OFGEM.

Regarding question two, there is indeed some frustration in the industry with the complex procedures involved in the connection process managed by the Grid for both gas and power.

However I don't believe radical change is needed in philosophical approach, especially in the direction of changes which might add to the costs passed on to final consumers.

The Grid is a large private company whose interest largely lies in satisfying the regulatory authorities it is conducting its business correctly. Its culture is therefore strongly legalistic and bureaucratic. Grid management recognise the criticism that they don't treat connecting parties as proper customers, but I sense they are finding it difficult to reconcile the irreconcilable.

The path the Grid has now chosen to codify the connection process, allowing more interaction and granting more rights to the connecting parties, seems to me to be sensible and pragmatic and it needs to be given time to be established.

Could I also take the chance to raise developments subsequent to my evidence on Clause 79 of the Energy Bill?

You will be aware Clause 77 (now 79) was approved in the Commons on 16 June without any amendments being tabled, but the opposition did ask a question about a PSO. The Hansard report of this debate is below.

Clause 79

Power of the Gas and Electricity Markets Authority to direct a modification of the Uniform Network Code Question proposed, That the clause stand part of the Bill.

Huw Irranca-Davies: I have a brief question. I welcome the clause, which does a lot of good things, and the Minister is to be congratulated. One question arises from it: does he see any future role for a public service obligation as a belt and braces, or is he confident that the clause will give us gas security?

Charles Hendry: I am grateful to the shadow Minister for that question, which goes to the nub of where we are on the issue. The United Kingdom does not have enough gas storage at the moment. As we move increasingly to becoming net importers of gas in particular—60% of our gas could be imported by the end of the decade—we must have a variety of ways to ensure that the consumer has security.

The investment secured under the previous Government in the liquefied natural gas terminals in south Wales and the Thames, and the Langeled pipeline to Norway, have dramatically enhanced our energy security. We had the coldest December for about 100 years, but we came through it without pressure on consumers. It might have been more challenging if we had followed it with a very cold January and February, but when we are becoming more reliant on imports, energy security will be an important part of the process.

However, we still want the market to deliver a solution. Storage is one part of that solution rather than the only part. I hope that our approach is creating a framework that will put much greater financial penalties on companies that fail to meet their supply obligations and so incentivise them to invest in whatever technology they think is most appropriate: gas storage, long-term contracts either through shipments or pipelines, or interruptible contracts with their customers, which would ensure that they found a way to deliver on their commitments. I hope that that will deliver more investment in gas storage. Rather than being too prescriptive, it is right that we try to use a market mechanism to give the industry the ability to react as it sees best to that process. I hope that reassures the hon. Gentleman.

Question put and agreed to.

Clause 79 accordingly ordered to stand part of the Bill.

We were pleased to see that the Energy Minister recognised the need for more gas storage. However we remain disappointed that he still appears to believe that Clause 79 will encourage more gas storage.

As I stated in my written evidence to your Committee, GSOG, which represents all storage interests in the UK, has formally written to OFGEM stating this measure will not incentivise more storage.

However there has been a significant development in that Alistair Buchanan the Director General of OFGEM, is now reported by Utility Week to have stated on 9 June that Balancing Reform is not wanted by industry and is likely to be scrapped.

It seems that, if this report is accurate, Parliament was asked to approve new powers for OFGEM which the DG is reported neither to want nor intends to use. We have checked with Utility Week who stands by their story but the OFGEM press office has not answered our questions. We suppose that, as with many media stories, there are probably unreported nuances, misreporting and a grain of truth.

July 2011

Memorandum submitted by UK Coal Mining Limited

Executive Summary

1. Greater emphasis should be placed on indigenous coal as part of a diverse, secure and affordable energy policy.

2. Current planning policy on new fossil fuel stations, which only requires carbon capture and storage (CCS) on coal plant, is influencing developers build gas to meet the forthcoming energy gap. This will have a negative effect on both security and affordability of supply.

3. New gas fired power stations should be subject to the same requirement to fit CCS.

4. The current winter cold spell has highlighted our reliance on gas with two national balancing alerts in the first week of January and many industrial consumers having their supply cut off. Future planned gas build will exacerbate this position.

5. Coal fired generation could virtually disappear from the UK electricity mix in the mid 2020s with only up to four UK Government supported commercial demonstration CCS stations in operation.

6. The uncertainty over the future size of the coal market for power generation is hampering current investment in deep mines which has a long development lead time and payback.

Introduction

7. UK COAL Mining (UKC) welcomes the opportunity to submit evidence to the Energy and Climate Change Committee looking into the UK's Energy Supply. UKC is Britain's biggest producer of coal, supplying around 5% of the country's energy needs for electricity generation. The Group has three deep mines and six surface mines located in Central and Northern England with substantial reserves and employs 3,100 people. Around 95% of the Group's 7Mt/year production supplies the electricity generation market and as such we are heavily influenced by policy objectives affecting the electricity sector.

8. The UK is facing energy security challenges presented by a dramatically changing global economic, geopolitical and energy landscape. Global reserves of oil and gas are increasingly concentrated in a limited number of countries and there is a clear risk that global supplies will not keep pace with demand. The market for energy in itself is becoming global; meaning more countries are now competing for those limited energy supplies.

9. Norway has just slashed its estimates for undiscovered gas resources by 31%,[23] which could lead to a decline in its gas production from 2015. The sharp revision comes following a lack of significant new discoveries in Norwegian waters last year. Norway, which supplies Europe with 20% of its gas, cannot be seen as a long term secure supplier.

10. This winter's extreme cold spell has highlighted our reliance on coal, with it supplying almost half nation's electricity requirements at peak periods. At the same time virtually nothing at all was produced from our windfarms, as high pressure weather systems dominated resulting in no wind.

11. Coal generation, therefore is vital to the UK's diversity and security of energy supplies especially at time of dwindling indigenous gas supplies and volatile international energy markets. It needs to be part of the UK's energy mix during the transition period to a low carbon economy. Coal stations are now likely to close early because of the introduction of carbon price support which was announced in the March 2011 Budget. As a result the capability for coal to contribute in the transition to a low carbon economy over the next 10–15 years is lost. This capacity will be replaced gas plant, more reliant on imported supplies.

12. Indigenous coal can provide security of supply during the transition to a low carbon economy which includes CCS and it is vital that the proposal to introduce a carbon price floor does not squeeze coal out of the energy mix.

13. UK considers that security of supply is best assured by having a diverse portfolio of sources available. This is particularly the case for electricity generation and particularly so at periods of peak demand. These

[23] Norwegian Petroleum Directorate—press release 13 January 2011

considerations will become even more important as decarbonised electricity replaces fossil fuels used for transport and heat.

14. All forms of energy supply have advantages and disadvantages which do not need to be repeated here. Coal has particular security of supply advantages in that it is abundantly available, including from UK sources, and can be transported and stored by flexible, low risk means. An energy portfolio without a significant contribution from coal is thus inevitably a higher risk portfolio.

Specific Questions Posed by the Committee

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

15. As the UK becomes more reliant on imported energy it will become more exposed to changes in international fuel prices. Energy is an international traded commodity and in a world where energy demand is forecast to rise by 49%[24] between 2007 and 2035, it will become highly sought after. Therefore to secure the country's energy requirements the UK will have to compete on the international market with the result that prices will inevitably rise.

16. The UK energy system can cope with higher prices, but can the UK consumer? If the UK ignores indigenous energy resources such as coal, then higher energy prices could drive UK businesses overseas to regions with lower energy costs.

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

17. At present there is 28GW of coal plant on the system, this equates to around 35% of current generation capacity. Of this 8GW will close by 2015 under the provisions of the Large Combustion Plant Directive (LCPD). Because carbon allowances under the European Union Emissions Trading Scheme (EU ETS) will have to be purchased with effect from the commencement of Phase 3 of the Scheme in 2013, some of this plant may close before the end of 2015. Such premature closures will increase the risks to security of supply in the period 2013–15.

18. The remaining 20GW of coal-fired plant will have to invest in additional abatement equipment, particularly for NOx, to meet the requirements of the Industrial Emissions Directive (IED) if it is to continue to operate after the end of 2023.

19. UKC is concerned that the introduction of the carbon price support mechanism and other market uncertainties are such that it will be very difficult to take major investment decisions in respect of this 20GW of plant. If most of this plant closes, the risks to security of supply in the mid-2020s could be severe. Generators will subsequently build unabated gas plant to replace coal capacity closed under the IED. Because the Electricity Market Reform (EMR) will not force CCS to be retrofitted through its grandfather proposals, the investment case is much clearer cut and we will see a further dash for gas. This will have a dramatic adverse affect on security of supply and at times of winter peak demand when we have a high pressure weather system sat over the UK, we could be reliant on 80% of our electricity dependent on imported gas from Russia and the Middle East.

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

20. Electricity demand for transport and heat will place a greater demand on our electricity system. This will require massive investment in new low carbon generation capacity. The UK currently has a good mix of generating plant however going forward, because of the reasons stated above, this is likely more concentrated on unabated gas and wind.

21. At present investment decisions are being made to build unabated gas, renewables and nuclear. Government policy on new coal requiring CCS for the outset creates huge market and technology risk so it is likely that only up to four coal demonstration schemes will be built, thus precluding coal from playing its part in the long term energy mix.

To what extent does the UK's future energy security rely on the success of energy efficiency schemes?

22. Energy efficiency is the cheapest and easiest way to save energy and hence provide a contribution towards energy security. However, whilst energy efficiency programmes have been talked about for years, no real gain has been seen from their introduction.

23. It would be therefore unwise to place over reliance on energy efficiency schemes and it must be questioned if the energy efficiency scenarios within the Government's pathway analysis will ever come to fruition.

[24] US Energy Information Agency—International Energy Outlook 2010 (July 2010)

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?

24. Government forecast that wind generation will account for 29% of the UK's electricity generation in 2020[25]. This intermittent capacity will require large amounts of fossil fuel back up as cover.

25. However, UKC disagrees with DECC's analysis[26] that it requires a relatively small intervention the market with an estimated 5GW of capacity required to 2030 to maintain margins at 10%. UKC believes, it is necessary to consider three types of capacity shortfall:-

- (i) At periods of peak demand, for a few hours and for a few GW.
- (ii) A shortfall that could exist between day and night in winter lasting for up to 12 hours a day and amounting to 10–15 GW.
- (iii) The capacity shortfall that will undoubtedly occur from time to time when climatic conditions result in minimal wind generation across the whole country. This problem will get greater and greater as the amount of wind generation capacity increases. Such conditions occur at least once every winter and in some winters last for several days, ie December 2010, which saw the lowest temperatures since national records began in 1910 and the lowest wind speeds since 2001.

26. Existing coal stations play an important part in ensuring that the lights stay on and that we have a sufficient spare capacity. Care must be taken within the Government's electricity market reform package that the existing coal fleet is not phased out too quickly hitting capacity margins and threatening the transition to a low carbon economy

What would be the implications for energy security for a second dash-for-gas?

27. The UK is currently headed for a second dash for gas as a result of the introduction of a carbon price floor and the Government requirement for new coal plant to be fitted with CCS at the outset through an emission performance standard (EPS); but not imposing any such requirement on new gas plant for the whole of their economic life.

28. Carbon price support will incentivise switching from coal to gas with all the security of supply and price risks that will entail. Whilst this may result in earlier carbon reductions, it will lock in carbon emissions in the longer term because of the amount of unabated gas plant that will be constructed as a result. This will make it more difficult to meet longer-term carbon reduction ambitions. We should also be mindful of the potential for existing nuclear plant to attract windfall gains from this mechanism.

29. The EPS proposal will push generators to build unabated gas. As such no one is likely to build a new coal plant when they can build unabated gas and not have the obligation to retrofit CCS due to the Government's grandfathering proposals. The proposed policy clearly discriminates against new coal fired plant in favour of unabated gas and will result in a fresh dash for gas, reducing security of supply and long term carbon lock in.

30. At present the position with new gas stations[27] is as follows:

Recent commissions	4.2 GW
Under construction	4.6 GW
Section 36 approvals	7.6 GW
Section 36 applications	5.5 GW

The above build will replace existing coal plant and will have a dramatic adverse effect on the diversity of supply and at times of winter peak demand when we have a high pressure weather system sat over the UK, where we could be reliant on 80% of our electricity dependent on imported gas from Russia and the Middle East.

How exposed is the UK's energy security of supply to international events

31. Current events show that the UK is massively exposed to the volatility of international events. The troubles in Libya and the Middle East have fed through into higher oil and gas prices, whilst the nuclear problems in Japan have closed reactors across Europe and have fed back into higher electricity prices in the UK.

32. Successive UK governments have championed the "market" in the energy sector and as energy markets become more global, therefore we will become more exposed to international events.

33. Utilising indigenous supplies of energy is therefore crucial in alleviating the effect of international events. The UK still has significant reserves of coal and believes that coal burnt in the existing coal powered fleet will play a vital role in keeping the country's lights on until the mid-2020s. UKC accepts that for coal to contribute to the UK's long term energy mix, it must be accompanied by CCS. Until CCS is proven and deployed, the existing coal power station fleet provides an essential low cost transition.

[25] DECC—Updated Energy and Emissions Projections, June 2010
[26] DECC—Electricity Market Reform Consultation, December 2010
[27] DECC—Electricity Development Consents Branch

34. Therefore proposals contained within the EMR package must not be detrimental to CCS development within the UK, or cause existing coal stations prematurely to close and encourage the "default" option of building gas plant to replace it, thereby locking in carbon emissions beyond the life of the current coal fired plant.

35. It is also important to ensure that these proposals do not kill off the indigenous coal production industry in the short to medium term. When coal is required to fuel our fleet of CCS power stations in the future; the UK coal industry will have supplied the transitional market and continued to invest and demand is not met solely by imports.

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?

36. The policy of the UK Government is for the market to provide what is required and has placed obligations on suppliers to do so. It is likely that UK companies will compete in an international energy market to acquire what is necessary; however the downside of such a policy is that there is no control over price and UK consumers are likely to have to pay higher and higher prices as world demand increases.

37. Rising energy prices will affect the UK's industrial competiveness and force more households into fuel poverty.

38. The use of indigenous resources will provide some shelter to the vagaries of the international market and UKC urges the Committee to recognise the role that the UK coal industry can play in the UK's energy mix.

39. In 2010 indigenous coal was used to generate around 12% of the UK's electricity. Going forward UK coal producers can continue to contribute at this level, provided that coal generation remains within the energy mix. Proposals put forward by the Government in their Electricity Market Reform consultation are likely to prematurely close existing coal stations before CCS is proven and deployed.

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

40. Coal production in the UK is a growth industry. Output has increased over the last three years and exceeded 18m tonnes in 2010. UKC believes that, with on going investment in new and replacement mining capacity, the reserve base is sufficient to attain an output of 20m tonnes a year and to maintain that level for many years. Some 90% of UK coal output is supplied to the electricity generation industry.

41. Investment lead times in the industry are long. If there is a perceived risk that the demand for coal in the mid 2020s may be less than that necessary to sustain an output of 20m tonnes a year, bearing in mind that the industry's customers will not wish to completely forego the import option, then investment will be at risk.

42. The UK's deep mines require periodic tranches of investment to access new areas of reserves if output is to be maintained. The investment decision cannot be delayed. There is a point of no return beyond which investment to access new areas of reserves cannot be completed in time. If investment decisions are not taken in time, then closure is inevitable.

43. Decisions on new investment at all of the UK's deep mines will need to be taken in the next few years, in some cases imminently. Without some confidence that there will be an adequate market in the 2020s, the risks are such that the investment will not take place resulting in premature closures. Similar, but less acute considerations apply in respect of surface mining capacity.

44. There is a real risk, therefore, that the growth in UK coal output will be brought to a halt, followed by a decline. Investment will be stifled and employment will fall. UK coal production will be replaced by imported gas or, if the market for coal proves to be higher than is feared, by imported coal. Overall security of energy supplies will be adversely affected and the influence of a significant indigenous source of energy in mitigating fossil fuel price increases will be lost.

March 2011

Supplementary memorandum submitted by UK Coal Mining Limited

1. *Can you explain why a carbon price floor would have a worse impact on coal than gas?*

The carbon price floor is being introduced by the charging of climate change levy (CCL) on fossil fuels used for electricity generation. The CCL rate varies dependent upon the carbon content of the fuel and hence as coal has the highest carbon content it is being hit the hardest.

One tonne of coal emits approximately 2.3 tonnes of CO_2 when burnt. In terms of emissions per kWh electricity produced coal emits around 900gCO_2/kWh, whilst in comparison emissions from gas are around 380g/kWh (about 60% lower).

The Carbon Price Floor proposals will increase generator costs by:

	£/tonne coal	*£/MWh electricity generated*	*Effect on gas generation £/MWh*
2013	11.88	4.95	1.82
2014	17.49	7.29	2.68
2015	23.69	9.87	3.62

Existing coal generators are coming up to investment windows where they will have to spend significant sums on NO_x abatement equipment on coal plant to meet the Industrial Emissions Directive (IED) which commences in 2016. The Association of Electricity Producers (AEP) estimates that it would cost in excess of £100m per GWe of capacity to install the necessary Selective Catalytic Reduction (SCR) equipment.

The carbon price floor changes the relative attractiveness of investment in coal plant and faced with the additional costs imposed on coal generation, UK generators are likely to abandon their coal investment plans. Without investment in SCR, coal plant will have to reduce their running hours and close by 2023.

The closure of this coal plant will:

(i) Reduce the market size for our product.

(ii) Create uncertainty about the on-going role of coal in the energy mix.

(iii) Make it impossible to raise long term funding for the mining business, especially deep mines, leading to its early demise.

New gas CCGT stations will be the direct beneficiary of these coal station closures, which will allow to be built without CCS under current proposals.

A further issue which significantly affects indigenous coal is the decision to apply a flat carbon price support rate per tonne, irrespective of carbon content. Coal is not a homogenous product and is sold universally to the electricity generation sector on its heat content (measured in gigajoules GJ) to represent the amount of useful energy that can be extracted.

In general indigenous coals have a lower heat content than imported coal and hence a lower carbon content. As a result they emit lower volumes of CO_2 per tonne of coal burnt. If coal is taxed on a per tonne rate ignoring carbon content, generators will naturally opt to purchase higher calorific value coals as the tax per GJ will be lower.

We estimate that indigenous coals, on average, have heat content around 8% lower than imported coals. This results in imports having a monetary advantage of £0.95/t in 2013/14 rising to £1.90/t in 2015–16, based on indicative tax rates published in the consultation document.

2. *Unlike gas, coal is easily stockpiled, so why is reliance on coal imports such a bad thing?*

As the UK becomes more reliant on imported energy it will become more exposed to changes in international fuel prices. Energy is an international traded commodity and in a world where IEA forecast a rise in energy consumption by 49% between 2007 and 2035, it will become highly sought after.

If we become solely reliant on imported coal (and imported energy in general), we would be opening ourselves up to being buffered by international events such as wars and natural disasters such as flooding and earthquakes. Over the last six months energy prices have risen in response to the Libyan war, the Fukushima nuclear plant accident and flooding in Australia which seriously disrupted coal supplies out of Queensland. Who can predict what is likely to influence energy prices in the future?

Utilising indigenous supplies of energy is therefore crucial in alleviating the effect of international events. The Coal Authority has identified approximately 3.5 billion tonnes of coal resources within Great Britain. These are split as follows:

(Million tonnes)	*Deep Mines*	*Surface Mines*
Current mines & licences	595	112
Identified prospects	2,020	737
Total	2,615	849

The above reserves equate to over 190 years at the current rate of extraction in the UK.

3. *Russian coal accounts for approximately one third of the UK's total coal consumption—should we be concerned about coal imports from Russia?*

Russian coal is mined predominantly in the Siberian coalfield and travels overland over 4,000km to the Baltic ports before it is shipped to the UK. This lengthy journey can present logistical problems and shortages of railcars are not uncommon.

Transport over these large distances creates a large carbon footprint in comparison to local supplies. We estimate that transport emissions can be up to almost 300 times[28] higher than using local indigenous coal supplies.

Also this coal could just as easily travel eastwards to meet the growing Chinese demand for coal and Russia is now looking to target sales in this rapidly growing market putting price pressure on sales into the Atlantic basin. Russian exports to China have grown rapidly over the last two years from around 0.75mt in 2008 to 11.75mt in 2010.

Russian producers have a track record of withdrawing from the market when prices in the NW European market are low and with everything continuation of reliable supplies will come down to price.

The reliance on a high proportion of our coal supplies coming from one source will always give rise to the potential for disruptions and a risk to our security of energy supply.

4. *How does the price of imported coal compare to that produced domestically?*

Currently the price of international coal delivered into North West Europe is around $121 or £72/tonne. Delivered into UK power stations, we estimate it is costing UK generators around £79/tonne.

In 2010 the operating cost of our deep mines after depreciation but before non-exceptional items was £55.10/tonne.

The above comparison does not mean UK COAL is currently benefitting from these high prices as we are tied into historic contracts which are limiting our opportunity to sell additional tonnages.

5. *How does the volatility in the price of coal compare to that of gas?*

Gas is becoming the main driver of electricity prices within the UK. Looking at price movements since September 2009, wholesale gas prices have risen from around 20p/therm to around 57p/therm today, an increase of 185%.

In contrast international coal prices over the same period have risen from $68/tonne to $121an increase of 78%; less than half the increase of the wholesale gas price.

The remaining questions are CCS specific and probably best left to the CCSA to respond.

6. *How flexible would a power plant fitted with CCS be in comparison to a standard non-CCS plant, and what could the impact of this be on the security of the system?*

7. *What are the relative volumes of CO_2 produced in coal- and gas-fired power generation—as well as major industries—and what do these different levels mean for the cost of CCS and the volume of storage required?*

8. *What is the UK's available capacity to store CO_2, and what is the estimated cost to build the infrastructure necessary to transport the CO_2 to storage locations?*

9. *Will potential operators be willing to store CO_2 without indemnity against potential future CO_2leakage?*

July 2011

Memorandum submitted by BP plc

Summary

- Gas is well placed to make a valuable and necessary contribution to Britain's energy mix in the future.
- Gas is naturally the cleanest burning fossil fuel, producing 55% less CO_2 emissions than unabated coal.
- Natural Gas has the advantage of being competitively priced, and as a mature technology requires no subsidies to guarantee future supply.
- Unconventional Gas creates additional supply and security in the market place.
- Evidence suggests that the Gas spot price is decoupling from the Oil price.
- Gas security can be further enhanced by increasing storage capacity and enhancing connectivity of Gas markets within the EU.
- The UK has a strong infrastructure base with capacity more than expected to outstrip demand.

Introduction

1. Rather than responding to the questions directly, BP is best equipped to offer a more general response in the area where our expertise lies, namely the role which gas can play in the United Kingdom's future energy mix. For both security and environmental reasons, gas will continue to play a highly significant role in the UK's energy mix, not least because it is the cleanest burning of all fossil fuels, as well as being extremely

[28] Comparison of Russian imports and indigenous coal from Kellingley Colliery supplied to Drax power station.

efficient, flexible, versatile and well placed to back-up the intermittency of renewable energy. We will also offer some general comments on Energy Security and the role of Renewables.

Saving Energy Through Efficiency

2. Gains in efficiency have the potential to reduce the overall amounts of energy used and hence the carbon that is emitted globally without inhibiting economic growth. Efficiency can be increased in many different ways such as through improvements in vehicle and appliance technology, and through programmes that encourage or require people to be more conscious of their energy use. Often these gains can be achieved at relatively low costs or even at a net saving over all.

3. In transport, efficiency efforts could have an especially big impact. BP believes that advanced biofuels combined with several vehicle combustion engine and power train technologies, including hybridization, offer the quickest and most effective pathway to a secure, lower carbon future, at least cost in the short to mid term. For passenger cars, the potential carbon savings from this combination of vehicle and fuel side technology options could equal those that are possible through widespread adoption of electric vehicles powered by a gas-fired electricity grid—and could be achieved more quickly, at less cost, lower technology risk and on a larger scale and using existing fuel distribution infrastructure and an appropriate legal and regulatory environment.

Maintaining a Diverse Energy Mix

4. BP believes the energy challenge can only be met through a broad and diverse mix of fuels and technologies. That is why BP's portfolio includes conventional oil and gas as well as oil sands, shale gas, deepwater production and alternative energies. At a fundamental level, we believe the most effective means of finding, producing and distributing diverse forms of energy is to foster the use of open, competitive markets. This should include secure access for exploration and development of resources with defined mutual benefits for resource owners and development partners.

Renewables

5. BP estimates that emerging renewable resources like biofuels, wind and solar will meet around 6% of the total Global energy demand by 2030. Over the longer term, BP believes that they will play an essential role in addressing the challenge of climate change, as well as offering important energy security benefits. Generally, renewable low-carbon energy is not yet competitive with conventional power. With regard to transportation fuels, their technologies will need to be deployed at scale and some of the technologies will need to make significant progress down their cost-curves in order to become competitive with their conventional fossil fuel equivalents even with the current or expected carbon price. Significant research and technological advancement as well as industrial scaling up are required before they will be ready to fulfil a large portion of the worlds energy needs.

The Qualities of Gas

6. Gas is naturally the cleanest burning fossil fuel, producing 55% less CO2 emissions than coal when burned for power generation, whilst also producing relatively little nitrogen oxide, sulphur dioxide or particulates. It also has a higher conversion efficiency, which means it loses less energy than other fossil fuels when producing electricity or heat. The reliability and flexibility of gas also make it an essential backup to intermittent low carbon sources of generation such as wind and solar.

7. Natural Gas also has the advantage of being competitively priced, and as a mature technology requires no subsidies to guarantee its future availability. As well as its competitive market price, new gas CCGTs also benefit from having a low capital cost and take as little as three years to build.

Unconventional Gas

8. In addition, and a more recent development, is the increasing role of Unconventional Gas which, at least in the United States, appears to be a "game changer". This is not just important for the US but has significant implications for the global market as well.

9. This "revolution" in developing new supplies of gas in North America has occurred in relative obscurity, but is no less significant for that. As little as four or five years ago, the United States of America was expecting to become a major net gas importer merely to satisfy its own existing needs. But technological advances in hydraulic fracturing and horizontal drilling are now being used to access unconventional gas deposits in tight/shale gas formations, as well as coal bed methane. The result is that, while estimates vary, the United States can now confidently assume the existence of between 50 and 100 years' worth of recoverable natural gas.

Gas as a Global Commodity

10. This has one direct consequence for countries such as the UK—namely, that vastly increased US production of unconventional gas will in turn free-up LNG cargoes for the rest of the world. The expected increase in uncontracted LNG cargoes will be free to go to wherever the price mechanism signals the greatest

need. This is especially important for Europe, because it addresses the misconception that increased use of natural gas involves greater dependence on a narrow range of gas suppliers. In fact, the opposite is becoming true. The UK is particularly well placed in this connection because the investment which has already been made in UK LNG infrastructure allows us to cope with increased LNG imports.

11. However, it is not just that US unconventional gas relieves the pressure on LNG supplies. The new technologies currently being applied in the United States have only just begun to be applied in the rest of the world. Worldwide and in total, unconventional gas has the potential to increase significantly Global Gas reserves.

12. Gas is increasingly becoming a global commodity—more flexible, more transportable and (given its diversity) more secure than ever in the past. There are now twenty two countries importing LNG, whereas a decade ago there were as few as nine. The movement and nature of the trade is also changing—from traditional point to point cargoes, to multi-basin, multi-point deliveries with increased trade between the Atlantic Basin and Asia-Pacific.

Gas Prices

13. There is an increasing body of evidence that suggests that the price of spot Gas is rapidly decoupling from the price of Oil. There is also evidence that long term contracts which have been traditionally linked to oil have been negotiated down in the light of LNG displaced from the US market being made available to Europe and Asia.

14. This means that the UK need have little hesitation in accepting the significant role which gas is destined to play in the UK's energy mix—and especially in paving the way to a low carbon future without risks to security of supply. The discovery and exploitation of Shale Gas should also sound a cautionary note for those who see no option other than reverting to heavily regulated and controlled markets. Nobody predicted its significance even six years ago.

The Role of Gas in Reducing Carbon Emissions

15. The intermittent nature of renewables requires some complementary form of load management to match supply and demand when generation is not available. Over time, the roll out of smart grids, smart meters and smart appliances is expected to contribute via the demand side, but the lead times necessary to replace the appliance stock are likely to be extensive and the overall effects are as yet uncertain. Taken together all of this is likely to be insufficient to guarantee supply, requiring some additional load-following generation at scale within this time period to provide a balance. Correlation between peak demand and low wind generation at times of low temperatures will also mean that such generation must also be guaranteed to be able to run at peak. It is likely that a substantial proportion of this capacity will be provided by new CCGT facilities.

Gas Storage

16. To bring the UK in line with other major EU markets, gas storage capacity should be increased from today's 4.4bcm to about 15bcm. For this to happen, it is necessary to consider ways of incentivising additional storage projects. It is also important for HMG to prioritise greater transparency of "public service" obligations imposed by EU member states on national energy champions to ensure piped gas responds to price signals, and to enhance connectivity within Europe, enabling current arrangements and agreements to work as planned.

17. The UK is in a relatively strong position with regard to import pipelines and LNG infrastructure. Planned investments are more than adequate for National Grid's predicted level of future imports beyond 2020. Greater integration within Europe would help to further diversify supply, thus creating security.

Conclusion

18. Natural Gas offers the UK an effective means to achieve energy security in the UK. Its competitive cost, and wide supply base, coupled with cheap capital costs and quick build times for Gas power stations—and an excellent infrastructure system—means that the use of Gas in our energy mix can only enhance our energy security.

March 2011

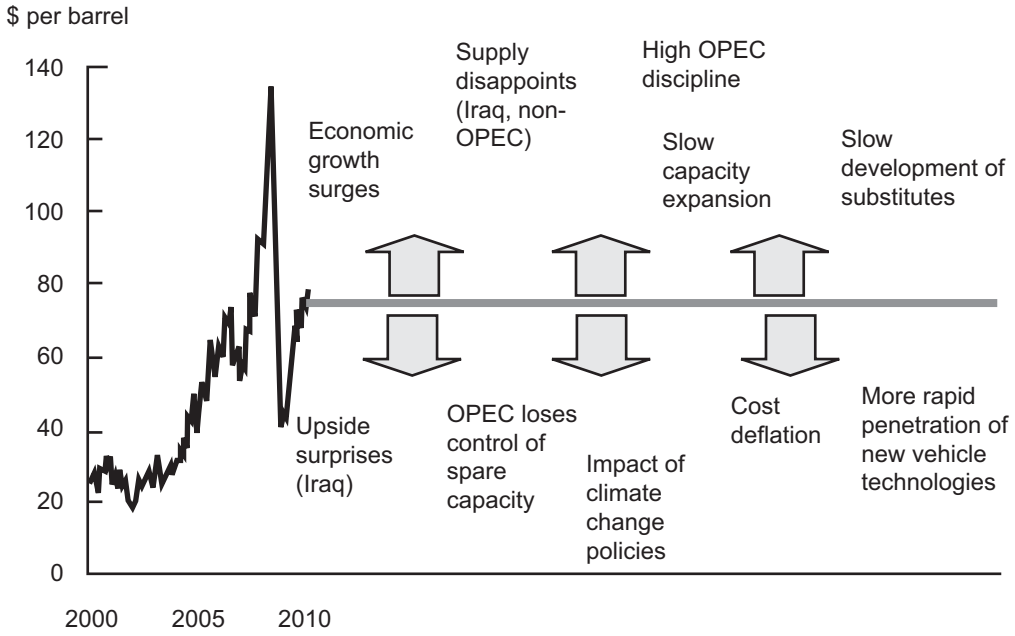
Supplementary memorandum submitted by BP plc

During the oral session on "The UK's Energy Supply: Security or Independence" held on Tuesday, 28 June we were asked to provide additional information in writing to the Committee on the topics of the global oil price and emergency stocks. The information is as follows.

Q.318–321 BP was asked by the Committee to describe how the oil price is determined and then clarify the role of international oil companies (IOCs) in determining those prices.

The oil price is determined by supply and demand. In simple terms, when demand increases (or supply drops) the price can be expected to go up. Correspondingly, if demand falls (or supply increases) then prices should fall. While this generally holds true, in practice there are complicating factors surrounding the oil industry which make it somewhat unusual when compared to other industries. These include, for example, market inelasticity which can produce high price volatility; the prominent role and unusual longevity of a major cartel (OPEC); the absolute size and scope of the oil industry and its important links to industrialization, economic growth, and the global distribution of wealth; plus a host of geopolitical issues which reflect the uneven distribution of oil deposits around the globe.[29] Yet the fundamentals remain the same, as illustrated by recent market behaviour in light of the situation in Libya. The onset of the Libyan crisis led to the imposition of UN sanctions on Libyan exports which resulted in a drop in the supply of crude to the markets. As supply decreased, prices responded accordingly by rising, and then responded again by falling when Saudi Arabia pledged to increase supply. They fell further when IEA opted to release their emergency stocks to the markets.

Oil price movements are accounted for by a combination of external shocks and internal dynamics. External shocks comprise wars, revolutions, economic "booms and busts" and natural events such as extreme weather. Internal dynamics, on the other hand, would include more normal occurrences such as significant decisions within OPEC. Through maintaining quotas on production, OPEC attempts to manage the price within a target band (sometimes explicitly, more often implicitly). This can produce episodes of relative stability, but the system is vulnerable to sharp shifts and when the market is tight (with spare capacity at very low levels), OPEC has little power to prevent upside spikes.



With this as background, we turn to the second part of the question relating to the impact which an international oil company such as BP might have on the oil price. A brief history of the IOCs from 1950 onwards is relevant. In the years following World War II, the world witnessed a surge in demand for crude and crude products, with consumption growing by 10% pa. During this period, the ten IOCs together controlled over 50% of global production, with full vertical integration from production through to refining and marketing. This control gave the IOCs a strong influence over the oil price. The 1970s saw a wave of nationalisation throughout the Middle East and other OPEC countries, which dramatically reduced the market share of IOCs in the upstream and severed the ownership link between Middle East production and OECD refineries. As a consequence of nationalisation OPEC took control of oil pricing away from the IOCs. During the 1970's pricing became a markedly political tool, as demonstrated by OPEC's decision to unilaterally raise prices during the 1973 Arab Israeli war. The waves of nationalisation and subsequent price spikes combined with the recession of the early 1980s led to several changes in the international market. Firstly, continuing political crises in the Middle East pushed buyers and sellers into the growing spot market. Over time, these developed into deep, liquid and transparent price discovery mechanisms and their growing strength brought an end to

[29] James L Smith, *World Oil Market, or Mayhem,* 2009, *Pg 2.*

OPEC pricing during 1987–88. In response to the end of OPEC price setting OPEC introduced production quotas maintaining some control over pricing through manipulation of the supply side. Non OECD growth since the year 2000 has further eroded the power of the IOCs, with emerging economies becoming more active players in the commodities markets.

Today, the IOCs together own around 5% of total world reserves, meaning that their impact on the price is negligible. Out of the world's top twenty oil and gas companies, sixteen are National Oil Companies (NOCs) and only four are super majors. Moreover, oil and gas reserves are very concentrated within these sixteen NOCs, with the top five NOCs holding 70% of world oil reserves. It is only the countries which hold large resource bases that have the flexibility of production to influence the price on the supply side. In contrast, the IOCs are "price-takers", not "price-makers": They maximise production whatever the prevailing price (except where IOC projects are in countries subject to OPEC quotas). The only influence IOCs have on the oil price in the short run is unintentional, when unanticipated outages cause a loss of supply.

Q328: BP was asked by the committee to clarify why pre-tax fuel prices spiked in 2008–09 during a world recession given earlier comments made by Peter Mather of BP that the oil price is determined by supply and demand.

Crude oil prices reached record levels in the first two quarters of 2008, driven by rapid growth in the emerging economies. Growth did not begin to fall until the third quarter of 2008. This decrease in economic activity and resultant fall in demand led to a decrease in crude and product prices, which reached their lowest levels in December 2008. While UK economic growth continued to slow-down throughout 2009, only returning to growth in the fourth quarter, the cost of gasoline increased markedly during the period. This increase in the pre tax gasoline price was consistent with an increase in crude prices throughout 2009, which doubled from near $40 a barrel in late 2008 to $80 a barrel by the end of the calendar year. Despite the global recession, this increase in price was consistent with the principles of supply and demand. While 2009 saw a drop in demand for gasoline globally, it also saw OPEC restrict the supply of crude to the market with OPEC production down by over 2% year on year. This fall in production was greater than the fall in demand for crude and its associated products during the period, pushing the price upwards. This was supplemented in the UK by a poor exchange rate against the dollar which exacerbated the pressures created by falling production and increasing demand.

Q237–8: BP was asked provide additional information on possible double accounting in the UK emergency stocking rules.

We refer the committee to the DECC document "UK Emergency Oil Stocks: A guide to the measures the UK adopts to meet its international obligations to maintain emergency oil stocks".

In compliance with the IEA obligations, the UK has bilateral agreements with several other EU countries which enable company stocks to be held in other countries. Plans are in place to repatriate any such stocks to the UK in the case of an emergency and are documented and endorsed by DECC. Therefore double-counting of such stocks should not occur.

July 2011

Memorandum submitted by John Mitchell, Chatham House

1. This submission aims to assist the Select Committee by suggesting questions to be addressed to government departments, and to energy industries with the resources to provide detailed answers.

2. The submission does not advocate a detailed energy policy for the UK Government, which needs to ensure the functioning of the UK energy market, security of supply to the UK, achieve the UK's climate change objectives, within the framework of the UK's market economy, and within the international obligations and political interests of the UK, including those arising from its membership of the EU.

3. Submission plan:

(a.) The concepts of energy security and energy independence;

(b) The international energy outlook, identifying how critical uncertainties are related through time;

(c) Summary and the committee's questions.

Security and Energy Independence

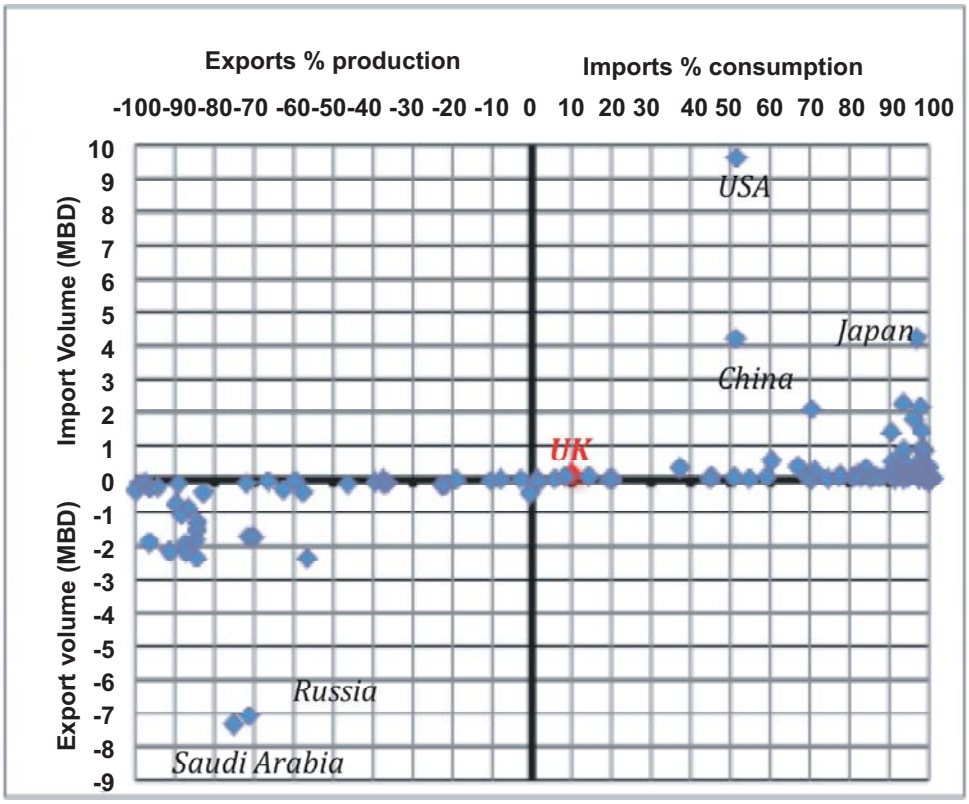
4. The concept of "Energy Independence" can be a misleading and costly guide, as the history of President Nixon's 1974 policy shows. In reality, very few countries are "self-sufficient" in energy; the geography of resources does not correspond with the geography of consumption. International trade provides markets for producers and suppliers for consumers, to the economic benefit of both. The UK participates in this trade, but is less dependent in it than any other EU member (except Denmark). As the UK's resources deplete its degree of energy independence will depend more on the development of renewable energy and reducing the oil fossil fuel intensity of the UK economy.

Global Oil

5. Chart 1 shows the measure of "dependence" on international oil trade (percentage of consumption for importers, and of production for exporters) on the horizontal axis with the exporters towards the left of the chart and importing countries to the right. Most countries are either exporters or importers, with the few "near independent" countries (including the UK) clustered at the centre of the chart. The vertical axis shows (in the bottom left corner) the volume of exports from each country, and in the top right corner the volume of imports for each country.

Chart 1

OIL MARKET INTERDEPENDENCE 2009



Source: US Energy Information Agency International Energy Outlook 2010.

6. The UK, with 10% of its oil consumption supplied by net[30] imports, was among the least dependent countries. Less dependent are Brazil (1%), Peru (6%) Indonesia (8%) Papua New Guinea (1%). These "near oil-independent" countries account for only 6% of world oil consumption.

7. Globally, only about 40% of oil consumption was supplied by production in the consuming countries themselves or their close regional neighbours; the balance of 60% came from the surpluses of oil-producing countries.

8. Exporters that are the least dependent on international oil markets are Tunisia (3%), Surinam (8%), and Vietnam (10%). These countries accounted for less than 1% of world oil production. The global oil market took 60% of the exporters' production.

9. Global oil trade is therefore inevitable. It is more or less free from tariffs and from import or export quotas. Commodity markets in New York, London, and Dubai provide the global oil prices to which the international oil trade is anchored. The global oil price is the opportunity cost against which oil-substituting or oil-saving policies can be measured.

10. Access to the global oil market is the fail-safe supplier for the UK as for other importers; its diversity is greater than can be provided by any one source of supply or small group of exporting countries.

11. UK oil security is served by policies promoting investment in the expansion and stability of global supply. These interests are shared by other importing countries, such as the US and China, and are beginning to be recognised in the EU's external energy policy.

[30] The UK imports and exports oil and products equivalent to its consumption, and exports about 90%, to take advantage of the higher value of UK crude in the international market, and of logistic and quality differences. These advantages are dependent on participation in the international market.

Global Gas

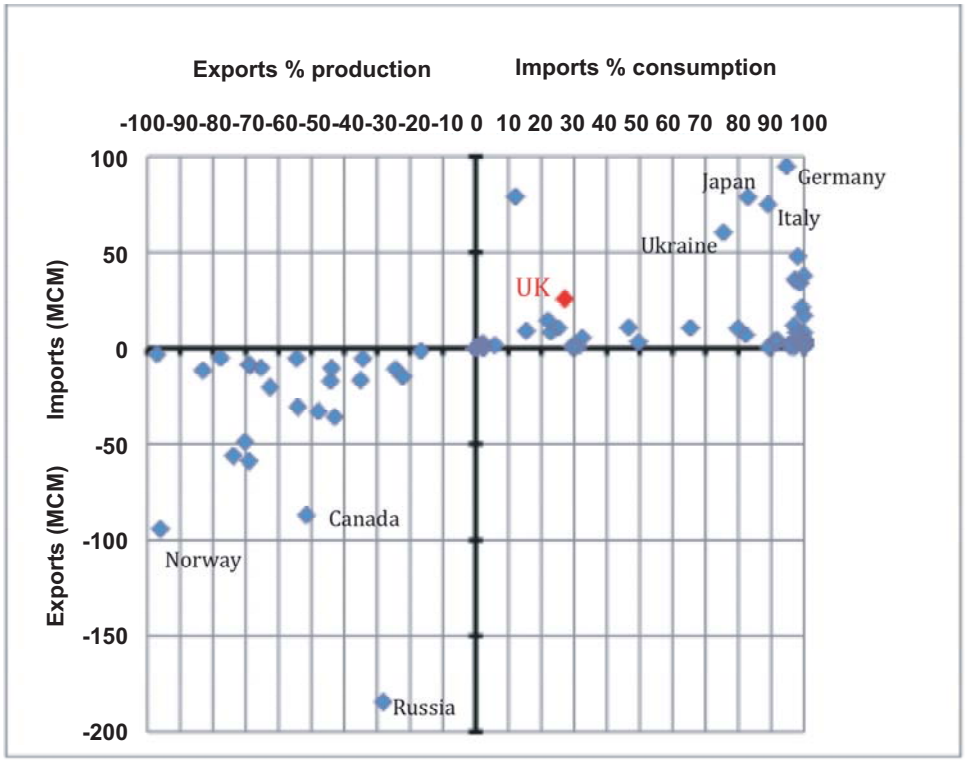
12. The international gas trade is also an important source of diversity, but fewer countries are involved; the high transport costs of gas relative to energy content limit consumption mainly to countries with their own production or access to regional supplies. These together supplied 87% of global gas consumption in 2008.

13. Within the group of gas trading countries, the UK in 2008 was among the less dependent on imports (27% of 2008 consumption) though this figure is expected to rise for the UK and for other EU countries, and for China (Projections for 2020 suggest a 52% gas deficit for China).

14. Importing countries with lower dependency on imports than the UK accounted for only 5% of world gas consumption in 2008. Chart 2 shows the UK position relative to other gas consuming countries. In the chart, seven countries clustered at the centre of the chart neither depended on gas imports nor consumed gas.

Chart 2

GAS MARKET INTERDEPENDENCE 2008



Source: US Energy Information Agency: International Energy Outlook 2010.

15. Transportation costs divide gas trade into regional markets: the North Atlantic, continental Europe and Asia. Competition within each market is increasing as more suppliers are developed. In Europe competition will come mainly from LNG imported from North and West Africa and the Caribbean, as local production declines. In Asia, Qatar and Australia will supply most of the growth in demand for LNG, with marginal Asian surpluses and deficits put into, or taken from, the Atlantic.

16. In the US and Canada, prices are set competitively by short-term contracts at the Henry Hub distribution centre. The US capacity to import liquefied natural gas (LNG) means that its prices influence the Atlantic LNG market and, through it, UK prices, which are set by short-term contracts at the National Balancing Point (NBP).

17. There is a straightforward commercial contradiction between the short-term, gas-to-gas competition of the Atlantic market and the long-term, oil-related pricing system of much of continental Europe, dependent on Russia. EU policies for creating a single European gas market are aimed at opening the continental pipeline system to competition and will therefore strengthen the "Atlantic pricing" system.

18. Imports to Asian markets are currently mainly supplied by LNG, mainly under long-term contracts related by formulae to oil prices. This link is likely to weaken as gas-on-gas competition increases.

19. In the UK, unlike continental Europe, there is no shortage of gas import infrastructure. Four pipelines and six LNG plants (two under construction) give a capacity 40% greater than UK forecast total consumption to 2020. National Grid forecasts LNG supplying 25% of UK consumption, Norway 35%, leaving about 10% to be supplied through the EU pipeline system, ultimately from Russia and Central Asia.[31]

[31] National Grid: Gas Transportation 10-year statement 2009, Table 4.8Ai.

Imports, Efficiency, and Security

20. Security and efficiency are addressed by policies which reduce the use of energy without reducing welfare and economic activity. The amount of energy used per unit of GDP is an indicator of this "energy efficiency". Policies to promote efficiency differ for transport, building, industry etc. which face different import risks depending on which fuel the they mainly use.

21. Low levels of energy input to GDP mean low levels of impact from high energy prices and low levels of disruption to energy supplies. In an open economy like the UK, international prices will be transmitted to domestic prices. Domestic producers will gain or lose. The country's net national income will be affected by the *combination* of price changes and the proportion of supply derived from imports. In the UK, broadly speaking a $10 increase in the price of crude oil will raise internal prices by $10, but reduce net national income by $1, because only 10% of UK oil is imported. This is an indicator of the net exposure of the UK economy as a whole to the international price of oil, and provides a benchmark for the cost of policies to reduce exposure to oil prices.

22. The UK has a comparative advantage over other economies, both in its lower oil intensity and its lower use of imports, as Table 1 shows:

Table1

EXPOSURE TO OIL PRICES (2009 DATA)

	Oil intensity barrels/ $1000 GDP PPP	*% oil deficit (<imports>)*	*Net national exposure bbls/$1000 GDP PPP*
UK	0.26	10	0.03
China	0.35	51	0.18
India	0.31	71	0.22
US	0.48	52	0.25
Germany	0.30	94	0.28
France	0.31	96	0.30
Japan	0.39	97	0.38

Sources: BP Statistical review of World Energy 2010: World Bank Development Indicators Database 2010.

23. For gas, the UK has a competitive advantage relative to its main continental competitors, but not in relation to the US or to China and India, which were small users of gas and small importers (2009)—a situation expected to change. Decline in UK gas production will increase the gas deficit to around 70% by 2020,(despite little or no growth in demand). The UK gas deficit will still be lower than Germany's or Italy's, but if the UK maintains its relatively high gas intensity the advantage will disappear. Table 2 shows the comparison. The net exposure calculation is a benchmark for policies to reduce the high gas intensity of UK GDP.

Table 2

EXPOSURE TO GAS PRICES (2009 DATA)

	Gas intensity cubic feet/ $1,000 GDP PPP	*% gas deficit (<imports>)*	*Net national exposure cubic feet?$1,000 GDP PPP*
China	0.34	1	0.00
India	0.49	25	0.12
US	1.62	12	0.19
UK	1.35	27	0.37
France	0.69	98	0.68
Japan	0.75	95	0.71
Germany	0.93	83	0.77

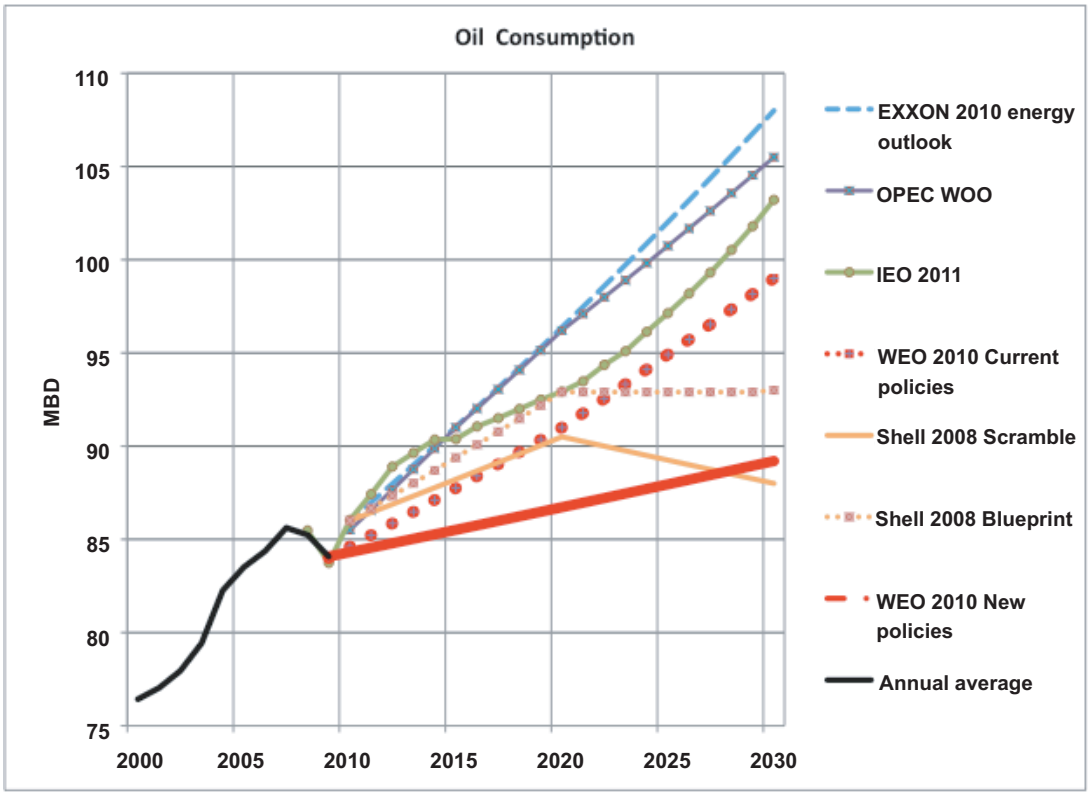
Sources: BP Statistical review of World Energy 2010: World Bank Development Indicators Database 2010.

The Outlook

24. Long-term projections and forecasts for energy consumption are currently particularly difficult, with uncertainty about the long-term sustainable rate of economic growth, the severity of climate change policies, the cost and availability of energy supplies, including renewables, the effect of Fukushima accident on global nuclear investment, and the timing and scale of investment in energy consumption to modify energy inputs to GDP. The range of forecasts is illustrated in Chart 3, showing recent projections of oil consumption by leading agencies:

Chart 3

PROJECTIONS OF GLOBAL OIL CONSUMPTION



Sources: OPEC : World Oil Outlook 2010, WEO: International Energy Agency: World Energy Outlook 2010.

IEO: US Energy Information Agency International Energy Outlook 2010; Shell and Exxon publications

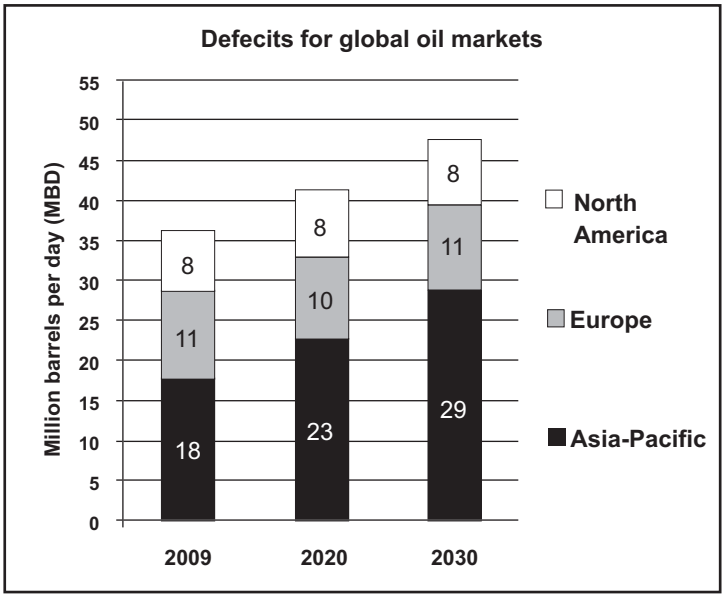
25. The important assumptions within all these forecasts are that Iraq will not develop its full production potential before 2020, that there will be little development of shale gas outside North America, and that energy efficiency, including oil efficiency, will improve at a faster rate than in the past, due to the higher prices.

Shift to Asia

26. All mainline projections show a shift in the international and gas markets as Asian consumption overtakes that of Europe and North America and is met by supply from the Middle East. Charts 4 and 5 show how oil and gas demand in the main consuming regions is expected to be met: "Global supplies" in the chart means supplies from surpluses in Russia, North and West Africa, Central Asia, and the Middle East.

Chart 4

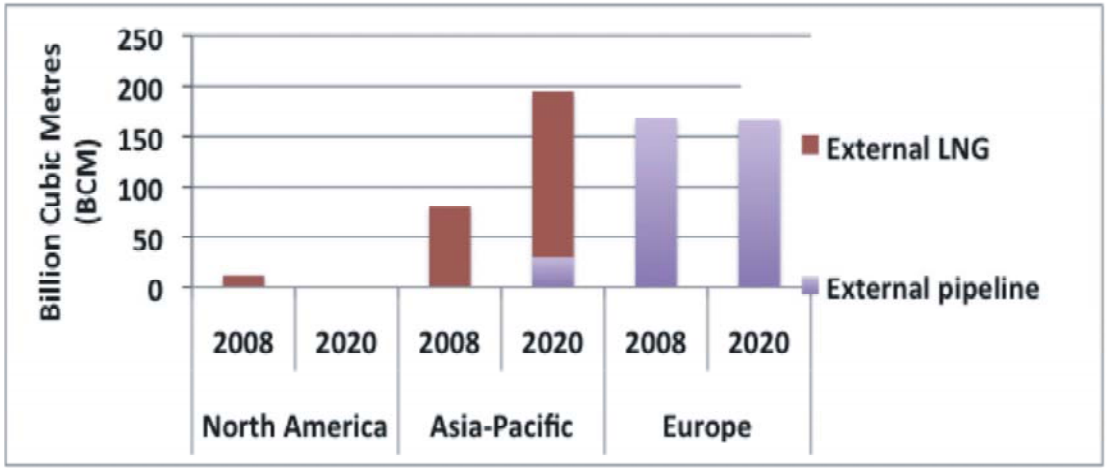
DEFICITS FOR GLOBAL OIL MARKETS



Source: US Energy Information Agency: International Energy Outlook 2010.

Chart 5

DEFICITS FOR GLOBAL GAS MARKETS

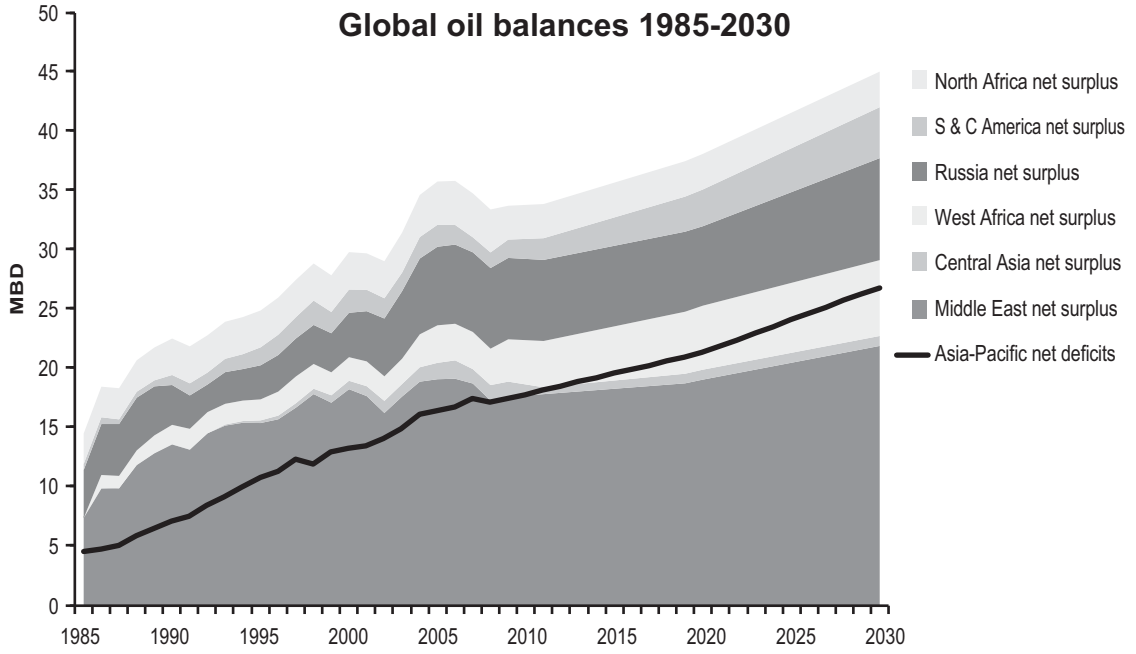


Source: US Energy Information Agency: International Energy Outlook 2010.

27. Both oil and gas projections show that Asian dependence increases massively. The oil market is at a "tipping point" where Europe and North America will no longer depend on Middle East oil supplies: these are not enough to cover the Asian deficit. The key balancing regions will be West Africa, Central Asia. Eastern Russia, and Iraq, roughly equally placed for Eastern and Western markets. Though prices will remain global, the main direct impact of any disruption of supplies will fall on Asia. Chart 6 shows that this reversal of past trends is occurring about now.

Chart 6

MIDDLE EAST OIL SURPLUSES COMPARED TO IMPORTERS' DEFICITS



Sources: US Energy Information Agency: International Energy Outlook 2010; author's adjustments (see John V. Mitchell "More for Asia", Chatham House 2010).

Disruptions

28. These scenarios do not include a temporary disruption of oil supply due to unforeseen natural or political events. For oil, the essential policies to cope with physical disruptions are in place, through the UK, IEA and EU obligations for compulsory stocks and emergency sharing of oil supplies. The Energy Bill 2010–11 will provide powers for OFGEM to strengthen incentives and obligations for UK operators to maintain and share gas supplies in emergencies.

Limitations of these Projections

29. These projections, as usual, do not reflect the idea of a "supply crunch" due to a failure to invest[32] . All of these projections were made before the Japanese nuclear disaster, the "Arab spring" and the civil war in Libya.

Step-by-Step Policy

30. The combination of these effects is difficult to estimate. With such uncertainty, policies will inevitably change as conditions change. Designs for energy supply and demand 20 or 30 years in the future are not credible.

31. Policy analysis should focus on key events or developments likely to occur in the next 5 to 10 years which will seriously affect the subsequent future and on appropriate responses for UK policy. Table 3 below is a rough sketch of circumstances whose outcomes are uncertain. The Committee may wish to ask whether policies have been prepared for these contingencies.

Table 3

Possible event in 2011–16	*Impact after 2016*	*UK policy question if it happens*
"Arab Spring": Setback in oil and gas investment in Libya, Yemen, Syria	Oil prices persist >$100	More or less Government intervention for, renewables, efficiency, electric vehicles and North Sea production?
Fall in oil production and investment in Saudi Arabia, Iraq	Period of "very high" oil, UK oil and gas production supported by prices. But prices induce global and Asian recession	

[32] Paul Stevens: The Coming Oil Supply Crunch" Chatham House 2008; International Energy Agency, World Energy Outlook 2009.

Possible event in 2011–16	*Impact after 2016*	*UK policy question if it happens*
Prolonged and large scale leakage from Fukushima	Nuclear programmes reversed or on hold in Japan, Continental Europe and US delayed in China, India et al: higher demand for (& price of) gas: Greater demand for renewable energy leads initially to higher prices, but then economies of scale deliver cost reductions	UK nuclear decisions: delay threatens power supply. UK power grid: capacity to handle additional renewables.
Shale Gas: Resources and viability established outside North America	Commercial investment, higher gas production	If UK shale resource viable, regulatory and environmental protection.
Carbon capture and storage: no large scale demonstration projects completed	Identification of best process and viability remains uncertain	Permitting of coal generation in question.

Executive summary

32. The exposure of the UK economy to global oil and gas prices is less than most of its competitors. Declining UK oil and gas output will reduce the advantage unless if the and gas intensity of the UK economy is not reduced more rapidly than that of its competitors.

33. Analysis should focus on what to do if various risks materialise in the medium term, rather than on long term design of the energy system. For example:

(a) The response to high oil and/or gas prices in the medium term: will taxation policy allow them to stimulate domestic production, and will the level of support for renewables and energy efficiency continue to be necessary (apart from a floor price for carbon)?;

(b) How to avoid power capacity falling short of demand in 2020–30 because of uncertainty about how to reduce nuclear risks, and how to scale Combined Cycle Carbon Capture and Storage (CCS) technology.

The Committee's questions

34. Brief responses to the committee's questions are set out below (numbers as in terms of reference):

(1) The UK economy is reasonably more resilient to changes in oil and gas prices than most major economies, due to its lower dependence on imported supplies (Paras. 22–23). Integration with the world oil market and to the Atlantic short-term gas market give the energy system access to flexibility and a range of diverse suppliers (Paras. 6 & 13). The question of future uranium prices is moot, given the uncertainties over global nuclear expansion since the Japanese nuclear disasters;

(2) Because of its existing investment in gas imports and distribution, and UK energy security is not threatened by an increase in gas imports or to the variability in domestic gas demand due to renewable penetration into the power market. However, the gas intensity of UK GDP is relatively high and could be reduced. (Para. 23);

(3) Increased electrification would increase the demand for imports of LNG as a mid-load fuel or as a variable back-up for renewables. The critical question for increased electrification is the level of investment in nuclear power and the matching of increased demand with increase capacity in the medium term (Para. 31, Table 3);

(4) Energy efficiency is a major contributor to reducing the impact of global prices in the UK economy (Paras. 20–21). However, efficiency in the transport sector does not affect exposure to gas prices, and efficiency in the built environment (insulation etc) does not change exposure to oil prices, because only a small proportion of oil is used for heating in that sector;

(5) Delays in building new nuclear stations and/or in accessing viable carbon capture and storage (CCS) technology on a commercial scale would lead to a higher increase in gas imports. If good prospects for shale gas materialise globally the price risks associated with this increased exposure would be reduced.(Para. 31, Table 3);

(6) International events undoubtedly contribute to the risk of disruptions of global oil supply and to the medium and long-term levels of oil prices. The UK's exposure is less than that of its major competitors (Para. 5, Table 1). However, higher prices and variability would affect the need for government interventions to support (for climate change policy reasons) renewables and energy efficiency supply unless these are strictly based on greenhouse measures (Para.31, Table 3);

(7) UK energy security policy appears to recognise the UK's continuing dependence on a degree of access to global markets. More emphasis could be given in forums like the WTO, the International Energy Forum, and the EU to support the openness and competitiveness of these markets both for trade and investment;

(8) The balancing points of the global energy system are shifting from the Middle East to intermediate

regions such as West Africa, Iraq, and Central Asia, as a result of the shifting balance of demand to Asian markets. (Paras.26–27, Chart 6). More attention should be given to promoting the political and economic development of these countries as a basis for investment in stable supplies.

(9) Because of the great uncertainties about the long term global and UK energy outlooks, attention should be given to policy responses to events which, in the near-term, might substantially affect the UK's long term energy situation (Para. 31).

March 2011

Memorandum submitted by The Gas Forum

"The UK's Energy Supply; security or independence?"

1. The Gas Forum was established in 1994, acting as a body that represents the views of Gas Shippers and Suppliers active in the GB Market. The Forum now counts among its membership virtually every significant GB gas shipper and gas supplier. Its members are Centrica, BP, Total, Shell, E.ON, npower, EDF Energy, BG Group, Scottish Power, Statoil, Corona Energy, ExxonMobil and GDFSuez.

2. The Gas Forum promotes policy developments that support the continued development of the competitive energy market in the UK, building on the trading arrangements that exist today, in order to allow gas to take its rightful place as a fuel of choice in a low carbon economy.

3. Outlined below are the Forum's views on the questions that the Committee has asked in this inquiry. There are a number of areas where Forum members have not developed a specific position, but other parts of their individual business may respond to the Committee on those topics. If the Committee requires any further information the Forum would be happy to answer additional questions in writing or at any hearings.

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

4. In terms of gas supplies, the GB's competitive market means that Forum believes that gas can be attracted to the UK at market prices if the market is left to work. The GB market has a variety of infrastructure to take a wide range of gas supplies. One of the benefits of the competitive market is that the market responds to global signals, eg if global prices rise, so will the UK price, but this should in turn attract future investment, which will then have a downward pressure on prices.

5. Over recent years Forum members, as well as other market participants, have responded to the change in the structure of the market. Where the UK was previously self-sufficient in gas, we are now a net gas importer and therefore have needed new ways to deliver gas to the market. As well as the existing gas interconnector to Belgium, the market now has new LNG facilities and is increasing the amount of gas storage. New infrastructure between Norway and the UK has also been built and the range of supplies that the UK can facilitate has improved accordingly.

6. If prices do go up in markets which compete with the GB market for gas deliveries then our prices will raise as well. Recent events in Japan have seen prices for GB gas also increase as LNG cargos that could have landed in the UK may now go to Japan as their prices rise in line with increasing demand from their electricity generation sector. The Forum does not believe that the GB market can, or should, try to insulate itself from global pressure, but must facilitate the increasing levels of investment in facilities that will help ensure that the gas demand of UK plc can be met in an efficient and cost reflective manner, maintaining secure supplies.

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

7. Delivering secure gas supplies at internationally competitive prices can only be done by ensuring that efficient and timely investment in the gas supply chain is facilitated. The Forum believes that the GB market has an extremely good track record on delivering investments as required. The market participants have responded to the economic signals that the market creates and coming forward with a range of investments, all of which have made a contribution to meeting the future demands of the country. These investment decisions have been helped by the open, competitive market with a relatively stable regulatory regime. If the Government remains committed to open markets the Forum believe that companies will go on investing in the market.

8. There have been a few problems in developing infrastructure in a timely manner, such as the building of new compression equipment required to meet the full capacity of the LNG facilities in South Wales and some storage developments. The common factor with these projects has been the planning regime that has created project delays and Forum members have ongoing concerns about the changing nature of the planning regime. It is as yet too early to tell if the new regime will help or hinder progress, but the UK more generally does appear to have had numerous problems in getting timely permissions for major infrastructure in a variety of sectors. The Forum very much hopes that these problems will be resolved.

9. In terms of the investment decisions made by the monopolies (gas transmission and distribution owners), the Forum believes that new investment may be may need to facilitate the delivery the Government's EMR proposals. The Forum has suggested in its response to the DECC EMR consultation, that they should consider

the impacts of the policy proposals on the gas market. In particular our members believe that increasing the flexibility of gas fired power stations may require additional reinforcements to the gas networks. In order to affect timely delivery, the monopolies would need to agree with Ofgem that any required investments should proceed sooner rather than later.

10. More generally, the Forum would rather see Ofgem allowing the monopolies to build a degree of flexibility into their networks to ensure that the networks can more easily take delivery of the cheapest gas at any given time. There is always a balance between "gold plating", at the expenses of the customers, and building flexibility that provides the market with more competition in delivering supplies. If the system has no flexibility then the options for delivery will be reduced.

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

11. Electrification of the transport network will have very limited direct impacts on the gas market. What is more relevant is the way that the electricity market demand for gas could alter as a result of the more to lower carbon forms of generation, notably the changing role of gas from base load generation to more flexible output. The Gas Forum has responded to the Government's consultation on the Electricity Market Reform and we are enclosing a copy of that paper for information.

To what extent does the UK's future energy security rely on the success of energy efficiency schemes?

12. The Gas Forum members support the efficient use of energy in all sectors, including in our own delivery of energy to customers. We note the many initiatives the current and previous Governments have developed to promote energy efficiency and some, like the role of smart meters, will impact the operation of the gas market. Generally improved efficiency of energy use should slow the rate of growth in energy demand.

13. Given the widespread use of gas fired heating and cooking, which is very efficient, it seems likely gas demand will still increase, but possibly at a slower rate as usage becomes more efficient. We are aware that improving the insulation on houses often leads people to live in warmer homes, rather than always reduce energy consumption. The Forum members believe that developments, such as the time based tariffs which may be possible with smart meters, are unlikely to have a significant impact of the shape of demand as people will still want to heat their home when it is cold. However, our members believe that the UK gas market will adapt to changes in usage as they arise in the meantime we support the Government's drives to encouraged increased efficiency in energy use.

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?

14. The focus of Government policy, in terms of lowering the UK's greenhouse gas emissions, is currently concentrating on decarbonisation of the electricity generation sector. As with other changes to the UK electricity market the impact on the gas market is of a secondary order. As noted above, the Forum has included its response to the Electricity Market Reform document with this response.

15. There is also a role for bio gasses in helping to cut the UK's carbon emissions. The Forum members are committed to working with those who are developing bio gas that can be added to the gas network, reducing the carbon intensity of the gas delivered across the UK. As projects are developed changes will be need to be made to the Uniform Network Code that governs the way that gas is transported across the networks. The Forum members will work with other market participants to try and ensure that the market rules treat all forms of gas equitably and any central contractual issues are resolved. Gas is a relatively low carbon, clean fuel. It has a role to play in meeting the energy needs to the country while carbon emissions are reduced.

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

16. As already noted, the Forum believes that gas will play an important role in meeting the UK's future energy needs. Gas is efficient, reliable, relatively green and secure. It will be part of a lower carbon future and investment in the sector must therefore be encouraged. The Forum believes that the UK gas market is well placed to respond if there is another dash for gas. However, the Government will need to make sure that it remains committed to competitive markets if it is not to undermine the future investments that the market will need.

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

17. As an open, competitive market that competes for gas supplies from a number of regions of the world. The market is therefore impacted by the global market for gas, which is likely to increase if interconnectivity and greater reliance on imported LNG grows over time. However, the market impact will be in terms of the link with global gas prices as the deliveries of gas from other markets will be dependent on the prices in the relative markets. As noted above, recent events in Japan have increased global gas prices and UK gas prices have also risen in line.

18. The Government should not be overly worried about the global gas price link though as gas comes to the UK from a wide variety of sources, making gas deliveries, assuming the market prices respond, come to the UK. The Forum does recognise that not all Governments will have the same free market approach and it is therefore vital that the UK continues to promote competitive markets, notably in the EU, so that the UK can competitive on a level playing field with other nations to receive gas. The Forum members will also be working through a variety of EU bodies to encourage the European regulator to remove arrangements that create a barrier to cross border flows and artificial restraints to competition, thereby increasing the diversity of supplies that can come to the UK.

19. It is vital that the market is allowed to remain competitive though if the prices are to reflect the supply demand balance. If a Government tried to cap prices or place obligations on gas shippers or suppliers, for example to book gas storage, these measures will distort the market and lead to unintended consequences. The Forum has recently responded to Ofgem's review of security in the gas market and have continued to urge the regulator and Government to balance the roles of the market and the need for intervention under different supply scenarios.

20. The UK does have gas storage that can also be used in ensure secure supplies. The market uses storage for seasonal and daily gas management. There are a number of new gas storage projects proposed in the UK. These investments are likely to be undermined if the Government were to start putting obligations on players to use the facilities. The economics behind such investments are based on the operator being able to use the facilities in a commercially flexible manner as demanded by the market. It is vital to the longer term health of the market that the economics of such investments are not undermined by increasing regulatory burdens and obligations.

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. The Forum believes that the competitive gas market is well placed to respond to global risks and wider uncertainty.

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

22. The Forum members have had concerns about the potential for gas quality to stop gas flowing into the GB market via the existing interconnector. The pipeline was built when gas quality was not a significant issue and the UK was a net exporter of gas. Even if shippers book the right specification of gas on the continent there is no guarantee that the flows on the day (over which the shipper has not control) will mean that gas flows east or west, or is comingled. The shared nature of transportation means the gas a shipper "puts in" may not be the same gas they "take out". The competitive nature of the interconnector capacity holdings, where a shipper may only hold some capacity for relatively short periods of time also means the shipper cannot force the interconnector to invest in gas quality controls. We therefore believe that were Ofgem to require National Grid to provide a gas quality service at the entry point, where shippers could be charged when the service was sued, this would enhance security of supply.

23. The Forum is aware of the work being undertaken in Europe on gas quality. It may be the case that the specification moves closer to the UK gas specifications and the issue will be reduced if not removed. However, it would be worthwhile Ofgem reviewing the case for such investment.

24. Planning permissions remain a major hurdle to the ongoing investments in the gas infrastructure. The difficulties seen by storage developers, National Grid and the energy industries more widely do make timely investments more difficult and more costly to deliver. As noted above, the Forum hopes that the planning regime will improve, but the Government must keep this under review if the UK is going to achieve its policy goals.

25. In looking at any changes to the regime to improve security of supply, all policy makers must be mindful of the impact of changes not only during an incident where security may be jeopardised, but also after any security issue has been resolved. For example, the use of market incentives are of little benefit if they put parties out of business. Take a gas emergency with market prices rising rapidly, a shipper with gas in storage, but the terminal that is cut off is the storage terminal. The shipper will have to go on buying high priced gas, hitting credit limits and ultimately possibly going out of business. When the terminal is restored, the market has reduced liquidity because the emergency arrangements simply put companies out of business. In security emergencies there is a balance between letting markets work and protecting the longer term health of the market.

26. Finally, the Forum believes that there may be some benefit in ensuring that all energy policies are developed in a more "joined up" way, ie where any electricity policy specifically take account of secondary impacts on the gas market.

March 2011

Memorandum submitted by the Association of Electricity Producers

About the Association

1. The Association of Electricity Producers (AEP) represents the many different companies, both large and small, that make the electricity upon which the UK depends. Between them, AEP members account for more than 95% of the country's electricity generation capacity and embrace all generating technologies used commercially in the UK—coal, oil, gas, nuclear power and a range of renewable energy technologies. A list of our members can be found online at www.aepuk.com

2. At the time of receipt of this inquiry members were heavily involved in developing a number of extremely detailed consultation responses including Electricity Market Reform and the Ofgem Significant Code Review of Gas Security of Supply. It is rather difficult to understand the urgency and timing of this inquiry, together with the one launched on the European Supergrid. In debating this inquiry's terms of reference members came to the conclusion that almost all questions could potentially merit an individual thought piece to capture all of the relevant issues required to provide the fullest response, however, we trust our responses below go some way towards covering the issues highlighted within the terms of reference.

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

3. There is evidence that the market has worked to date to encourage new investment and commodity trading, for example there has been around £10bn infrastructure investment over the last five years. We agree it is reasonable to review where we are, however we feel that this most probably sits with the Electricity Market Reform work being undertaken at this time.

4. The question itself requires some clarification in that the term "energy system" here could mean one of two things. Either the System's physical security or the insulation of GB customers against global price spikes? In order to provide answers to both of these scenarios it would be prudent to undertake an economic modelling exercise. This is something we would look to Government, individual members or academic institutions to carry out.

5. We know that the UK's planned and existing fleet of nuclear power stations require supplies of uranium to make the fuel used. We also know that Uranium is widely distributed in the earth's crust, with plentiful reserves in Australia, Canada and Kazakhstan with other recoverable reserves also found in many other countries. There are other areas worldwide which have good prospects for uranium reserves. This is evident from reference to the reviews published by the International Atomic Energy Agency (IAEA) and the OECD Nuclear Energy Agency, the most recent of which estimated that uranium resources worldwide amount to around 5.4 million tonnes, which are economically recoverable at prices up to $130kg. This is sufficient for around 80 years of supply, if estimates are based upon the 2008 rate of usage.

6. There is evidence of an open, competitive and volatile market for uranium oxide ("yellowcake") which is the raw material for fuel manufacture with the spot price for yellowcake trading between $105–190/kgU over the last six months. However the raw uranium price makes up a very small proportion of the total cost of nuclear generation and this level of volatility will only have a relatively small impact on the cost of nuclear generation.

7. In our view the gas market works well and there is no fundamental need to change it; this is also the view of Poyry in its report to the Gas Forum in October 2010.[33] In recent years there has been substantial investment in gas infrastructure to secure supplies in anticipation of increasing import dependence. We now have around 150 bcm of import capacity,[34] by pipeline or LNG tanker, against an annual gas demand of 100bcm, although annual demand is projected to fall in the medium term. Whilst having import capability is no guarantee that gas will arrive, it does provide a route to market and the GB market is generally considered to be one of, if not the, most liquid markets in the world. This provides assurance that at times of supply/demand tightness the market can signal its willingness to pay, attract imports and secure supplies for GB customers. Most recently Centrica has announced a longer term LNG contract with Qatar.[35]

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

8. Investment in transmission infrastructure, whether that be wires or pipes, is crucial for security of supply. For generators, wires provide a route to market for their product whilst for gas fired generation, pipes deliver the fuel required. Timely connections and system reinforcement for both electricity and gas are therefore important to our members, whilst recognising the changing generation mix as we move to a low carbon economy. Generators too are progressing investments in new plant with a number of wind farms and CCGTs recently commissioned and a further 5.5 GW gaining consent since the Statutory security of supply report was published in November 2010[36] which reported that there was 10.8 GW with consent. This demonstrates generator's timely response to the tightening capacity margin as plant closures under LCPD and IED are

[33] http://www.ilexenergy.com/pages/Documents/Reports/Gas/528_GB_Gas_Security_&_Market_Arrangements_v1_0.pdf
[34] http://www.nationalgrid.com/NR/rdonlyres/E60C7955–5495–4A8A-8E80–8BB4002F602F/44779/TenYearStatement2010.pdf
[35] http://www.centrica.com/index.asp?pageid=39&newsid=2163
[36] http://www.decc.gov.uk/assets/decc/What%20we%20do/UK%20energy%20supply/resilience/803-security-of-supply-report.pdf

anticipated. Again whilst consent does not guarantee that these plant will be built, it is a required step along the development process toward a final investment decision. We note however that the current generation-led approach to transmission investment presents a real risk to energy security through introducing additional delay in deployment of resources especially renewables located in the north of the country. This should be viewed as unnecessarily risky given the relatively low cost of transmission capacity relative to the value of lost load.

9. The Association welcomes the Government's recognition of the issues surrounding investment decisions in the electricity industry and its efforts to address them. Whatever the outcome of the current electricity market reform we would wish to see encouragement of a robust, competitive and liquid wholesale electricity market, which should provide a reliable and credible wholesale price where the investments required to meet the Government's energy policy objectives are fully rewarded. The transition to the new arrangements must be carefully managed so as to retain investor confidence in the UK, with the transition path being set out in the forthcoming White Paper. Existing investments must be protected and the Government should consider carefully the potential unintended consequences of the proposed reforms on these projects and on all types of participant in the market. We urge HMG to seek early engagement with EU legislators to identify and resolve any conflicts between each element of the EMR proposals and EU legislation or policy. Regulatory certainty is paramount.

10. Clearly the baseline investment plans and uncertainty mechanisms that form part of National Grid's electricity and gas transmission price control will have a key role in enabling these plants to connect to the networks.

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

11. Increased levels of electrification in areas not previously electrified will impact demand patterns and may put pressure on energy security and capacity. However, such a move could be good for UK energy security by increasing overall energy diversity given that the primary energy used to generate electricity comes from a substantially greater variety of fuels and sources than primary energy currently supplying the energy needs of the transport and heat sectors. However the signal to invest in generation capacity, both to replace older generation capacity that is forecast to decommission and to meet new demand is weak at present. If there is an expectation that increased levels of electricity usage can help manage energy security it is essential that the risks associated with this should be borne by society rather than the generation industry.

12. It is also important that current disincentives for electrification, such as the lack of a carbon price signal on use of gas for heating, are resolved as soon as possible. At present these differences between the treatment of electricity and gas will cause significant lock-in of non-electric heat.

13. The Government's 2050 Pathways Analysis forecasts that electricity demand could double from today's levels by 2050 to provide additional demand for the increased electrification of heat and transport[37]. We note that it is expected that much needed decarbonisation of the heat and transport sectors which are currently extremely reliant on fossil fuels, will be achieved by utilising low carbon electricity. Early consideration must be undertaken regarding the appropriate electricity infrastructure systems over the next two decades together with continued investigation into the impacts of increased levels of electrification of the transport and heat sectors on energy security should be undertaken within the ongoing 2050 Pathways exercise. This work also needs to critically examine the concept and application of Demand Side Management, the role of Distributed Generation and increasingly the move towards a Smart Grid, so that any infrastructure investment is properly optimised when these additional significant new large domestic electrical loads are increasingly supplied by intermittent or must run generation sources.

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

14. Members acknowledge much activity surrounding the delivery of efficiency programs however would be concerned if Government were to rely on headroom created by energy efficiency to assist with long term UK security of supply. Again it is important that the risk posed by energy security is not borne by the generation industry.

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*?

15. The intermittency of certain types of renewable generation will be an issue, in particular contractual arrangements or physical assets will be required to provide back-up generation. Both gas and electricity networks will need to be managed more dynamically to ensure continuity of supplies. However the increased penetration of intermittent renewables in the generation mix will not happen in one step rather it will evolve over time and potentially in parallel with other developments including smart grids, increased interconnection with Europe and further demand side response. This will allow time for developing a greater understanding and experience of system operation with a growing percentage of intermittent generation and allow for a full evaluation of any system investment needs to help manage the changing dynamics of supply and demand on

[37] HM Government, 2050 Pathways Analysis, July 2010

both the electricity and gas networks. We would expect the uncertainty mechanisms that form part of the price control to have a role here in supporting any such investment should it become necessary during the price control period.

16. Demand side response is not limited to the electricity market it may have an important role to play in gas too. The current significant code review looking at gas security of supply is considering the role of demand side response in averting an emergency. The gas fired generation fleet and large industrial customers could provide significant demand side response once an emergency was imminent and may be a cost effective option.

17. Several types of electricity generation assets, such as pumped-storage hydro, can assist with energy security. These assets, which have long lead times and high commercial risks, could not be constructed quickly without some form of underwriting from society.

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

18. A second dash for gas could result in growing annual gas demand if increases were not offset by efficiency measures or increased renewable generation. Subject to biomethane and shale gas developments this may lead to increased import dependency but as stated above the UK already has substantial import capability via pipeline or LNG tanker and further LNG import facilities may be built. LNG may be sourced from the Middle East, Africa, the Caribbean, North America, Norway etc and this diversity of supply sources provides a range of options for bringing LNG to the UK. Whilst relying heavily on a single commodity (within the fuel market) would expose the UK to extreme price shocks and security of supply uncertainty, encouraging diversified investment in cost effective flexible renewable and low-carbon options, such as co-fired biomass, dedicated biomass, and CCS, would help to mitigate the fuel demand price risk. When coupled with pipeline supplies from Norway, which has substantial reserves, in addition to indigenous supplies, our own storage capability and interconnectors to European markets, the UK has a well diversified supply mix which provides assurances over security of supply. However this does also underline the importance of liberalisation of European markets and full implementation of the 3rd package.

19. In planning power station developments companies will make a judgement about being able to obtain fuel, without which their investment would fail. For its part, the Government would have to judge the impact of that production on its target for carbon emissions.

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

20. The UK is exposed to international events whilst importing fuels, as the recent crisis in Japan has demonstrated, with gas and coal prices rising to pre-recession levels. However this is an inevitable consequence of global trade in these commodities and a sign of these markets working effectively. Japan is reliant on imports for virtually all its primary energy needs but has a diverse generation mix with nuclear and gas each accounting for about 25% of its generation with coal and oil together about 40%[38]. Whilst the loss of nuclear capability is clearly very significant its impact in Japan will be less than if it had been a larger fraction of electricity generating capacity. The impact on the UK will be higher gas and coal prices and consequently electricity prices too, for a period of time. Japan has a gas market of a similar size to that of the UK and is the worlds largest importer of LNG accounting for around a third of all trade and this will give it the capability to increase LNG imports, to help meet the nuclear generation shortfall, clearly supporting diversified generation mix.

21. The UK should not be afraid of being dependent on imports, but will have to recognise prices will be driven by international events rather than only domestic supply and demand.

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*?

22. We can never achieve 100% security irrespective of money spent. The big question is around what an acceptable level of supply security is and how we ensure that we have all relevant enablers in place to deliver the required appropriate level. Government and industry needs to be sure that the arrangements around planning and consenting are robust, certain and efficient. Whilst regulatory certainty must be a given. It takes a long time and lot of money to get a project from the drawing board to production, if we can minimise some of the uncertainties along the way this should help. The delivery of System resilience should assist in protecting consumers.

23. Government could undertake some form of multi client study to ascertain individual company responses, however must be aware of the commercially sensitive nature of some of the questions it would need to ask. Work could also be linked to Project Discovery modelling.

[38] http://www.fepc.or.jp/english/energy_electricity/optimal_combination/sw_index_02/index.html

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*?

24. Security of Supply enhancements can only be delivered at cost to consumers. However the more secure a system design then the higher the cost. We note that we have never had a gas or electricity emergency under the present arrangements.

March 2011

Supplementary memorandum submitted by the Association of Electricity Producers

1. *To what extent do you think carbon capture and storage technologies will be able to deliver the flexibility required to balance a low carbon electricity system?*

CCS still has to be demonstrated on a commercial scale—to date only pilot projects, e.g. units in the <30 MW range, have been built. A demonstration programme of commercial size units (>300 MW) is currently being developed at European level, but a number of financing and public acceptance problems are being encountered. As a result, the aspiration of making CCS a commercially viable technology by 2020 may not be met, though AEP is confident that the technology has an important role to play in the medium to longer term. Given the much higher capital costs of CCS (at least double the cost of conventional units), CCS plant will have to operate on baseload. Furthermore, the specific cost of CO_2 abatement from gas will be significantly higher than from coal, so that economic viability is likely to take rather longer. In this light, it seems unlikely that CCS will be able to provide flexible generation for a considerable time to come.

It is our understanding that if CCS is fitted to existing CCGT it will become non flexible baseload unless temporarily disconnected from the CCS kit. This will have major impacts on security of supply post 2020. Future build with CCS capability remains technically challenging. By the early 2020s (when we know CCS will be not much different to now) CCGTs will probably be running on lower load factors so will be continually ramping output up and down. In those circumstances given that it is necessary to disconnect the CCS when the plant is varying its output the CCS equipment will be permanently disconnected which is not efficient and will not reduce carbon emissions.

2. *We have heard some concerns about the current "generation led" approach to transmission investment and proposals for an "anticipatory" approach to be taken instead. Can you explain what the problems with the current system are and what changes you would like to see?*

GAS

Gas transmission investment will be needed for some generation projects and there may be locations where some anticipatory investment is appropriate or where there are multiple projects. Eg. the potential for multiple stations in south east where capacity is currently tight. There is likely to be investment needed to manage changing flows on the network as a result of less gas from St Fergus, more gas from Milford Haven and greater variation in CCGT gas demand due to wind intermittency (although for the latter when and how much remains unclear).

ELECTRICITY

Member preference is for an anticipatory approach towards transmission investment. Given the planned growth in renewables, together with the need to maintain back up generation, it is clear that significant transmission investment will be required to provide generation access and to maintain system constraints at a reasonable level in the future. Transmission investment tends to be "lumpy" in nature. National Grid therefore needs to anticipate the additional investment needed and take decisions now based on available information.

We acknowledge that given there is significant uncertainty around future generation requirements (size and location) and retirement plans of existing plant, such decisions cannot be risk free. However, we support anticipatory investment as we believe the GB risks associated with underinvestment far outweigh those of assets being "stranded". The recent transfer to a 'connect and manage' approach for transmission grid connections illustrates the need for an early transition to a more forward looking, anticipatory approach.

National Grid has raised CMP192 User Commitment which proposes to amend the charging regime such that generators would be required to provide four years notice of closure in order, National Grid argues, to manage connection to the transmission system. This "rule" does not exist for gas where 14 months is required to give notice of plant surrendering their exit capacity rights.

3. *Price security is an important element of energy security. To what extent do you think energy prices becoming unaffordable is a plausible risk for the UK?*

The rise in numbers for those in fuel poverty is evidence that energy prices for some, even at today's levels are a real risk. SMART Metering should enable Suppliers to offer attractive tariffs to encourage consumers to sign up for supplies which offer additional flexibility (seasonal Time of Day tariffs) to vary load. This may lead to additional price volatility for those who do not sign on to the benefits of SMART tariff innovations.

Some energy-intensive users are subject to international competition and, if energy prices become too out-of-line with international levels, may relocate production away from the UK. The EU has taken on greenhouse gas abatement and renewable energy targets which are much more ambitious than those in most other developed economies and this could have impacts on competitiveness. UK energy prices are also likely to rise relative to those in continental Europe, as the UK is taking additional measures, eg carbon price support and an emissions performance standard, and also faces more challenging renewables targets than most other Member States.

4. *The Government has ambitious plans to improve domestic energy efficiency through the Green Deal. Are there other measures they should be considering as well as the Green Deal, and to what extent will the Green Deal deliver greater price security for domestic consumers?*

Commodity prices are an issue in increased energy prices. So too will be the cost of schemes to encourage low carbon generation—FIT/ CfD, carbon floor price. Environmental schemes already make up 9% of domestic energy bills. The massive investment in additional transmission and low carbon generation schemes will also lead to higher energy prices.

Other Issues to be Considered Which Might Impact on Security of Supply

We need to assess the impact of nuclear closures in Germany, in particular to watch for any knock-on effects for the UK and on Eon and RWE here in the UK. Until Germany builds new generating capacity (perhaps gas-fired) to replace the nuclear stations then there are likely to be more occasions than in the past when UK interconnectors operate in exporting rather than importing mode.

The unknowns in EMR, EU Network Code development and Project Transmit have huge impacts. We do not know the running environment, the technical requirements or charging regime under which future plant will operate. This is a significant risk. There are further unknowns in relation to environmental regulation post-2015, particularly with the detailed arrangements for the implementation of the Industrial Emissions Directive and the revision of EU guidance to environmental regulators on the use of Best Available Techniques for the control of emissions from large combustion plants (the BREF document). Inflexible regulation could hasten the closure of some existing coal and gas-fired plant that could otherwise run in mid-merit or peaking mode.

A number of European network codes are currently under development and could have a major impact on UK generation. For instance, the pilot network code developed by ENTSO-E introduces a range of additional connection requirements which have not so far been seen as necessary in the UK. Unless significantly modified, this code would be likely to result in the early closure of considerable amounts of older fossil and nuclear plant.

Investment has been adversely impacted by charging uncertainty. Market investors are extremely concerned about regulatory uncertainty and in particular any retrospective application of change. Ofgem is currently pursuing a change which will lead to the introduction of Generator Distribution Use of System charge for pre 2005 generators who paid up front, in the form of 'deep' connection charges for the future use of the distribution system. Such regulatory change worries investors, who find it impossible to assess accurately the whole cost of investment here in the UK.

Points for Clarification

In addition we were asked for clarification around the following questions:

(a) *whether you had a "preference" as to the EU 3rd Package's basic unbundling models*

Most AEP members prefer the ownership unbundling model, which is the predominant model in the UK market and which ensures a level playing field in generation and supply. However, it should be recognised that the ISO and ITO models are much stricter than the unbundling arrangements in the first two EU liberalisation packages. A whole range of management and financial requirements have to be met in order to ensure ring-fencing of the TSO, and the TSO then has to be certified by the national regulator and approved by the European Commission. If these provisions are properly implemented at national level (which has not always happened throughout the EU in the past), they should ensure non-discriminatory access to networks and thus fair competition in generation and supply.

(b) *whether you think that different approaches to implementing unbundling in different European countries will impact UK energy security*

The rationale for the unbundling provisions in the Third Package is to avoid discrimination against players which do not have electricity or gas network interests and thus promote a fully competitive energy market. AEP does not believe that these provisions will have an impact on security of supply in the UK or elsewhere.

Ownership unbundling of transmission is now the dominant model in electricity across the EU and there is no evidence of this impacting on security of supply. Integrated TSOs are more common in gas, but a number of countries including the UK and the Netherlands have standalone transmission companies and have

maintained high standards of reliability. Similarly, the ISO and ITO models reduce the risk that incumbents will block cross-border trade and should therefore be positive for security of supply.

June 2011

Memorandum submitted by the UK Petroleum Industry Association

The UK Petroleum Industry Association (UKPIA) represents the oil refining and marketing interests of the nine main downstream oil companies in the UK. Our member companies operate all the major crude oil refineries, supply one-third of primary UK energy demand and ~85% of the transport fuels and other oil related products used in the UK. As such, we have a major interest in the topic of security of energy supply and welcome the opportunity to respond to the Committee's consultation on this important issue.

Our responses to the Committee's Inquiry are confined mainly to those questions or areas where we have specific knowledge or expertise, namely the wide range of fuels and feedstocks derived from the refining of petroleum.

Background Context

UK operating refinery capacity is ~1.7 million barrels of crude oil per day (~12% of the EU).

Oil currently accounts for ~37% of all the UK's energy needs and UKPIA member companies supply around 85% of transport fuels used in the UK.

One UK refinery closed in 2009 and currently four of the eight operational refineries are for sale, with announcements in the last weeks of agreed terms, subject to completion, for two of them.

The main markets in the UK are:

Retail (forecourt service stations): ~ 29 million tonnes per year of petrol and diesel

Aviation: ~12 million tonnes per year jet kerosene

Commercial: ~18 million tonnes per year (Commercial vehicles, Heating fuels & Marine)

Speciality (Bitumen, Lubricants, LPG, Solvents and Coke etc): ~5 million tonnes per year

Petrochemicals: ~2 million tonnes per year

UKPIA members also:

- Invested £3 billion in fixed assets over the last five years, much of it to meet tighter fuel and environmental standards and to enhance process safety.
- Operate 36 distribution terminals & 1,500 miles of pipeline
- Own 2,230 out of the 8,921 filling stations in the UK
- and support the employment of ~150,000 people across the UK either directly or indirectly.

The value of refining to the UK economy is estimated at £200 billion+ and each large refinery is estimated to inject ~£60 million+ into the local economy where it is located.

The downstream oil sector collected ~£33billion in duty and VAT on fuels in the last financial year.

Summary

UKPIA's views can be summarised as follows:

1. *Oil products will continue to be an important part of the future fuel mix*

The oil industry believes that due to their low cost, on-going availability, and ease of use petrol and diesel will remain the dominant road transport fuels globally to 2035 and beyond, a view that is shared by the International Energy Agency (New Policies Scenario) and others in their forecasts of future energy use. However, a range of alternative fuels, including initially first generation biofuels, will have an increasing role to play in what is likely to become a more diverse energy mix aimed at meeting carbon reduction and other environmental targets. The oil refining industry will also play an important role in facilitating the introduction of these alternatives as part of the oil industry's investment in low carbon infrastructure to complement fossil fuels. However, some of these alternatives, especially advanced biofuels, are likely to take time to develop fully for commercial scale production so are unlikely to make a significant contribution until at least 2020.

It is important that policymakers bear in mind the importance of oil in making this transition to a lower carbon future. In some transport sectors, due to technical and other reasons, this change is not going to happen overnight. For some industrial sectors oil feedstocks may be impossible to substitute. Even under the most promising scenarios, it will take decades for alternatives to reach the affordability, reliability and scale of fossil

fuels. The thrust of recent policy and indications of future direction largely ignores the important role oil will continue to play beyond 2020.

2. *Energy security and diversity of supply should be part of overall policy, consistently applied*

Meeting the UK's future energy needs in a secure, diverse and sustainable way that also meets environmental and air quality objectives, is a huge challenge. It requires policy that is closely aligned in these key areas. UKPIA believes that energy and environmental policy should continue to be based on maintaining a reliable UK energy system meeting all three pillars of sustainability—economic, environmental and social—with clear targets underpinned by a framework for their achievement. Policy objectives should not be dominated by any one of these pillars, should also avoid "picking winners" and be applied in the UK on a basis that is consistent with the relevant EU Directives and avoids "gold plating". Sound science should also be a cornerstone of this policy to ensure goals are met cost effectively and with sufficient flexibility to take account of developments in technology/scientific knowledge so that unintended consequences are avoided.

UK refining and the associated storage/distribution infrastructure will need investment in order to meet the UK's changing energy needs in the coming decades. Competition for investment funds is global and the oil industry works to long-term time scales, given the size and complexity of major projects. Confidence in future policy direction and stability in the way it is applied is essential to attract future investment.

In shaping its energy policy, the Government must recognise the crucial importance of a healthy UK refining sector and define its policies to help deliver the desired outcome. Clearly market and commercial considerations are important influences but if Government wants a strong domestic refining industry in the UK, then energy and other policies must not place it at a commercial disadvantage compared to its overseas competitors.

The right policy conditions will assist UK refining in continuing to be an important element contributing to the UK's energy supply security and resilience.

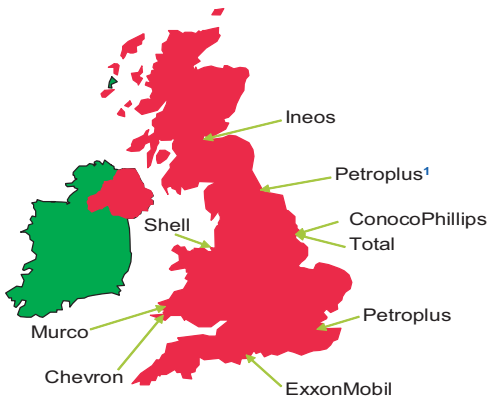
3. *Oil refining sector and its contribution to security of supply*

The UK derives significant benefits from having a competitive domestic refining industry that substantially enhances supply security and resilience. However, although greater reliance upon imports is a feasible solution to meeting the UK' s changing fuel needs, the international crude oil market is far larger than that for refined products so a domestic industry potentially enables a rapid domestic response in an emergency. However, refinery closures in Europe may in future reduce the fluidity in the NW Europe refined products market as the supply chain lengthens with greater reliance upon middle distillate (diesel, gas oil, jet fuel) supply from outside Europe.

The number of UK refineries has declined from eighteen in the late 1970s to eight currently, in response to changing market conditions and demand. The UK has the fourth highest refining capacity in the EU and until 2009 had nine major operational oil refineries. One closed at the end of 2009 and has become an import terminal. Four of the remaining eight refineries are for sale, with buyers recently announced for two of them- Valero for Pembroke refinery and Essar Energy for Stanlow.

Main Fuel Refineries	Owner	Capacity (bpcd)
Coryton	Petroplus	163,400
Fawley	ExxonMobil	317,000
Grangemouth	INEOS	196,650
Killingholme (Humber)	ConocoPhillips	190,000
Lindsey	Total	218,000
Milford Haven	Murco	102,600
Pembroke	ChevronTexaco	209,000
Stanlow	Shell	267,000
Teesside[1]	Petroplus	111,000

8 refineries ~ 1.8 mb/d, ~ 12.5% of EU



Note 1: Teesside closed end 2009

UKpia

The UK refining industry recognises the inevitable challenges associated with the transition to a lower carbon economy. However, this coincides with a period when the sector is also experiencing difficult commercial conditions and many other challenges, as outlined in 4 below.

A combination of all these factors may result in further closures; once a refinery closes it is rare for it to re-open.

4. *UK refining faces challenging conditions*

UK refining faces many challenges. These partly stem from difficult market conditions (weak demand, low return on capital employed), competition from new export orientated refineries in Asia and a depressed outlook for refining margins to 2020 (energy analysts Wood Mackenzie report).However, there are also mounting costs associated with meeting tougher EU/UK legislative requirements (EU Emissions Trading Scheme, EU Renewable Energy and Fuels Quality Directives, EU Industrial Emissions Directive which together will impose a £1 billion plus burden on the UK refining industry) that do not apply to non-EU refineries, and UK only policies on climate change (eg CRC Energy Efficiency Scheme, Carbon Floor Price etc) that may penalise UK refining versus its EU and global competitors.

The refining sector also faces a growing imbalance in petrol and diesel supply/demand. The effect of fiscal policy and the better fuel efficiency of diesel vehicles have increased diesel demand in the UK by ~38% since 1998. Petrol demand has been in steady decline since the peak reached in 1990 and the surplus is exported, much of it to the USA. The same trend is apparent in the rest of the EU. Addressing this imbalance is a growing challenge for UK refineries; solutions include substantial investment (£500 million+ per refinery) to equip refineries with upgrading units to produce more diesel or alternatively greater reliance upon imports. There are also consequences for air quality and for refinery emissions in meeting this additional diesel demand—more energy intensive refining processes to upgrade heavier residues into diesel with associated increases in CO_2 and other emissions.

Increasingly, EU/UK refineries are facing competition from new large—scale refineries in Asia designed to maximise the output of diesel, aviation fuel and kerosene with a low proportion of heavier residue products such as fuel oil for marine use. These refineries in the shorter term have a significant export capability and crucially do not face the same burden of legislative cost as UK refineries.

Responses to Questions Posed by the Committee:

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

1.1 Provided UK government policy recognises the value of UK refining, the ability of the industry to process crude oil from over 120 global sources will ensure the nation's ability to mitigate against energy supply tensions—without indigenous refining capacity the nation is at "the end of the chain" in terms of finished fuel products. In common with most developed economies, the UK is heavily dependent upon oil- 30% of UK primary energy demand and ~95% of road transport demand comes from oil. Oil derived feedstocks are also vital for many industrial processes such as manufacture of petrochemicals.

1.2 The era of comparatively cheap energy is over and the challenge of meeting future energy demand is well illustrated in the International Energy Agency's World Economic Outlook 2010. By 2035, the IEA's "New Policies Scenario" estimates that global primary energy demand is likely to be about 36%% higher than in 2008. Most of this additional demand will be driven by population growth, higher living standards and expanding non-OECD economies, particularly those of China, India, the Middle East, Asia and Latin America.

1.3 Measures to improve energy efficiency and diversify the UK's energy mix may reduce the UK's exposure to fossil fuel price increases but the alternatives are not necessarily cheaper or less volatile. Indeed, with the EU and many OECD countries pursuing similar alternative fuel policies, similar demand driven cost pressures affect these feedstocks.

1.4 The UK economy has in the past had to face several oil price shocks, starting in the early 1970's. Generally the impact has been to suppress economic activity but over time industry and consumers have adjusted. The impact of these events has varied across sectors but at the macro level, the UK benefited during the period when it was a net exporter of crude oil from the North Sea. However, oil is a significant element of transport costs, so in the short term this also feeds into domestic inflation.

1.5 In recent years the UK economy has become less energy intense due to a shift away from heavy industry, overall energy consumption having increased by 7% between 1990 and 2009 (Source: DECC, DUKES data). Since 2004, oil prices have been on an upward trend, despite the post 2008 peak adjustments and recessionary impact, which was reflected in overall energy consumption in 2009 falling by 10% in comparison with 2004.

1.6 Within the transport sector, road fuel demand has increased by close to 50% since 1973 with much of this increase pre 1990. Since 1990, road fuel demand has increased by 7% but registered a decline in 2008 vs. 2009 in response to a combination of recession, higher oil prices and duty increases.

1.7 The path to greater resilience will lie in the UK having a robust and diverse mix of energy sources, in which oil is likely to play an important part, allied to increased efforts to improve energy efficiency across all sectors. This will most likely entail a mixture of domestic as well as imported sources.

1.8 The challenge is to ensure that in the coming decades the UK continues to have access to affordable, secure supplies of the required oil products as both sources of crude oil and consumer demand change. In this respect UK refining can have an important role. If investment is not made in UK refineries to keep up with changing consumer demand, the UK can import products in deficit and export products in surplus. However, a growing dependence on imports/exports could result in:

— reduced security of supply as imported products may be less immediately available in times of emergency or crisis.

— pressure on the profitability of UK refineries which in future periods of poor refining margins may lead to further UK refinery closures.

— the added value of UK refining being captured in part by overseas.

— refineries the UK balance of payments being adversely affected.

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

2.1 The UK's energy security is extremely sensitive to attracting inward investment into its refining sector. As stated in 1.1 above, a healthy indigenous refining sector has the reach and versatility to provide finished fuel products, provided government policy recognises the importance this vital industry. Currently the domestic UK oil refining industry, with its good links to other European refiners, access to North Sea crude oil (from both the UK and Norwegian sectors) and other crude oil sources, provides the UK with a secure, reliable and economic source of transport fuels and other petroleum products. As supplies of crude oil from the North Sea decline, the UK's security of supply for oil products can be maintained by a strong and healthy refining sector, able to process a range of crude oils from diverse sources, domestic or overseas.

2.2 The market for refined petroleum products is global by nature, and although domestic production of key fuels gives added flexibility in the event of external disruptions or emergencies, in recent years the growing deficit in middle distillate products- diesel and aviation fuel- has resulted in an increased level of imports. By 2020, the import requirements for diesel and jet fuel are likely to double (increasing to 7 million tonnes per year from the current 3.5 million for diesel and from 5 million tonnes to 9 million tonnes for jet fuel. *Source: Wood Mackenzie study for DECC)*. If the UK were to lose 25% of its capacity because of refinery closures, it is likely that imports of each of these products could increase to ~ 11 million tonnes per year.

2.3 The capacity and efficiency of the country's refining and distribution infrastructure has been a significant factor in helping to deliver the benefits of a secure and flexible system responsive to the needs of consumers. The industry has made significant investment to develop and maintain this infrastructure but in the last two decades much of it has been geared to meeting tighter operational, safety and environmental standards as well as production of cleaner fuels.

2.4 This investment has not increased refinery output significantly or improved the profitability of UK oil refineries. Major refinery projects take five years or more to plan, build and commission which exposes companies to the risk that future return on capital may not cover the investment costs. Combined with uncertainty over the future policy framework and the cost of meeting legislation, this may lead to investment being delayed or permanently shelved, as importing products rather than building new processing equipment may be a more attractive option.

The investment strategies of integrated oil companies may also mean that internal competition for investment funds globally is strong, with investment being channelled to those projects in exploration and production or overseas downstream projects that produce higher returns than those in UK refining.

2.5 These structural changes and challenges, and the likely increase to 90 days in the UK's Compulsory Oil Stocking Obligation under IEA/EU rules in the coming decade as UK North Sea oil declines, will require further investment in refining and storage infrastructure.

This will involve increasing UK strategic storage capacity by over 50% in the next 10 years or more, at a cost of £3-£4 billion. Our government is fairly unique amongst its EU partners in placing the nation's strategic oil stocks burden on the UK refining and importing companies. Most other Member States have recognised the "national" aspect of these stocks and manage the issue through an agency.

UKPIA and its members urge the Government to take the opportunity to reform the current stockholding system to establish an independent stockholding entity to address now the long-term challenges of security of supply that will be faced in the coming years as North Sea oil decline increases the UK's stocking requirements.

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

The main area of interest for UKPIA is electric vehicles for road transport.

3.1 Electric vehicles fall broadly into two main categories; full electric (BEV) and plug-in hybrid (BHEV) that work in conjunction with an internal combustion engine. The advantage of a battery electric vehicle is that it has zero tailpipe emissions compared with a vehicle powered by an internal combustion engine using fossil fuel. This brings benefits for local air quality as well as reducing noise pollution. For these reasons and to reduce fossil fuel dependence, government policy in the UK is aimed at fostering the uptake of electric vehicles.

3.2 The zero emissions, however, are only at the point of use; in order to charge the battery, electric power is required that in turn will have generated CO_2 emissions at a power station unless the source is wholly

renewable or zero carbon. The use of well to wheels studies is therefore essential to give a fair comparison between options with different patterns of emissions from use and production.

3.3 The main technical challenges with current battery technology are performance, payload, range, cost and battery life, linked to the trade off between the battery energy density (driving range) and power density (charging/discharge rate). BHEVs are an interim step to overcoming some of the performance/range problems until such time as a step-change from current leading lithium-ion battery technology to the next generation advanced lithium-ion batteries is achieved.

3.4 For these reasons, and barring a major breakthrough in energy storage, it seems unlikely that BEVs will form a significant part of the road vehicle fleet within the next 15 years but in the meantime on-going research and wider availability of BHEVs will move technology forward. In the interim, there is a real danger that policymakers will look optimistically towards a BEV future and enact policies harmful to fossil fuel production. Refineries do not reopen once closed—when they're gone, they're gone.

3.5 However, there are major implications for power generation and grid distribution to facilitate the move to more electric vehicles. The Climate Change Committee's recommendation to largely decarbonise electricity power generation by 2030 is central to this but achieving it presents major challenges technically and environmentally, as well as gaining consumer acceptance. Power generation from a low carbon or CCS source will be crucial to meeting carbon emission targets so the proportion of renewable, nuclear, gas or coal fired will influence the security of energy supply of each energy source. Aside from raw materials used in the primary energy source, there are also security of supply issues affecting many of the raw materials that go into components used in these generation processes.

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

4.1 In this context we refer to schemes aimed at cutting energy consumption rather than encouraging energy from renewable sources. Improved energy efficiency in the short to medium term is one area where there should be added focus, as energy saved immediately has a major impact upon both carbon emissions and security of supply. However, this appears to be an area where comparatively slow progress is being made, although DECC estimate that domestic energy consumption might be twice the current level vs. 1970 if efficiency improvements had not been made. For the industrial sector consumption has fallen 31% 2009 vs. 1990 (DECC, DUKES data) but much of this may be attributable to structural changes in the UK economy relating to domestic manufacturing being substituted by imported goods/components.

4.2 For domestic consumers there are numerous measures to incentivise householders to save energy—for example Warm Front and the Carbon Emission Reduction Target requiring energy providers to take action to help consumers reduce consumption. Generally, the UK still lags many other EU countries in the level of energy efficiency of our dwellings. High cost of energy is a major influence upon behaviour and an incentive to reduce consumption but has major implications for fuel poverty. For industries exposed to carbon leakage, it has significant implications for competitiveness.

4.3 The oil refining sector has improved energy efficiency in recent years through the adoption of Combined Heat & Power systems for refinery process operations. It is also subject to the EU Emissions Trading Scheme and the CRC Energy Efficiency Scheme (CRC).

4.4 CRC is a mandatory UK scheme designed to encourage energy efficiency by large non-industrial public & private sector energy users through a system of a CO_2 emissions cap and allowances with auctioning. The scheme is complex and administratively burdensome.

4.5 The cost of the Scheme to UKPIA member companies increases by over £12m+/year and there are concerns about consistency of treatment of refinery CHP plant. The impact varies by company, but is dominated by cost increases incurred by refineries, due to the need to purchase allowances for self-supplied electricity.

4.6 Following the Comprehensive Spending Review, auctioning revenues go to HM Treasury; the scheme is now looking like a burdensome additional tax that does little to encourage energy efficiency beyond what prudent businesses do already and indeed potentially penalises CHP which is designed to use energy more efficiently with benefits for security of energy supply.

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*?

5.1 The use of renewables can have unintended consequences. The Renewable Heat Incentive levy as originally planned would have been applied to fossil fuel derived co-process heat used in refinery production, the effect of which would have been to potentially wipe out the gross margin made by refineries. Although the RHI is now to be funded from general taxation, for much of 2010 there was complete uncertainty about the impact upon refining for a scheme that was due to commence in April 2011.

5.2 The use of biofuels in road fuels is one of the measures to reduce carbon emissions. It should be noted that UKPIA members have a wide spectrum of views on the extent to which biofuels will contribute to diversity in the supply of UK liquid fuels. Some members believe that biofuels have a positive role in diversifying the UK's liquid fuel mix and thus contributing positively to security of supply. Others take the view that their use

tends to complicate the supply chain both in terms of the reliable supply of quality assured biofuels and operational requirements: segregated blending of ethanol at road tanker loading points (not at refinery); extra housekeeping associated with storing biodiesel blends; careful batching of biodiesel blends in pipelines; risk of FAME in jet fuel. With EU countries pursuing the same biofuel targets there is a shortage of vegetable oil even before non- transport sector requirements come into effect. Most of the biofuel components are imported from non-EU sources and in the shorter term until issues of sustainability and indirect land use change are resolved, the benefit to security of supply diversity is unclear.

5.3 The Renewable Energy Directive and Fuel Quality Directive currently being transposed in to UK law require refiners to reach 10% by energy biofuel content in transport fuels (RED) and reduce carbon content by 6% by 2020 (FQD).

5.4 The targets for both the RED & FQD trajectories towards 2020 must be set at levels that are both practicable and achievable in the market. They should be consistent with the capabilities of vehicles, forecourts and existing distribution infrastructure. Also full trading of Carbon and Energy certificates should be allowed with buyout options and also the flexibility to carry over certificates from one obligation year to the next. The Directives also need to take serious note of the sustainability issues around biofuels and UKPIA's longstanding position that the most effective use of biomass is in replacing inefficient power and heat generation.

5.5. An impracticable target will restrict supply of fuel to the UK market (refiners unable to meet the target so cannot supply) with the potential for supply shortages. Targets should be no higher than other EU states to allow fuels to be transported across member states and therefore increasing availabilities of fuels suitable for the UK market.

5.6 Achieving the 2020 targets may require four grades of fuel on larger forecourts (from 2015>) with two high bio blends of a least for petrol E10+ and diesel B10+. Smaller filling stations may be disadvantaged as they can only accommodate "protection grades" E5 and B7. It is vital therefore that there is flexibility in the way in which the Renewable Energy Directive is transposed into UK law in order not to increase the risk of further closures of rural/small filling stations unable to meet these requirements. This will affect supply resilience particularly in those rural areas where sites already face considerable commercial pressures.

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

We have no comment on this question as it is outside UKPIA's remit.

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

This question is largely addressed in response to 1 & 2 above but also see 9 below.

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*?

As stated previously, UKPIA's firm view is that a strong and healthy indigenous refining sector ensures the nation's "base load" of transport fuels, chemical feedstocks and other vital products is maintained whilst the transition to a lower carbon economy takes place. Policies that take careful note of this fact will also secure the significant energy requirement that only oil can provide for decades to come.

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*?

In 2.5 UKPIA pointed to the key importance an Agency to manage the nation's strategic oil stocks has on the future of UK refining. The significant investment needed to meet the UK's obligation under EU/IEA rules are best met from a central entity, rather than by imposition on commercial undertakings.

In a similar vein, the cost of permits for UK refineries under the EU ETS Phase III scheme is likely to be around 150 million Euros in 2013 in one hit with no transition arrangements.

The first issue is totally within the gift of UK government. The second requires recognition by UK policymakers that industry cannot easily withstand costs of this nature. UKPIA assume government would prefer UK refining and energy intensive industry generally to survive climate change policy and provide their vital products for the nation's future wellbeing.

We thank you for the opportunity to contribute to this important debate and would be pleased to elaborate on our views should the Committee so wish.

March 2011

Memorandum submitted by the Institution of Engineering and Technology

Evidence from the Institution of Engineering and Technology (IET) endorsed and supported by The Royal Academy of Engineering, The Institution of Mechanical Engineers and the Institution of Chemical Engineers.

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.[39] 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.

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; and
- 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[40] 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.

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

[40] 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.

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 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; and

— 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.

March 2011

Supplementary memorandum submitted by the Institution of Engineering and Technology

You emphasised the need for a systems approach to energy policy. Do you have any comments on DECC's capacity and approach to systems thinking with respect to energy security?

1. The key point about a systems approach is that the boundary has to be drawn in the right place. Energy systems extend across all areas of government and, in particular, encompass most of the activities of DfT and much of the work of DCLG and the boundary of the energy system has to include these.

2. Policies in other areas feed directly into the energy system. For example, a new high-speed railway would impose a different type of load on the electrical network to a fleet of electric cars. (The former would be concentrated at the 275kV transmission level and would occur during the daytime peak periods; the latter would be concentrated at the 415V distribution level and could be time-shifted to match the availability of renewable energy.) Even policies that are not normally thought of as energy related, such as on faith schools, have a direct influence on energy use by adding to "the school run".

3. It is thus important for the system to be considered across departmental boundaries, with the implications of different policy options being considered in the round. As mentioned in the IET's oral evidence, we believe that Infrastructure UK could play an important role in this area.

4. We commend the recent initiative by DECC to increase its engineering capacity through recruitment, and to raise the profile of engineers internally, however this appears to be targeted at policy implementation rather than policy development. Engineering considerations need to be at the heart of policy decision making, this would include a systems view. An example would be consideration of delivery risks for say offshore wind or nuclear, the impact of these on timescales and/or target achievement, and how to facilitate appropriate industry responses. DECC receives a high level of lobbying and other external input from companies with strong financial interests in the sector and needs to have greater capacity to understand this within an engineering systems context.

Do you think that departmental Engineering Advisers would facilitate a systems approach?

5. Departmental Engineering Advisors could facilitate a systems approach but only if:

— they act in a cross-Departmental framework so that system boundaries are drawn appropriately;

— they are given sufficient influence over policy formulation; and

— they are of sufficient calibre, credibility and with broad industry experience.

Given that expertise within government may be constrained, what is the minimum level of coordination between departments and teams within departments that would be needed to address your concerns about a systems approach?

6. The Treasury takes a systems level view of government expenditure with responsibilities for all expenditure, wherever it occurs. A similar over-arching view of energy is required. If the government is serious about meeting an 80% reduction by 2050, then it will require energy and carbon budgets enforced with the same rigour as the deficit reduction budgets are today. We believe that a systems authority (possibly built around Infrastructure UK) that assesses evolving policy in departments for energy system impact and has authority to direct change where necessary would be a key part of the solution. This would need to be allied to engineering capability in policymaking in key departments that worked closely with the systems authority. None of this need employ large numbers of staff, a small unit of high calibre people forming the systems

authority, and a few suitable empowered people in departments would be sufficient. The key to success would be empowerment.

Are there any risks associated with taking a more top-down systems approach?

7. The largest risk is that the concept will be misunderstood or applied inappropriately within a system boundary that is too small. There is already evidence of this in the CO_2 emissions targets in that national reductions, caused by outsourcing manufacture to the Far East, are treated as a British success story while, as Professor Dieter Helm has shown, the total emissions caused by British consumption have actually risen since the Kyoto treaty was signed, rather than fallen as ministers have claimed.

8. A further risk is the signals such a change in approach would send to investors. In the long run the rational long term framework that would evolve under a systems authority could assist investor confidence substantially by creating visibility of the long term. However, a transition from now to then would inevitably create winners and losers and would need appropriate management.

Dr Harrison told the Committee that CCS on coal was cheaper per unit of carbon captured than on gas. Given that gas plants produce more energy per unit of carbon, how do the costs of CCS on gas compare with CCS on coal when measured per unit of energy generated?

9. Another apparently simple question with a complicated answer! The cost of removing the CO_2 will be cheaper per unit of CO_2 for coal than for gas. When looking at the costs/MWh generated:

- More carbon is produced per MWh for coal so transport and storage costs will be greater than gas/MWh.
- The uplift on generation costs/MWh will be greater overall for coal than gas because of the very much greater carbon intensity of coal/MWh.
- Relative gas and coal prices have a major impact on relative generation costs, and without CCS gas is cheaper than coal in virtually all scenarios, ignoring carbon allowance costs.
- Applying DECC's carbon price projections creates a further strong advantage for gas versus coal (without CCS).

10. Understanding the impacts of this on overall generation costs from coal and gas with CCS requires making a large number of assumptions many of which are quite uncertain, including plant capital and operating costs, efficiencies, load factors, fuel costs and carbon price. Various studies are available (there are no real examples yet).

11. Examples from such studies show:

Study	*Gas (£/MWh)*	*Coal (£/MWh)*	*Comparison*
Mott MacDonald for CCC (2011)	105	146	Coal £41/MWh more
PB Power for DECC (2011)	105	108	Coal £3/MWh more
ZEP for EU (2011)	89	72	Gas £17/MWh more

12. Whilst inconclusive, these data do show how uncertain the projections are at the moment. Overall we think that for reasonable scenarios for the UK we expect gas with CCS to likely be cheaper than coal with CCS/MWh but not by a large margin, meaning that if the UK moves to CCS it may make sense to retain a diversified coal and gas portfolio for security reasons.

What types of electricity storage technology do you think could feasibly be developed in the UK? And what are the costs and timescales associated with these technologies?

Types of storage

13. There are different types of grid connected storage depending on whether the objective is

- short term (to cope with load fluctuations lasting from a fraction of a second to a few minutes);
- medium-term (to flatten the 24-hour variability of demand) or; and
- long-term (to compensate for a 10-day anticyclone when there is little wind power).

14. As well as a capital cost, all storage carries an efficiency penalty: less energy comes out of the store than one puts in because of conversion losses and leakage. This is typically in the range 20–30% depending on the technology and its application.

15. Other forms of storage can consist of converting electrical energy into another form that can be stored, with no intention of reconversion to electricity but instead avoiding future use of electricity. Examples might include:

- pumping water to reservoirs and water towers only at time of electricity surplus;
- the manufacture of hydrogen as a transport fuel; or
- the use of surplus electricity to heat stored water in homes.

16. Several other energy storage options need to be considered to understand the total picture (another example of drawing appropriate system boundaries). Examples include:

- stored heat within district heating networks; or
- inter-seasonal storage of heat in aquifers (given the right geology it is possible to store heat extracted from buildings in summer and recycle it during winter).

17. For *very short term* storage, such as to reduce the flicker effects as the blades of a wind turbine pass the tower, and thus lose power, or to absorb the braking energy from a metro train coming into a station and release it as the train accelerates 30 seconds later, high-speed flywheels have been used. These have a high peak power rating, but low total energy storage. So called "super-capacitors" have a similar characteristic. The total energy they can store is low but they can release it in a very short time frame. Both technologies are useful in helping to iron-out short term peaks and troughs on electricity networks. More recently there have been several lithium ion battery systems installed for similar purposes.

18. For *medium term* storage, the current large scale technology is pumped hydro, which continues to be planned and built in Europe, and throughout the world. A Scottish power company is proposing an extension for pumped storage on an existing hydro power station. Pumped hydro power, whether new-build or up-rating existing facilities is available at relatively low capital costs. [41, 42]

19. Also for medium-term storage, as well as the existing option of pumped hydro, secondary batteries[43] can be used. Currently, the largest commercial installation anywhere in the world is rated at 34 MW and over 200 MWh, and there are numerous installations of more than 5 MW. Tokyo Electric Power Corporation which is linking their network of 200 individual MW size batteries to form a smart grid solution provides an example of innovative development in this area. More recently, in order to overcome severe shortages of peak power in Northern Japan, an 80 MW, 480 MWh battery is under construction and due for commissioning in January 2012.

20. For *longer term* storage, please refer to the final question.

Development in the UK

21. In the UK, there are a number of small scale distribution network-connected storage projects, most of which have been undertaken using funds from the Innovation Funding Initiative (IFI), and Registered Power Zones (RPZ) initiatives or Low Carbon Network Funds. Scottish and Southern Energy have installed a 100 kW flow battery at a substation in Nairn and are currently in the final stages of installing a 1 MW, 6 MWh battery in Shetland. UK Power Networks have installed a 200 kWh lithium ion battery adjacent to the Hemsby wind farm in Norfolk[44] (see paras 35–36) and other distribution companies are considering small scale deployment. However the scale of these installations is several orders of magnitude below that which would be of significance to the operation of the national network.

22. It is important to put these figures into perspective: in winter, the surge in UK electricity demand at the end of the afternoon is 5,000 MW. With the current scale of battery technology, a huge number of storage installations would be needed to cope with national load fluctuations, but they can be useful to deal with local problem areas. Batteries are also expensive with installed costs around £300/kWh.

23. There are thousands of battery storage systems in the UK, generally known as uninterruptible power supplies (UPS), which are used to provide back-up power to computer servers, hospital operating theatres and similar applications. Small units cost around £300/kW and are designed to maintain the supply for a short period—for some, only a few minutes until the computers can be shut down safely or a standby diesel generator can be started, for others, costing significantly more, for several hours.

24. An interesting synergy between plug-in vehicles and renewable energy is the concept known as V2G (vehicle-to-grid storage) in which Electric Vehicle (EV) batteries are used to support the grid. If a commuter arrives home at 16:00 hrs with a half-discharged battery, plugs in his EV and tells the charger that he next needs it at 07:00 hrs the following morning, it is of no consequence to the driver whether the battery is charged there and then or whether some of the remaining energy is used to support the grid during the 17:00 to 19:00 demand peak and the battery is then recharged between 12:00 and 03:00 hrs the following morning. The benefit of V2G storage is that the battery and its charging connection are already paid for and so the marginal capital cost is very low. However, for the technology to achieve widespread adoption, a high-integrity "smart grid" capable of controlling load at the local level will be needed. The commercial aspects of the energy trading also have to be worked out in detail.

25. A large amount of R, D and D is in progress on storage around the world, with many technologies showing promise, but costs are likely to remain high, and the different technologies have different performance characteristics, thus suiting them to different roles within the energy system. The UK has a rich research base spread amongst its universities with valuable research being undertaken.[45]

[41] Redpoint, EMR analysis of policy options, December 2010.
[42] EON's Waldeck http://www.eon.com/en/media/ http://www.scottish-southern.co.uk/SSEInternet
[43] Broadly similar to those used in EVs but optimised for the rather different application of grid storage.
[44] http://www.electricitystorage.eu/documents/UKPNEnergyStorageDevice.pdf
[45] Energy Research Partnership: The future role for energy storage in the UK, June 2011.

26. There are also several commercial organisations in the UK developing small and large scale electrical energy storage technologies. Highview Power's cryogenic system, which uses the expansion and compression of liquefied nitrogen, is currently being demonstrated in a 500 kW installation in Slough, along with flow battery developments by REDT, C-Tech, and Sharp Laboratories. In addition, thermal systems under development by GPE, store energy as latent energy (Heat and Compressed Air) which can be used to drive a captive hydroelectric turbine to produce electricity. Another UK company, Isentropic, is developing a heat transfer mechanism to drive a reversible heat engine.

Costs and Timescales

27. With the exception of pumped storage, where the costs of particular schemes can be estimated quite accurately, most storage technologies are at demonstration stage with costs and timescales relatively uncertain. The timeline on which storage will be needed on a large scale is around 10–15 years from now, which should be sufficient for technologies to advance substantially given adequate resources. More work is needed to understand the role of storage in the future energy system, which will better inform decisions about which technologies to promote. We refer the Select Committee to the report by the Energy Research Partnership in June 2011 entitled, "The Future role for energy storage in the UK".

If storage technologies were located close to wind farms, do you think they could represent a cost effective alternative to grid reinforcements?

28. In general onshore wind farms are in remote and rural locations and the constraints on grid reinforcement (visual impact of new transmission lines) would apply as well to new storage facilities of any scale, which would typically require buildings and other supporting infrastructure. Pumped storage hydro plant would potentially have significant landscape impact including new reservoirs. Ideally individual circumstances would be taken into account to balance the costs and benefits of local storage versus grid reinforcement and more remote storage.

29. There are several battery storage systems associated with wind farms but these often have a primary objective of improving voltage fluctuation and other "power quality" issues, rather than large-scale energy storage. For example, the 10MW Hemsby Wind Farm near Great Yarmouth in Norfolk[46] has a system housed in a 25m² building containing eight stacks of 13 lithium-ion batteries. The total storage capacity is reported as 200kWh[47], which is adequate for ironing-out short term peaks and troughs and improving power quality, but would be capable of storing only a few minutes worth of the energy produced by the wind farm. The purpose of the battery is to secure the voltage and operating stability of the network, and not to smooth out the production from the wind turbines.

30. However, the current regulatory environment makes this type of optimisation difficult. This form of short term storage within the distribution network is novel in the UK and not compatible with current regulation. The Regulator has not yet confirmed how storage could be handled regarding electricity storage being seen as "generation" at the time when it feeds back into the electricity network. Distribution Network Owners are not currently allowed to own and generate their electricity so an exception was applied for the Hemsby installation to operate as a trial under the Low Carbon Networks Fund.

31. If a systems approach to energy is adopted, some non electrical storage might usefully be deployed. For example, the £46 million Northern Isles New Energy Solutions (NINES) project in the Shetland Isles will demonstrate how a combination of electrical storage using a 1MW battery as well as thermal storage using both domestic heating tanks and district heating schemes will be able to absorb surplus energy. A key component of the system will be the "smart grid" that will control generation, storage and use of electricity. Shetland emerged as the ideal testing ground for this new approach because the isles' grid is not connected to the national grid and has already reached its capacity for accepting intermittent wind energy.

What scope do you think there is for the development of technologies that could store electricity on a long-term basis (for several days or more)? Could hydrogen produced through electrolysis be a potential option for multi-day storage?

32. Fossil fuels offer the cheapest form of energy storage; the coal storage yard in a large power station can store more than 5,000 GWh of energy. To give an idea of scale, a battery capable of storing that amount of energy would cost more than £1 trillion and using electrical of mechanical methods, such as batteries or flywheels for long term storage of energy is likely to be prohibitively expensive for the foreseeable future.

33. For large scale renewable energy storage, hydrogen could be produced from low-carbon electricity as a means to use surplus electricity when supply outstrips demand. This hydrogen could then be used as a transport

[46] The Norfolk storage project was part of a Smart Grid test project funded by EPSRC, ABB, Scottish Power and EDF (now UK Power networks) under the IFI funding. The project name was Aura NMS (standing for Automated Regional Area Network Management System). Its aim was to demonstrate the use of active network management techniques. The storage element was not able to be sized any larger due to cost constraints but was implemented to demonstrate the trading, balancing and uses of storage in an offshore wind farm/town/constrained network situation. Some very interesting work is still to be completed on this project. The project has now completed and results are still being analysed to understand how successful this type of storage option is.

[47] http://eandt.theiet.org/news/2011/jun/energy-storage.cfm

fuel, or potentially could be converted back to electricity in a turbine if needed to cover supply gaps of several days or longer. The infrastructure to store and reconvert the hydrogen would however be relatively costly, especially if its capacity utilisation is low and there are conflicting views on whether this would be more or less economically advantageous than other schemes.

34. One established technology is pumped storage. The UK already has four such large power stations dating from the 1950s to the 1980s. There is significant potential[48] for additional pumped storage in the UK, and perhaps for the conversion of some existing hydroelectric plants to pumped storage, and/or to peaking duties providing high power for short periods. The classical use of pumped storage is to cover in-the-day or shorter term variability. There is no technical reason why longer term storage services cannot be supplied from such plant, but the resulting tying up of a capital intensive asset as a water store would make this expensive.

35. Other solutions, particularly if we move towards a more electric world for heating, would be to exploit large and very well insulated hot water storage at domestic level; schemes have been proposed with several thousand tonnes of water in a specially constructed cellar—obviously not applicable to all housing types. The Shetland heat storage LCNF project referred to above could potentially be replicated elsewhere on a much wider scale. An alternative form of inter-seasonal heat storage has been proposed using deep aquifers and other indirect storage.

36. This is not an easy problem to solve, and it is hard to envisage not having to hold significant reserves of thermal power plant (perhaps fuelled from biofuels) to deal with long periods without wind. Interconnection to Europe at large scale may help too by spreading the risk of local wind shortfalls and providing access to a greater pool of diverse low carbon sources. This is discussed further in our evidence to the ECC Select Committee on the European Supergrid.

July 2011

Memorandum submitted by Electricity North West Limited

I write in response to your call for evidence published in January and welcome the opportunity to comment. Electricity North West Limited is the electricity distribution network operator based in the North West of England, with no supply or generation interests. Our comments are therefore from the perspective of an energy network provider regulated by Ofgem. We have recently responded to the Department for Energy and Climate Change's Electricity Market Reform consultation which discussed the same issues but was predominately focused on ensuring that low carbon electricity generation assets are delivered in a timely and efficient manner. Whilst we support the Government's objectives, we are particularly concerned with the implications for electricity networks of decarbonising the UK and note that many of these issues are not addressed in that document.

The energy security versus independence debate must recognise a third factor—cost. It is appropriate that the UK should make a conscious decision on the balance between energy independence (secured through renewable or localised resources) and security of resources, but the debate must consider the wider picture of increasing costs of electricity.

Moving to a lower carbon generation mix will have implications for networks. The increasing use of renewable resources as part of the energy mix decreases the flexibility of the energy supply. To maintain the current standards of performance, the solution will be increasing management of electricity demand. Networks must assume an important role in balancing the available supply with customer demand. A failure to achieve this control will either result in increased requirement for flexible, carbon intensive generation or risk supplies being unavailable to consumers.

We have focused this response on the relevant questions which affect the Network Companies.

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

The UK's energy security is very sensitive to the level of investment in energy infrastructure. The UK energy sector faces two capacity challenges—availability of generation and availability of network infrastructure to deliver energy to consumers. The focus of most publications has been the need to build a new, low carbon generation fleet with a passing reference to the ability to connect the assets to a network. The Government must recognise that the future role of networks will need to change radically to facilitate the decarbonisation of energy usage. This role is critically important and goes beyond the physical connection of new generation fleet to the connection of small scale renewable generation and ensuring that sufficient capacity is available throughout the network to allow energy usage to switch from high carbon gas, petrol and diesel for heating and transport toward low carbon electricity. The Committee must ensure that these issues receive serious attention from Government in order to prevent additional significant barriers to low carbon investment.

[48] This potential includes exploitation using seawater as the lower reservoir and potentially also underground aquifers. The studies exploring these possibilities are getting old and require review and updating.

The Government must recognise the potential financial constraints placed on the networks. The UK will be undertaking an unprecedented increase in network and generation infrastructure investment at the same time as many other international economies. The Government must ensure that regulators are required to provide appropriate financing arrangements to ensure that debt and equity investment is available for networks as well as generation. There is a global market for infrastructure investors and these markets will become saturated potentially raising the cost to customers. Securing sufficient favourable financing is key to ensuring that our objectives of delivering cost efficient decarbonisation. Therefore regulators must be conscious of the investment climate being created now.

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

Electricity usage will increase in scale and in usage profile with significant impacts on the requirements on networks. To be successful in achieving our decarbonisation goals, the 2050 Pathways Analysis demonstrates that the low carbon policy objectives must penetrate all sectors including transport, space heating and process heating. Our domestic load growth projections based upon the expected impacts of electric vehicle charging and the growth of heat pump usage suggest that the level of network reinforcement investment will need to increase dramatically in the next five to ten years. Initial estimates suggest a minimum doubling of domestic electricity demand, even if the new loads are optimally scheduled.

On a localised level, a single fast electric vehicle charger or small number of domestic heat pumps in a street will often cause significant issues for the local low voltage grids. This is likely to cause voltage limits to be breached and significant investment will be required in distribution transformers due to peak load having doubled. This issue is clearly illustrated when one appreciates that the expected additional demand increase due to electric vehicle charging in Manchester city centre almost matches its present total day-time demand.

We estimate that using current network management standards and policies these load increases would require a minimum of £1 billion of investment before 2030 in our network area alone, with a quarter of this funding required in our next price control period (RIIO-ED1, 2015–23). Using traditional techniques, load related expenditure within our next price control would be expected to rise by over 200%.

To mitigate the twin risks of high reinforcement costs and delays in the delivery of additional network capacity, significant technology innovation and investment will be required in load management and demand side response; there is greatest opportunity for this at the higher voltages. In some instances, networks will be the key enabler of localised generation. It is therefore important that network development must at least match generation development. The (unstated) working assumption is that issues created by the introduction of heat pumps and electric vehicles will be addressed by network companies in an efficient and timely manner. This will not be the case without changes to the current regulatory framework. DECC must provide regulators with clear guidance on the need for networks to support wider policy objectives or risk delays in both local generating capacity and low carbon reduction technologies.

DECC must also ensure that Ofgem provide sufficient incentives to deliver the innovation required to tackle these issues and recognise that innovation represents a significant departure from typical infrastructure investor risk profiles and will require appropriate return on investment.

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?*

The chosen solution to meeting our greenhouse gas targets via renewable generation will improve the UK's energy security but we recognise that there is a balance required between energy security, carbon reduction and affordability for customers. For network companies, the traditional approach of physical network reinforcement will create significant increases in customer bills at a time when generation charges will also increase. The generation profiles of the new low carbon fleet will significantly differ from the existing assets and therefore a new approach to network management is vital to deliver the Government's targets at an affordable price.

Our view is that Government, Regulators and Network companies need to understand how to match increasing demand patterns with intermittent and/or less responsive generation. We suggest that there will ultimately be a need for a Distribution System Operator role to achieve the desired low carbon penetration. The existing approach of matching generation to meet demand requirements will need to change to an optimised supply matching approach, where customers' demand profiles can be matched to availability of generation capacity. On a local level, Distribution Network Operators have begun to experiment with commercial agreements to defer investment requirements. This approach will need to be replicated and expanded to manage the localised capacity issues.

Linked to this issue is the current approach to incentivisation of network management. Networks are currently incentivised to increase utilisation rather than increase capacity. When regulators were responsible for capturing short term efficiencies on behalf of customers, these objectives were appropriate but we now operate in an environment which requires a longer-term, expansive view of efficiency. The current approach will result in the availability of network capacity becoming a "bottle-neck" that delays the move to the low carbon economy, and in particular can create issues for future generation investments. If the future role of

networks is to facilitate the transition to low carbon generation, the incentive mechanisms adopted by Ofgem must change to support this changed role. To achieve this, Ofgem must be given clear guidance on the objectives and roles for future networks, to ensure that the mindset of Ofgem changes away from a narrow focus on cost efficiency to the efficient enablement of a low carbon economy.

Regulators should be free to determine the appropriate tools to deliver the policy but the overall objectives must be consistent with Government policy. Ofgem are somewhat restricted in adopting this wider perspective by their statutory duties. DECC can support and enable Ofgem to make this change by drafting more explicit Social and Environmental Guidance for Ofgem that reflects the key implementation requirements of government policy.

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

Whilst a generation fleet with greater reliance on local renewable energy resources increases security of supply, the global energy markets are all looking to decarbonise, replace or build generation assets. There will be international demand for infrastructure finance and manufacturing resources which will have significant implications for the UK's ability to deliver its carbon and energy diversity targets. Ofgem suggested that over £200 billion will be needed to deliver the required investment and whilst a sizeable portion could be raised through the debt markets, equity will continue to play a vital role. The amount of finance which could be provided by typical infrastructure investors is uncertain and highly sensitive to changes in risk profiles. With competition for these scarce resources from other UK and international investments, DECC must ensure that the appropriate long-term commitments to investors are retained or enhanced. For regulated networks this can only be achieved by ensuring that Ofgem provide long-term competitive returns packages whilst minimising the level of uncertainty associated with investments. It is reassuring that Ofgem has recognised the long-running and consistent opposition of investors and network businesses alike to its proposals for financeability under their RIIO model and has made several concessions in the Gas and Transmission reviews. These adaptations must be carried into the RIIO ED1 controls to demonstrate Ofgem's and the Government's commitment to investors.

March 2011

Supplementary memorandum submitted by Electricity North West Limited

Q1. *You suggested that new network investment would only be forthcoming if an "appropriate" rate of return was allowed by Ofgem. In your view, is the standard rate of return on offer sufficient to deliver the £32 billion investment that Ofgem has estimated will be needed by 2020?*

It is important to understand how network companies make investment decisions and why Ofgem's current approach to modelling returns may not provide sufficient rewards for companies to invest in low carbon infrastructure. In order to provide significant finance for decarbonising the network, investors (both debt and equity) look for long-term stable returns which are commensurate with the risks their investment assumes. In a competitive global market for funds the future UK regulatory framework must provide these conditions. Ofgem's new regulatory framework RIIO (Revenue = Incentives + Innovation + Outputs) uses a model called the Return on Regulatory Equity to prescribe how network companies earn returns for investors and the scale of those returns. Ofgem used this model for the first time in our last price control to set a range for the total returns available to shareholders. This approach had a significant impact as it suppressed the core returns to investors (the allowed cost of equity). This model fails to recognise that business cases for investments will be assessed against the guaranteed returns ie the allowed Weighted Average Cost of Capital (WACC). Furthermore, Ofgem's RIIO policy decision increasing depreciation life from 20 years to 45 years has the effect of returning investments over a much longer period than was previously the case. In addition, Ofgem has introduced a new cost of debt measure based on a 10 year trailing average. Ofgem do not currently accept that these proposals will change the perception of risk and hence increase the cost of capital. As economies across the world respond to carbon reduction challenges there is growing competition for investment finance. Any decision to invest will be made based on the overall returns available to debt and equity investors but, in isolation, I am concerned that the current returns and increased risk to financeability are jeopardising the UK's competitiveness for global investors. In addition to delivering the £32 billion to reach the 2020 targets we are also acutely aware of the succeeding ramp up in investment to deliver the 2050 targets. The current rate of return, in our view, is not sufficient for this as investors may well look to alternative investment opportunities given the risk profile and returns available.

There is also a concern that the RIIO framework will not provide stable cash returns. Both debt and equity infrastructure investors require some of their return in the form of regular, stable cash yields. Debt providers need regular interest payments to be made and equity providers (usually pension funds) have regular obligations to meet. We have not seen how Ofgem will ensure that these important conditions will be achieved and worry that they believe new investors will emerge, prepared to sacrifice cash yields today for high returns in the future. Indeed, in the RIIO consultations to date Ofgem has clearly focused on returns in period rather than the requirements for a sustainable annual return.

Q2. *We have heard that network operators may need to engage more with customers in the future to encourage them to participate in demand side measures. To what extent do network operators currently engage with customers directly and are there any plans or strategies in place for how engagement might be improved?*

We do believe that we will need to engage more with customers to encourage them to participate in demand side measures and have unilaterally started work on how best to do this. Since privatisation, and particularly since the separation of distribution and supply business by the Utilities Act 2000, distributors have been actively discouraged from engaging directly with customers regarding their use of the network. Network operators have and continue to engage with customers over planned outages, faults, new or augmented connections etc—but this has been difficult and is often confusing for the customer. Fortunately, Ofgem's RIIO model does recognise this issue and places much more emphasis on customer and stakeholder engagement in determining planning and investment priorities, but some of the energy suppliers are resisting this change and wish to maintain their position as the primary or sole contact with the customer.

In recognising the importance of demand side management in the move towards the low carbon economy, in 2008 we conducted a survey of industrial and commercial customers in a key area where reinforcement of the distribution system was required. In 2009 and 2010 we then contracted directly with specific customers for the provision of demand side services—we were the first DNO to do this. As we have no resources or funding for contacting customers in this manner, in 2011 we have recently engaged an aggregator to work with a broader range of customers on our behalf to provide a specific level of demand side response to further areas of our network. We believe these are the first contracts of their kind for a distributor in GB. We are currently developing our plans for improved direct communication with larger industrial and commercial customer to explain the benefits of demand side response. Whilst we are leading the way in this area, we are still only developing and proving the communication mechanisms. We are trying to use the Low Carbon Network Fund to develop this further with our current "Capacity to Customers" bid. Currently the energy suppliers are Ofgem's focus for Demand Side Response and we believe the DNO role is still largely overlooked. We have tried to force our way into the Ofgem Demand Side Response group as no Distributors are represented there. Explicit recognition by the Committee of the role that network operators will have to have in Demand Side Response would be extremely helpful in opening eyes and doors around the industry to the importance of these developments.

Q3. *Could the roll-out of smart meters provide an opportunity for network operators to start to engage with consumers?*

Smart meters are primarily targeted at small domestic/commercial customers. Whilst smart meters will undoubtedly improve the ability of network operators to offer demand side management services, we would not at this stage envisage direct engagement with this mass market. The costs of direct engagement will currently be expensive on a per customer basis compared to the amount of demand side response each can provide. We would therefore expect that demand side response for network operators through these types of customers are more likely to be enabled by the subsequent development of smart appliances that are able to receive direct communication from market participants, including DNOs. To this end a key development we are devoting resources to is the development of appropriate standards for the design of the next generation of electrical appliances, such as heat pumps and electric vehicles. The inherent communication standards and operating protocols for such appliances are another area where we would welcome the investigation and consideration of the Committee.

July 2011

Memorandum submitted by National Grid plc

Executive Summary

1. Diversity of sources of supply, both fuel type and location, is the key aspect of UK energy security as it serves to minimise reliance on any single source and reduces risk. This is important when many energy sources can be affected by geopolitics and natural disasters.

2. Alongside this, National Grid recognises that security of supply has to be discussed with reference to both sustainability and affordability. National Grid recognises that in the longer-term, the demand side will play an increasingly important role in mitigating security of supply concerns by postponing energy use until generation or network capacity becomes available through the use of smart technology or more proactive participation in the provision of system operator commercial services. In the near-term there will be the need to manage increasingly volatile generation patterns and gas demand profiles as the level of intermittent generation increases.

3. Issues associated with energy supply security are summarised below:

— In order to meet the environmental targets, while maintaining energy security, there is a requirement for a balanced, diverse approach to the electricity generation mix to minimise exposure to a single supply source. This would see an even emphasis on development of low carbon generation technologies—eg a combination of nuclear, Carbon Capture and Storage (CCS) plant and renewables.

— In gas markets there will be an ongoing requirement to integrate diverse gas supplies as the level of imports increase due to diminishing UK Continental Shelf (UKCS) sources. In addition new gas storage sites are likely to be developed and the gas network will need to be more flexible in order to cope with the range of import options and fluctuations in flows due to gas-fired power demand responding to intermittent renewable generation. Non UK demand will have a greater influence on the market and competition with other markets will result in a need for wider market opportunities and arbitrage in order to attract new supplies.

— Generation and supply terminals are expensive and it is important that networks are invested in to deliver flexibility and certainty so that connecting customers can be confident of getting energy to the market. This will increase both security and lower overall costs.

— A significant amount of investment in the energy infrastructure is required in order to deliver sustainable and secure markets for 2020 and further into the future. With significant development in the electrification of the heat and transport sectors in the coming decades, investment in electricity networks is unavoidable if secure supplies are to be delivered to meet growing demand. Smarter energy solutions, optimising between gas and electricity networks are important in assuring affordable, secure, low carbon energy. Although demand side participation in markets is expected to increase it will only be one part of the solution with a key aspect being that demand cannot be delayed indefinitely.

— Increasing levels of intermittent renewable generation are expected to require back-up generation and increased levels of system reserve requirements. In the longer-term, demand side response will become increasingly important to alleviate intermittent supply issues. The changing make-up of UK electricity generation with an increasing contribution from wind will also significantly impact the operational characteristics of running the UK's gas network, with gas-fired power generation identified as the primary source to cover for wind intermittency in most instances.

— A greater level of interconnection in the power market will provide greater diversity of potential supplies as well as facilitating competition in the European market and assisting the transition to a low carbon energy sector by integrating various renewable sources. It is an established view that increased interconnection with Ireland and mainland Europe can help with the intermittency issues posed by renewable (mainly wind) generation and so aid and support electricity security of supply.

— The slow development of new low-carbon generation and the closure of existing nuclear plants will probably result in a heavy reliance on gas-fired generation and will effectively result in both gas and electricity markets being reliant on significant levels of imported energy.

— Any market intervention to deliver a long-term sustainable energy sector has to also consider the security of supply implications.

Introduction to National Grid

4. This response is provided on behalf of National Grid which owns and operates the high voltage electricity transmission system in England and Wales and, as National Electricity Transmission System Operator (NETSO), operates the Scottish high voltage and offshore transmission system. National Grid also owns and operates the gas transmission system throughout Great Britain and through our low pressure gas distribution business we distribute gas in the heart of England to approximately eleven million offices, schools and homes. In addition, National Grid owns and operates significant electricity and gas assets in the US, operating in the states of New England and New York.

5. In the UK, our primary duties under the Electricity and Gas Acts are to develop and maintain efficient coordinated and economical systems and also facilitate competition in the generation and supply of electricity and the supply of gas. Our activities include the residual balancing in close to real time of the electricity and gas markets.

6. Through our subsidiaries, National Grid also owns and maintains around 18 million domestic and commercial meters, two electricity Interconnectors facilities operating between England and France (IFA) and England and the Netherlands (BritNed), and a Liquefied Natural Gas importation terminal at the Isle of Grain. We have also formed National Grid Carbon Limited which is a wholly owned subsidiary advancing the transportation and storage elements of the Carbon Capture and Storage (CCS) supply chain.

7. National Grid welcomes this opportunity to provide comments on the inquiry to explore the nature and extent of UK energy security. Our submission relates to our UK businesses, with the response concentrating on the gas and electricity sectors of the UK energy industry.

Q1. *How resilient is the UK energy system to future changes in fossil fuel and uranium prices?*

8. The UK gas and electricity markets are sensitive to changes in global fossil-fuel prices. Changes to these prices are more likely to have a strong influence on the type of fuel used for power generation, the level of energy demand and end-user prices rather than any security of supply implications.

9. As the amount of imported gas increases, the UK will become more exposed to increasingly complex world gas markets. Given the lack of long-term supply contracts the UK will need to be competitive against these markets to secure supplies. This does not necessarily result in security of supply implications provided that there is a diverse range of potential supplies. Should new low carbon generation be slow in reaching the market, the most likely impact will be a high percentage of electricity generated from gas, thus potentially exposing the UK market to high gas prices, resulting in higher end-user tariffs.

10. Gas and coal-fired generation are far more exposed to changes in fuel prices than nuclear power plant. The variable (fuel) costs of gas and coal plant is likely to be around 75% of the lifetime costs of the plant while, for nuclear plant, it is more likely to be around 10%. It would therefore take a substantial increase in the price of uranium to result in an impact in the operation of nuclear power plant.

Q2. *How sensitive is the UK's energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?*

11. A significant amount of investment in energy infrastructure is required in order to facilitate sustainable, secure and diverse markets in the future. National Grid is planning to deliver a ~£16 billion investment programme, in the UK's energy infrastructure, over the next 5 years. This investment will focus on our regulated networks businesses (funded through the RIIO (Revenue = Incentives + Innovation + Outputs) price control framework and other regulatory mechanisms) but may also include commercial ventures, for example, our LNG terminal facility at the Isle of Grain.

12. One of the key elements in delivering this investment will be the planning regime. An efficient planning process is required in order to facilitate the delivery of large scale investment in new power generation, transmission and distribution infrastructure and gas storage facilities.

13. In the next decade the focus of network investment will be centred on the transmission networks to connect new power generation and reinforce networks to deliver increasingly diverse power flows. Beyond 2020, significant investment in electricity distribution networks will be required to enable the electrification of the heat and transport sectors.

14. Without network investment there are a number of significant components of security of supply that could not be realised. Much of the focus of the debate is on the connection of supply and demand to networks, particularly as the sources of supply are anticipated to change significantly as energy is decarbonised. A second key area of investment is in maintaining existing networks, to continue to secure reliable supplies of energy (the UK electricity transmission network reliability is typically around 99.9999%, with the UK gas transmission network at 100%).

15. Below we summarise the key investment drivers and describe the supporting network required to deliver them. In addition our annual documents—Gas Transportation Ten Year Statement and Electricity Transmission Seven Year Statement—detail the forecast level of investment on National Grid's Transmission Systems. National Grid also expects to have a significant amount of input to Ofgem's new annual statutory security of supply publication.

Power Generation Mix

16. During the course of this decade we will see the power generation mix in the UK change substantially. Normal power station asset ageing, together with the legislation in the form of the Large Combustion Plant Directive (LCPD) and the Industrial Emissions Directive (IED) is expected to result in around 20GW—or approximately 25% of existing capacity—of fossil-fuel generation capacity closing by 2020.

17. Driven by the 2020 EU renewable energy target, there will be an increase in renewable capacity, principally wind. In 2020, gas-fired power stations are likely to still make up a significant proportion of the capacity mix, although the amount of wind power will have significantly increased from around 5GW to approximately 28GW connected to the Transmission network. Other renewables and interconnectors will also have increased their contribution, while coal fired power station capacity will decrease significantly due to environmental legislation. Nuclear power station capacity is likely to remain broadly the same or decrease over the next decade, with any decrease likely to be offset by further gas-fired capacity. In the period post 2020 the picture is likely to change even further with the drive for lower carbon generation resulting in new nuclear plant, fossil-fuel plant with carbon capture and storage (CCS) technology and further renewable development.

18. National Grid's analysis suggests that there is sufficient contracted generation (customers with grid connection agreements) to meet the 2020 renewable targets. There is also sufficient Combined Cycle Gas Turbine (CCGT) plant with a connection agreement and/or planning consents to fill the supply gap created by the plant closures detailed above. This should not result in complacency with regard to security of supply however, as history has shown that a large number of plants do not progress from this stage to construction.

The main barriers to progression are planning and financing (securing consents and capital). The vast majority of the capital costs are associated with the Engineering, Procurement and Construction (EPC) phase of a project.

Electricity Network Investment

19. All this points to a significant amount of investment required in order to deliver sustainable and secure markets in the future. The long-term history of the power markets has been one of supply in the north and demand in the south around population centres. Transmission networks have been developed, incrementally, to accommodate these north to south power flows. Going forward, the next generation of UK electricity supply will have much greater geographic diversity (see figure 1), with these changes already impacting the development of the gas network.

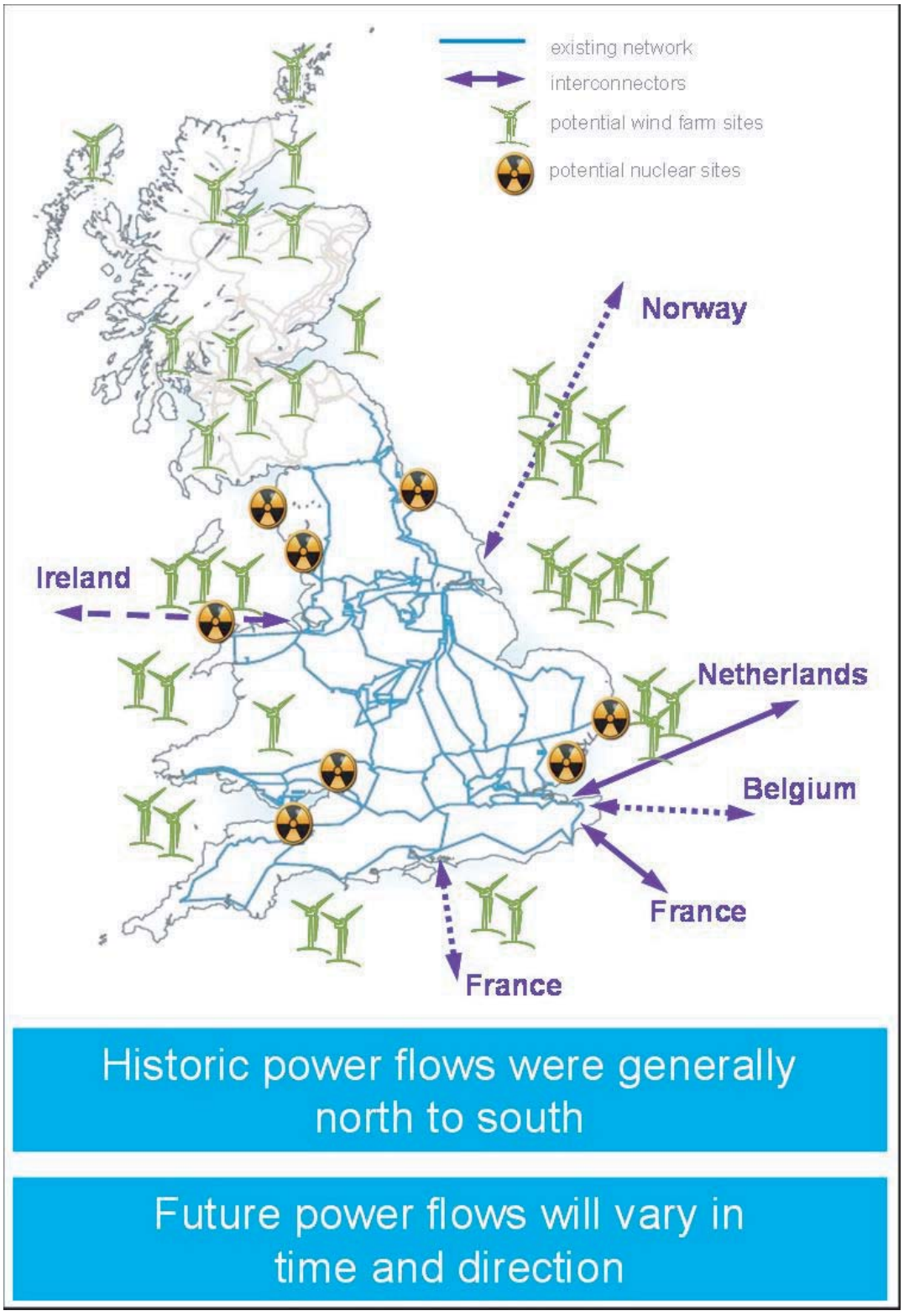
20. Most new wind power generation will be deployed at locations across Scotland, mid Wales, and at offshore locations around the entire UK coastline. New nuclear power stations will be deployed at coastal sites around the UK. Interconnection with mainland Europe will also bring electricity import/export points into the UK mainland network at diverse coastal locations. Many of these new power generation facilities will exist in areas where transmission capacity will need to be significantly increased, thus driving a step-up in investment in new power lines. Future power flows will therefore also vary in time and direction (unlike the historic relative stability of north to south power flow).

21. An important aspect of network investment is asset replacement (maintenance capital investment) as this seeks to ensure that the networks maintain their current levels of reliability (UK electricity transmission network reliability is typically 99.9999%, with the UK gas transmission network at 100%). This type of investment is critical as a 1% reduction in the reliability performance of the electricity transmission network would result in around 230,000 households not being supplied for an entire year.

22. There is also a need for a timely connection process with regulatory allowances for wider network reinforcement and anticipatory investment in order to ensure that power is supplied to the market.

Figure 1

UK ONSHORE ELECTRICITY TRANSMISSION NETWORKS



23. A greater level of investment in electricity interconnection capacity with our European neighbours will promote greater diversity of potential supplies. It is an established view that increased interconnection with Ireland and mainland Europe can help with the intermittency issues posed by renewable (mainly wind) generation and so aid and support electricity security of supply. National Grid is currently exploring the opportunities for increased electricity interconnection capacity; with new links to European countries (Belgium, Norway and France) currently being evaluating and/or actively progressed.

Gas Network Investments

24. In gas markets there will be a requirement to integrate an increasing diversity of gas supplies as the level of imports increases due to diminishing UKCS supplies. In addition new gas storage sites, potentially with high injection/withdrawal rates, are likely to be developed and the gas network will need to be more flexible in order to cope with the range of import options and fluctuations in gas-fired power demand driven by intermittent renewable generation.

25. Like electricity supply, the location for future gas supply is also forecast to change further. Historically gas supply flowed predominately from north to south, however in recent years the development of new import routes has shifted the gas supply away from the north to create in terms of network entry a more balanced and diverse network. This however has not reduced network investment, as the supply concentration at the individual entry locations (particularly for imports) has in most cases significantly increased to an extent where the aggregated supply capability requirements now far exceed the peak day supply requirements. Peak demand is around the 500 mcm/d level, with aggregated supply requirements reaching 600 mcm/d. Going forward this trend of increasing supply concentration at many entry locations is expected to continue to require further investment, with the capability requirements likely to be around 700 mcm/d.

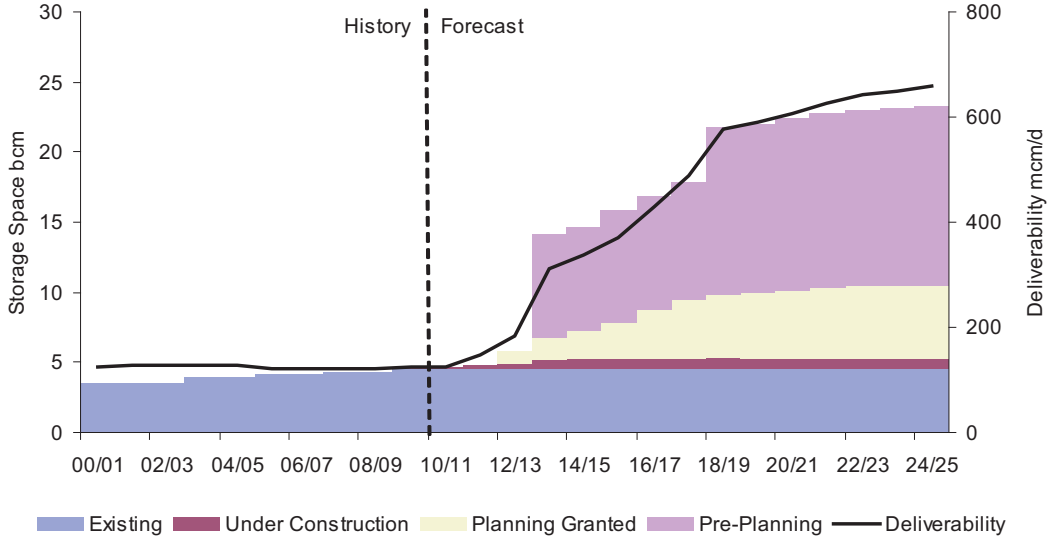
26. The specifics of future UK gas supply continue to be dominated by further declines in supply from the UKCS and growing import requirements. Currently imports make up 50% of annual supply; this is forecast to increase to about 75% by 2020. Imports are currently sourced from Norway, LNG and the Continent through BBL and IUK. Over the past year or two on the back of disappointing Norwegian exploration and reserves down grading we are now forecasting a plateau in Norwegian gas production followed by a decline. This has significant implications as future imports will probably need to be sourced more from either LNG or from the Continent. With European gas supply also in decline any imports via the Continent will essentially be displaced by supplies from either Russia or to a lesser extent North Africa and the expansion of existing LNG terminals. Longer term if new pipelines to Europe are built, these could also be from the former Soviet Union or even the Middle East. The investment implications of more imports from LNG or the Continent could be significant if existing entry points are expanded or if new terminals are built.

Gas Storage

27. It is expected that further UK gas storage will be developed beyond that currently under construction. Currently with low summer/winter price differentials (including those on the forward curve) the most likely type of new storage facilities will be fast cycling facilities driven by short-term volatility, rather than seasonal storage. These are most likely to be developed in the UK's salt strata located primarily in the Cheshire or Yorkshire areas. Other salt bearing locations include Lancashire and Southern England and proposals to develop facilities in these areas also exist. In aggregate, the potential delivery from new fast cycling storage and storage under construction could be considerable; potentially well in excess of 100 mcm/d. To meet the entry and exit requirements, these storage facilities may require significant network investment. Figure 2, from National Grid's Ten Year Statement, shows the potential build up of new storage developments in the UK market.

Figure 2

POTENTIAL UK STORAGE DEVELOPMENTS



Electrification of Heat and Transport

28. With significant development in the electrification of the heat and transport sectors, investment in the electricity networks is unavoidable if secure supplies are to be delivered to meet growing demand. Should the 2050 carbon reduction targets be met then we estimate that the Transmission electricity network would need to grow to 1.7 times the 2010 level with the electricity distribution network needing to grow to more than 4 times the 2010 level.

Q3. *What impact could increased levels of electrification of the transport and heat sectors have on energy security?*

29. Much of the future scenario work to date has focussed on achieving 2020 renewable targets and carbon reduction targets. These approaches have naturally drawn attention to the role of electricity, which in all scenarios is significant and increasing with electrification of many of our energy needs. To date, less focus has been placed on the transition period post 2020, during which an increasing amount of the energy requirements for heating and transport will transferred from the gas to electricity network. This post 2020 period will also see a change of emphasis for the gas sector; as its role in facilitating the delivery of the peak energy requirements increases.

30. As discussed in question 2, increased levels of electrification in the heat and transport sectors could impact on energy security should the requisite level of infrastructure not be in place. An increasing level of heat energy provided from electricity will introduce a much greater level of seasonality to the electricity demand profile. This, combined with a large proportion of intermittent renewable generation, will require backup energy requirements for heat. This could be delivered by gas heating providing peak heat requirements as well as backup for intermittent electricity supply. This would require the maintenance of the gas distribution network in order to provide this security.

31. The electrification of the transport sector will increase electricity demand with the requirement for back-up plant in order to maintain supplies.

32. Whilst the dependency on electricity for all our energy needs will grow, electric vehicle charging and electrification of heat could however help deliver greater security of electricity supply by introducing greater levels of demand side response. These electrical appliances can allow supply interruption without appreciable loss of amenity and, as already noted, demand could be flexed to meet available generation or network capacity.

Q4. *To what extent does the UK's future energy security rely on the success of energy efficiency schemes?*

33. The most cost effective way of reducing demand and therefore emissions is by improving levels of energy efficiency; this is especially the case for building heat insulation—it should therefore be the first element of a low carbon strategy. Without energy efficiency measures, demand requirements will be greater, resulting in greater investment requirements and a greater reliance on imported gas supplies.

34. However, even with improvements in energy efficiency there will still be significant energy requirements in the UK and all the security of supply implications discussed in this response.

Q5. *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?*

35. In order to meet the UK's targets for greenhouse gas emissions reductions as well as the increased penetration of renewables, while maintaining energy security, there is a requirement for a balanced diverse approach to the power generation mix to minimise exposure to a single supply source. This would see an even development of low carbon generation technologies—a combination of nuclear, CCS plant and renewables.

Plant Closures and Generation Requirements

36. If the expected 'energy gap' due to LCPD, IED and nuclear plant closures is replaced with intermittent and inflexible plant then there is a definite risk that the 'Expected Energy Unserved' (EEU) will increase if no action is taken. In order to maintain supplies, this intermittency will require flexible back-up generation, probably at almost a one-for-one capacity basis given the possibility of a low contribution from wind generation at the time of peak demand. Should this back-up generation be principally gas–fired then this would result in a less predictable operation of the gas networks (see below).

Operating the Electricity Networks with new Nuclear Generation

37. The connection of new nuclear plant to the transmission network will increase the size of the largest individual loss of load (from 1.26 GW to 1.8 GW). This increases the amount of reserve generation required in order to counter this potential loss. It is also unclear how flexible new nuclear and CCS plant will be. The requirement for flexible back-up plant to counter the intermittent nature of wind generation will also impact the type and amount of reserve plant required.

Operating the Electricity Networks with Intermittent Generation

38. As discussed in question 3, the electrification of heat increases the dependency on electricity and therefore need for back-up energy requirements to counteract the intermittency of renewables, but it also affords the opportunity for greater demand side response.

39. This intermittency will also impact the operation and balancing of the transmission networks. Our consultation on operating in 2020 suggests that electricity system reserve requirements will rise in order to manage uncertainty in output, with more wind generation connecting to the system. As the amount of wind generation capacity grows, operational procedures have to be developed with relation to forecasting wind output and to cater for wind generation output uncertainty.

40. The addition of a significant amount of renewable energy to the generation mix will add diversity with the focus moving from 'where the energy will be supplied from' to 'when it will be supplied'. In the longer-term demand side response mechanisms have the potential to alleviate some of the risk associated with an intermittent supply source (please refer to question 9).

41. Additional interconnection, while adding to the diversity of supplies, will also add to the uncertainty and potential volatility of supplies with an increase in the possible range of interconnector flows from maximum exports to maximum imports and interaction with an increasing number of markets.

Operating the Gas Networks With Intermittent Generation

42. As wind generation capacity increases, the network operation challenges become material in both the electricity and gas networks. In most instances, gas fired power generation has been identified as the primary source to cover for wind intermittency. The consequences of this are largely dependent on the level of installed wind capacity and the location of gas fired power generation.

43. A major impact of wind intermittency is rapidly changing gas demand (in terms of volume (higher and lower) and location) and the increased frequency and rate of such demand changes. Obviously the resulting demand changes will require similar changes to the gas supply, notably from flexible supply sources such as gas storage and possibly Interconnectors and LNG. This will require a gas network that can flexibly respond to significant short term supply and demand changes. To enable such a response the network will have to operate in a less predictable manner than is currently experienced, which will in turn require significant network investment to enable variable flow patterns and potentially increased pressure variations. These needs are also compounded by the changing nature of future supplies, notably the expected increase in supply concentration and the coincidental loss of any major supply source.

Q6. *What would be the implications for energy security of a second dash-for-gas?*

44. It could be argued that we are already in a second dash for gas with around 10 GW of new gas-fired power generation connected since 2009 or currently under construction.

45. With the imminent closure of the LCPD opt-out coal and oil plant, gas' share of the power generation market in output terms is likely to rise to over 50% in the first half of this decade, notwithstanding the relative coal and gas prices. The continued decline of the UKCS will result in an increase in gas imports and could therefore result in both gas and electricity markets being effectively reliant on imported energy.

46. A combination of slow development of non-renewable low carbon options and the closure of the existing nuclear plants could exacerbate this position and result in gas' share of the market becoming greater. This scenario could result in gas demand growing over the longer-term (post 2020) thus resulting in additional import requirements. This would also result in the power market being overly exposed to a single fuel source with the need for a diverse range of gas supplies even more important.

47. This could also impact on gas network investment lead times, with new capacity struggling to keep pace with demand should there be a rapid change in policy and/or market conditions such as the closure of existing nuclear stations.

Q7. *How exposed is the UK's energy security of supply to international events?*

International Events

48. Recent events in Libya and Japan have highlighted the exposure of the UK market to international events. The increasing reliance on gas imports will only increase this exposure. The events in Japan are likely to impact the global LNG market, but in the absence of long-term contracts, exposure to all gas import sources needs to be examined. The key is again a diverse set of import options to mitigate the risk of exposure to one supply source. Currently the development of shale gas in the United States and elsewhere may provide a security upside in that a greater level of LNG is available to the market.

49. There are two aspects to the impact of international events to consider. The first is related to supply availability constraints where, for example, supplies are restricted in Libya or diverted to Japan. The second relates to market sentiment—eg the recent events in Japan impact on planning consents and consultation

periods associated with new nuclear plant. In this instance there is a requirement for a clear and unwavering government commitment.

Interconnection

50. A greater level of interconnection in the power market will provide greater diversity of potential supplies as well as facilitating competition in the European market and assisting the transition to a low carbon energy sector by integrating various renewable sources. It is an established view that increased interconnection with Ireland and mainland Europe can manage the intermittency challenges posed by renewable (mainly wind) generation and the flexibility challenges posed by wind and nuclear generation, so aiding and supporting electricity security of supply. Increased interconnection does increase the risk of a reliance on imported power, particularly if changes to the UK market were to provide an incentive for this eg through a UK carbon floor price mechanism. A reliance on imported energy is, however, not uncommon in many parts of Europe.

Q8. *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?*

Market Intervention

51. As stated above an energy policy that encourages a diverse set of supply sources is important to minimise risk. Therefore any market reform should also therefore address any security of supply implications. The Electricity Market Reform seeks to address this through proposals such as carbon price support, a feed-in tariff for low-carbon generation and a capacity mechanism. This form of market intervention can encourage the market to deliver the changes required to ensure the continued diversity in the sources of energy supply.

52. This approach has been adopted by several other European countries which have introduced market incentives to encourage the delivery of low carbon generation. Examples of this approach can be found in Germany, Spain, the Netherlands and Denmark.

Market Mechanisms

53. Although the carbon floor price mechanism has the potential to promote the necessary investment in appropriate, low-carbon technologies, we are concerned that it could create an incentive to import electricity to the UK to the extent that it may create a price materially above the EU traded carbon price. This could result in a reliance on imported power and potentially a slower rate of power generation development in the UK market. There are still many issues to be resolved to overcome some of the consequences of introducing a capacity mechanism, not least the risk of a central approach making incorrect decisions on the level of capacity and the mix. The market-based approach provides diversification of decision making which should produce the most efficient solution.

Q9. Are there any other issues relating to the security of the UK's energy supply that you think the Committee should be aware of?

Demand Side Response

54. In principle, demand side response enabled through smart meters and smart grids, has the potential to affordably enhance security of the UK's energy supply by allowing energy use to be postponed until off peak times, or when generation (eg in the case of wind) is more plentiful. In this way, less peaking generation will need to be built to deliver the required level of security. Short-term generation shortfalls could also be overcome by postponing the use of energy until replacement generation output is established. There is however uncertainty about how much demand side response will be available, when in the future it might materialise, and how long it can be postponed for. In the domestic setting, existing wet appliances (washing machines etc) offer the foremost opportunity for demand response, with electric heating, cooling and electric vehicles (EV) charging offering the greatest future opportunity; the key is the ability to interrupt use without appreciable loss of amenity. In the commercial arena, building services management of heating and cooling also offers the opportunity to provide demand side response. The introduction of time of use tariffs for all users, education and consumer engagement and perhaps in some instances mandating appliance standards for energy consumption, are key to cultivating demand side response. It is important to understand that this is only a short-term mechanism and that demand cannot be delayed for protracted periods.

55. Demand side response is also important in reducing gas demand through high gas prices. To date, the majority of any response has been through fuel switching for power generation and to a lesser extent large industrial users. In the future this could be extended to smaller gas consumers.

Strategic Storage

56. Though current gas prices do not favour the development of large offshore seasonal storage, such projects may still be developed to satisfy shipper needs and a UK market that has appreciably less storage than any other major market in Europe. Obligations on shippers or a shift in opinion for increased UK energy security through the need for strategic storage would also promote such developments. If built offshore storage would probably utilise depleted gas fields in the Southern Basin and flow to/from Bacton or possibly Theddlethorpe

or Easington. To meet the entry and exit requirements, these storage facilities would require significant network investment.

HIGH IMPACT/LOW PROBABILITY EVENTS

57. The UK's gas supplies, although increasingly diverse with the advent of significant LNG supplies, have a number of large single supply sources on long supply chains outside of UK waters eg Norwegian gas supplies via the Langeled pipeline. Supply sources such as these have a potential exposure to high impact/low probability events, the consequences of which are highlighted by recent events in Japan.

March 2011

Supplementary memorandum submitted by National Grid plc

1. *You suggested that new network investment would only be forthcoming if an "appropriate" rate of return was allowed by Ofgem. In your view, is the standard rate of return on offer sufficient to deliver the £32 billion investment that Ofgem has estimated will be needed by 2020?*

It is really too early to say. Negotiations under the RIIO approach concerning transmission and gas distribution activities will continue until the end of 2012. Ofgem have indicated a broad range for the rate of return likely to be available and detailed discussions will take place over the next eighteen months to finalise both the allowed return and the level of risk that network companies will face. At this stage we are optimistic that an appropriate risk-reward balance will be struck.

2. *You suggested that electricity storage technologies on wind farms could help to tackle some of the intermittency/transmission problems associated with wind power. What types of technology do you think could deliver this and what are the costs likely to be?*

Storage could be located on or away from windfarms.

There are a range off different storage technologies which could suit. The storage solution would depend on the:

- detailed application;
- location; and
- point of connection of that storage, for example transmission or distribution, onshore or offshore.

The electricity network will facilitate a considerable degree of freedom of choice as to type and location unless the electrical connections between the windfarm and the integrated network form a constraint because they are of insufficient capacity.

The broad categories of electricity storage that could be considered in this application are:

1. Hydro (pumped storage, lagoon, tidal).
2. Compressed Air (underground caverns or pressure chambers).
3. Battery—various types, Flow Cells.
4. Thermal, hydrogen.

Other forms of storage (eg flywheels, supercapacitors) are likely to be better suited to short term storage applications and the provision of frequency response services to National Grid.

The first category (hydro, etc) is likely to require significant natural resources—such as water reservoirs, man made lagoons, tidal barrages—but the technologies are readily available and there is good industry experience from around the world including costs, etc The second, compressed air, also requires natural resources (typically underground caverns or pressure chambers) and some large scale demonstrators are now running.

The third category (batteries, etc) requires a large number of small cells to be interconnected to provide the required capacity. The current intensive research into electric vehicles is likely to continue to drive up energy densities and drive down costs, although there is still a significant amount of development and possible breakthrough still required to optimise. Batteries could be applied as a distributed resource on Distribution networks as well as on the Transmission network or close to source of electricity production.

The fourth category also holds a lot of potential for very high density (ie grid or megawatt scale) storage although many of the technologies are still in their infancy.

Comparisons of approximate costs are available but more detailed work would be required to give more accurate costs for a given application and technology.

National Grid is a member of the Electric Power Research Institute (EPRI). EPRI has published a table which summarises the status of technology type, application and size, efficiency, and construction and running

costs. This is available on page 11–12 of the Executive Summary of their report: Electric Energy Storage Technology Options: A Primer on Applications, Costs & Benefits:
http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=221&PageIDqueryComId=0

The UK Energy Research Partnership—a public/private collaboration between government and major players in the energy industry is just publishing a comprehensive report into storage, with more specific detail for UK. The Executive Summary can be found via the link below:

http://www.energyresearchpartnership.org.uk/tiki-index.php?page=page12

3. *Is electricity storage a cost effective alternative to further grid reinforcement and if so, who might invest in it—National Grid or the wind farm operators themselves?*

Electricity storage has potential applications for:

1. Generators in self balancing their portfolio to avoid exposure to market imbalance prices.
2. National Grid as system operator, for residual real time energy balancing.
3. National Grid and other network operators for managing network constraints.

Different types of storage will have different characteristics and may be targeted at a particular application. The electricity networks will provide flexibility as to storage location.

Storage projects will also likely compete with alternative solutions such as flexible demand side response services and network reinforcement investment. The trade off between different solutions will be both economic (what is the most cost efficient solution for the consumer?), and carbon based (what is the lowest total carbon solution?). This trade off will vary from project to project depending on location, type of storage and the purpose for which it will be utilised.

Given that storage may be valued by National Grid, other network operators, and market participants, there are multiple parties who have the potential to invest in it.

4. *Would it be feasible to maintain the gas distribution networks in a future where domestic gas consumption was drastically reduced as a result of improved energy efficiency and switching to electric heat?*

It is feasible to operate the gas network to relatively low levels of demand. It is quite normal that areas on our low pressure networks fall to less than 10%–20% of average demand levels within summer. Accordingly, we do not expect any operational issues from operating at low levels of demand. It is expected that the viability of the gas network is more driven by the number of gas consumers connected and contributing to the operational costs rather than the technical levels of demand flowing through the system.

5. *At what level of gas consumption would it become uneconomic to maintain the gas distribution network?*

To date no work has been carried out to identify the level of gas consumption at which it becomes uneconomic to maintain the gas network. The economic viability of the network depends not on the volume of gas conveyed but on the acceptance of consumers to pay the ongoing costs to operate the network in a sustainable way. The average cost per residential consumer is about £110–130 per year. This equates to less than 20% of the average gas bill. The majority of these network costs relate to the recovery of capital investments, tax and business rates, along side the costs to operate a geographical network. Only a very small proportion of our costs relate to the level of gas volumes conveyed. The individual charge to consumers would start to become prohibitive if a large proportion of end consumers switched to all electric solutions.

Switching to electric heat is dependent on the cost and practicality of electric heat solutions. A large proportion of domestic properties have a high peak heat demand which is four to 12 times greater than the energy used in summer (even after insulation upgrades). Heatpumps are better suited to flat demand profiles. Therefore, a large proportion of UK properties would require additional heat at peak times to supplement the heatpump. This additional heat would be most affordably and practically delivered by gas. Over time, a significant proportion of this "top up" gas could be renewable gas—ie biomethane produced from renewable resources such as waste.

If instead the country opted to decarbonise heat by electrifying it all, then due to its seasonal nature, a significant amount of new generation and electricity infrastructure would need to be built. This generation would be used in some cases for only a few weeks of the year and hence would be prohibitively expensive. The Electricity Networks Association (ENA) Redpoint report from November 2010, identified that scenarios featuring gas could be up to £700 billion less expensive than options that rely on complete electrification.

Therefore we envisage a role for the gas distribution network operating at significantly lower demands in the summer but still providing an economic peak heating solution alongside baseload electric heat solutions long into the future.

6. *What are the options available to the Government to ensure that new gas storage capacity is built and what approach would you favour?*

There are four main options:

(i) market based;

(ii) industry obligation;

(iii) indirect or virtual storage via demand management; and

(iv) government develop, where they hold strategic reserves.

(i) Market Based

This is generally where we are today, where the development and utilisation of storage facilities is dependent on market incentives, generally summer versus winter forward gas price differentials. The narrow price differentials present now, and over the past few years, have not favoured the development of new storage especially large/seasonal storage facilities like current Rough storage facility or other offshore proposals as they limit the ability for storage operators to recover their investment. The above price differentials are also volatile and therefore add risk into any storage investment proposal.

Markets do not "ensure" that storage facilities will get developed, so targeted additions over and above the market mechanism, that encouraged the development of additional storage capacity, would be needed if assurance was necessary. These market interventions generally stray into the development of obligations on one or more parties.

Historically, planning permission has been reported as a barrier to storage development; however, this would appear to be less so now with many storage proposals having the necessary permits to proceed. In addition, storage developers have regularly referred to regulatory risk and uncertainty as barriers to the development of new storage projects.

(ii) Obligations

Developing appropriate obligations could provide greater assurance that storage capability is increased (from current levels). However, the development of storage capacity does not in itself increase security of supply. The arrangements for the utilisation of the storage facilities would need careful consideration to ensure that sufficient gas was stored to meet the agreed standard of security. Currently there is no specific "security standard" for GB and therefore the level of system security required is imprecise. A European Regulation on security of supply has been developed, with a requirement for Member States to show compliance.

There are a number of options in the placement of an obligation from a central single storage developer to individual supplier/shipper obligations. This decision is one based on policy with the focus on speed of implementation and efficiency of investment.

(iii) Indirect or virtual storage via demand management

With electricity generation acknowledged as the main growth driver for the demand for gas in the coming years, the capability for this sector to offer demand management services, or indirect storage, could be developed further.

For example, all future CCGT power stations could have a requirement to install alternative back-up fuel. When requested, the generator could then switch from the primary fuel (gas), to the secondary fuel, hence providing a similar service to gas storage. In addition to providing gas "indirect storage", ensuring CCGTs have an alternative fuel other than gas would improve the robustness of the electricity system in times of gas transmission system stress.

This policy could be extended to other large demand side users, where such users could reduce their gas demand when requested.

(iv) Government develop, where they hold strategic reserves.

One option is for the Government to ensure that storage capacity is developed and suitable gas reserves are stored, either by holding strategic reserves itself or directing the industry to hold strategic reserves, similar to the arrangements used to ensure strategic oil reserves.

Favoured Option

Each one of the options on its own may not deliver the desired solution. Where possible market solutions should be developed to enable the correct investment decisions to be made. However market solutions may not work without some form of intervention. Our favoured approach would be an amalgamation of a market

based approach with suitable obligations developed that improve the incentives on storage development and utilisation and encourage demand side participation.

July 2011

Memorandum submitted by the Energy Networks Association

Introduction

The gas and electricity networks are a key part of the UK's infrastructure and play the central role in our energy economy.

Gas is a major part of our energy mix: the fuel of choice for most of the UK. In 2009 gas provided over 30% of final UK energy demand. The gas network companies connect up to 100,000 new gas consumers a year and are currently replacing up to 4,000km of mains per year.

Both the gas and electricity networks are currently facing the challenge of replacing and redesigning the GB energy infrastructure to meet the Government's climate change objectives. Indeed, Ofgem predict that over £30bn of network investment will be required by 2020 to support the development of the new renewable generation.

ENA is concerned that Ofgem's current proposals will deter rather than encourage investment, and so put at risk the delivery of the investment required in GB infrastructure over the period to 2020, with obvious implications for both energy security and the prospects of moving to a low carbon economy.

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

Reliable energy networks are critical to the UK's energy security. The energy network companies are effective monopolies and are therefore subject to economic regulation which is overseen by the energy regulator Ofgem. Since the privatisation of the companies, the regulatory framework which was created has encouraged them to reduce costs and increase operating efficiencies whilst maintaining or improving their customer service.

However, Ofgem recognised that if the sector is to contribute fully to the transition to a low carbon economy, such an approach may not be appropriate. In the future significant increases in investment will be required together with the development and adoption of new technologies. Ofgem therefore conducted a major review of the regulatory framework culminating last October in RIIO—A New Framework for Energy Regulation. RIIO (Revenue=Incentives+Innovation+Outputs) has been specifically designed to incentivise companies to meet the unprecedented challenges they will face during the next decade, in particular to find the over £30 billion of investment needed to meet environmental targets and secure energy supplies through to 2020, while delivering long-term value for money for consumers.

The RIIO framework is currently being implemented in the two price control reviews for the gas distribution and gas and electricity transmission companies, which will be effective for the eight years from April 2013. The next price review for the electricity distribution companies will not be effective until April 2015.

ENA supports a number of the RIIO proposals, particularly the emphasis on longer well justified company business plans, enhanced engagement with stakeholders and the encouragement of innovation. However, there remains a very important area in the context of a low carbon future where ENA members have significant concerns. This relates to Ofgem's proposals on financeability.

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

Energy networks are vital to the delivery of our low-carbon future and as such gas and electricity networks will be at the heart of the transformation needed. Increased levels of electrification of the transport and heat sectors will have a profound impact upon both the development and operation of electricity networks. The increase in demand, and changes to the load characteristics of that demand, together with the expected increase in the amount of distributed generation connecting to the electricity distribution networks will present significant challenges to the network operators (DNOs) and in turn could impact security of supply. This transformation will be different in shape and nature from anything that has gone before.

ENA is working with its members, other trade associations and Government organisations in both the UK and Europe to examine how best to meet these challenges and effect the transformation necessary in our energy networks, to ensure no impact to supply security. At the heart of this work is research into the development of smarter electricity grids and the potential change is gas supply and use, which will be required to accommodate these profound changes in energy production and consumption, whilst maintaining supply reliability and ensuring costs to customers are kept to an absolute minimum.

The primary role of the networks will continue to be to transport the energy from wherever it is generated to wherever it is used. However, in order for the costs of meeting the expected increase in electrification to be mitigated, networks will also need to engage with customers to encourage them to actively participate in the

process by moderating their demands or perhaps shifting their consumption to different times of the day to avoid the need for costly reinforcement investment.

Customer choice is crucial in all this. A smart grid in partnership with smart meters can empower the consumer by providing tools such as real-time displays, remotely read meters, financial incentives and time-of-use tariffs to encourage customers to modify their energy usage.

The Distribution Network Operators (DNOs) are key in this process of transforming the electricity grid and will be at the cutting edge of this new approach to energy production and consumption.

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?

It will be important in developing UK energy policy that the uncertainties inherent in moving towards a secure, low carbon energy environment are acknowledged. This will require a flexible strategic planning framework that can adapt to changing circumstances and new developments without compromising the country's energy security and low carbon aspirations. One very important element of such a framework is to ensure that the importance of gas in any long term UK energy scenarios is recognised. ENA members are convinced that there is a very important long-term role for gas in helping deliver the UK's energy security, affordability and sustainability targets.

Gas is central to the UK economy and has an ongoing role in the energy mix. It is the cleanest fossil fuel and with carbon capture and storage and bio-methane injection into the grid it will be crucial in meeting our low carbon targets. Gas is tried, tested and proven—and more importantly the heating fuel of choice for most of the UK's households. The UK gas network is a national asset and has and continues to provide for security and diversity of supply.

As part of their DECC 2050 pathways analysis the government is reviewing the future of energy and new technologies. ENA has a major role in these discussions and commissioned an in-depth, independent analysis into the future role of gas in a low-carbon economy, by the respected energy consultants Redpoint.

The Report found that gas (including biogas) can continue to play a major role in our energy mix and can provide a low-cost, sustainable, secure and flexible solution to our energy and climate change needs. There could be savings of up to £700bn between 2010 and 2050—around £20,000 per household or £10,000 per person—relative to scenarios where gas is phased out of the energy mix by 2050. All potential pathways to a low-carbon future will involve huge investment in new technology, with its associated risks and uncertainty, so there is significant value in retaining the option for a 'high gas' future, with proven and existing technology.

The Report concludes that gas is the cleanest fossil fuel and new supplies being discovered could also be relatively plentiful and low-cost. It can enhance diversity of energy supply and provide additional flexibility with respect to energy balancing particularly at times of low renewable output. Finally, the report also established that maintaining existing gas networks is less expensive than other options for meeting the UK's energy needs.

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

Skills

In its bid to help halt climate change and to tackle the growing threats to UK security of energy supply the energy industry must recruit and grow workers with new skills, to meet the challenges of new technologies, as well as maintain its pool of skills in more conventional areas.

ENA is at the forefront of the development of energy networks for the future that will help deliver UK targets for reduction of carbon dioxide emissions by 2050. We are acutely aware that the energy sector requires engineers and technicians who are able to develop and operate the smart, low-carbon energy systems needed for the future.

ENA has for many years supported the Sector Skills Council for the energy sector. Energy and Utility Skills has established an employer-led forum to consider the skill challenges for the gas and electricity sector and, supported by ENA, has been successful in a bid to develop a National Skills Academy for Power.

Significant investment is expected in energy networks to bring on the connection of renewable energy sources, to install gas and electricity smart metering in every property and to accommodate the increased electricity demands in heat and as transport moves away from carbon-based fuels. This will take future energy networks away from current designs. It will require sophisticated monitoring and communications systems to deliver the information required to maintain reliable energy supplies while accommodating intermittent renewable energy sources.

Planning

Network companies were heartened by the approach the Coalition Government has taken on the Energy National Policy Statements (NPSs). With the need for £200 billion of energy infrastructure investment by 2020

getting planning right is crucial. The NPSs are central to underpinning the new planning system. We believe the energy NPSs are a significant step in delivery of vital energy projects. We also welcome the emphasis on accountability and proper scrutiny—we have long said that the key to delivering effective planning reform is ensuring the NPSs have the necessary democratic accountability.

We also welcome the development of a National Planning Policy Framework (NPPF) which we hope and expect will deliver consistency, certainty and clarity across the entire planning system. If the reports that the NPSs are not to be incorporate in the NPF are true, we believe that this would be a mistake.

We look forward to a national debate on energy infrastructure development and network companies are actively engaging with local communities to ensure they are fully consulted and understand the need for the essential energy development needed to support the UK.

SUMMARY

The gas and electricity sectors are facing significant changes in order to meet the Government's climate change targets and the networks will play a fundamental role in achieving these policy objectives. A regulatory framework that encourages the network companies to carry out the required investments in infrastructure is essential.

Considerable investment will be required to meet our energy security needs. A smart grid will allow us to allow us to make more efficient and targeted investment on behalf of the UK. The Secretary of State for Energy & Climate Change has talked of the "lowest possible cost energy security"—the smart grid can help facilitate this by ensuring energy is used more effectively. The networks companies will be at the heart of delivering a smart grid.

March 2011

Supplementary memorandum submitted by the Energy Networks Association

Please find below answers to all your questions. We also attach an appendix setting out potential scenarios taken from a Report produced for ENA by Redpoint. If you have any further questions do not hesitate to contact us.

1. *The written evidence we received from ENA suggested that biogas could be used to provide low-carbon heating in the future. Is there potential for biogas to replace all of the natural gas that is currently used for heating or would biogas need to be used in combination with other low-carbon heating options, such as heat pumps?*

We estimate the potential maximum biomethane supply to be between 100–200TWh/a which would supply up to one third of the current UK demand for residential, commercial and process heating. But with high level uptake of energy efficiency measures in future residential heating demand could reduce down to 200TWh/a in which case biomethane could meet almost all of that demand which more economically meets the peak heat requirement than low load factor generation and heat pumps.

Accordingly, we envisage a situation where heat demand is met with a combination of base load heat supplied by heat pumps and peak heat met by gas, of which biomethane provides a large proportion.

This alternative fuel source represents an economic, affordable and renewable solution for space, water and process heating without the need for changes to infrastructure or appliances which would mean immense costs to both UK Plc and consumers. It is also recognised as one of the lowest cost forms of carbon abatement from heat by the Committee on Climate Change

Biogas from anaerobic digestion used for electricity generation is at relatively low efficiencies (particularly if the waste heat is not utilised) at around 30%. However, if this biogas is upgraded to biomethane, injected into the gas grid and transported to consumer homes for heating purposes, it can be utilised in modern condensing boilers at over 90% efficiency. As a result of these efficiencies, using the biogas for grid injection can increase its contribution to the EU 2020 renewables targets as more of the final energy consumption is renewable and over the longer term, can provide greater carbon savings than for electricity generation.

Although the introduction of the RHI is a big step in the right direction we still believe that further work is required to ensure a level playing field for biomethane injection, resolving technical, regulatory and commercial issues and removing barriers to entry for producers.

2. *Would it be feasible to maintain the gas distribution networks in a future where domestic gas consumption was drastically reduced as a result of improved energy efficiency and switching to electric heat?*

It would not only be feasible to retain the gas distribution network in future, it would be vital.

The gas distribution network currently provides heating for 80% of current UK homes as well as commercial heating and industrial processing, the latter with few other alternative fuel substitutes as acknowledged by the

Committee on Climate Change. Full electrification of heat for the current housing stock is not feasible in the timescales required and would come at a very high cost to UK Plc and consumers both through electricity network investment required, gas network decommissioning costs and replacement of consumer appliances. As can be seen in the Redpoint Gas Future Scenario Report, scenarios with higher gas usage ensures potential savings of more than £700 billion over the 2010 to 2050 period—around £20,000 per household or £10,000 per person (see Appendix) whilst still meeting the climate change targets.

As well as providing the public fuel of choice for heating, cooking and industrial usage, the gas networks are high value, extensive, safe and reliable and we don't see any economic rationale for the decommissioning of this valuable asset from UK infrastructure.

The costs of gas distribution are largely fixed, driven by the need to provide for "Peak Capacity consumption", maintenance of the network and Provision of a gas emergency service rather than by annual consumption. As stated at the evidence session, there are many homes within a reasonable distance from the existing gas network and if more people were connected then the cost per household would actually reduce. This could help alleviate fuel poverty, emissions and security of supply issues for those currently on Coal or Oil. The connection to the existing gas infrastructure may be the best option for these end users who are relatively close to the existing network.

Maintaining the existing gas network is not expensive, given it is a sunk cost, and it actually represents very good value to UK plc to continue to supply existing customers. If large number of users did however leave the network and usage decreased due to energy efficiency the transportation element of a customer bill (currently around £11 per month) would increase but as users would be using less this would have a minor impact.

The maintenance of the Gas Network is not just an economic argument. Homes and families need safe, secure heat in the winter and these factors also need to be taken into account.

3. *At what level of gas consumption would it become uneconomic to maintain the gas distribution network?*

To date no work has been carried out to identify the level of gas consumption at which it becomes uneconomic to maintain the gas network. The economic viability of the network depends not on the volume of gas conveyed but on the acceptance of consumers to pay the ongoing costs to operate the network in a sustainable way. The average cost per residential consumer is circa £110–130/a, less than 20% of the average gas bill. The majority of costs relate to the recovery of capital investments, tax and business rates, alongside the costs to operate a geographical network. Only a very small proportion of our costs relate to the level of gas volumes conveyed. The individual charge to consumers would start to become prohibitive if a large proportion of consumers switched to all electric solutions.

Switching is dependent on the cost and practicality of electric heat solutions, a large proportion of domestic properties have a high peak heat demand 4–12x (even after insulation upgrades) the energy used in summer whereas heat pumps are better suited to flat demand profiles. Therefore, a large proportion of UK properties would require additional heat at peak to supplement the heat pump, which could be supplied by gas in an economic way.

Due to its seasonal nature, in order to electrify heat, a significant amount of new generation and electricity infrastructure would need to be built, which would be used at low load factor and hence would be prohibitively expensive. The ENA Redpoint report Nov 2010, identified that scenarios featuring gas could be up to £700 billion less expensive than options that rely on complete electrification.

Therefore we envisage a role for the gas distribution network operating at significantly lower demands in the summer but still providing an economic peak heating solution alongside baseload electric heat solutions.

4. *What are the options available to the Government to ensure that new gas storage capacity is built and what approach would you favour?*

Four main options

(i) market based;

(ii) industry obligation;

(iii) indirect or virtual storage via demand management; and

(iv) government develop, where they hold strategic reserves.

(i) Market Based

This is generally where we are today, where the development and utilisation of storage facilities is dependent on market incentives, generally summer versus winter forward gas price differentials. The narrow price differentials present now, and over the past few years, have not favoured the development of new storage especially large/seasonal storage facilities like current Rough storage facility or other offshore proposals as they limit the ability for storage operators to recover their investment. The above price differentials are also volatile and therefore add risk into any storage investment proposal.

Markets do not "ensure" that storage facilities will get developed, so targeted additions over and above the market mechanism, that encouraged the development of additional storage capacity, would be needed if assurance was necessary. These market interventions generally stray into the development of obligations on one or more parties.

Historically, planning permission has been reported as a barrier to storage development; however, this would appear to be less so now with many storage proposals having the necessary permits to proceed. In addition, storage developers have regularly referred to regulatory risk and uncertainty as barriers to the development of new storage projects.

(ii) Industry Obligations

Developing appropriate obligations could provide greater assurance that storage capability is increased (from current levels). However, the development of storage capacity does not in itself increase security of supply. The arrangements for the utilisation of the storage facilities would need careful consideration to ensure that sufficient gas was stored to meet the agreed standard of security. Currently there is no specific "security standard" for GB and therefore the level of system security required is imprecise. A European Regulation on security of supply has been developed, with a requirement for Member States to show compliance.

There are a number of options in the placement of an obligation from a central single storage developer to individual supplier/shipper obligations. This decision is one based on policy with the focus on speed of implementation and efficiency of investment.

(iii) Indirect or virtual storage via demand management

With electricity generation acknowledged as the main growth driver for the demand for gas in the coming years, the capability for this sector to offer demand management services, or indirect storage, could be developed further.

As an example of the above, all future CCGT power stations could have a requirement to install alternative back-up fuel, such as distillate. When requested, the generator could then switch from the primary fuel, ie gas, to the secondary fuel, distillate, hence providing a similar service to gas storage ie an increase in gas supply relevant to demand. In addition to providing gas "indirect storage", ensuring CCGTs have an alternative fuel other than gas would improve the robustness of the electricity system in times of gas transmission system stress.

This policy could be extended to other large demand side users, where such users could reduce their gas demand when requested.

(iv) Government develop, where they hold strategic reserves

One option is for the Government to ensure that storage capacity is developed and suitable gas reserves are stored, either by holding strategic reserves itself or directing the industry to hold strategic reserves, similar to the arrangements used to ensure strategic oil reserves.

Favoured Option

Each one of the options on its own may not deliver the desired solution. We believe that, where possible, market solutions should be developed to enable the correct investment decisions to be made. However, as stated above market solutions may not work without some form of intervention. Therefore, our favoured approach would be an amalgamation of a market based approach with suitable obligations developed that improve the incentives on storage development and utilisation and encourage demand side participation.

5. *Should the Government have different policy approaches to seasonal gas storage (ie buying in the summer for the winter) and strategic gas storage (in case of an unexpected cut in gas supplies)?*

The approach, to some degree, depends on what event you are seeking to secure against. Therefore, the security standard is all important. As long as the security standard is robust, the event should be secured during all time periods whether winter or summer.

6. *We have heard that network operators may need to engage more with customers in the future to encourage them to participate in demand side measures. To what extent do network operators currently engage with customers directly and are there any plans or strategies in place for how engagement might be improved?*

Before gas distribution network investment is approved by Ofgem, to cater for increased capacity, gas distribution networks have to demonstrate "efficiency" of spend. Part of the current test is to explore demand side management with "Very Large" users of the networks. Every year, all networks currently hold auctions by local distribution zone to fulfil any capacity gaps. Where the gaps are not filled, networks then explore investment options. The current Ofgem incentive regime encourages this activity.

The RIIO/Regulatory Framework is also introducing better incentives for networks and consumers to consider options for meeting demand in different ways including demand side measures.

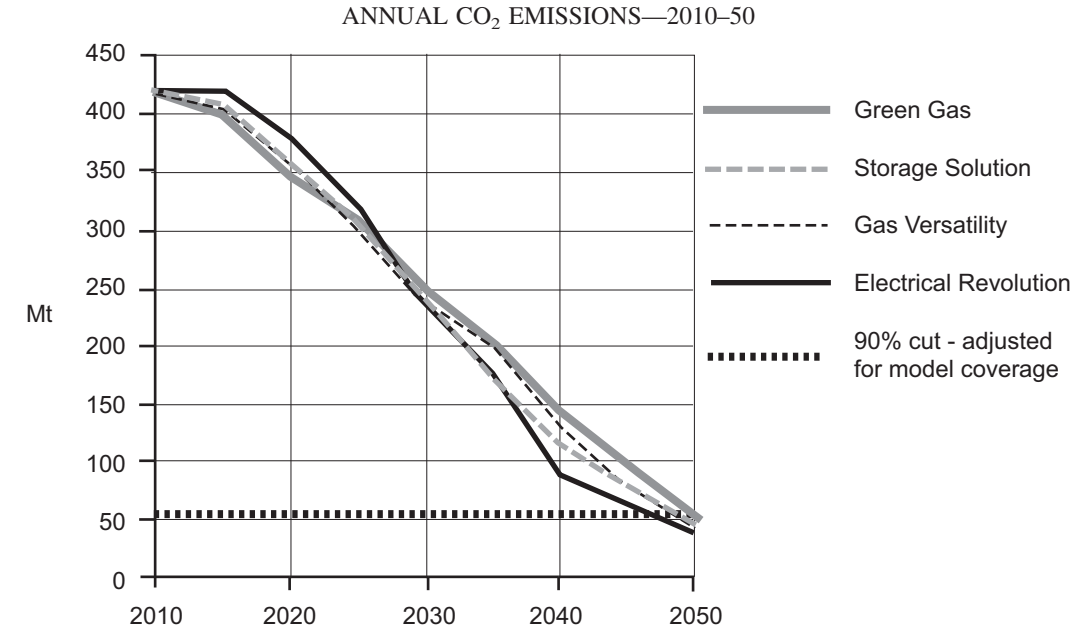
7. *Could the roll-out of smart meters provide an opportunity for network operators to start to engage with consumers?*

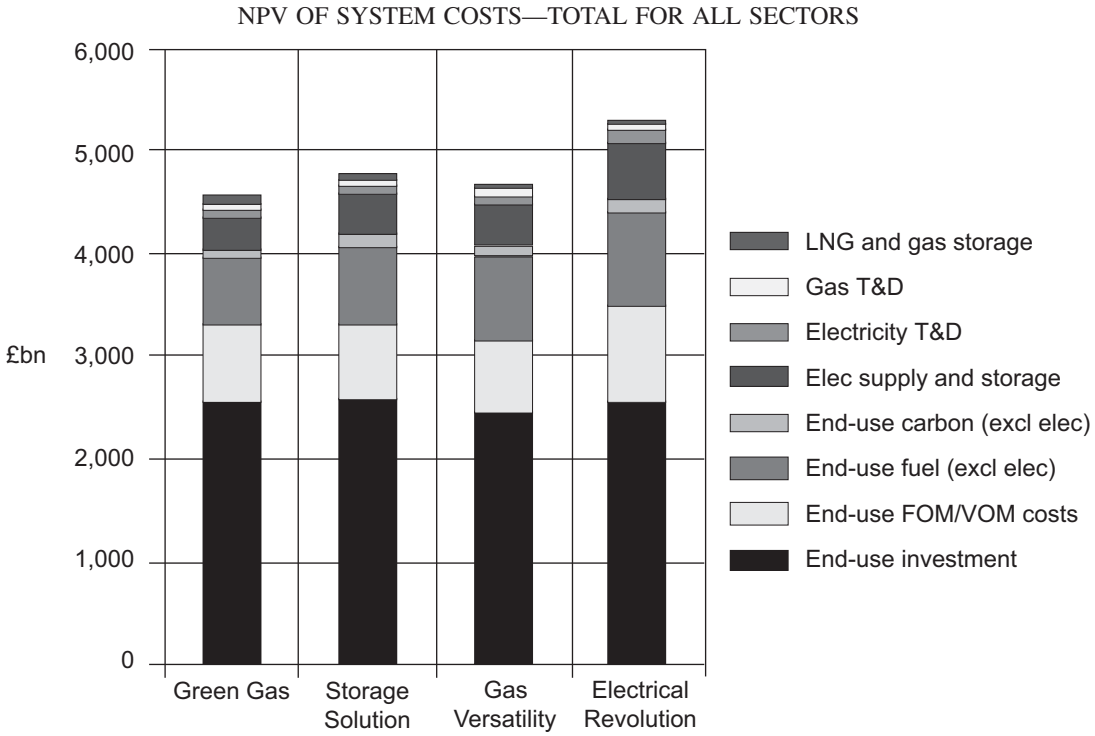
Although smart metering is likely to have a small impact on networks in terms of demand reduction, the information and functionality that will be provided by smart meters could be used by networks both to engage with customers and inform investment decisions going forward. GDNs will be evaluating how best to use this technology as the roll-out continues and its potential is better understood.

APPENDIX 1

SCENARIOS FROM REDPOINT REPORT

DIMENSION 1: Commercialisation of Carbon Capture and Storage Technologies	DIMENSION 2: Commercialisation of Electricity and Heat Storage Technologies	
	Low / Slow	**High / Rapid**
High / Rapid	**GREEN GAS** ***Transmission-delivered gas 2050: HIGH*** - gas + CCS - some unabated gas for balancing ***Distribution-delivered gas 2050: HIGH*** - 'dual fuel' world for domestic heating - biomethane injection - district heating + CCS - some use of CNG in transport	**STORAGE SOLUTION** ***Transmission-delivered gas 2050: HIGH*** - gas + CCS - small amount of unabated gas - additional balancing via electricity storage and demand-side response (DSR) ***Distribution-delivered gas 2050: LOW*** - heating and transport largely electrified - heat storage used to balance seasonal heat
Low / Slow	**GAS VERSATILITY** ***Transmission-delivered gas 2050: LOW*** - renewables / nuclear dominate - some unabated gas for balancing ***Distribution-delivered gas 2050: MED*** - biomethane at max potential - some use of CNG in transport	**ELECTRICAL REVOLUTION** ***Transmission-delivered gas 2050: NONE*** - renewables / nuclear dominate - balancing via electricity storage, flexible nuclear, interconnection and DSR ***Distribution-delivered gas 2050: NONE*** - heating and transport largely electrified - heat storage used to balance seasonal heat





July 2011

Memorandum submitted by Oil & Gas UK

INTRODUCTION

Oil & Gas UK is the principal trade association representing the offshore oil and gas exploration and production (E&P) industry within the United Kingdom, with more than 100 members ranging from the largest, integrated oil and gas companies through independent E&P operators to an extensive supply chain.

Much of this response was drafted before the Chancellor of the Exchequer made his Budget statement on 23rd March. We would like to thank the Committee for allowing us some extra time in which to make this submission, given the tax changes introduced by the Chancellor which directly affect the E&P industry in this country and have caused us to insert some new paragraphs and alter a number of our comments.

The industry has consistently been the largest investor among the UK's industrial sectors over the past 30 years, with some £6 billion of capital spent in 2010 and up to £8 billion forecast to be spent in 2011, when the results of our Annual Activity survey were published in late February. The industry currently supports about 450,000 jobs across the economy through its activities on the UK's continental shelf (UKCS) and in the export of oil and gas goods and services to various parts of the world which are estimated to be worth more than £5 billion a year, with the prospect of an increase of the order of 10–15,000 jobs resulting from increasing UKCS investment. However, we are now re-consulting our members so that we may understand the potential consequences of the latest change in tax.

Currently, oil and gas comprise 75% of the country's primary energy supplies and this is forecast to decline only slowly during the next 20 years, eg to about 70% in 2020 (ref DECC). In 2010, production from the UKCS accounted for more than 90% of oil and 60% of gas demand by volume, ie after netting imports and exports. While UKCS production will continue to decline slowly (it peaked in 1999 for oil and 2000 for gas), with the right investment climate, we had expected that it could still satisfy some 60% of our oil and gas demand in 2020 and that we would continue producing into the 2040s. Therefore, we believed that the UKCS had the potential to continue to be a major contributor to the future security of energy supplies, but the latest measures have cast some doubt on the extent of this role. Nonetheless, we are pleased to be able contribute to the Energy and Climate Change Committee's new inquiry into this important subject.

General

Before addressing the Committee's specific questions, it is perhaps worth noting some broader policy points at the outset. As is evidenced by the Committee's introductory words in its press release of 11th February 2011, they provide the context for this inquiry.

Government has three over-arching policy objectives: reduced emissions of GHGs, security of energy supplies and affordability. We fully support the government's desire to reduce emissions of GHGs in economically efficient ways and to encourage investment that will achieve this objective, coupled with securing the country's energy supplies in a manner which is both affordable for consumers and keeps the economy competitive. It is also worth noting that long established policy, agreed between government and the industry, has been that the United Kingdom should recover as much of its oil and gas resources from the UKCS as it economically can. A necessary part of achieving this desirable goal is that there should be fiscal and regulatory predictability.

We understand the government's desire to end some of the investment uncertainties which are currently evident in the electricity generating market, in particular. It is probably worth noting that such uncertainties have not so far been evident in gas (but please see our paragraphs below concerning 2011's Budget), with perhaps the exception of storage where the economics is currently difficult. Gas has seen multi-billion pound investments in new supplies and infrastructure in the past five years which have stood the country in good stead during the severe weather conditions experienced last winter (2009–10), the coldest for more than 30 years, and during the early part of the recent winter (in late November and through December 2010), the coldest start to any winter for which detailed records exist. According to National Grid, of the ten days of highest demand for gas ever seen in Great Britain, nine occurred in 2010, with three in January and six in December. In other words, the gas market has worked, so there may be lessons from it which are applicable to electricity.

The Budget 2011

Until the Chancellor's statement on 23 March, Oil & Gas UK and its members had come to understand, as a result of various discussions with the coalition since it came into office last May, that the need to retain investors' confidence in the fiscal regime for the UKCS was fully understood by the government, following a period of almost ten years of repeated changes. The tax increase in the Budget which came without any warning has completely undermined that returning confidence; the statement is of immense disappointment to the industry.

In late February, Oil & Gas UK published the results of its latest Annual Survey of members' investment intentions and oil and gas production forecasts. These demonstrated this returning confidence, with investment intentions recovering strongly after the fiscal uncertainties of previous years and the downturn caused by the recession, and a forecast of up to £8 billion being invested in 2011 (£6 billion in 2010, itself an increase from 2009). In particular, the changes made towards the end of the previous administration with regard to the taxation of small fields, heavy oil fields, deep water gas and very high temperature, high pressure (HP-HT) fields, endorsed by the coalition government, were seen by the industry as representing a growing understanding within government that a mature oil and gas province such as the UKCS needs well tuned taxation in order to stimulate the necessary investment and ensure the maximum economic recovery of its remaining reserves. But instead, a perception of political risk, through fiscal instability, has been rekindled.

As a result, the growing optimism portrayed by our survey is now under threat. Members are reconsidering their plans and it is almost inevitable that some new investment will be put on hold or even cancelled. Indeed, there have been announcements to this effect already. None of this will enhance the UK's future security of energy supplies.

Furthermore, the Budget statement ties the new tax increase to the price of Brent crude oil, overlooking the facts that heavier grades of oil trade at a discount of up to $12 per barrel and, more significantly, that 45% of UKCS production is gas which is priced independently of and at a large discount to oil (eg 35–50% less in energy equivalent terms). The Treasury's blunt instrument is, therefore, doubly damaging.

We now turn to the individual questions posed by the E&CC Committee.

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

The energy system in the UK has shown itself to be very resilient to changes in the prices of fuels during the past 20 years, mainly on account of having open markets which adapt to such changes as no other mechanism can do. As long as markets are allowed to continue to operate, there is no reason to believe that this should change in future.

Furthermore, no one should underestimate the benefits which open energy markets have brought to Britain, above all security of supply combined with generally lower prices than in the rest of western Europe. It is almost paradoxical that, at the very time when the European Commission has at last enabled the opening of the electricity and gas markets across the EU, by way of its Third Package of liberalising measures for which the British government has lobbied long and hard, we in Great Britain seem to be having doubts about the benefits of markets and are proposing internal reforms which will involve much more intervention by government. This runs a serious risk of undoing the good which has been done and of moving Great Britain back in the direction of "picking winners" with all the adverse consequences that that will entail.

The Advantages of UKCS Production

As well as the advantages for security of oil and gas supply, UKCS production has provided the country with a shield from the full effects of changes in prices, by virtue of the tax revenues derived, the investment[49] and jobs created and the benefits to the balance of payments. In addition, the widespread use of gas throughout the economy, as heat in homes, shops, offices and industry and, since the 1990s, as a fuel for power generation, resulting from having our own production, has had immeasurable economic, environmental, social and health benefits.

With the right policies in place, these advantages can continue to flow in future.

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

As mentioned in the Introduction, the offshore oil and gas sector has consistently been for several decades and continues to be the largest industrial investor in the country. This has not only ensured that the UK has been and remains a substantial oil and gas producer, but the UK and Norway have dominated European production of oil and gas for the past 30 years.[50] The continued investment by the industry throughout the north-west European continental shelf has played a major role in securing our energy supplies.

At the time of publishing the results of our Activity Survey[51] in late February, the investment outlook for the UKCS was very encouraging. It is most unfortunate that the Treasury has decided to allow short term considerations, however understandable, to over-ride the need in an industry such as ours, with its lengthy investment timeframes, for fiscal and regulatory predictability. Confidence in the regime which investors face is an integral part of their decision making.

The Gas Market

The market for gas in GB has become an international model, respected for its open-ness, good liquidity and competitive pricing. As mentioned under "General" above, gas has seen multi-billion pound investments in new supplies and infrastructure in recent years; investment on such a scale would probably not have happened without an open and liquid market. The only exception to this has perhaps been in gas storage where there have been many projects being promoted, but various obstacles to their achievement in recent years, including poor economics currently. As Ilex Energy Consulting, now part of Poyry, stated in a report for ourselves a few years ago, there is a paradox about storage: "When gas prices are low, no one wants storage; when gas prices are high, no one can afford storage."

Nonetheless, the scale of the gas infrastructure which has been built, the variety of gas sources which Great Britain now has (UKCS production, pipeline and LNG imports and storage) and an open market have jointly delivered security of supply.

As is widely known, there are very large amounts of power generation capacity to be renewed in the next 15 years. There has, of course, been a substantial move to gas fired power generation since the early 1990s, with all the benefits which that has produced: lower costs and fewer emissions of CO_2, NOx, SOx and particle

[49] More than £280 billion of tax paid and £440 billion of capital invested, since production began (in 2010 money).
[50] The Netherlands is the third, large producer in the EU-EEA, but only of gas, not oil.
[51] Oil & Gas UK's recently published Activity Survey for 2011 refers: http://www.oilandgasuk.co.uk/news/news.cfm/newsid/584

matter when compared with the coal fired plant which has been replaced. Gas remains the technology of choice and, to the best of our knowledge, gas fired power generation is being built at a rate which will replace all of the coal and oil fired plant which has to be closed by the end of 2015 on account of the Large Combustion Plant Directive.

However, DECC's 2050 Pathways document published in July 2010 projects gas demand to fall by about 30% by 2020 and nearer 90% by the mid-2040s. This offers no encouragement for future gas investment, whether in new supplies as UKCS production declines or in storage (the main infrastructure has been built already). Not only do such projections discourage future investment, but they also discourage those who currently provide a wide variety of international supplies to this country from including Great Britain in their longer term plans, other than occasionally.

By seeming to think of gas as little more than a short to medium term stop-gap and then future back-up for intermittent renewable energy, to be switched on and off at will, there is an appreciable risk to both security of supply and affordability. To say the least, Oil & Gas UK thinks that this approach is short sighted, particularly when due consideration is given to the renewal of power generating capacity referred to above and the need to replace this capacity with reliable power supplies.

It has, however, been encouraging to note that both the Secretary of State of DECC and the Energy Minister have stated that carbon capture and storage (CCS) with gas should form at least one of the four demonstration projects. If CCS can work with coal, it can work with gas and probably at lower cost.[52] DECC's recently published response to its call for evidence regarding its 2050 Pathways does now recognise the possible use of CCS with gas, if somewhat belatedly.

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

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

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*?

We believe that questions 3, 4 and 5 are inextricably linked and therefore we are taking the liberty of answering them together.

It is now clear that current policies which aim to de-carbonise electricity generation by 2030 and electrify the economy are going to be very expensive. Also, it must be doubtful if the necessary capital can be raised within the timeframe contemplated, never mind spent to good effect, without straining the supply chain's resources such that it leads to significant cost inflation, which would be the worst of all outcomes.[53]

Furthermore, current policies assume the simultaneous and successful introduction of a wide range of new technologies and changes in the way we live:

- 12–15GW of new nuclear power plant.
- CCS becoming commercial.
- offshore wind power of a scale, complexity and distance from shore never undertaken before.
- development of a smart and much expanded electricity grid.
- widespread introduction and use of electric vehicles.
- electrifying home heating (80% of homes currently use gas).
- introduction of smart metering across the country.
- dramatic improvements in energy efficiency and the way society uses energy.

There are, therefore, very considerable financial and practical risks with today's policies. The likelihood of so many new technologies and such profound changes all coming to fruition within the same, comparatively short timeframe and at an affordable cost is extremely small.

Given the difficulties of raising the necessary capital and the restraints in the supply chain, particularly of suitably qualified people, the current target for 15% of the UK's energy needs coming from renewable sources by 2020 is, more realistically, a target for 2030, a point which we have heard wind power developers acknowledge. It would greatly help if government were to recognise this reality and adjust its policies accordingly, even though this will mean having to re-negotiate the UK's commitments within the EU. This will be less damaging to the economy than attempting to achieve the target in 2020 which, according to our information, the Commission is well aware the UK is likely to miss by a significant margin.

The consequences of current policies were analysed in two separate reports which were published last autumn, the first by Poyry Energy Consulting for Oil & Gas UK[54] and the second by Redpoint Energy for the

[52] Ref Mott Macdonald for DECC, June 2010.

[53] As we pointed out in our response earlier in March to DECC's consultation about Electricity Market Reform, it is worth noting that the much quoted £200 billion of energy infrastructure investment during 2010–20 excludes our sector, where £50–60 billion of capital investment is expected in the decade.

[54] See http://www.oilandgasuk.co.uk/Role_of_gas.cfm

Energy Networks Association.[55] Poyry noted in its report that "There is a greater risk of the lights going out from a lack of power generation than there is of gas interruptions because of a shortage of gas".

Although approaching the subject from very different directions, the two reports came to similar conclusions, namely that using more gas in the energy mix would be more affordable, less risky and, therefore, more likely to succeed. Indeed, Redpoint estimated that it could save up to £700 billion over the years from 2010 to 2050.

More recently, McKinsey has published a report for the European Gas Advocacy Forum which came to similar conclusions looking across the whole EU.[56] Again, savings of hundreds of billions (€) are forecast for the power sector alone, between 2010 and 2030, with similar amounts possible although less certain between 2030 and 2050.

There surely has to be merit in broadly similar findings by three separate consulting organisations of such considerable expertise and stature.

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

A so-called "second dash for gas" in the UK could only occur in power generation where, as mentioned above, there is a very large amount of capacity to be renewed by 2025. Under almost all of its future scenarios, DECC expects a reduction in the demand for gas. The only question would appear to be by how much and when, but it seems unlikely that annual demand would be higher than it has been in recent years, even if substantial amounts of new gas fired power generating capacity were commissioned. Significantly, the main gas infrastructure has already been built and works well although, as the UK's production declines, some further storage is likely to be required in due course.

In terms of the overall market, the International Energy Agency (IEA) foresees a "golden age for gas" in the next 25 years. By any measure, global gas resources are very large—at least two hundred years of today's supply. Nonetheless, coal currently provides the backbone of the world's power generation and, although there is a swing towards gas expected with its lower cost, greater efficiency and lower emissions, coal will remain the world's leading power generation fuel for many years to come (ref IEA).

As well as higher demand worldwide, the IEA is also forecasting a significant increase in gas supplies, particularly in the form of Liquefied Natural Gas (LNG). Exports of Australian LNG are expected to overtake Qatar's during the current decade. There is increasingly a world market for gas, driven by new supplies of LNG from Africa, the Middle East and the Far East, complementing traditional pipeline gas.

The importance of an open, liquid and competitive market cannot be over-emphasised in maintaining security of supply. This is where, at present, Great Britain has a considerable advantage over its competitors. It is necessary to ensure that policies do not undermine the functioning of the market, otherwise security of supply would be threatened (ref our answer to Q.2 above).

The main implication of a "second dash for gas" is that it would be substantially cheaper and easier to deliver than present policies are; it would be much less resource intensive. It would also be a more secure way with which to renew the large amounts of generating capacity which have to be replaced, whereas present policies with their inherent risks and extremely high costs pose appreciable threats to security of electricity supply, affordability and economic competitiveness.

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

No country is immune from international events in the supply of the basic necessities of life, such as food, energy, water and clothing. This is why it is so important to have open markets and free trade to provide variety and resilience in the supply sources and routes to market of such essentials. Furthermore, open markets are necessary to ensure realistic price formation and appropriate responses to pricing signals. Governments both here and in the EU should encourage the opening of markets and the free flow of energy across international boundaries and should help to remove any barriers which hinder such trade.

The long established policy of recovering as much oil and gas from the UKCS as is economically possible remains a crucial part of the UK's energy security. Although some 40 billion barrels of oil equivalent[57] (boe) have been recovered since the late 1960s, it is forecast that there are up to 24 billion boe still to be recovered from the UKCS during the next 30–40, perhaps 50 years. Government and industry should be continuing to work together to ensure that this comes about, instead of being diverted by a need to try and repair the damage done by an ill considered fiscal change.

The equivalent figures for Norway's oil and gas resources are 35 billion boe already recovered, with 46 billion boe forecast still to be recovered during the next 50–80 years, so Norway and the UK combined have 70 billion boe forecast to be recovered in the decades ahead. To put this in perspective, 70 billion boe represent more than 60 years of the UK's current annual consumption of oil and gas. Norway currently is and will remain a very important supplier for this country.

[55] See http://2010.energynetworks.org/reports/

[56] See http://www.statoil.com/en/NewsAndMedia/News/2011/Pages/24Feb_EGAF.aspx

[57] barrel of oil equivalent: this includes oil, gas and other hydrocarbons and equates all of these with oil, so that a common measure can be made of any one of them, or of two or more in combination (1 boe = 164 cubic metres or 5800 cubic feet of gas).

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*?

Current policies contain very considerable financial and practical risks, as identified in our answers to questions 3, 4, 5 and 6 above. There seems to be an implicit assumption within DECC that all of these policies are deliverable at reasonable cost and in a manageable timeframe. In our judgement, this is highly questionable.

Renewable or Low Carbon Energy

Among the policies being implemented, the one we believe is the most mistaken is the renewable energy target for 2020. It would have been much more beneficial if it had been a target for low carbon energy which would have opened the way for investment in a wider range of technologies. Instead, the policy represents a commitment to offshore wind power on a very large scale that is not only extremely expensive and, therefore, highly resource intensive, but the effectiveness of this form of energy is of dubious value at times of greatest need, because of its intermittent nature, which has been brought sharply into focus by the coldest winter for more than 30 years in 2009–10, followed by the coldest start to any winter on record in late 2010. In an analysis of the winter 2009–10, we found that:

> "Also worth noting in the context of security of supply is the fact that, over a 90 day period during the heart of the winter, actual output of wind generation connected to the electricity grid only averaged 21% of its nominal capacity and on 83 of the 90 days it did not exceed 50%, with one period of seven days during which it never rose above 10%. The maximum achieved on any one day was 67% and the minimum was less than 1%. While the proposed offshore wind projects mentioned above are likely to perform better because it is windier offshore, these figures illustrate vividly the need for other means of reliable and flexible generation in order to maintain electricity supplies. It should be noted, though, that maintaining large numbers of wind turbines in maritime conditions will unquestionably be more difficult than onshore." (ref p.17 of Oil & Gas UK's Economic Report, 2010).

Some simple arithmetic illustrates the point vividly. Peak, winter demand for electricity from the national grid is currently some 60GW, requiring back-up of about 12GW to guard against breakdowns or other unpredictable eventualities and, therefore, a total generating capacity of 72GW (Great Britain temporarily has more than this: 80+GW). As the economy becomes increasingly electrified, it is expected that peak demand will rise to 100–120GW, implying a back-up requirement of 20–24GW and a total generating capacity of 120–144GW, based on the usual assumptions. However, if 40GW of the 100–120GW are in intermittent wind power, this would lead to some 52–56GW of back-up being required, ie similar to current maximum demand on a typical winter's day. While these numbers are only a simplified illustration, they are an indication of the excessive power generation and, as a result, grid capacity and concomitant cost which current policies will inevitably entail.

Therefore, it is our firm belief that the current commitment to renewable sources of energy needs to be re-thought. The target should focus on low carbon sources, especially of electricity generation. In the first instance, this means more gas fired power plants which, even if large amounts of wind generation are built eventually, will still be required, albeit in more of a back-up role. Gas fired power will reduce emissions of CO_2, NOx, SOx and particle matter substantially (by 50+% for CO_2), compared with the coal and oil fired plants to be replaced, and at an affordable cost. Even if they do not deliver the reductions in emissions desired in the much longer term (2040–50), they will create the time and space in which to develop and introduce some of the new technologies, one of which, CCS, may well be applicable to those selfsame gas fired power plants.

Such a way forward would pose much smaller and more manageable risks than the current path chosen by DECC which is being determined by the EU's renewable energy target for 2020.

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*?

Japan

It is worth commenting briefly on events in Japan and the possible consequences of the nuclear emergency which has ensued. It is likely that this will increase the demand for gas (and, probably, coal) in Japan and elsewhere (eg Germany) in future. This happened in Japan during 2007 when the country suffered another nuclear mishap. The scale of any future changes in overall demand cannot be ascertained at this stage, but it is unlikely to be substantial.

However, it is equally likely that there will be a supply response, as those with large reserves of gas offer to increase their production by bringing forward projects. Russia has already responded in this way regarding supplies from its far east. Given the size of the world's gas resources, this should not be of concern to policy makers. The reaction in the market thus far has been to increase the price of gas in GB by a few pence per therm.

Nord Stream

Finally, it is worth noting that Nord Stream is due to begin operations towards the end of this year. It comprises twin pipelines being built by Gazprom and its German, Dutch and French partners to bring gas

directly from Russia to northern Germany via the Baltic Sea, by-passing Ukraine and Belarus. The first line, with an annual capacity of 27.5 billion cubic metres (bcm), is due to be commissioned in time for winter 2011–12, with the second line of the same capacity in time for winter 2012–13. To put this in perspective, the total capacity of 55 bcm/year is about equal to 2/3rds of Germany's annual consumption of gas (Germany is the second largest gas market in the EU, just behind the UK). This very large investment will considerably improve the security of Russian gas supplies to NW Europe.

April 2011

Memorandum submitted by Centrica

SUMMARY OF RESPONSE

Centrica welcomes this inquiry that evaluates security of supply at a critical juncture for the UK.

In terms of Gas security of supply, we are concerned that Budget 2011 significantly increased tax rates for companies investing, and producing oil and gas, in the North Sea. The UK's upstream tax regime is at odds with the goal of maximising economic extraction of dwindling reserves.

The proposed tax increases apply equally to gas and oil though the economics are very different, with the gas sector realising lower returns:

— Gas is trading at around $55 barrel oil equivalent, much less than the $75 trigger price for the increased levels of taxation, whereas oil is trading at over $115 per barrel.

The potential impact of the tax increase across the UK gas sector could lead to 47–95bcm of UKCS supply destruction, equivalent to two years of current UK continental shelf production. This will inevitably lead to increased reliance on higher priced imported gas. There will be reduced UK investment, jobs and tax receipts as projects are cancelled.

There will be increases in gas and power costs for industry and consumers with increased imports heralding a potential move to oil price linkage:

— Higher oil taxes may not feed through to consumers as there is a deep liquid market for oil with a single global price. However, the material impact on UK supply from the tax increase will feed directly into higher UK gas prices. Gas markets are regional and shallow, with no single price for gas across the global market. We will also need to compete for additional gas imports with higher priced international markets such as the Far East.

Centrica strongly recommends the exclusion of gas from the tax increase:

— Oil prices have recently risen further and faster than UK gas prices

— It is practical to split out oil and gas.

In terms of electricity security of supply, we support the Government's analysis in the Electricity Market Reform (EMR) consultation that, without significant policy changes, there could be an issue with security of supply, both in terms of supply adequacy (ensuring enough low-carbon plant is built) and supply reliability (ie sufficient flexible plants to cover intermittent generation).

Centrica broadly believes the UK is on the right track regarding electricity security of supply, provided the EMR programme, which will encourage low-carbon and flexible plant, continues apace. Though there are worrying signs of slippage to the timetable. We welcome the recent Carbon Price announcement in Budget 2011 of £30 by 2020.

The planning regime is still causing significant delays for our renewables power projects hampering the UK's ambitious wind programme and therefore undermining much of the work the Government has done on National Policy Statements.

QUESTIONS

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

The UK enjoys well-developed gas import infrastructure as well as competitive gas and power market arrangements. These help shield customers from volatile global commodity markets as well as enhancing the UK's security of supply.

Nevertheless, as part of a global market, UK consumers will continue to be exposed to global movements in gas prices, which also feed into power prices. These are likely to follow a higher upward trend as global demand picks up.

Global gas markets are expected to tighten sometime in the period 2013–15, at this time we might expect an upturn in UK gas prices towards global oil linked prices, though the offshore tax increases proposed in Budget 2011 could accelerate the UK's move to gas-oil price linkage.

In terms of nuclear, the Massachusetts Institute of Technology (MIT) estimated in 2010 that the cost of uranium typically represents less than 2% of the cost of electricity from nuclear plant. Uranium prices are therefore of less of a concern to UK consumers than fossil fuel prices.

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

Upstream Gas

Budget 2011 significantly increased tax rates for companies investing, and producing oil and gas, in the North Sea. The marginal tax rate increases from 75% to 81% for Petroleum Revenue Tax paying fields, and from 50% to 62% for other fields.

The UK's upstream tax regime is at odds with the goal of maximising economic extraction of dwindling reserves. UK hydrocarbon tax levels are amongst the highest in the world. UK finding and development costs are also high. This makes the monetisation of the UK's undeveloped reserves, in what is a mature basin, very challenging.

Budget 2011 Supplementary Charge Tax increase (from 20% to 32%) applies equally to gas and oil, even though the economics are very different, with the gas sector realising lower returns:

— Gas prices are around half oil prices in thermal equivalents;

— Gas is trading at around $55 barrel oil equivalent, much less than the $75 trigger price for the increased levels of taxation, whereas oil is trading at over $115 per barrel;

— Gas returns are lower than for oil, these lower returns are pushed even lower by the tax increases.

The adverse effects of this tax increase on our gas project pipeline and exploration programme means a number of projects will no longer meet investment criteria. The potential impact of the tax increase across the UK gas sector could lead to 47–95bcm of UKCS supply destruction (2 years current UKCS production), leading to increased reliance on higher priced imported gas. There will be reduced UK investment, jobs and tax receipts as projects are cancelled.

There will be also increases in gas and power costs for industry and consumers as increased imports could hearld a potential move to oil price linkage:

— Higher oil taxes may not feed through to consumers as there is a deep liquid market for oil with a single global price. However, the impact on UK supply from the tax increase will feed directly into higher UK gas prices (gas markets are regional and shallow, there is no single price for gas), as the impact on supply is material.

We strongly recommend the exclusion of gas from the tax increase:

— Whilst higher oil taxes may not feed through to consumers, higher gas prices will result from the tax increase as the impact on supply is material and gas prices are regional;

— It is practical to split out oil and gas.

Gas Storage

Centrica currently owns and operates Rough storage, Western Europe's largest storage facility and over 70% of the UK's existing storage capacity.

The UK has 4.3 billion cubic metres of gas storage, equivalent to nearly 15% of demand on a peak winter's day. Whilst estimates of how much new storage is required vary, National Grid believes that storage needs might need to double by 2020 as we continue to increase our import dependence, and as more intermittent renewables come on stream requiring flexible back up generation and therefore flexible gas supply. Storage provides flexibility to the market though it is not the only form of flexibility, it competes with demand side response and more recently LNG has also been meeting this role in the UK market.

Centrica is evaluating plans for another 2.4bcm of storage capacity at the Baird facility in which we own a 70% interest. Baird is approximately 70% the size of Rough and would cost approximately £1.5n to develop. However, the economics are marginal at present, particularly against the backdrop of reduced summer/winter price differentials, a key driver of the value of these kinds of storage facilities. We continue to review the project design and the project economics and expect to make an investment decision in 2011.

Electricity

The electricity market in the UK has delivered a secure supply of power to Britain's homes and businesses over the past decades. However, there are significant challenges ahead. One third of existing UK capacity will need to be replaced from 2015, when the Large Combustion Plant Directive (LCPD) will close many existing coal plant and when the UK's current nuclear fleet will begin to move offline. This plant will need to be replaced with nuclear, renewables and some flexible gas in order to meet the UK's binding carbon and renewables targets whilst ensure security of supply. Ofgem predicts this will require an investment of c. £200billion by 2020.

Such investment is complicated by the fact that current market arrangements are not designed to meet the multiple goals of security of supply, decarbonisation and promoting renewables, all at least cost. We support the Government's analysis in the Electricity Market Reform (EMR) consultation that, without significant policy changes, there could be an issue with security of supply, both in terms of supply adequacy (ensuring enough low-carbon plant is built) and supply reliability (ie sufficient flexible plants to cover intermittent generation).

We are pleased with the announcement in Budget 2011 of a carbon price of £30 by 2020, providing greater financial certainty for the significant investment decisions being made in the next few years. However, while carbon price support is necessary, it is not sufficient on its own to deliver the scale of investment required to meet the UK's carbon targets and secure energy supplies. It is therefore important that it is seen in the broader context of the forthcoming electricity market reform proposals

The EMR consultation is promising but we note that the Government has an extremely short window of opportunity to reform these arrangements and influence investment decisions. There have been worrying recent signs of slippage to the Government's timetable.

Planning

The planning regime is still causing significant delays for our renewables power projects, hampering the UK's ambitious wind programme and therefore undermining much of the work the Government has done on National Policy Statements.

Electricity Transmission

Electricity network transmission investment can take many years. Centrica believes that "anticipatory" investment in the transmission system is essential to ensure the timely connection of the significant amounts of new generation capacity with only minimal risk of stranded investment. . Investing in transmission only after there is certainty that the generation will go ahead risks transmission capacity not being available in time. Underinvestment risks security of supply issues and/or rising transmission constraint costs which will result in increased electricity prices for consumers.

This anticipatory transmission investment should be based on a long-term investment study, for example, the Electricity Networks Strategy Group (ENSG), "Our Electricity Transmission Network: A Vision for 2020" with full stakeholder input.

See also our response to question 3

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

Extra capacity will undoubtedly be needed to ensure the complete electrification of transport. However, in the medium term, much of this increased demand is significant only if it falls during peak use. For example, the Climate Change Committee advises that to meet our climate-change targets, 16% of new cars (5% of all cars) should be electric by 2020, rising to 60% by 2030. This would mean a 4.4TWH increase in demand by 2020. As National Grid describes, if every tumble drier was put on at the same time, this would also equal 4TWH of extra demand. The key is therefore flexibility, which both electrified transport and heat can provide. Ofgem noted in July 2010 that: "Demand from electric cars and electric heating, which have the facility to store energy, could be relatively flexible and could therefore shift in response to supply conditions"

Centrica agrees with Ofgem's conclusion that, to facilitate this, "the electricity system will need to be able to intelligently integrate the actions of all users connected to it, including generators, consumers and those that generate and consume electricity. The development of a smart grid will facilitate this integration by providing improved information and allowing automation (eg electric cars recharging automatically during periods of low prices). This will allow consumers to manage their electricity use."

British Gas is involved in the largest Low Carbon Network Fund trial, fitting 14,000 homes in the North East with Smart Meters and modelling the effects that decentralised energy, microgeneration, electric cars and demand management (including time of use tariffs) will have upon the grid.

Ensuring the roll-out of smart meters is a priority for managing both intermittent renewables and electrified heat and transport at the lowest cost (with the latter offsetting the former—provided the consumer receives clear price signals). We strongly believe that 2020 is the absolute latest for a full smart meter rollout, and have already begun our own go-early roll-out.

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

As DECC noted, in their response to this Committee on National Policy Statements, "DECC's central projection for UK gas demand in 2020 is now around 70 billion cubic metres (bcm) per annum compared with around 85 bcm in 2010." This is as a result of energy efficiency measures.

We support the general hypothesis that energy efficiency has an important role to play in energy security by reducing demand.

In 2010, we asked the Centre for Economic and Business Research to evaluate 40 million British Gas meter readings, taken over a four year period—the largest ever independent analysis of natural gas use in the home. It found that British Gas customers have cut their gas consumption by an average of 22% in the past five years—and saved £322 a year by installing cavity walls, energy-efficient boilers and loft insulation. This 22% average figure masks large differences between homes. Some customers have cut their consumption by more than 44%—whilst some households have still to take up energy efficiency at all. British Gas estimates our customers could save a further £3.6 billion over the next five years if they invest in energy efficiency measures—and believes the Green Deal will be crucial in delivering this.

However, Centrica also notes that this reduction in the use of gas due to energy efficiency could be offset by an increase in demand due to the electrification of heat and cars. Of equal importance for overall UK energy demand is undoubtedly the rollout of smart meters, which will help to manage and smooth demand. In the near future, we believe smart meters will be able to interact with smart appliances in the home to eg charge a car when demand (and therefore prices) were low, smoothing out the demand curves which currently require significant excess capacity.

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*?

As answered in Question 2, Centrica supports the Government's analysis in the Electricity Market Reform (EMR) consultation that there could be an issue with security of supply, both in terms of supply adequacy (ensuring enough low-carbon plant is built) and supply reliability (ie sufficient flexible plants to cover intermittent generation). Ensuring policy support for both low-carbon plant and flexible capacity is essential, as is unblocking the planning system and facilitating a flexible smart grid, as discussed in Question 4.

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

The first "dash to gas" in the late 1980s/1990s saw a huge shift in generation from coal to gas (which went from 2% of power generation in 1990 to a third by 2002).

A second "dash for gas" would not be nearly as significant. In most future scenarios, declining longer term gas use in other sectors would outweigh any increase in power generation volumes so that overall UK gas demand will still fall. For example, the Nov 2010 Redpoint report for ENA called "Gas Future Scenarios Project" showed four scenarios for UK gas demand to 2050 of which the highest (known as "green gas") broadly flat at/around current level.

This suggests that UK plc should be able to cope, notwithstanding long term declines in UKCS production—providing we continue to ensure sufficient diversity of supply sources, import routes and provide government support for longer term import contracts where appropriate.

The core concern of any "dash to gas" would be ensuring the UK continues to meet its renewable and carbon targets. Gas can still have a role in this. For example, the European Gas Advocacy Forum, of which Centrica is a member, noted earlier this year that gas offers an economically attractive option to meet our climate change targets, including the UK's ambitious 2020 renewables targets. Gas could be expected to displace coal (at half the carbon intensity), providing back up generation to renewables and, eventually, become a clean fuel via CCS.

At the overall EU level, the Forum suggested that: "Between 2010–30 alone, total investment costs in the power sector could be €450–550n lower if between 2010 and 2030 we complement building Renewable Energy Sources with a mix of gas and nuclear. This equates to annual cost savings of €150–250 per household."

Centrica therefore agrees with the Government that gas will continue to have an important role in the future, and that this must be planned for appropriately.

At the present time, the investment environment is looking difficult for new build gas CCGT particularly with plant margins at very high levels. As mentioned in response to Question 3, we look to the government's EMR to provide the appropriate investment signals for flexible gas plant. With this in mind, Centrica believes that any move towards gas would be manageable provided regulatory risk regarding upstream investments is appropriately managed.

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

As Churchill argued, energy security lies in diversity of supply. 24 companies from 11 countries have invested over £10 billion in UK energy markets in the past decade. New gas capacity has taken the form of new Norwegian pipelines, enhancements to existing interconnectors with continental Europe as well as new LNG import facilities. Such diversity is a testament to the success of the liberalised UK market with liquidity of the traded gas market at the national balancing point (NBP) giving confidence and clear price signals to investors.

Nevertheless, there is no room for complacency. Since 2004, the UK has been a net importer of gas. In 2010, the UK imported 40% of its gas needs and this is expected to rise to 55% by 2015. This is misleading, as UK production was equivalent to 59% of consumption in 2010 and this may fall to just over 45% by 2015.

The UK gas market has become increasingly linked to the global gas market. Five factors influence the UK's exposure to the global market (and to price movements as a result):

1. UK continental shelf (UKCS) production and pipeline capacity: as the UK's reserves decline, we are becoming more exposed to global events because we are buying from a global market. This can be seen, for example, in the way forward UK wholesale gas prices increased recently in response to the expectation of greater gas imports into Japan. Maximizing recovery from the UKCS is essential; Budget 2011 was unexpected and unhelpful.
2. EU and Norway pipeline imports and capacity: The UK imports most of its gas from Norway, so Norwegian production is important, as are interconnector pipelines with Belgium and The Netherlands which supply the UK. Historically, Continental gas import contracts have been oil-indexed, whereas the UK moved away from oil-linked gas prices in its transition to liberalised markets a number of years ago. Recently we have seen the gas-oil link beginning to weaken in Continental markets and the continued move towards liberalised markets. A key question is whether this momentum is maintained in the coming years so that Europe genuinely becomes an added source of flexibility for the UK, rather than a problem for the UK market as it has been in the past.
3. LNG import capacity and Atlantic Basin LNG (linked to Pacific and US markets): The onset of scale production of North American shale gas has fundamentally changed future outlooks. As recently as 2008, the world was predicting that North American imports would accelerate to satisfy demand. Now, North America is expected to be self-sufficient for at least a generation, resulting in an increased supply of LNG available for the rest of the world—at least in the short-term. European shale is not expected to be a game changer. Whilst considerable uncertainty remains, significant shale discoveries elsewhere in the world (eg China) could have knock on effects on the UK market, though not for a decade or more.
4. Gas demand: The global recession resulted in a decline of global gas demand by c. 2.1% in 2009, leading to a more liquid market and increased availability of both pipeline gas and LNG. However, global gas markets recovered significantly in 2010 and are expected to tighten further sometime in the period 2013–15.
5. Gas storage capacity: As discussed in our response to Q2, whilst estimates of how much new storage is required vary, National Grid believes that storage capacity might need to double by 2020 as we continue to increase our import dependence, and as more intermittent renewables come on stream requiring flexible back up generation and therefore flexible gas supply. Storage provides flexibility to the market though it is not the only form of flexibility as it competes with demand side response and more recently LNG and interconnectors to/from the Continent have also been meeting this role in the UK market.

The UK enjoys well-developed import infrastructure and competitive market arrangements which cope well in tight situations by sending the appropriate price signals needed to ensure new gas supply.

The strength of the liberalised model has been demonstrated repeatedly, not least how the market coped with record demand during the past two winters.

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*?

Provided the barriers identified in Question 2 are tackled, we believe UK energy security can be maintained. In particular, we welcome measures proposed by the Government to enable Ofgem to keep existing market mechanisms open for longer in the event of a gas emergency. The Energy Bill will give Ofgem the power to direct changes to the industry code (the Uniform Network Code) which governs how the gas market operates in order to sharpen the commercial incentives for energy supply companies to meet the needs of their customers before and during a Gas Supply Emergency (if one should ever arise). In turn, this should also sharpen incentives to avoid the occurrence of such an emergency. In particular, we believe that there is scope to provide greater encouragement for the forward commitment of demand-side response.

April 2011

Annex

ABOUT CENTRICA PLC

Centrica plc is the parent company of British Gas:

- British Gas is the UK's largest energy supplier, with c. 16 million customer contacts in the domestic sector and around 1 million in the non-domestic sector.
- We are the leading supplier of energy efficiency in the UK, insulating 270,000 homes this year
- We are the UK's largest supplier of micro-generation, including solar (via our subsidiary, Solar Technologies) Biomass/CHP (via a 19% share in Econergy, a leading biomass boiler producer; Micro-CHP (working with Ceres and Baxi) and Air and Ground Source Heat Pumps.

— British Gas is also committed to Smart Meters, rolling out 260,000 this year

— Altogether, British Gas employs c. 10,500 people engineers who require green skills, many of whom are trained in one of British Gas' Six Energy Academies.

Centrica plc also owns upstream gas production and power generation assets through Centrica Energy to support our supply businesses:

— Centrica is the second largest producer of gas in the North Sea (the UK Continental Shelf, or UKCS), investing more than any other company in UK security of supply.

— We own 8 gas-fired power stations in GB including one in Langage, near Devon, that is one of the UK's newest and most efficient generating sets.

— We are a leading developer of offshore wind and were recently awarded exclusive rights to develop the Irish Sea zone which provides us with the potential to develop up to an additional 4.2 gigawatts of renewable electricity.

— Centrica plans to play a role in the UK's new nuclear renaissance. We own 20% of British Energy, through our Joint Venture with EDF Energy and are undertaking the pre-development activities for a planned nuclear new build programme

— Centrica also has a North American supply and generation business, Direct Energy, which is the largest competitive energy supplier in the USA.

Supplementary memorandum submitted by Centrica

1. *To what extent do you think carbon capture and storage technologies will be able to deliver the flexibility required to balance a low carbon electricity system?*

Centrica is not involved in any CCS projects, so we have limited detailed knowledge of engineering specifics.

Our understanding is that post-combustion CCS on gas CCGT is not likely to affect the flexibility of plant from a technical perspective. As such, gas with CCS could continue to act as a flexible back-up to intermittent renewables in much the same way as gas is likely to at present. In addition to this, CCS on gas CCGT would also operate as a low carbon source of energy in its own right.

Commercially, however, there will be a strong initial desire to run CCS on gas CCGT near baseload when possible, given the high capital cost and the linkage between support payments and generated output.

We also note that, given current commercial viability, CCS is unlikely to make a meaningful impact until the 2030s.

2. *We have heard some concerns about the current "generation led" approach to transmission investment and proposals for an "anticipatory" approach to be taken instead. Can you explain what the problems with the current system are and what changes you would like to see?*

Given the planned growth in renewables and nuclear, together with the need to maintain back up generation, it is clear that significant electricity transmission investment is required to provide generation access and to maintain system constraints at a reasonable level in the future. As transmission investment tends to be "lumpy" in nature, and takes longer to build, National Grid should anticipate the additional investment needed and take decisions now based on available information. Work on transmission should commence well ahead of any generation construction.

Transmission's longer construction lead time compared with wind farms and CCGTs is primarily driven by Planning but also because Transmission requires more consenting and land acquisitions etc. The Beauly-Denny transmission upgrade in Scotland is a recent example where permission was sought in 2005 and finally granted, albeit with over a hundred conditions, in 2010. Once the pre-conditions are met this transmission upgrade is expected to take a further four years to construct (a total of circa 10 years) whereas CCGTs and windfarms typically take two to three years to build.

Until very recently Ofgem required National Grid to have signed generation connection agreements before investing in transmission. This "generator-led" requirement has resulted in insufficient network capacity being available. A queue of generation connections, out to 2022, resulted in the DECC decision to introduce the policy of "Connect and Manage" in 2010. This allows the connection of some generation ahead of any necessary transmission reinforcements but requires National Grid to manage the resulting constraints. The costs associated with these constraints could escalate significantly if National Grid is not allowed to anticipate and commence investment in transmission.

We do not believe that transmission operators have the right incentives for network investment. However, the current Ofgem Price Control Process is underway and could remedy this deficiency. We believe that investment needs to be "anticipatory" and hope that the new regime will enable this to take place. As an interim measure, we support the more recent Ofgem move to approve the funds needed (on a case by case basis) for pre-construction (primarily desk based) work on specific strategic transmission projects (endorsed in

the Electricity Network Strategy Group study "Our Electricity Transmission Network: A vision to 2020") ahead of any formal generation commitments.

We acknowledge that there is significant uncertainty around future generation and the retirement plans of existing generation. Anticipatory network investment will not be risk-free, however, we believe the risks associated with under investment far outweigh those of stranded network assets.

3. *Price security is an important element of energy security. To what extent do you think energy prices becoming unaffordable is a plausible risk for the UK?*

Physical gas supply security may be the main issue, but in a competitive market such as the UK, the first thing we tend to notice when markets get tight is a rise in price—long before there is any real physical shortage. These raised wholesale prices are part of creating the right incentives for more gas to be delivered into markets like the UK. This should normally help to ensure that those tight markets and raised prices (eg 2004–06) are then alleviated—as we have seen in the last few years.

Nevertheless, as we move from being a net exporter to a net importer of gas, we will suffer more price volatility and also be more exposed to international prices. Prices will rise if international demand increases significantly, as we have seen with Japan and Germany moving towards using more gas. But there are also a number of inherent uncertainties, not least the potential impact of shale gas.

Rising energy prices as a result of increased global energy demand are a plausible risk, given that wholesale energy costs are responsible for 56% of the average gas bill and 46% of the average electricity bill (DECC, June 2010). DECC noted in the 2010 Annual Energy Statement that wholesale energy prices will be c. 15% higher, but this assumes oil at $80 per barrel by 2020 (based upon real 2009 prices). This was before oil prices roses to over $100 a barrel and also before Germany committed to moving away from nuclear. This suggests that DECC's next forecast (expected imminently) could forecast even higher wholesale prices.

Another factor which could increase energy bills is domestic policy, for example the need to move to a low carbon economy. On top of the c.15% wholesale price rise predicted by DECC by 2020, DECC also estimated that, as result of Government policies to promote a secure, low carbon economy, energy prices (for the domestic sector) will be c. 18% higher for gas than Business as Usual (BAU) and 33% higher for electricity than BAU by 2020

Nevertheless, DECC has mentioned energy bills will be only 1% higher than BAU as a result of customers taking up renewable electricity, renewable heat and energy efficiency measures. We know from our own experience that these can make a significant difference—British Gas customers have cut their gas consumption by an average of 22% over the past five years by installing energy efficiency measures. However, we also know that uptake is nowhere near where it needs to be to make the savings DECC expects to bring down bills—we need to have a huge push to make the additional 1% increase a reality.

Diversity of supply and infrastructure is important to energy security but such diversity also ensures that we avoid undue price volatility and the problems inherent with a single technology. The UK already has diversity in its primary energy mix with gas, coal, petroleum, nuclear and increasingly renewables. The UK also enjoys well-developed gas and electricity infrastructure. For example, the UK's competitive market has delivered a variety of gas import infrastructure so that the North Sea's declining production is complemented by import capacity of 140 bcm per annum compared to annual demand of around 95 bcm. We have gas import routes consisting of pipelines from Norway's continental shelf, interconnectors with Belgium and Netherlands as well as LNG import terminals enabling the UK to access supplies across the globe.

The UK's energy policy framework should ensure continued diversity in the generation mix. We will need renewables, nuclear and gas as we continue to reduce the carbon intensity of the sector. The Energy Market Review will have to provide the right incentives to ensure this diversity.

The government should continue to promote competitive markets to deliver lowest cost solutions and diversity both here in the UK but also across the EU and globally. Affordability is critical so we will need to see a step change in energy efficiency via the roll-out of smart meters and delivery of the Green Deal. This should help to ensure affordability is balanced with the need for a low carbon economy.

4. *The Government has ambitious plans to improve domestic energy efficiency through the Green Deal. Are there other measures they should be considering as well as the Green Deal, and to what extent will the Green Deal deliver greater price security for domestic consumers?*

As outlined above, we believe the Green Deal has considerable potential to cut bills—provided there is sufficient customer uptake, which is currently a significant barrier.

Centrica has been an early supporter of the Green Deal announcing last year that it planned to "go early" on a Green Deal offering to gain early learnings before full roll out. In preparation for this, we have held a number of focus groups with customers to test understanding and appetite for the Green Deal. Key learnings include:

— The core idea of saving money works well;

— However, energy efficiency is not seen as a priority and gains low levels of interest. Microgeneration is far more popular;

— Mainstream consumers do not seem to like the "green" link. It also creates expectations of a subsidy; and

— Customers are highly sensitive to the interest rate. A report prepared for DECC by Quadrangle in 2009 noted that "By switching from an interest free loan to a 2% loan, you will lose up to 20% of the people interested (eg 24% vs. 19%). By switching from a 2% to a 7% APR, you can lose a further 20% (of the people interested)."

In addition to the Green Deal, we therefore believe that:

— Customer demand must be actively stimulated, for example via council tax and stamp duty rebates. The DECC-Quadrangle report noted that "both the council rebate of £250 over three years and a one-off upfront council rebate of £500 have an uplift of 15%". Energy Minister, Greg Barker, clarified during the Energy Bill Committee that the Treasury is actively looking into this, and we would urge a thoughtful package of incentives in advance of the Green Deal.

— The Green Deal needs to include measures that will excite customers, as energy efficiency alone will not. It is crucial that microgeneration is included within the Green Deal proper. Without this, the Green Deal will largely be an insulation programme that will not capture the public imagination. DECC's intention for the FIT and RHI to "work alongside" the Green Deal will not be sufficient. As Quadrangle notes, Microgeneration is extremely powerful at creating demand: "In terms of technology, higher savings lead to higher levels of uptake, but the level of saving appears to be beaten [*sic*] by the actual type of technology, with solar water heating and triple A rated windows both more appealing than wall insulation (external or internal)."

The different nature of the business sector is likely to require tailored incentives. Tenanted properties dominate and SMEs have little appetite to invest in energy efficiency measures. Green Deal and associated default debt risk would be attached to the property (and therefore freeholder/landlord). To overcome this challenge, the landlord needs additional incentives. For example, consideration could be given to reduced business rates or capital allowances against Green Deal assets.

July 2011

Memorandum submitted by Shell

EXECUTIVE SUMMARY

— The greatest resilience in terms of energy security is achieved through diversity throughout the full supply chain, a key feature of current global oil and gas markets. The UK oil and gas industry has had a strong track record when it comes to delivering secure supplies and the investment needed to respond to the declining indigenous production.

— The UK and wider Europe benefit from abundance, accessibility and diversity of natural gas supplies. In particular, the game-changing effect of the development of unconventional gas globally means that there is now at least 250 years of global natural gas supply at current rates of production.

— Priority should be given to further strengthening gas infrastructure and interconnectors to ensure that the UK and Europe benefit from diversity and enhanced supply security from LNG.

— Concerns about gas price volatility and oil linkage are misplaced and overstated. For example, when oil prices averaged $130/barrel in summer of 2008, the gas price did not exceed the equivalent of $90/barrel. The structure of gas contracts tends to limit gas prices when oil prices are high by, for example, having fixed or variable pricing and other smoothing mechanisms.

— Maintaining investment in the UK Continental Shelf (UKCS) will be critical for realising the UK's domestic oil and gas production potential and therefore ensuring that domestic supplies contribute to the UK's energy security for several years. The recent Budget increase to the Supplementary Charge on North Sea production risks long lasting detrimental impacts on investment in the UKCS.

Q1. *How resilient is the UK energy system to future changes in fossil fuel and uranium prices*?

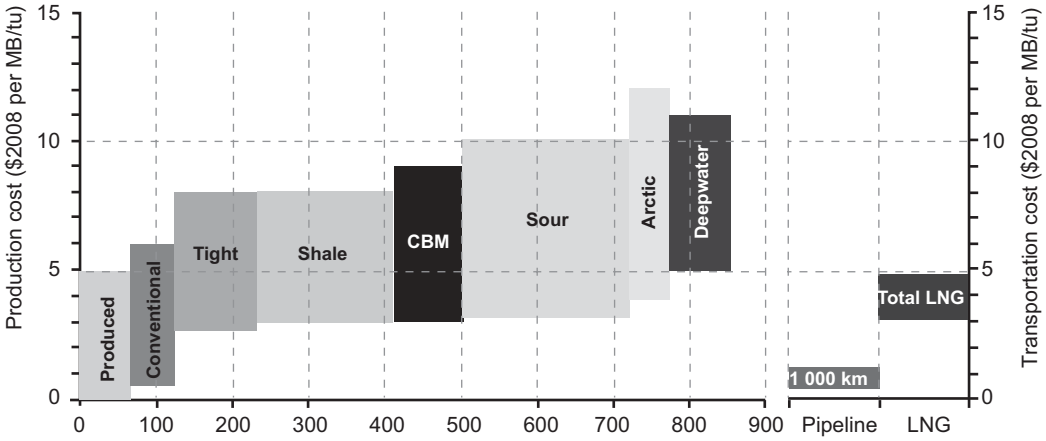
1. Oil price volatility is often cited as a threat to energy security. Prices tend to be set by the marginal cost of production. Short-term volatility however cannot be ruled out given the risks around geopolitical and supply disruptions. In addition, oil prices respond not only in cases of actual supply disruptions but also in cases of perceived threats to supplies, reflected for example in price premia at times of geopolitical instability. Improved vehicle efficiency, further use of biofuels, use of new technologies and electrification in transportation can all help mitigate then impact of oil price volatility on the UK economy. So can efforts to improve transparency in markets and promote dialogue between consuming and producing nations, reducing any barriers to timely supply development.

2. There have recently been concerns raised about gas price volatility, particularly in the context of the UK moving towards greater dependence on gas imports. However, the past few years have seen a spectacular improvement in gas supplies from two key sources: unconventional/tight gas and liquefied natural gas (LNG). The IEA now estimates around 380 tcm of unconventional gas reserves are recoverable, which in addition to conventional recoverable resources of 405 tcm, means there are now over 250 years of gas resources at current production rates. These effects have created a well supplied market and had a moderating impact on prices.

3. The projected rapid growth in upstream gas supplies over the next 10–20 years can probably be achieved at costs below $10/MMBtu on average. Given the resource base available, there is more than 100 years of current world consumption available at this cost level (see Figure 1).

Figure 1

ESTIMATED LONG-TERM SUPPLY COST CURVE FOR RECOVERABLE NATURAL GAS RESOURCES



Source: IEA, World Energy Outlook 2009

Despite the reasonable costs of producing gas there is a widespread perception that future gas prices will be very volatile. Gas price contract indexation to oil is often seen as the key problem. However, in reality:

— Gas prices have historically been competitive to oil prices (on a thermal parity basis).

— Gas prices indexed to oil have been less volatile than gas prices linked to NBP[58] or HH.[59].

4. Short-term volatility is best, and powerfully, avoided through having a diverse mix of gas supplies, sufficient storage capacity and an interconnected, reversible-flow pipeline network allowing gas to flow when and where required. Increased European gas market liberalisation will enhance all these characteristics. The UK is one of the best examples of a country with very diverse gas sources. For example, in 2009 the UK imported gas from 10 different countries: piped gas from Norway, the Netherlands and Belgium and LNG from Algeria, Trinidad and Tobago, Qatar, Egypt, Norway, the USA and Australia.

5. Moreover, there are many mechanisms in use in the gas market today to smooth price volatility for gas buyers and consumers such as a fixed priced deals (up to three years), flexible pricing (eg linked to the NBP or similar) or a variable price with the option to additionally hedge a proportion of the contract and other smoothing mechanisms such as S-curves or indexation to other commodities. So even if oil prices are high, gas prices do not necessarily follow. For example, when oil prices averaged $130/barrel in summer of 2008, the gas price did not exceed the equivalent of $90/barrel.

6. Long-term contracts can incorporate a mix of these mechanisms, where the supplier or intermediary is managing both supply risk and mitigating contract price volatility. Long-term contracts provide benefits in two ways: the buyer is assured of supply, and can negotiate on price and terms to reduce volatility. The supplier is committed to supply even if the price in that market is less favourable than achievable elsewhere.

7. Positive political messaging between supplying and consuming countries can support the development of long-term partnerships and contracts.

8. It should also be noted that greater reliance on intermittent renewable generation in the electricity market is very likely to increase electricity price volatility with prices even being negative when there is too much wind generation on the system. A greater role for gas in the generation mix would offer additional supply flexibility and therefore help to balance supply and demand.

9. The UK's efforts to meet its 2020 and 2050 carbon targets will further diversify its energy mix in all sectors of the economy. Diversification will aid resilience and provide a hedge against cost and technical and

[58] NBP—National Balancing Point—the UK's traded marker price.
[59] HH—Henry Hub—the USA's primary traded marker price.

political uncertainties. This applies to sources of primary energy, to energy conversion and to energy transmission, transportation and distribution. Within any primary energy source, diversification of sources of supply is also needed. Diversification is relevant both to geographic sources and to methods of transportation.

Q2. *How sensitive is the UK's energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?*

10. Investment in energy infrastructure along the whole supply chain from production to distribution in all forms of energy is key to maintaining UK energy security.

11. Maintaining investment in the UKCS will be critical for maximising the UK's domestic oil and gas production and therefore ensuring that domestic supplies contribute to the UK's energy security for several years. In 2010 the industry invested £6 billion of capital and £6.9 billion in operating costs which contributed to the discovery of another 300–400 million barrels of oil equivalent and initiated the development of 13 new fields and four major incremental fields.[60] The increased investment plans for the UKCS could halve the decline rate of the UKCS over the next five years from 6.5% per annum seen over the last decade to around 3%. If maintained, the recent rise in investment, could have a significant impact on the contribution that domestic resources make to the UK's future energy supply. However, the recent Budget announcement of the increase in the Supplementary Charge on North Sea production from 20% to 32% could put this at risk and hence as a consequence reduce longer term production. Prior to the new tax changes it was estimated that investment in oil and gas production would increase to £8 billion in 2011, but the recent rise is making companies re-assess their plans. If not mitigated, the tax rise could lead to a loss of planned investment and thus indigenous oil and gas production which increased imports may need to replace.

12. It is also important to note that energy infrastructure projects have a multi-decade lifespan often with very long pay-back periods. Uncertainty over the fiscal, regulatory and market environment could delay or deter such projects coming forward.

13. The UK and European markets have already begun to effectively address the inevitable long-term decline in domestic oil and gas supplies. Europe—including the UK—is within economic distance of 70% of global gas resources. Europe already has an extensive and well-established network of gas infrastructure including many LNG regasification terminals as well as various long-haul pipeline connections for the North, East and South. At the same time, the diversification of pipeline supplies into Europe continues, although the total amount of pipeline supplies is expected to remain fairly constant. This gradually reduces transit risk and the reliance on single pipelines. The majority of the projected European gas demand growth is therefore expected to be met by LNG. This has led many countries already to build their own regasification facilities, sourcing their gas directly and thus avoiding any possible transit issues, while also gaining access to the international spot LNG market. The IEA's projection of inter-regional trade flows clearly demonstrates the strongly growing degree of global interconnectivity, with new (mostly LNG) supply corridors opening up from Africa, the Middle East, the Caspian region and even South America.

14. In addition, political signals from consumer governments to major resource holders such as Russia and Qatar will also play a powerful role in encouraging continued investment and alleviating their concerns over demand security. Clear messages to these producing partners that, even as European countries transition to low carbon economies, gas will continue to play a key role in their future energy mixes both in the short to medium term and with CO_2 mitigation as a long term option, will be helpful in this context.

15. In the UK, there has been accordingy to DECC figures a 500% increase in gas import capacity in the last decade, the majority of which has been built since the winter of 2005/06. UK infrastructure is now capable of importing around 125% of annual gross demand. Storage capacity in the UK has increased by 25% over the last decade and there are around 22 more storage projects planned, though the increase in LNG flows during the winter may jeopardise some of the storage economics. Increases in the UK's re-gasification capacity as well as strong interconnection with Europe has widened the diversity and availability of sources of gas supply. The improving physical interconnection between European market regions is an essential factor for enhancing security of supply. As seen in the UK during winter 2009–10 when there were technical supply constraints from Norway coinciding with record gas demand, and the UK relied on increased imports from the continent to successfully help make up the shortfall.

16. In terms of electricity markets, significant investment is needed to meet the UK's 2020 and 2050 carbon targets both to decarbonise the generation sector but also potentially double the electricity supply by 2050 as the heat and transport sectors move towards electrification. Ofgem have estimated that at least £110 billion of investment is required in new generation and transmission assets in electricity—over double the rate of the last decade. Switching from coal to gas is the fastest and most cost-effective way of reducing carbon emissions in the power sector. Using gas also relies less on further development of emerging technologies and therefore presents less uncertainty around implementation. Having gas in the generation mix would also require less build out of transmission capacity. An EU level study[61] showed that pursuing a future generation mix that has

[60] Oil and Gas UK—2011 Activity Survey.

[61] EGAF (2011)."Making the Green Journey Work : Optimised pathways to reach 2050 abatement targets with lower costs and improved feasibility".

a strong role for gas would require 25–40% lower build up of transmission capacity across the EU over the period 2010–2030, in itself saving between €30–50 billion.

Q3. *What impact could increased levels of electrification of the transport and heat sectors have on energy security?*

17. The Department of Energy and Climate Change (DECC) has suggested that electricity generation may have to be close to zero-carbon by 2030. In addition to this challenge, power sector demand may double by 2050, as decarbonisation of the heat and transport sectors means increased use of electricity.

18. Energy security must not be defined solely on the level of reliance on imported fuels, *but on the ability of the entire energy supply chain to balance supply and demand at a reasonable cost.* Though increased electrification provides further diversity of fuel sources to the transport and heat sectors and as such will increase energy security in these sectors, there will be a challenge to overall security of supply if the electricity system is not resilient.

19. So developments in electrification in the heat and transport sector have to happen in parallel with the appropriate investment in the UK's electricity generation and transmission capacity. The electricity capacity margin must remain sufficient to keep the lights on even in a situation with higher demand and greater renewable generation on the system. Though technological developments may enhance the ability of the electricity system to deal with greater intermittency, there will be a continued need for some form of flexible, reliable generation.

20. CCGTs as well as gas with Carbon Capture and Storage (CCS) could provide this flexibility, though there is concern that the future structure of the market may limit the periods when their flexibility is rewarded through peak prices. The role of capacity mechanisms should be considered in this context and we have provided further detail to this effect in our response to DECC's consultation on Electricity Market Reform.

Q4. *To what extent does the UK's future energy security rely on the success of energy efficiency schemes?*

21. Much improved energy efficiency is vital not just in tackling climate change but in supporting economic development and enhancing energy security. The European Commission, alongside its publication of the 2050 Roadmap highlighted that although the EU is making good progress on the 2020 carbon and renewables targets, the EU is currently only halfway towards the third goal for 2020—improving energy efficiency by 20% and that much greater efforts will be needed to meet this target.

22. Energy efficiency will also help meet our climate and energy security targets at least cost. DECC's estimates of the costs to the consumer of decarbonising the electricity sector for example rely heavily on assumptions made about the uptake of energy efficiency measures and the impact it will have on demand. It is crucial therefore for the UK's competitiveness that progress is made in this area.

23. In developing policy to promote energy efficiency, consideration needs to be given to the fact that the price signal for energy may be too muted to have sufficient impact on energy efficiency and using price alone to impact energy demand could be regressive. Standards and regulations in transport, buildings, industrial processes and appliances therefore have a critical role to play in encouraging efficiency.

Q5. *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?*

24. Diversification of energy sources and energy technologies will increase the resilience of the UK electricity sector, but there is a serious risk that an excessively target/volume driven focus on delivery of renewable technologies could create a much more expensive system than is necessary with the costs borne by the consumer and taxpayer. It is not clear that the intermediate 2020 target of 15% renewables for the UK economy is a cost effective or attainable way of meeting the 2050 carbon targets.

25. The increased use of renewable generation will require very large changes to both the operation of the current electricity market and to the generation and networks required to maintain a balanced system. With the increasing penetration of zero marginal cost generation (nuclear and renewables) there will be increasing periods when the electricity price will be zero (or even negative), which will not provide enough reward to generators building peaking capacity, potentially affecting investment in supply. In addition, gas-fired power can be sited close to demand centres whereas accessing electricity from renewable generation located in remote areas will require strengthening the transmission system. Further international interconnection may also be required to balance a more intermittent system. Building interconnectors is a costly and slow process.

26. Last December in the UK, during the three coldest days when temperatures were below zero degrees, wind generation output only averaged 3% of metered wind capacity. Significant back-up and system flexibility will be required to mitigate against these types of shortfalls in wind generation, especially as it becomes a growing proportion of the mix. As mentioned above, gas can be a good complementary technology to intermittent renewable generation. Gas fired power is also technologically proven, has a small footprint, fits into the existing infrastructure and is relatively cheap and quick to build and by replacing coal is the fastest

and surest way of making significant CO_2 emission reductions. There is a need to ensure in the new market arrangements that gas-fired peaking capacity is sufficiently rewarded.

27. In the heat sector, all types of technology will be important in meeting the carbon reduction targets required. Renewables and electrification will have an important part to play in diversifying the energy sources used for heating. Conventional gas boilers will still be necessary however in areas where the other solutions are not appropriate or too costly. The benefits of Combined Heat and Power (CHP) plants should not be overlooked and a supportive policy environment must be implemented. CHP is an efficient method of producing both electricity and steam, thus leads to reductions in energy use and reduced carbon emissions.

28. Global transport fuel demand is set to rise by 45% between 2006 and 2030 therefore efforts to reduce greenhouse gas emissions and satisfy this growing demand will require all the sustainable transport fuel options available. These include efficiency improvements for internal combustion engines, progress on battery technology and plug-in hybrids, current and next generation biofuels and, in due course, hydrogen. Given the positive contribution biofuels can make to reducing emissions, Governments should encourage and reward biofuels that demonstrate good CO_2 performance and are produced from more sustainable sources. To this end, Shell encourages the adoption of international standards for sustainable sourcing and participates in several initiatives that are working on voluntary guidelines for particular feedstocks.

29. As well as being sourced from a number of regions around the world, biofuels can also be grown domestically further enhancing UK energy diversity and supply security. For example, the Ensus wheat biorefinery, in northeast England turns 3000 tonnes per day of wheat into bioethanol, high protein animal feed, and CO_2 for the food and beverage sector and saves around 1 million tonnes CO_2 equivalent of global GHG emissions per annum.

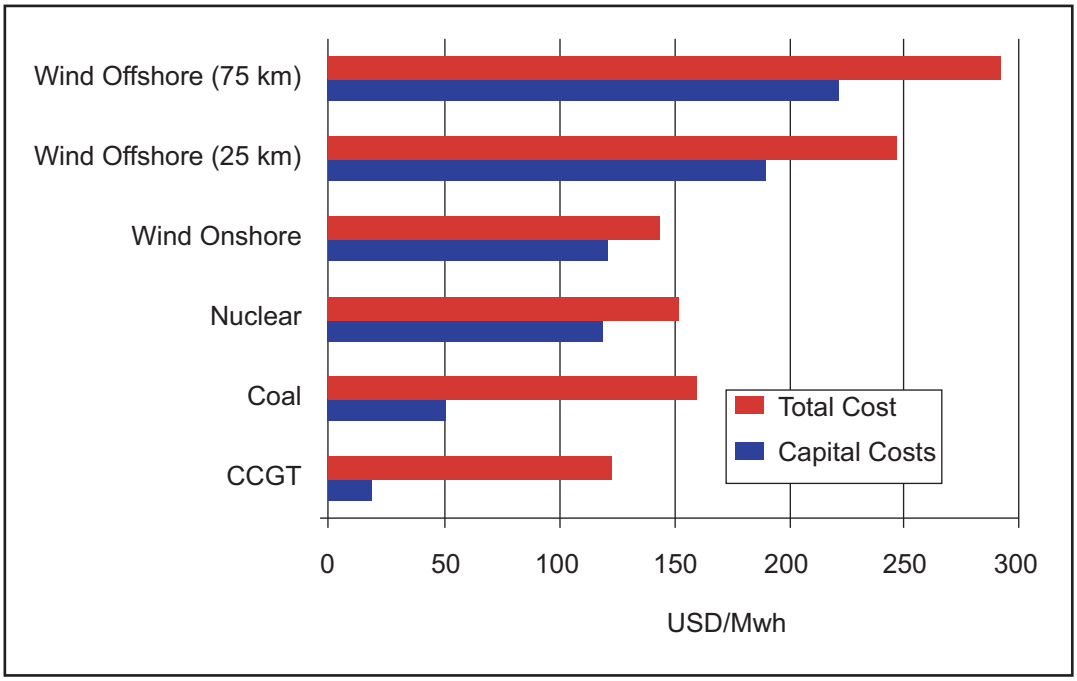
Q6. *What would be the implications for energy security of a second dash-for-gas?*

30. The term "dash for gas" is often unjustifiably used with negative connotations. History shows us that the reality is very different. The increase in the use of gas in the power sector in the 1990s helped the UK meet its Kyoto targets and led to a period of relatively low electricity prices in the UK while having supply security. Despite its very significant advantages, Shell is not advocating sole reliance on any one fuel in any one sector. As noted above, the key way of ensuring the UK's energy security of supply is maintaining diversity throughout the supply chain. There are many benefits however to the UK energy sector and wider economy in maintaining an important role for gas in the UK energy mix.

31. The benefits that the use of gas can bring from a macro-economic perspective are often underestimated. With deficits and government debt at historically high levels, there is an acute need for strict budget discipline. Most countries will find that natural gas is far more affordable than any other source of electricity, especially in front-end (capital cost) investment terms. Shell estimates that the capital cost comparison of gas-fired power versus other power sources as approximately: gas 1; coal 2–3; nuclear 5; onshore wind 7–10; offshore wind 10–15. (*NB* These estimates are in line with other estimates, such as those produced by Mott MacDonald and included in Figure 2 below. Moreover these estimates do not include the additional balancing and network costs that renewables would incur).

Figure 2

COSTS OF DIFFERENT GENERATING TECHNOLOGIES[1,2]



[1] CCGT = Combine Cycle Gas Turbine

[2] Total costs = Capital costs + Fuel Costs + Operating Costs

Source: Mott MacDonald for DECC

32. A recent report by Redpoint for the UK Energy Networks Association,[62] found that pathways with greater ongoing gas use could offer a cost-effective solution for a low-carbon transition relative to scenarios with higher levels of electrification. Their baseline assumptions indicate potential savings to Great Britain of almost £700 billion over the 2010 to 2050 period on a Net Present Value (NPV) basis—around £20,000 per household or £10,000 per person—with consequential benefits for consumers, the economy, and the competitiveness of GB industry. For the power sector the avoided costs are £244 billion over that same period. Moreover, the conclusion that more use of gas in the power sector is the lowest cost pathway is robust under different gas price sensitivities. In addition, this scenario requires the least interconnection with other countries, which can be costly and slow to build. And critically, with this pathway, the UK can still meet its CO_2 emissions reduction AND renewable energy targets.

33. Similarly a study[63] from the European Gas Advocacy Forum (a group of European gas companies)[64] supported by McKinsey, shows that the EU can meet its 2020 targets[65] and an 80% CO_2 emissions reduction in 2050 by adopting a pathway that maintains a strong place for gas in the energy mix. Compared to the pathway with 60% renewables by 2050 presented in the European Climate Foundation (ECF) Roadmap 2050 work,[66] the pathway with a stronger gas component would reduce investment costs by €450–550 billion in the period to 2030. This translates into a €150–250 saving per household per year and will help preserve Europe's economic competitiveness. In comparison, a 60% renewable pathway would have a direct impact on energy intensive industries in Europe, reducing their margins by 5–10% and putting 20–25 million jobs at risk. Adopting this optimised pathway leaves several technology options that can each deliver the 2050 reductions but does not lock Europe into reliance on a small set of costly technologies.

34. The major energy transformations that are required both in the UK and the rest of the Europe to meet both climate and energy security goals carry significant risks and uncertainties. A key way to mitigate these is to incorporate into the transition process the knowledge gained as sector learning curves develop and supply chains evolve. Growth in gas-fired power in the short to medium term enables a more measured transition to renewables and nuclear, allowing the optimisation of technology and driving down of cost. Some government

[62] Redpoint (2010)—"Gas future scenarios project". http://energynetworks.squarespace.com/storage/ena_publications/ena_gas_future_scenarios_report.pdf

[63] EGAF (2011)."Making the Green Journey Work : Optimised pathways to reach 2050 abatement targets with lower costs and improved feasibility".

[64] The European Gas Advocacy Forum (EGAF), is an industry group including Centrica, E.ON Ruhrgas, Eni, Gazprom Export, GDF SUEZ, Qatar Petroleum, Shell and Statoil.

[65] EU targets for 2020 are: 20% improvement in Energy Efficiency; 20% Renewables Contribution and 20% CO2 Emissions Reduction from 1990 levels.

[66] European Climate Foundation (ECF): "Roadmap 2050—A practical guide to a prosperous, low-carbon Europe". http://www.roadmap2050.eu/

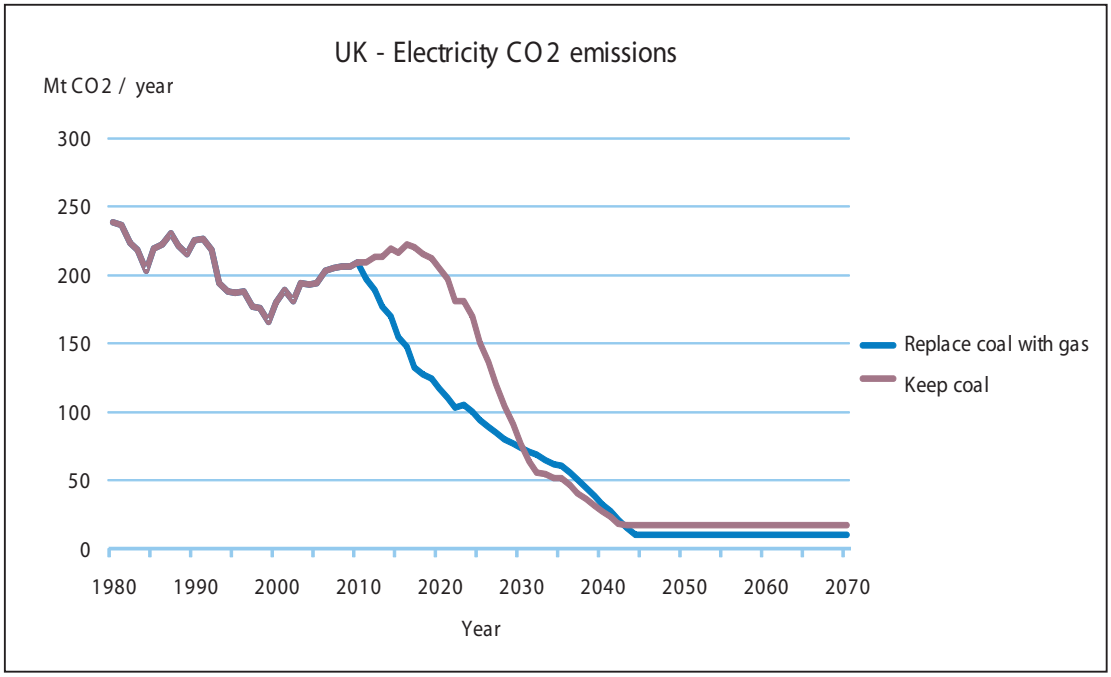
policies at present effectively "over-subsidise" renewables, involving very substantial investment in early generation wind turbines and solar panels well beyond the pace needed to provide an efficient learning curve for the sector. A more calibrated approach could deliver the same capacity in 10–20 years time at significantly lower cost and with increased reliability and efficiency.

35. Similarly, the supply side of renewable and nuclear sectors risks being overextended as supply chain may not be able to track the growth in demand sufficiently fast, leading to significant cost inflation. Slower build-up in demand would enable significant cost savings as more capacity would be provided later by a deeper, more efficient and lower cost supply chain.

36. One of the main challenges to the case for growth or maintenance of gas in the power generation mix is the perceived likelihood of "lock-in" of fossil fuel technology and their respective CO2 emissions, or the "stranded asset" problem—ie constructing plant which becomes redundant when more stringent CO2 regulation is implemented. Neither scenario need be the case. First, it is coal-fired power which is currently responsible for the fastest sector growth in CO2 emissions worldwide. Modern gas-fired plants emit between 50% and 70% less CO2 than coal plants per kilowatt hour of electricity generated. So replacing coal with natural gas is the surest, fastest and cheapest way to reduce CO2 emissions over the next ten vital years. For the UK, Shell analysis shows that, replacing existing coal with gas power plants would lead to a 24% cumulative reduction in UK CO2 emissions by 2050 (see Figure 3).

Figure 3

UK ELECTRICITY CO_2 EMISSIONS UNDER DIFFERENT SCENARIOS



Source: Shell internal analysis

37. Longer-term, gas power plants should and can be retrofitted with CCS which reduces emissions by 90%. CCS is technically established (all elements are well proven) but the market still has to see scaled-up demonstration and then widespread application. There is very little reason to doubt this is achievable by 2020 and, provided the appropriate regulatory framework is established, we should see large scale CCS take off by 2030. Mott Macdonald (2010) predicts that the premium for CCS versus unabated plants is £32–38/MWh, although the carbon penalty on the unabated coal and gas plants will be in the order of £40/MWh and £15/MWh, respectively (for projects started in 2009). In the longer term, as these technologies move to "n^{th} of a kind status" (or mature status), the levelised costs of CCS equipped plant are predicted to undercut those for unabated plant and CCS equipped plants will see levelised costs of £105–115/MWh with gas at the lower end, and coal at the upper end of the range.[67]

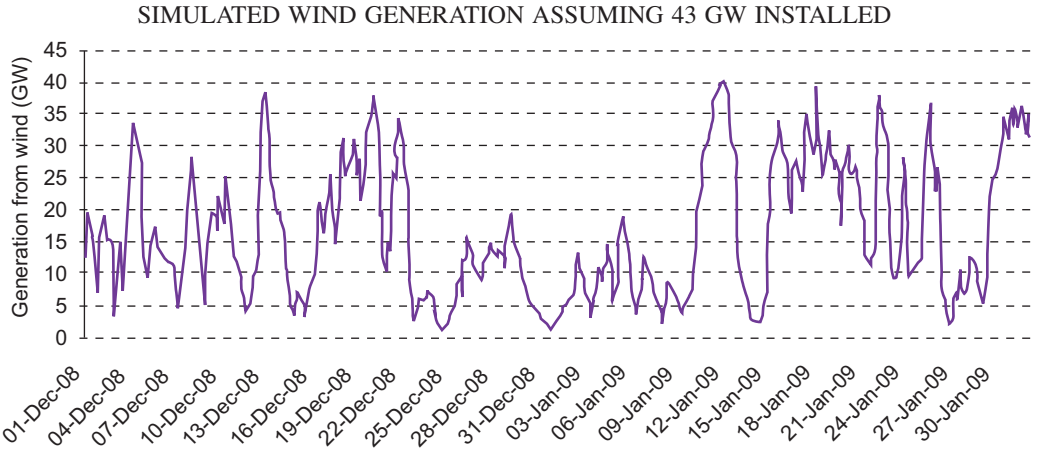
38. So over the long term, retrofitted gas CCS is cost-competitive with coal-CCS. Moreover, Shell estimates that at $60–120/tonne CO_2, retrofitting CCS to modern CCGT power stations will be very cost competitive with new wind and solar—even post 2030 after allowing for their respective learning curves. For example, it costs roughly three-and-a-half to five times as much to reduce CO_2 emissions through offshore wind—at $275–$400 per tonne. Even if gas prices more than doubled from today's levels, according to the Mott

[67] Assuming DECC's carbon price projection which sees EUA prices rising to £70/tonne by 2040, and CO2 transport and storage charge of about £6/tCO2e.

MacDonald report gas-CCS would still be cheaper than offshore wind (gas prices would have to be higher than $19/MMBtu for gas-CCS to be more expensive than offshore wind).

39. In addition to the ability to capture the emissions from gas-fired power stations through CCS, there is a vital long term role for gas in a low-carbon power sector as the natural complement to intermittent renewables which need back-up power. Figure 4 below simulates the variability of wind generation in the UK assuming 43 GW of wind capacity installed and real weather experienced in the winter of 2008–09. These facts clearly indicate the need for additional generation that can respond during the extended periods when the electricity output from wind decreases.

Figure 4



Source: Poyry Energy Consulting

Q7. *How exposed is the UK's energy security of supply to international events?*

40. The post-quake humanitarian emergency in Japan and current unrest in the Middle East and North Africa are stark reminders that the energy sector operates in a volatile world and the UK must be ready to respond to external events. But there are many factors which can help mitigate the impact on the supply of fossil fuels.

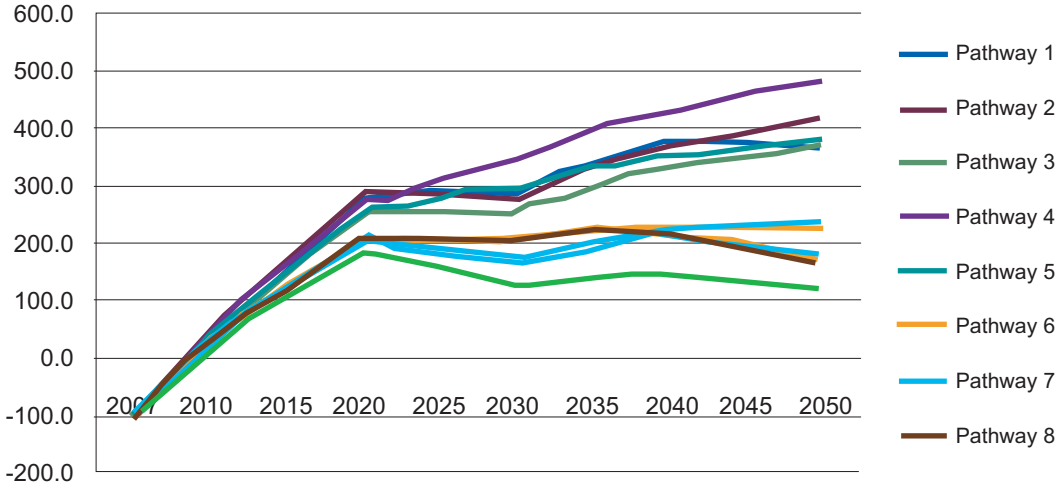
41. First, the growth in available gas resources—alongside continuing growth in global LNG production capacity—has radically changed the global gas market picture both in terms of supply security and diversity, and price outlook. The risks to the UK of negative gas market shocks are therefore much diminished given this additional global gas market resilience.

42. Second, oil is easily transported and stored. In addition there are many sources of supply. Therefore, in normal circumstances, physical security of supply should not be a problem because supply is likely to be available at market price. International cooperation and an efficient market would ensure that in times of disruptions spare production and refining capacity in the oil market is made available. A robust global supply chain alongside the appropriate use of stocks can help mitigate most supply disruption scenarios.

43. Even with a successful transition in the UK to a low carbon economy by 2050, we are still likely to be increasingly reliant on imports of oil and in some scenarios gas as well over this period. The new DECC 2050 Pathways show that for most scenarios there is a significant increase in oil imports in the period to 2020, and even out to 2050 there are numerous scenarios under which oil imports continue to grow (see Figure 5). Hence, under most credible scenarios the UK will always need to participate in global energy markets and is very unlikely to ever be energy independent. Energy interdependence is a key driver in international relations and energy security will benefit from greater dialogue and a mutual recognition of demand and supply interests.

Figure 5

ESTIMATED UK OIL IMPORTS UNDER DIFFERENT POSSIBLE PATHWAYS TO 2050



Source: DECC

Q8. *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*?

44. The UK's energy policy since market liberalisation has been very effective in delivering secure, affordable supplies and ensuring that the UK meets all its energy needs and broader energy sector objectives. There have been no interruptions to supplies in the recent past and the UK has enjoyed some of the most competitive energy prices in the EU.

45. However, it is clear that with interventions in the market already underway with the introduction of a carbon price floor and proposals in the Electricity Market Reform Consultation, UK policy is shifting away from the fully liberalised model. Within this context Shell believes the following key actions and considerations are needed to underpin the resilience of the UK's energy sector:

- Recognise the significance of oil and gas production within the UK for a secure energy supply and generate a stable and supportive environment for continued investments in oil and gas production and infrastructure (see further detail in Question 9 below).
- Encourage investments in producer and transit countries by making clear and consistent statements about the important and continued role for gas in the UK and European energy mix.
- Resolve planning issues for gas infrastructure such as pipelines, regasification terminals, underground storage and CCS.
- Focus on harmonised implementation and effectiveness of existing European legislation/regulation.
- Strengthen the incentives for low-carbon investment, through a robust carbon price and targeted support for early-stage, non-commercial technologies. But take account of the risk that substantial support to nuclear and offshore wind may reduce the attractiveness of, and thus crowd out, investment in gas-fired generation.
- Strengthen the EU ETS in a multilateral way as the best approach to meeting the UK and Europe's carbon targets and maintaining the market incentives to maintain secure supplies. We recommend that the Government urgently pursues two actions on the ETS with the EU and other Member States:
  - A balanced reduction of available credits from Phase III of the ETS.
  - Early action on Phase IV, including the announcement of a reserve price on auctions.
- For CCS, ensure the four-project UK demonstration programme is delivered through effective funding/financing and with greater clarity on the relationship with the mechanisms proposed to support low-carbon technology.
- Introduce some form of capacity mechanism that offers appropriate incentives to maintain capacity on the system to ensure security of electricity supply. Under the envisaged market structure described in the latest electricity market reform proposals, flexible peaking plant may not be sufficiently remunerated.
- For biofuels, support the introduction of mandatory sustainability criteria and encourage the adoption of international standards for sustainable sourcing.

Q9. *Are there any other issues relating to the security of the UK's energy supply that you think the Committee should be aware of*?

46. The UK's domestic oil and gas resources, even in decline, significantly contribute to greater energy security. Maximising remaining production must be a priority. The recent Budget increase to the Supplementary Charge on North Sea production could reduce future oil and gas production and increase the UK's reliance on imports. In order to mitigate the impact of this tax on investment a number of key issues must be addressed. These include:

Gas: 45% of the North Sea's output is gas, and current UK gas prices are an equivalent of about $60 a barrel—not much more than half of oil prices. Maximising recovery of the UK's indigenous gas supplies is vital not only for our energy security at a time of concern over reliability of gas imports, but also because availability of lower carbon gas to replace coal for power generation is the quickest, biggest and cheapest route to meeting the UK's carbon emission targets in the short term. The different status of, and particular threat to gas production by this rise in SCT should be addressed as a priority by the Government to ensure that investments in gas developments, in particular in "difficult" reservoirs, continue to be attractive.

Lost investment opportunity: The market for most of the industry supply chain is global, and a one-off shock in one jurisdiction at a time of higher oil prices will lead to resources (rigs, vessels, people etc) being redeployed in higher margin/more stable jurisdictions elsewhere. Moreover, the maturity of much of the infrastructure in the North Sea means that any hiatus in planned investment could hasten decommissioning of existing infrastructure. Much of the hitherto planned investment depends on this infrastructure, and will be irretrievably lost once decommissioning sets in.

Field allowances: Investment in some of these categories (Deepwater West of Shetland; Heavy Oil and High Pressure, High Temperature gas and liquids) was partly incentivised by allowances in the pre-Budget 2011 fiscal regime. These special field allowances are at risk of being undermined by the SCT rise and a review is required to ensure that new developments will still proceed.

Decommissioning: Despite the current joint government-industry process to resolve continuing uncertainty around decommissioning costs, the Budget also restricted decommissioning tax relief to the previous SCT rate of 20% alongside the SCT increase to 32%. This creates additional uncertainty on the relief for PRT fields.

Older PRT fields: These will also be hit particularly hard as the marginal tax rate increases to 81%. They are generally older, higher opex, lower unit margin fields requiring significant investments to maintain the facilities. Many of these fields have cessation of production dates looming, which may now be accelerated, bringing unnecessary loss of production and revenues.

April 2011

Supplementary memorandum submitted by Shell

This document contains information in answer to the supplementary questions received from the Energy and Climate Change Committee on 14 July 2011.

1. *In reply to Alan Whitehead's question about the proportion of oil stocks held by industry in other European countries (Q 316), Mr MacArthur's offered to send further information on this. The Committee would be very grateful if you could provide this information.*

Extensive information on industry stock levels is published by the International Energy Agency. They publish this information on their website which can be accessed at the following link: http://www.iea.org/netimports.asp

A copy of the information they publish is also attached at Annex A.

Information on Shell's oil stocks is commercially confidential.

2. *Shell's currently energy scenarios, Blueprints and Scramble, show very different paths for biofuel and gas development. Blueprints has more gas, while scramble has more biofuels. In your evidence, however, you advocated for both gas and biofuels. Would you please briefly explain the roles of gas, biofuels and other energy sources in the two scenarios, identify which scenario you would recommend that the UK pursue, and then explain how this is consistent with the position you took in your evidence?*

There are different projections/pathways for gas and biofuels in the two scenarios, Blueprints and Scramble.

Biofuels: Both scenarios see a large demand rise for road transport—both passenger and freight, but a major differentiator is the greater pace of development at scale of electric road transport (both battery electric and hydrogen) in Blueprints, lessening the pressure on liquid fuels demand. In Scramble, the internal combustion engine and hence liquid fuels remain predominant, so we see there a very strong biofuels development pathway. That said, there is still substantial biofuels growth under Blueprints, representing a global biofuels demand of 15 EJ/year in 2030 and 24 EJ/year in 2050, compared to around 3.7 EJ/year in 2010.

Gas: The development of unconventional gas is one of the most significant changes to the world energy outlook since the Shell Energy Scenarios were published in 2008. We are only now recognising the scale and impact of this, but the drivers that affect the use of gas between the two scenarios would still hold. Blueprints has the development of a meaningful CO_2-price mechanism (while Scramble does not), and other policies to drive the low carbon transition, which leads to more gas being chosen over coal. In our modelling, most of the extra gas in Blueprints is used in heat and industrial processes directly, rather than electricity generation. But we now believe that recent changes to the competitive position of gas versus coal in electricity generation is likely to lead to a strong and growing gas demand for electricity generation through the period to 2050 as well.

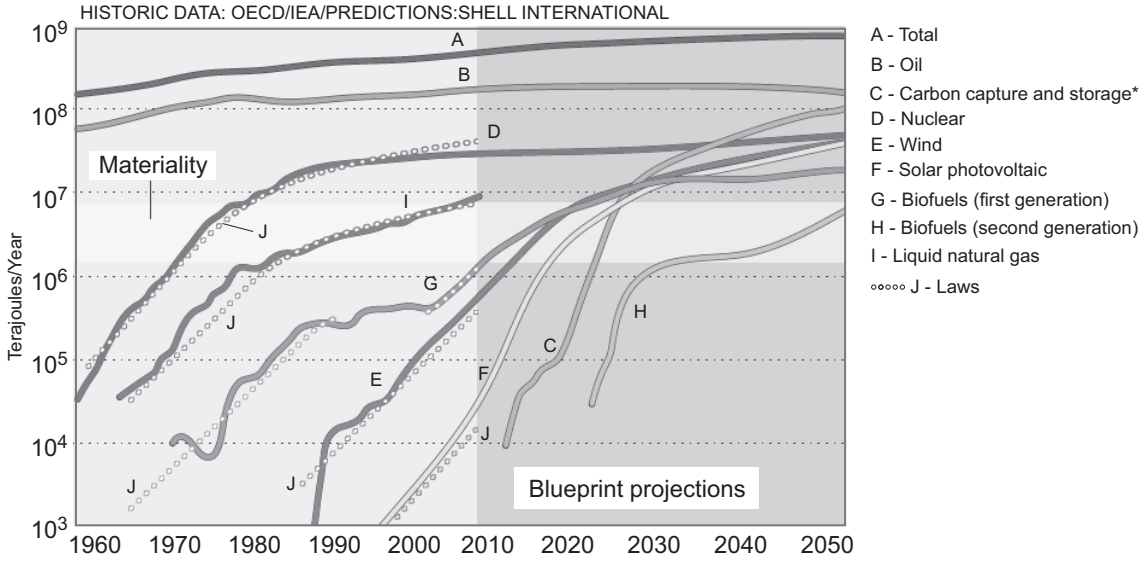
Shell's scenarios are not produced to advocate a particular vision, but rather to think through the development of plausible, consistent future alternative worlds that we think are useful for Shell and its partners to consider when developing strategies for the future. Our Scenarios are one way of challenging how robust our company's strategy is to different outcomes. Shell Scenarios could therefore also be used to test the robustness of UK energy policy to different future outcomes.

In reality, the pathway will be most likely a mixture of both scenarios. However, in our view, the Blueprint's outcomes offer the best hope for a sustainable future, whether or not they arise exactly in the way we describe. For the UK a Blueprint's scenario could deliver long term advantages, because a market driven CO_2 price will stimulate local innovation (supply response) and accelerate the required energy efficiency step-up (demand response).

3. *We have heard that Shell has done some interesting work on the possible future technological evolution of CCS and how CCS today compares to other new technologies at this stage in their development. Would you be able to share this work with the committee?*

Historically new energy technologies have taken decades to scale up. A paper published in Nature last year,[68] authored by two Shell experts, found that it takes around 30 years for a new energy technology to reach a 1–2% share of world energy demand (see graph below). Changing the energy system therefore takes time and there are many reasons for this. One of the crucial factors is the rate of scale up of industrial capacity. Our Blueprints scenario shows a strong deployment of CCS from 2020, which beats those historical deployment rates, underpinned by a scenario story of substantial movement on climate-actions including governments taking a market based approach, supporting low carbon energy technology through the demonstration phase and robust CO_2 pricing which supported moves towards a lower carbon economy.

ENERGY-TECHNOLOGY DEPLOYMENT



** Coal and natural gas used in electricity generation with carbon capture and storage*

We believe CCS could beat the historical "laws" for energy technologies because it is able to tap into existing industrial capacity and expertise from both the oil and gas and electricity industries. We have seen a similarly strong take-up in unconventional gas on this basis. Simply put, all the ingredients required for CCS are available to us today but the challenge is proving them in an integrated fashion and preparing them to scale up. However, there are indications now that for CCS this prospect could be at risk from insufficient public funding for pilot and demonstration programmes, delays in setting the regulatory framework and public acceptance issues. Shell remains convinced that CCS has great potential value as part of the CO_2 mitigation effort, a view shared by the IEA which has said without CCS the costs of dealing with climate change will be 70% higher, and policymakers should seek to address these challenges and overcome barriers.

[68] Gert Jan Kramer & Martin Haigh (2009). "No quick switch to low-carbon energy". Nature, Vol 462/3.

Costs relative to other low carbon technologies will also be a key factor in the pace of deployment of CCS. A report commissioned by DECC and carried out by Mott MacDonald indicated that the premium for CCS versus unabated plants is £32–38/MWh, although the carbon penalty on the unabated coal and gas plants will be in the order of £40/MWh and £15/MWh, respectively (for projects started in 2009). In the longer term, as these technologies move to "nth of a kind status" (or mature status), the levelised costs of CCS equipped plant are predicted to undercut those for unabated plant and CCS equipped plants will see levelised costs of £105–115/MWh with gas at the lower end, and coal at the upper end of the range.[69] Moreover, Shell estimates that at $60–120/tonne CO_2, retrofitting CCS to modern CCGT power stations will be very cost competitive with new wind and solar—even post 2030 after allowing for their respective learning curves. For example, it costs roughly three-and-a-half to five times as much to reduce CO_2 emissions through offshore wind—at $275–$400 per tonne.

4. *What level of gas storage do you think the UK should have and why hasn't the UK market delivered greater levels of storage to date?*

To date the UK has had low levels of storage relative to winter demand, in comparison with other large gas consuming countries in Europe, because the majority of the required supply flexibility to meet peaks in demand has been provided by indigenous (largely North Sea) production. However, indigenous gas production peaked early in the last decade and has been declining since at an average annual rate of 6.5%. The associated loss of supply means that more flexibility will have to be provided by other sources.

The UK already has around 4.6 bcm of underground gas storage and around another 1.2 bcm of cryogenic storage at LNG regasification terminals. According to the DECC reports, further projects are coming on stream and a number of new facilities are under construction, in addition to which the Aldbrough underground gas storage facility in Yorkshire has recently been expanded. DECC reports a further 15 or so proposed storage projects that together could quadruple current levels of GB gas storage capacity by 2020.[70]

Gas storage is not however the single answer to UK gas flexibility needs, nor is it always the most economic or profitable. Import infrastructure can provide significant additional flexibility to help the UK deal with swings in demand and supply.

UK gas import infrastructure has increased significantly in recent years in order to compensate for the declining supply and flexibility from the North Sea. There has been a 500% increase in gas import capacity since 2005, whilst total import capacity (equivalent to around 125% of annual gross demand) now has a deliverability of around 340 mcm per day and is sufficient to meet demand on a typical winter day alone, even in the absence of gas supplies from storage and the North Sea. The UK is therefore well placed to attract gas from a variety of sources and mitigate against the risk of supply disruptions.

Consultants Poyry published three reports in July last year examining the robustness of UK gas supply, looking in turn at domestic supply and policy, European supply and policy, and global LNG supply. By taking a scenario-led approach, they stress tested the UK gas supply infrastructure and concluded "*It is our opinion that the GB gas market will be sufficiently resilient to security of supply risks and able to withstand most foreseeable problems, and that no major changes to current policies are required*."

This concurs with the DECC Gas Supply Statement mentioned above which, also highlights that, *"Risks to gas security are very low up to 2020 and beyond. High annual demand projections can be met up to 2020 and beyond, by existing import capacity and projected supply from indigenous resources. 2020 peak demand can also be met by capacity that is existing or under construction. After 2020, planned infrastructure would provide sufficient capacity to supply the highest peak demand scenarios, even if only a minority of the planned projects succeeded in coming to market."*

In addition to flexibility on the supply side, the UK has additional flexibility on the demand-side as electricity generators and industrial and commercial customers can choose to reduce gas demand by responding to price signals or having interruptible contracts.

As a result of this combination of supply and demand flexibility the UK coped effectively with the simultaneous occurrence of a number of separate disruptions to gas supply and the second highest ever daily gas demand during winter 2010–11. National Grid's review of this period highlighted the increased flexibility from non storage supplies.

5. *Is the key driver behind gas storage economics the difference between summer and winter prices?*

Yes. For seasonal gas storage the key value driver comes from the ability to arbitrage between summer and winter gas prices, so called "intrinsic value". The summer-winter differential though is not fixed and varies over time, driven by a variety of factors. There is also the risk of negative realised (out turn) prices—where summer prices can be above winter gas prices.

[69] Assuming DECC's carbon price projection which sees EUA prices rising to £70/tonne by 2040, and CO2 transport and storage charge of about £6/tCO2e.

[70] Security of Gas Supply Statement, DECC, Apr 2010.

There is another value component in storage economics which derives from the ability to physically switch between injection and withdrawal at short notice to take advantage of market price developments; this is often referred to as "extrinsic value". For seasonal storage this component is often small compared to the intrinsic value. However, for storage that provides short term flexibility—for instance fast cycle salt cavern storage, the majority of the value will come from extrinsic rather than intrinsic value. This type of storage will become increasingly important as more and more intermittent wind generation comes on the system, by supplying gas at very short notice to the gas fired power stations which will provide the required back up electricity generation.

Another key factor for gas storage economics is the cost of "cushion gas", ie gas that always remains in the gas storage facility in order to maintain pressure. This can represent a large proportion of the capital expenditure of a new storage project, especially when gas prices are high, and have a major impact on the economics of a project. We therefore welcome the UK Government's decision in 2009 to allow storage site developers to claim tax relief under the capital allowance regime on cushion gas, helping with the overall costs of storage facilities.

6. *What role is there for Government in providing additional incentives or obligations to increase investment in gas storage?*

We believe the role of Government should be to provide an appropriate regulatory framework that facilitates investment in storage. Direct intervention by Government in the market risks crowding-out private sector investment in storage.

The action Government has taken to date to encourage the investment in storage includes considering ways to change the emergency cash-out mechanism. Under the current arrangements, the "emergency cash-out" arrangements are based on freezing system prices prevailing at the time that an emergency is declared and for the duration of that period. This may be below market prices elsewhere, limiting the effectiveness of price signals to attract more gas into Great Britain.

Hence, it has been suggested that unfreezing emergency cash-out prices will put a premium on stored and/or flexible gas, and thus an added incentive for investment in storage. It may be appropriate to consider such a proposal, which, by its very nature, centres on a one-off or infrequent event (we have yet to experience one) alongside a proposal to increase the differential between System Buy and System Sell prices in *normal* market operations. Depending on the availability and use of other sources of flexible gas, a combination of the two measures could have an enduring effect on forward prices and hence the incentives to invest in storage.

It is important to note however the certain subsequent increase in shippers' credit requirements, which would arise from such a change applying to normal market circumstances, could be prohibitive, so careful consideration needs to be given to the impact on competition.

In addition, there are aspects of the regulatory framework for storage that could be reassessed, namely the operation of the Negotiated Third Party Access (NTPA) regime. We welcome Ofgem pursuing such an approach as it effectively allows the market to determine tariffs—and therefore investment returns—and is a helpful mechanism to encourage investment in storage (and other infrastructure).

There are two further areas of the regulatory framework in relation to the associated process for applying for an exemption from having to offer third party access (the so-called TPA Exemptions regime), where policy could be reconsidered to help reduce investment risk:

- The nature of the competition test in assessing an exemption application—the regulatory authorities have suggested they will use a test that is effectively based on temporal considerations. If so, this may increase doubts regarding the enduring certainty of the application and this is unhelpful for long-term, lumpy investment; and
- The need for a storage developer to hold an Open Season (the period of time when shippers can bid for storage space) prior to an exemption application—such a requirement could result in a developer receiving bids from 3rd Parties that are either non-binding or reduce the amount of own use capacity (which may be required for a long-term contract underpinning the storage investment) or both.

July 2011

Annex A

CLOSING OIL STOCK LEVELS IN DAYS OF NET IMPORTS—INTERNATIONAL ENERGY AGENCY APRIL 2011

Countries	*TOTAL (1)*	*Industry (2)*	*Public (3)*	*Of which, held abroad (4)*	
				Industry	*Public*
Canada	net exporter	0	0	0	0
United States	159	87	72	0	0
Total IEA North America	159	87	72	—	—
Australia	82	82	0	0	0
Japan	173	78	95	0	0
Korea	197	99	98	0	0
New Zealand	93	90	3	0	3
Total IEA Asia Pacific	167	82	85	—	—
Austria	99	99	0	12	0
Belgium	119	57	61	9	33
Czech Republic	137	40	97	8	3
Denmark	net exporter	0	0	0	0
Finland	132	75	57	0	0
France	98	35	63	0	2
Germany	146	43	103	5	0
Greece	97	97	0	0	0
Hungary	166	63	103	0	0
Ireland	105	38	67	0	37
Italy	126	126	0	16	0
Luxembourg	91	91	0	82	0
Netherlands	176	98	78	0	54
Norway	net exporter	0	0	0	0
Poland	120	105	15	0	0
Portugal	112	77	34	3	12
Slovak Republic	142	59	83	0	0
Spain	106	64	41	1	0
Sweden	111	111	0	7	0
Switzerland	157	157	0	0	0
Turkey	104	104	0	0	0
United Kingdom	480	480	0	109	0
Total IEA Europe	127	81	47	—	—
Total IEA	180	107	73	—	—
Total IEA net importers	147	84	62	—	—

(1) IEA stock levels in days of previous year's net imports using IEA methodology. Total may not equal sum of Industry and Public due to rounding.

(2) The portion of total days of net imports covered by industry stocks. This includes stocks held for commercial and operational purposes as well as stocks held by industry to meet minimum national stockholding requirements (including stocks held for this purpose in other countries under bilateral agreements).

(3) The portion of total days of net imports covered by government-owned stocks and stockholding organisation stocks held for emergency purposes (including stocks held in other countries under bilateral agreements).

(4) The portion of a country's Total stocks which are held in another country under a bilateral agreement. In specific instances, member countries can count stocks held in the territory of other countries as part of their stocks to fulfil their minimum IEA stockholding requirements (see explanation on stocks held abroad). Sometimes these stocks are indeed owned by the entities having the stockholding obligation; in other cases these stockholding amounts are in the form of tickets (see explanation on tickets).

Days of net imports for regional totals include IEA net importers only.

Supplementary memorandum submitted by Jonathan Stern

1. *You mentioned that we came close to a gas security incident earlier this year through a "constellation of unusual events". Would you be able to provide more information about what this problem was and how it was averted?*

At the beginning of January 2011, after the coldest October to December period in 30 years (and since records began in some parts of the country), Table 1 shows that UK long range storage levels were 44% and 37% below corresponding levels on that date in 2010 and 2009 respectively; medium range storage levels were

37% and 29% below.[71] These levels were historical low points for a country where the coldest winter months—where storage is generally most heavily used—are January-March. Table 1 shows that had storage withdrawal patterns during these months followed the trend of 2010 (when the weather during this period was very cold) long and medium range storage would have been exhausted before the beginning of March, increasing the likelihood of significant price spikes and possible customer interruptions.

These low storage levels were accompanied by a series of unconnected events with the potential to impact supplies:

— On 18 January, the Brent field, which accounts for a few percent of UK gas production, shut down following an accident.

— On 27 January, the Norwegian Troll field—the largest gas field in the North Sea experienced some technical problems and flows to the UK through the Langeled pipeline dropped to 11% of the previous day's level.

— On 8 February, workers at five service companies at the Suez Canal went on indefinite strike. This threatened the passage of LNG tankers through the Canal which could have extended the period of time needed to reach the UK by a number of days.

— Anecdotal evidence around this period suggested that companies were experiencing some problems with the ballasting of LNG supplies (ie the modifying the quality of imported LNG to make it compatible with pipeline gas specifications).

In the event, none of the anticipated events materialised. In 2011, the period January-April was 45% warmer than average and Table 1 shows that both long and medium range storage began to refill during March and ended the winter (on April 1) at significantly higher levels than in 2010. The Brent field, Troll field and any LNG ballasting problems resolved themselves relatively rapidly, and the Suez Canal strike had no impact on LNG supplies. However, had even a few of these events turned out differently—for example a continuation of very cold weather combined with a shortfall of Norwegian supplies[72]—this would, at a minimum have increased prices significantly, and extreme conditions could have caused a security problem.

Table 1

GAS IN LONG, MEDIUM AND RANGE STORAGES IN THE UK, JANUARY–APRIL 2006–11
(CLOSING STOCK LEVELS ON THE FIRST DAY OF EACH MONTH GWH)

LONG RANGE STORAGE

	*2006**	*2007*	*2008*	*2009*	*2010*	*2011*
January	28,415	32,188	26,659	27,730	31,339	17,435
February	21,494	27,625	19,422	14,371	17,656	12,345
March	18,449	21,936	11,488	8,591	8,020	9,968
April	18,446	20,904	8,059	11,263	4,767	11,442

** note that the Rough accident in early February meant that no gas could be withdrawn for the rest of the winter.*

MEDIUM RANGE STORAGE

	2006	*2007*	*2008*	*2009*	*2010*	*2011*
January	5,109	7,708	7,657	7,032	7,920	5,015
February	4,925	7,421	6,757	3,870	4,628	3,764
March	4,008	5,562	4,959	4,289	2,468	2,790
April	3,061	4,353	4,694	4,775	2,925	4,763

SHORT RANGE STORAGE

	2006	*2007*	*2008*	*2009*	*2010*	*2011*
January	1,677	1,574	1,864	1,864	1,251	463
February	1,671	1,620	1,796	735	719	452
March	1,467	1,600	1,326	615	715	433
April	417	1,526	1,197	571	608	425

Source: Operational data from National Grid storage websit
http://www.nationalgrid.com/uk/Gas/Data/storage/
http://marketinformation.natgrid.co.uk/gas/DataItemExplorer.aspx

[71] Short range storage levels were 63% and 75% below but this is an overstatement because some medium range storage had been closed during 2010.

[72] Both these conditions actually happened in January-February 2010 but the winter up to mid-December had been relatively mild. Jonathan Stern "Gas Storage: a Case of Market Failure", in eds Ian Rutledge and Philip Wright, *UK Energy Policy and the End of Market Fundamentalism*, OUP/OIES, 2011, pp. 129–164.

2. *You suggested that the Government might need to look at placing obligations (such as public service obligations) on companies to supply gas in certain circumstances in order to boost the UK's amount of gas storage. Would you be able to give a quick assessment of how the costs of such an approach might compare with the costs of energy security incidents in the UK (eg the Rough fire)?*

My comment referred to potential obligations which would ensure that suppliers could cover the needs of their customers in the event of unforeseen events which might deprive them of expected or contracted supplies, or increase the volume of gas which might be required to maintain their deliveries to customers. Obligations could be placed on suppliers to ensure sufficient contracted storage, either in the UK or continental Europe (the potential problem with Continental European storage being that problems with the IUK or BBL pipelines could disconnect UK suppliers from those storages).

It is difficult to compare the costs of such an approach with the costs of energy security incidents. Research shortly to be published by the OIES Gas Research Programme uses an estimate of £1.8 billion as the capital cost plus cushion gas of creating offshore (depleted gas field) storage with a working gas capacity of 3.3 Bcm.[73] This could suggest that the cost of creating an additional 5 Bcm of storage capacity—which would bring UK gas storage up to around 10 Bcm in total, which could be considered the minimum level necessary for a market with a demand of 90–100 Bcm/year—would be of the order of £3 billion.[74]

I have summarised the cost of gas security incidents which have occurred over the past few years as follows:

> "The [16 February–5 June 2006] Rough fire was the UK's most serious gas security incident, and with different timing or different weather conditions, could have had very severe consequences for consumers. The [July 2–4 September 2007] CATS pipeline interruption was far less serious. The price consequences for UK consumers are difficult to calculate, but Rough could have been responsible for raising NBP prices by as much as 50 pence/therm or more for a period of a few days in March 2006, and in the range of 10–30 pence over the entire four month outage; while the corresponding figure for CATS was probably closer to 5–10 pence/therm over a two month period."[75]

I have estimated the total consumption of gas over the relevant periods from the government statistical publication *Energy Trends*, and made some *pro-rata* adjustments to the quarterly data to fit the time frame of the Rough and CATS incidents. I have then taken a mid-point of my estimates of the price increases caused by these incidents ie 20p/therm for Rough and 7.5p/therm for CATS. The resulting calculation shows that, in total, the additional cost to British gas consumers as a result of insufficient gas in storage being available to moderate the price spikes caused by the Rough outage was of the order of £1.5 billion, and of the CATS outage was £133 million.

I stress that these are very rough estimates resulting from a quick assessment which assumes that NBP price increases were fully passed through to customers. This is more likely to be correct for industrial customers than domestic consumers (40–50% of total consumption during the CATS outage and 50–60% during the Rough outage) for whom wholesale prices are less immediately relevant. I have not carried out an exercise to determine whether subsequent increases in residential gas prices reflected the increases in NBP values estimated above. Also the volumes have been estimated from quarterly, rather than daily, demand data which means they are less accurate than would be desirable.

July 2011

Supplementary memorandum submitted by International Energy Agency

1. *At an international level, what are the biggest political and physical security challenges to UK energy supplies ie which types of international events pose the greatest threat to UK energy security?*

Given where the UK is sourcing its gas from, I think the biggest worry would be anything affecting global LNG trade, in particular Qatar and its possibility to export LNG. LNG capacity from the Middle East represents 37% of total LNG capacity and LNG capacity from North Africa 12%. There are two types of issues here: issues in the producing countries and issues regarding the transport routes. Regarding the first one, unrest in MENA countries is a concern, although so far only Libya has seen its exports being stopped and this is less than one bcm (300 bcm were traded in 2010). Despite the tensions, LNG exports from Yemen have not been affected so far. Egypt's LNG exports were not as well (but the pipeline to Israel/Jordan was blown yesterday for the fourth time in 5 months).

Regarding export routes, there are two main points for the UK: Hormuz and the Suez Canal. Through Hormuz goes LNG from Qatar and Abu Dhabi LNG, or 30% of total LNG liquefaction capacity. Qatar alone represents 28% of total LNG liquefaction capacity (or 105 bcm out of 373 bcm) and exports half to Asia and half to Europe (as of 2010, this may change with the recent events in Japan and the fact that LNG supplies

[73] Howard Rogers, *The Impact of Import Dependence and Wind Generation on UK Gas Demand and Security of Supply to 2025*, OIES (forthcoming 2011). Estimates are highly dependent on the cost of the cushion gas (which needs to be purchased at market prices) which in this example accounts for £1.040 billion with the capital cost of the storage at £804 million.

[74] Onshore gas storage capacity would be cheaper but there are fewer suitable sites of any significant size. Rogers shows that the need for gas supplies to respond quickly to intermittent renewable power sources will alone require more than 1 Bcm of additional fast-response gas storage.

[75] Stern, loc.cit.

from Qatar will increase further in 2011 as new plants recently started). Disruption from Qatar would have global implications, because Japan and Korea would need to replace that LNG by other LNG supplies or turn to expensive oil or possibly coal. Most of Indian LNG imports come from Qatar, having no pipeline connection they would have to try to find other sources of LNG or switch to naphta in the industry or other fuels in the power sector (which is difficult, so that may create greater power shortages). European countries could possibly turn to additional pipeline gas from Russia, Norway, the Netherlands and Algeria, Russia being likely to be the main provider. For the UK, that would mean getting more gas from Norway and from the Continent through BBL and the IUK. Given the stress under which the LNG markets would be, prices would be very high so that demand destruction/switching to other fuels will likely contribute to reduce global gas demand overall.

Through the Suez Canal goes most of the ME LNG targeting the European gas markets, essentially half of Qatar's LNG exports in 2010. The alternative would be to go through the longer route around Africa. The result would be an increase of international spot prices due to longer routes and tightness in the shipping market. It is likely that this would lead to switching to other fuels such as coal in the power sector.

Piracy could also be an issue, but unless it happens at the two points mentioned above, it would have an effect on some cargoes, not threatened supplies from a region. It would require to take longer routes and therefore increase the transport prices.

Regarding the disruption of Russian gas, although no Russian gas really comes to the UK, it would have an indirect impact because Europe would be trying to get additional supplies through the UK, and maybe limit exports from the Continent to the UK. Another effect observed in January 2009 was a more rapid stock draw in the UK.

The timing of the disruption is crucial; it makes a lot of difference on whether it happens during winter, summer, beginning of the injection period when storage are empty. Another cirsis example could be a couple of weeks of cold, windless weather (it can happen as far as I know), meaning that CCGTs try to substitute wind and put an additional pressure on an already strained gas system.

2. *What should the UK Government be doing to address these concerns?*

- Prepare emergency scenarios involving gas and power sectors.
- Work in collaboration with other European countries.
- Encourage better transparency of gas data, notably on LNG (very little timely data on exports).
- Enhance storage capacity.

3. *What alternatives are there to Nabucco to address the energy security concerns of Central and Eastern Europe?*

- *Could these concerns be addressed by building more (and more flexible) interconnections between Western and Eastern Europe?*
- *If so, would this be cheaper and less politically contentious than Nabucco?*

Nabucco is one of the many south Corridor pipelines proposed so far. There are others, such as ITGI and TAP. One of the key differences is that Nabucco is bigger (25–31 bcm) than the other pipelines proposed (12 and 10 bcm) and targets Central Europe/Austria. The others are smaller but target Italy. TAP is less advanced in terms of getting all the transit agreements ready.

The key for all these projects is to get Azeri gas from Shah Deniz 2, which should start flowing by 2017. From the 16 bcm, 6 bcm would go to Turkey and 10 bcm to Europe. Nabucco would need additional gas, from Iraq, Turkmenistan, which is less advanced.

One can add that there is also potential for more interconnections with Nord Africa, but where these interconnections go is crucial. For example the new pipeline Medgaz to Spain provides more gas to Iberia (which does not really need it) but there is limited interconnection with France so the gas is stranded there.

More interconnections between Western and Central Europe are necessary to enhance security of supply but do not create additional gas sources, unless the aim is to import more LNG and then ship it to Central Europe.

July 2011

Supplementary memorandum submitted by Dr Neil Strachan

Following oral evidence given on 24 May 2011, The Energy and Climate Change Committee have requested additional comments on the three questions below, related to their inquiry on *The UK's Energy Supply: Security or Independence.*

1. *In relation to the Chair's question on what key risks we should consider in assessing energy security, would you be able to provide some more information on UKERC's recent "Energy 2050" report, in particular how you decided what security risks to assess and what the headline results of your analysis were?*

The UKERC Energy 2050 project has been published in book form.[76] The summary report and supporting papers are available online.[77]

In relation to energy security, the most relevant chapters are: 6; A resilient energy system, and 12; UK energy in an uncertain world.

In Chapter 6 focused on energy infrastructures (especially electricity and natural gas) and undertook a review of historic shocks and disturbances to these key infrastructures. From this a set of quantitative resilience indicators were derived and applied to a combined modelling study using the combined gas and electricity network (CGEN) model, and the energy systems MARKAL model. These indicators were both a macro systems level as well as specific shocks. A key finding is that high level resilience goals are much more expensive that specific policies to guarantee supply or insure against infrastructure loss. On an annual cost basis (in £2010), by 2025 reinforcing gas infrastructure could cost £45 million (£2 per household), while ensuring electricity reliability could cost £300 million (£10–15 per household). However a broader response involving energy service demand reduction and diversity in primary energy and electricity supply could cost up to an annual £16 billion.

Chapter 12 recognised that the UK is dependent on a range of global driver (the UK's economy is currently only around 3.5% of GDP and relatively falling as developing countries grow faster), so the UK is unable to substantially influence a range of key drivers. This study focused on three key global drivers, as identified in past international collaborations[78] (eg, the Low Carbon society project:). These drivers were the fossil fuel prices (oil, natural gas, coal), availability and cost of international CO_2 emission credits, availability and cost of sustainable biomass imports. Uncertainties surrounding all these drivers are very substantial. In scenarios using the MARKAL energy systems model, these drivers were investigated in conjunction with meeting long-term—80% CO_2 reduction targets. International drivers have profound interacting effecting on the future energy systems and by 2050 can give a difference in costs of meeting decarbonisation goals of a factor of two—from £26 billion to £58 billion in 2050. However by imposing the high level resilience constraints as discussed in chapter 6 considerably lessened the impacts of international energy uncertainties. This is as energy demand reductions are a robust element in reducing energy resilience and security costs.

2. *In terms of overall resilience of the UK's energy system, what do you see as being the biggest weaknesses?*

This is a very difficult question to answer given the scope of the UK's energy system, and consideration of the near- vs. long-term. As discussed in UKERC's Energy 2050 project there are specific issues concerning strengthening existing electricity and gas infrastructures. However in the longer term, given the profound uncertainties in the evolution/revolution of the energy system and the price paths of alternate technologies, emissions markets and resources, a robust element to improve energy resilience is in the reduction in energy service demands. To do this is a highly complex issue, with prices playing a role along with other government policy options including innovation, information and measures to challenge ingrained social norms.

3. *You suggested that in future, dependence on biomass imports could represent a new threat to energy security. Please could you provide a bit more information on this? For example, how big a threat might it be compared to the current risks associated with fossil fuel use?*

The availability and costs of biomass imports into the UK are a source of profound uncertainty, quite likely more uncertain than future imports of fossil fuels. Biomass is a key option for decarbonisation of the UK energy system as it can be applied to produce electricity, heat buildings and power vehicles. The UK's limited land-use means however that domestic biomass will not be able to meet the majority of the UK's energy demand. Estimating UK biomass potential is extremely difficult with current major efforts underway by UKERC, CCC and DECC amongst others. But in a recent review of existing studies,[79] long term (post 2030) biomass primary energy potential in the UK may be between 400—1,100PJ. This compares to current (2008) biomass primary energy of 118PJ. As current (2010) UK primary energy demand is around 6,600PJ,[80]

[76] Skea J, Ekins P, and Winskel M (2011), *Energy 2050: Making the Transition to a Secure Low-Carbon Energy System*, Earthscan.

[77] http://www.ukerc.ac.uk/support/tiki-index.php?page=Energy+2050+Overview&structure=Energy+2050+Overview

[78] Strachan, N, T Foxon, Fujino, J, (2008), *Policy implications from the Low-Carbon Society (LCS) modelling project*, Climate Policy 8(1): 17–29.

[79] Slade R, Bauen A (2010), *The UK bio-energy resource base to 2050: estimates, assumptions, and uncertainties*, UKERC Working Paper, UKERC/WP/TPA/2010/002.

[80] DECC (2011), *Digest of UK Energy Statistics (DUKES),* Department of Energy and Climate Change, London.

therefore UK sources could at best meet around 10% of UK primary energy demand. Global biomass potentials are much higher, although highly uncertain. One oft referenced estimate[81] suggests a long-term global supply of up to 1,100EJ (1,100,000PJ). However the actual resource and how much of this the UK is allocated is very uncertain. This is because biomass imports depend not only on land prices and the structure of supply markets, but also on the competing demands for rising food production and the potential requirement by major developing countries for biomass resources for their own energy supply. Some studies have suggested that in the future major developing countries may be a net importer of biomass.[82] In terms of implication for the UK, recent modelling work carried out for the CCC's 4th budget report using a stochastic version of the UK MARKAL model,[83] indicates that if the UK's expected sustainable biomass imports tuned out to be unavailable, then the UK would *not* be able to meet its stringent long-term decarbonisation targets.

July 2011

Supplementary memorandum submitted by Katinka Barysch

What alternatives are there to Nabucco to address the energy security concerns of Central and Eastern Europe?

- *could these concerns be addressed by building more (and more flexible) interconnections between Western and Eastern Europe?*
- *if so, would this be cheaper and less politically contentious than Nabucco?*

In principle, the energy security of the CEE could be equally enhanced by linking them to the large Central European gas networks (Germany/Austria/Italy) which would allow them to ship in gas coming from the Dutch fields, the North Sea, Russia via Nord Stream, the British LNG terminals as well as Northern Africa via Italy/Spain/France. As the 2009 gas crisis showed, there are some interconnectors already that allowed gas to flow from west to east in an emergency situation. But it was nowhere near enough.

The European Commission is currently pushing EU member-states to enhance both their infrastructure and their preparedness to emergency situations (through storage etc). Progress is slow and piecemeal and I am not sure it will be sufficient to considerably enhance CEE energy security.

The construction of new west-east pipelines might well be cheaper than building Nabucco. But the CEE gas markets are probably too small to make the construction of such a pipeline infrastructure viable (since they can so easily be supplied through existing pipelines through Ukraine). Nabucco would target not only the CEE but also the main European markets via Baumgarten so has completely different economics. But the main point about Nabucco is that it could give the EU access to a completely new source of gas which has much bigger benefits in terms of energy security (and geo-politics since we profess to take an interest in the stability of the Caspian and Central Asia) than any west-east pipeline.

July 2011

Supplementary memorandum submitted by Peter Kaznacheev, Managing Partner of Khaznah Strategies Ltd

Following the Evidence Session which was held by the Energy and Climate Change Committee of the House of Commons on 5 July 2011, I would like to submit the following answers to questions that were raised. In this brief overview I tried to summarize my responses during the Session as well as address those questions which were not covered in the allocated time.

Three revolutions in global energy. The latest World Energy Outlook published by the International Energy (IEA) in June 2011 is referring to the current era as the "golden age of gas". Over the recent years, the world has benefited from two major technological breakthroughs, and one more is just in the making. All three of them are revolutionizing the production and transportation of gas.

Liquefied natural gas. The first one is the growth of LNG production which has allowed to detach gas transportation from pipelines and consequentially ignited the process of delinking gas prices from oil prices. According to the IEA, trade in LNG between major regions will double to over 1 tcm by 2035 and overall gas liquefaction capacity will increase by 40%. Regasification capacity is expected to increase even faster.

Shale gas. The second one is the shale gas revolution which turned the US from an importer to an exporter of gas and is leading to the emergence of new and unexpected centers of gas production. Shale gas reserves are very large and widely distributed: US, China, Europe, Latin America, the Middle East etc. Other unconventional resources will play a role too: in Australia coal-bed methane is already being liquefied and exported to China.

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[81] Hoogwijk, M, Faaij, A, Van Den Broeka, R, Berndes, G, Gielen D, and Turkenburg W. (2003) *Exploration of the ranges of the global potential of biomass for energy*, Biomass and Bioenergy, 25, 119–133.

[82] Bataille M, Tu J, Jaccaard M (2008), *Permit sellers, permit buyers: China and Canada's roles in a global low-carbon society*, Climate Policy 8(1): 93–107.

[83] Usher W, Strachan N (2010), *UK MARKAL Modelling—Examining Decarbonisation Pathways in the 2020s on the Way to Meeting the 2050 Emissions Target*, Chapter 3: Supporting research for the Fourth Carbon Budget report, Committee on Climate Change, London.

Arctic gas. And the third revolution in hydrocarbon production is just starting. According to Wood Mackenzie, the Arctic's combined gas potential represents 29% of global gas resources, three quarters of which are in the Russian territory. The Russian Kara Sea alone accounts for 45 billion boe of yet-to-find oil and gas. For context, Wood Mackenzie estimates yet-to-find volumes in Brazil's Santos Basin—currently the world's hottest exploration play—at around 32 billion boe.

The "gasification" of global energy. All three breakthroughs are not simply influencing hydrocarbon production but redefining the entire energy landscape. The IEA predicts that by 2035 gas will cover one quarter of global energy demand. In Europe the trend of "gasification" is much more significant: gas already covers 40% of energy needs and over the next two decades its share may raise up to 90%. Given the leap in gas reserves due to the shale gas revolution (and the development of the Arctic in the future) and the increased flexibility of gas markets due to LNG, the prevalence of gas in the European energy mix increases the overall energy security of Europe. For those policy-makers concerned with reducing CO2 emissions, the "gasification" of Europe has the extra benefit of reducing the carbon-intensity of energy at no extra cost.

UK energy interests. The UK's energy landscape appears to be even more secure than that of Europe in general. On top of all the positive developments described above which make global energy more secure, more diverse and more affordable, the UK benefits from two major characteristics of its energy market. First of all, it has significant (by Western standards) remaining indigenous hydrocarbon resources. Over 80% of UK gas demand is met by domestic production. This makes the UK market less dependant on imports and more secure in terms of physical supply. Secondly, unlike most other European countries, the UK does not depend on long-term contracts as it has a developed gas market where prices are set by competing producers and consumers—not bilateral negotiations which is still mostly the case in continental Europe. In addition, the UK has a developed infrastructure of LNG terminals (in South Wales, Kent, Essex and Middlesbrough) which is expected to grow and therefore increase overall market flexibility by allowing to switch suppliers or change their shares of imported gas.

Policy implications of "gasification" for the UK. All in all, from that point of view energy supply the UK is in a very strong position. There are no major energy-related issues which would potentially undermine the country's security. Realistically, major disruptions of imported hydrocarbons are very unlikely. The main issue of concern for the UK appears to be the future price of each source of energy. Given the global dynamic described above, it is expected that gas will become even cheaper relative to oil as new gas reserves (unconventional and then Arctic) will come on stream. A major shift to gas as an alternative to other fossil fuels would therefore benefit the UK economy. Such a shift is already taking place and should be welcome by policy-makers. The only policy suggestion which could further strengthen UK's position would be to moderately invest in some additional gas storage capacity. That may help to mitigate potential short-term price hikes and also further secure physical supply.

Eastern Europe's energy situation. Like the rest of Europe, Eastern Europe will generally benefit from the emergence of new major sources of gas, as the increased supply is pushing the price down. The key difference between Eastern Europe and the rest of the continent is the former's strong reliance on imported gas from Russia. Bilateral long-term contracts between Gazprom and respective companies in Eastern Europe are mostly pegged to oil prices which means that as global gas prices continue to decrease relative to oil, Eastern Europe and all other major Gazprom customers will be paying a higher price. This is the major risk that Eastern Europe faces as risks of physical shortages or supply disruptions are minimal. Europe continues to be Gazprom's only external gas market and therefore any major disruptions in supply would seriously harm Russia's position. The two short episodes of the "gas war" between Russia and Ukraine are highly unlikely to repeat again.

Price risks mitigation. The real price risk could be mitigated by two key policies. First, European countries should continue to insist on the price peg to the gas spot price instead of oil in Gazprom's contracts. On average, about 15% of the price formula is already tied to spot prices. If Gazprom's customers manage to increase this share or replace the oil peg altogether that will be a major improvement for European consumers.

Gas interconnectors. The other major step forward is to build interconnectors (short and relatively inexpensive pipelines), which could bring gas from LNG regas terminals and various sources other than Gazprom's gas, into the pipeline system of Central and Eastern Europe. Projects such as ITGI and TAP are capable to achieve exactly that. Other projects, such as Nabucco or South Stream which were designed in the era before the "three gas revolutions", are not relevant and hardly affordable. Both of them continue to enjoy some support for purely political reasons (from European and Russian politicians respectively). Neither of them appears to be commercial and Nabucco is almost certainly out of the question as it does not have a major sponsor.

Russia's overreliance on the European market. Overall, Russia's position appears to be less secure than that of her customers. European countries have various sources of gas, and those which still mostly rely on Russia are likely to diversify fairly easily. Russia, to the contrary, depends on its only external customer—Europe. Overreliance on the European market turned out to be a short-sighted policy as the fastest growing gas importers are not in the West but in the East. Current infrastructure is designed to serve the European market and the gas pipeline from Russia to China is only at the earliest stages of development.

Russia's challenges. Even more importantly, Gazprom is visibly lagging in LNG which is expected to become the major means of gas transportation. In addition, despite the largest gas resources in the world, gas

production in Russia is stagnant, as Gazprom has not sufficiently invested in the development of major deposits or is far behind schedule (Stockman, Yamal, Kovykta etc). And on top of that, as a the number one exporter of gas Russia is very concerned about the gradual gas price delinking from oil. All of that is a major challenge to Russia and its future economic development. However, it is unlikely to pose any major risk to Europe as Russia will continue to depend on the European market and therefore would not jeopardize its export obligations. In brief, Russia's economic dependence on Europe is greater than Europe's dependence on Russia.

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