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 following members were also members of the committee during the parliament:

Gemma Doyle MP (Labour/Co-operative, West Dunbartonshire)
Tom Greatrex MP (Labour, Rutherglen and Hamilton West)

Powers

The committee is one of the departmental select committees, the powers of which are set out in House of Commons Standing Orders, principally in SO No 152. These are available on the Internet via www.parliament.uk.

Publication

The Reports and evidence of the Committee are published by The Stationery Office by Order of the House. All publications of the Committee (including press notices) are on the internet at www.parliament.uk/parliament.uk/ecc.

The Reports 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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Memorandum submitted by Calor Gas Ltd

EXECUTIVE SUMMARY

1. Most attention historically in relation to security of supply has been given to interruptions of supply from third parties. Infrastructure delivery and affordability are just as important in securing our supplies.

2. In relation to both LPG and natural gas, there is no reason to fear interruptions of supply from third parties.

3. The threats, however, to infrastructure delivery are very real. Far from renewables being “crowded out by gas” they are simply underperforming despite heavy subsidies from the taxpayer. The 2010 renewables target cannot be reached.

4. The commonly accepted figure needed for investment in energy of £200 billion was calculated before the pure electricity play mooted in the Revised National Policy Statements on Energy (NPS) envisaged the need for doubling or tripling electricity generation. This has not been costed.

5. The major reliance put by NPS on wind power makes electricity unnecessarily expensive because it needs back-up by standby unabated fossil fuel capacity equivalent to some 80% of the installed wind capacity, and because the projected costs/MWh of offshore wind are roughly double those of onshore wind. Taxpayer subsidy to wind is on a trend rising to £5bn a year and for offshore wind definitely does not represent value for money.

6. Nearly a fifth of all households in England, over a quarter of those in Wales, nearly a third in Scotland and over a third in Northern Ireland are in fuel poverty. The figures have been going significantly in the wrong direction for years despite large sums of Government money being invested in energy efficiency in vulnerable households. OFGEM expects a 60% rise in energy prices and a 50% rise in fuel poverty to cover 6 million households. An energy policy that threatens to consign a large proportion of the population to fuel poverty is in effect stripping that group of consumers of security of supply.

7. The pure electric play favoured by NPS is far more costly than one which envisages a continued contribution from gas—the all electric “solution” to decarbonisation over the period 2010 to 2050 would cost £700 billion more than a “Green Gas” solution—that is equivalent to £20,000 per household or £10,000 per person. Green Gas would continue to enjoy the benefits of sunk costs in the gas main.

8. Domestic heat does not all have to come from expensive electricity, wastefully centrally generated by unabated gas: it can be generated by gas within the home using high efficiency (80–90%) fuel cell boilers—potentially by biomethane in urban areas, and biopropane in rural areas.

9. Distributed generation would help avoid the necessity for having expensive unabated fossil fuel generated at distance to generate 20% of our peak electricity needs for but 31 days in a year.

10. Distributed generation could be part of a low cost, low carbon solution. It will lower household fuel bills by some 25%, and could be an effective antidote to fuel poverty and avoid the insecurity of supply implicit in energy supplies driven to unaffordable levels.

What is Security of Supply?

Security of supply is not simply about ensuring the sourcing of the fuels necessary to keep the economy going and keep our homes lit, warm and functional. If the infrastructure necessary to deliver the quantum of generation we will need in future decades is lacking, or if power becomes so expensive to pay for that industry is exported abroad and our homes go unlit or unheated then that is a crisis of security of supply just as severe as interference with imports of fuels or power from abroad. To ensure security of supply we must give due consideration then to:

— Potential interruptions of supply from third parties.
— Infrastructure delivery.
— Affordability.

We believe insufficient attention has been devoted to the two last factors.

Is Gas Under Threat from Third Parties?

Calor Gas is currently a one product company distributing Liquefied Petroleum Gas (LPG) mainly to rural areas off the gas main. Our views in this submission are confined to gas. The UK is self-sufficient in LPG—indeed we export 45% of the UK’s LPG production. Europe is almost self-sufficient in LPG. Europe’s security of supply is further safeguarded by:

— a wide range of sources, both inside and outside Europe; and
— a flexible supply chain via water, rail and road with numerous routes and entry points into Europe.

In relation to natural gas, the recent report from Pöyry, “Gas: At the centre of a low carbon future” (September 2010) concluded: “Recent studies by, and supported by DECC, concluded that there are no major
security of gas supply concerns as Britain increases its gas imports...We also survived the coldest winter in over 30 years in 2009–10 with plenty of gas available and no impact on the wholesale price”. Pöyry went on to refer to a DECC study undertaken in 2009–10 to investigate the impact on the UK’s gas supply to a range of supply shocks and two others to examine the global gas market and the European gas market (including Russia): “By combining the analyses in all three reports we were able to take a view on the robustness of gas supply not only to events in the UK, but also the evolution of gas supply far across the globe. This work broadly concluded that the UK’s gas supply security is robust to a range of underlying demand scenarios, including in the event of low probability, high impact events causing disruption to gas supplies. Specific events modelled included:

- prolonged outages to key pipeline routes (from Norway and Russia); and,
- long disruptions to major LNG sources and LNG regasification capacity (Qatar and Milford Haven).

Outages were modelled under severe weather and using a very high UK demand profile (up to around 120bcm per annum), corresponding to National Grid’s top of the range of its central demand projections. While the events did cause increased UK gas prices, only in the coincident occurrence of the most extreme circumstances was there any gas interruption”.

Is There a Threat to Infrastructure Delivery?

Pöyry thinks so: “With large scale renewable build, new nuclear power stations and a major expansion in electric grid infrastructure (both offshore, mains transmission and within homes) required, there is an enormous challenge in putting together the resources, capabilities and skills required...Based upon various substantive analysis we have undertaken we believe there is a greater risk of the ‘lights going out’ through insufficient power generation and increased peak forecasts than any concerns over security and price from rising fuel imports”.

Will 30% of electricity generation come from renewables by 2020 as is envisaged by the Revised National Policy Statements on Energy (NPS)? At the end of 2009, 3% of our energy came from renewable resources (WA, 8.12.10). Is it really imaginable that we can increase that by a factor of 10 within nine years?

We believe that the wind energy targets—the ascribed primary source for renewables by the NPS—are “heroic”. The 2008 Fells Associates Report, “A Pragmatic Energy Policy for the UK” said that the UK Renewables Strategy would, “Require a monumental shift in investment and build rate for renewables”. It still does. The total installed capacity of windfarms in the UK according to the British Wind Energy Association (BWEA) as of February 2011 is 5,203MW—17% towards the target of 31,000MW (RAB). The targets look relatively harder for offshore wind turbines. In a Lords Written Answer on 19 January 2011, Lord Marland envisaged a scenario of 4,000 offshore turbines by 2020. The Carbon Trust points out that the build rate of offshore wind turbines build rate has been one every 11 days since 2003: 436 offshore wind turbines have been installed to date. To reach the 2020 target, therefore, would require the current installation rate to accelerate tenfold.

As for the potential contribution from biomass the Government acknowledged “constraints to the provision of such infrastructure” (“The UK Renewable Energy Strategy 2008) including ‘public hostility to combustion plant, particularly those burning waste’ (ibid.) Prof. David MacKay, Special Adviser in DECC unrepentantly called for “industrialising really large tranches of the countryside” (11.09.2009—Times Online) to supply biomass. The renewable strategy depends on doubling the land devoted to energy cropping in every year from 2010 to 2017. The expectations of biomass look as heroic as for wind: “To date there has been a failure to achieve significant planting of woody energy crops in the UK” (“Combating Climate Change, Forestry Commission”, 25 November, 2009, para.14.2).

Pöyry is rather dismissive of heat pumps: “Mass deployment of heat pumps is central to the electrification of the supply of heat. In July DECC published scenarios for renewable heat supply to 2020. Around 2,500 air source heat pumps are currently installed and sales are close to 3,000 units pa. For ground source heat pumps the respective figures are 8,000 installed and 4,000 pa sales. Yet in its central scenario there are 300,000 air source and 330,000 ground source heat pumps by 2020. For these, still relatively low, figures to be reached, annual sales over the next 10 years will need to be ten times current rates. This is not just a challenging sales target—it demands a massive expansion in the supply chain to manufacture, install and maintain the systems. How credible is such a sales plan in the face of a doubting public? Already there is information to doubt their value.”

Ground source heat pumps are disruptive to fit and are a very expensive way of addressing the problem, particularly in rural areas which would also require a very significant investment in electricity infrastructure where much of the electricity supply is single phase, limiting the power available for electric powered heating systems to approximately 3.5kW. Heat pumps have only limited output on single phase electricity and are of limited value in older properties.

The most recent study of currently installed heat pump performance, was published by the Energy Saving Trust on 8 September 2010—“Getting Warmer: a field trial of heat pumps”. The study reveals that the actual performance of heat pumps installed in the UK is surprisingly poor. The study showed that only 1 of the 22
properties with Ground Source Heat Pumps achieved the implicit minimum EU Directive Coefficient of Performance, and only 9 of the 47 sites with air source heat pumps achieved the standard. Since the 2009 European Directive on Renewable Energy excludes low performing heat pumps from contributing to the renewable energy targets, where it states that “Only heat pumps with an output that significantly exceeds the primary energy needed to drive it should be taken into account” the great majority of heat pumps studied by the EST cannot be considered as “renewable” or contributing to the renewables target. Furthermore, if they are not renewable then it would be wrong to apply subsidy to their installation.

Reality may possibly be beginning to break out. Charles Hendry MP, Minister of State at DECC on 8th December 2010 admitted in a written answer: “As a result of the failure to make sufficient progress in past years, the UK will miss the 2010 renewable electricity target this year... meeting our 2020 target is challenging but achievable.”

The ECC Select Committee saw a “risk that new conventional generation would crowd out renewables” (para. 79, Third Report, 26 January 2011); the risk is rather that renewables, as heavily subsidised as they are, will fail to rise to the challenge.

Does Affordability Threaten Domestic Supply?

Pöyry thinks that the sums involved for those building the necessary infrastructure are, “Stretching (in the order of £200 billion by 2020 and 400 billion by 2050) and there are questions over the ability of the market players to raise the necessary debt or equity funding.”

The most commonly—if rather loosely—used figure is £200 billion. We believe that that figure is consistent with OFGEM’s Project Discovery projections and with the original Draft National Policy Statements for Energy and were based on what we would regard as an optimistic view that grid peak demand would remain flat at 60GW to 2020. But, in the Revised NPS the full implications of a pure electricity play including the electrification of transport and heat are glimpsed for the first time: “Generation capacity will need at least to double to meet this demand and, if a significant proportion of our electricity is supplied from intermittent sources, such as wind, solar, or tidal, then the total installed capacity might need to triple” (para.1.66). This is an astonishing admission, with no doubt a similarly astonishing, and not yet revealed, cost. We believe that the commonly quoted costs of investment needed of £200 billion to deliver necessary capacity relate to the original target, not to the doubling, or tripling of existing capacity. If energy companies do find the resources to invest in doubling to tripling the generation capacity ultimately they will be hoping that the consumer of their electricity will pay for the increased cost of their electricity. We should have transparency as to what that will mean for the consumer.

Our projected future dependence on wind power is making our power unnecessarily expensive. The UK Renewables Strategy 2008 says this about wind:

“3.9.4 Analysis of wind patterns suggests that, at high penetration levels in the UK, wind generation offers a capacity credit of about 10–20%. This is an indicator as to how much of the capacity can be statistically relied on to be available to meet peak demand and compares to about 86% for conventional generation. This means that controllable capacity (for example fossil fuel and other thermal or hydro power) still has to be available for back-up at times of high demand and low wind output, if security of supply is to be maintained. New conventional capacity will, therefore, still be needed to replace the conventional and nuclear plant which is expected to close over the next decade or so, even if large amounts of renewable capacity are deployed...

3.9.6 In the British market electricity generating capacity does not earn money simply for being available; it earns money only when it actually generates. This is consistent with striking the optimal balance between costs and benefits of spare capacity on the system. It also means that wholesale electricity prices are likely to rise to very high levels at times when high demand and low wind speeds coincide. This is necessary in order to cover the costs of plant which does not get to generate very often, and so ensure that generators are incentivised to provide back-up capacity.

3.9.7 It is nevertheless possible that uncertainty over returns on investment, because of the difficulty of knowing how often plant will get the opportunity to run, will discourage or delay investment in conventional capacity—or speed up the closure of existing capacity—and hence increase the risk of occasional capacity shortfalls”.

The Revised Draft National Policy Statement on Energy accepts this argument: “However, some renewable sources (such as wind, solar and tidal) are intermittent and not all renewable sources can easily be adjusted to meet demand. An increase in renewables will therefore require additional back-up capacity and mean that we will need more total electricity capacity than we have now” (Para.3.3.11).

Put more plainly, every 10 new units worth of wind power installation has to be backed up by what are likely to be eight new units worth of fossil fuel generation, because fossil fuel can and will have to power up suddenly to meet the deficiencies of wind. Wind does not provide an escape route from fossil fuel but embeds the need for it. Nuclear runs at baseload and cannot power up to cover the absence of wind.

The true picture is even bleaker than that. If fossil fuel plant has to be constructed and stand by waiting for wind to default then its power will have to be more expensive in order for the plant to “wash its face”. So, the
effect of having a large investment in wind is to drive up the price of power generally. Charles Hendry has admitted that no-one has worked out the costs: “The Department has not provided estimates of the cost of constructing fossil fuel power stations to compensate for intermittency in the period out to 2030” (WA 9 February 2011, col. 356W). The subsidy to wind is not cheap either—by 2020 the subsidy will have risen to £5 billion in that one year alone (Written Answer, House of Lords, 19 January 2010).

Fells (op. cit.) points out that, “The National Audit Office identified wind power as one of the most expensive ways of reducing carbon emission, with recent reports claiming that abating one tonne of carbon costs between £280 and £510. This compares with £10 to £20 per tonne in the European Emission trading scheme (National Audit Office, ‘Department Of Trade and Industry: Renewable Energy’, report by the Comptroller and Auditor General, Hc 210; Session 2004–05, 11 February 2005 & D Helm, Wall Street Journal, 18 March 2008”).

The Daily Telegraph reported on 11 January 2010 that out of a UK capacity of 5% wind was delivering 0.2% during the January cold spell. The wind was not blowing when most needed. Andrew Horstead, a risk analyst for energy consultant Utilyx, commented: “This week’s surge in demand for energy in response to the cold weather raises serious concerns about the UK’s increased reliance on wind power...Failure to address these concerns could mean further rationing of energy in future years and could even lead to black-outs, so it is vital that the UK Government takes action now to avoid the lights going off,” (ibid.) The poor performance of wind in January 2010 was echoed in the cold snap of December 2010: The Times of 3 January 2011 reported that since the beginning of December turbines had been operating at only 20% of their capacity—on 2 January wind was contributing but 0.5% of the country’s power.

The Renewable Energy Foundation has put the following research data on its website: “It is now well known that low wind conditions can prevail at times of peak load over very large areas”. For example, at 17.30 on 7 December 2010, when the 4th highest United Kingdom load of 60,050 MW was recorded, the UK wind fleet of approximately 5,200 MW was producing about 300 MW (ie it had a Load Factor of 5.8%). One of the largest wind farms in the United Kingdom, the 322 MW Whitelee Wind Farm was producing approximately 5 MW (ie Load Factor 1.6%).

Load factor in other European countries at exactly this time was also low. The Irish wind fleet was recording a load factor of approximately 18% (261 MW/1,425 MW), Germany 3% (830MW/25,777 MW), and Denmark 4% (142 MW/3,500 MW).

Such figures confirm theoretical arguments that regardless of the size of the wind fleet the United Kingdom will never be able to reduce its conventional generation fleet below peak load plus a margin of approximately 10%.

They also suggest that while widespread interconnection via the widely discussed European Supergrid, may assist in managing variability, its contribution will not on its own be sufficient to solve the problems, since wind output is approximately synchronised across very large geographical areas.

Conventional generators acting in the support role and guaranteeing that load is met will be faced with operating in a market that is physically and economically volatile.

The now emerging fact that wind power can be highly variable year on year adds further layers of complication to this problem. Conventional generators will not only have uncertain income over shorter timescales, but will face significant year on year variations:

“The all but inevitable result of such uncertainties is higher prices to consumer”.

**RISING COSTS—RISING BILLS**

We have referred to HMG’s target of 4,000 offshore wind turbines by 2020 above. However, a recent report for DECC by Mott MacDonald, “UK Electricity Generation Costs Update” (June 2010) estimated the levelised cost of offshore generation to be £157–186/MWh, roughly twice that for onshore wind (£94/MWh). Offshore wind was by far the most expensive technology that MacDonald compared between gas, coal, nuclear and wind. Why are we subsidising such poor value for money in a technology?

On 16 December 2009, an OFGEM presentation showed 4 million households in fuel poverty and forecast fuel poverty to rise to cover six million. OFGEM has predicted a rise of up to 60% domestic fuel bills (Evidence to Energy and Climate Change Committee 2.12.09). The Renewable Energy Strategy admitted: “Poorer households are likely to spend a higher proportion of their income on energy and so increases in bills will impact more on them”.

A report, “The Cumulative Impact of Climate Change Policies on UK Energy Intensive Industries” (7 July 2010) published by the Energy-Intensive Users Group (EIUG) and the TUC forecast increases in total energy bills for industry, taking electricity, gas and emissions reduction schemes together, as high as 141% by 2020. In a Written Answer (18 November, 2010, col. 930W) Charles Hendry MP, Minister of State for Energy and Climate Change estimated that renewables policies would add £246,000 (25%) to the average medium sized annual non-domestic user’s electricity bill in 2020. The danger is that we will export our heavier industries to countries with lower fuel costs.
RISING FUEL POVERTY

Tom Lyon, an energy expert at uSwitch, claims that the necessary investment, “Comes with a hefty price tag and mounting concern over who should be footing the bill…The overall cost of the investment programme...equates to £769 per household. If consumers do end up footing the bill we could see the average annual household bill reach over £2,000, a huge 68% rise” (Daily Mail, 4 October 2010). An energy analyst at the M&C Energy Group, David Hunter, said in the same article: “Customers should expect a 60% hike in bills over the next decade or so”.

In the current economic context, these very high rises in fuel costs are unlikely to be underwritten by social transfers. This must raise questions of the potential impact on fuel poverty and social cohesion.

In 2003, 1.2 million households in England were in fuel poverty. “The Annual Report on Fuel Poverty Statistics 2010” states that, “In 2008, the number of households in fuel poverty in the UK was estimated to be around 4.5 million, a rise of around 0.5 million from 2007. This represents about 18% of all households.” It estimates fuel poverty as affecting 15.6% of English households in 2008. This is despite the Warm Front Scheme and annually improving measures of homes becoming more energy efficient.

November 2010 fuel poverty figures for Wales are a somewhat dated snapshot. In 2008, 332,000 of households in Wales were estimated to be fuel poor and that this figure has risen by 198,000 since 2004. This is despite the application of such measures as the Home Energy Efficiency Scheme. The rise represents an increase of 15%; in 2008 26% of Welsh households were estimated to be in fuel poverty. BRE models fuel poverty in Wales rising to cover 368,000 households in 2009. The targets set out in “A Fuel Poverty Commitment for Wales” (2003) remain rather heroically in place and are that, as far as reasonably practicable, fuel poverty will be eradicated: amongst vulnerable households by 2010; in social housing by 2012; and by 2018, fuel poverty in Wales would be abolished.

In Scotland, the position is worse. According to the Progress Report on the Scottish Fuel Strategy 2002 by the Scottish Executive published on 25th November 2010, fuel poverty affected 293,000 Scottish households in 2002 when it was set as policy to reduce the number of households in fuel poverty by 30%. But, it has risen inexorably year by year till it reached 770,000 households in 2009—and increase of 152,000 households in one year. 32.7% of Scottish households are now in fuel poverty. These figures have risen despite schemes to improve the energy efficiency and insulation within homes—140,000 homes in Scotland have been made more energy efficient since 2008. The Scottish Government states that up to 46,000 more households (ie 2% of households) will be pushed into fuel poverty every time energy prices rise by 5% (OFGEM’s prediction of a 60% domestic fuel price rise would mean 55% of all households in Scotland would be thrust into fuel poverty). The Scottish Government is committed to the abolition of fuel poverty by 2016 “as far as is reasonably practical”.

Northern Ireland comes out worst. The Northern Ireland Fuel Poverty Strategy aims to eliminate fuel poverty in vulnerable households by 2010, and in non-vulnerable households by 2016. Fuel poverty affected 34.2% of the population in 2006 (now a dated figure given significant rises in fuel prices since). Despite the application of the Warm Homes Scheme which has made 71,000 homes more energy efficient since 2001 the same inexorable rises in fuel poverty are evident as in the rest of the UK.

So, nearly a fifth of all households in England, over a quarter of those in Wales, nearly a third in Scotland and over a third in Northern Ireland are in fuel poverty. The figures have been going significantly in the wrong direction for years. It is not credible that the fuel poverty targets can be met in the statutory timeframe in any of the nations of the UK. Government seems in denial of the seriousness of the position.

On 10th February 2011 Philip Davies MP had the following question answered: To ask the Secretary of State for Energy and Climate Change what estimate he has made of the change in the number of people who will be classified as fuel poor as a result of increase in energy prices arising from the Renewables Obligation in each of the next five years.

Gregory Barker: There have been no recent estimates made as to the effect on the increase in the level of energy generated from renewable sources will have on the number of people in fuel poverty (Hansard col. 438W).

Some might comment that a policy that threatened to consign a large proportion of the population to fuel poverty is in effect stripping that group of consumers of security of supply, and that it would be a wise precaution to work out the effect of the renewable energy policy on future levels of fuel poverty. As Pöyry warns, “Many of the pathways rely heavily on improved energy efficiency so that consumers can pay a higher unit rate for energy in order to fund all this major investment referred to above. Unless changes in consumer behaviour deliver their side of the equation we will see a substantial rise in the numbers of consumers in fuel poverty.”

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

The Committee has already attempted an answer to its own loaded question: “We recognise that gas will continue to play a role in the UK energy mix. Gas plant provides low-cost, flexible generation that can be brought online quickly and reliably. Limited generation by unabated gas may be important at times of peak
demand in order to balance an increasing amount of intermittent generation from renewable sources. A dash for gas, however, would have considerable implications for the UK’s climate change mitigation targets, especially in the event that CCS does not become commercially or technologically viable.” (Paragraph 80, Third Report, 26 January 2011).

Historically, gas has a very creditable green record. Pöyry points to the benefits accruing from the first “dash for-gas”: “The UK is on target to achieve its Kyoto commitments mainly because of the major expansion of gas-fired power generation in the 1990s. Its widespread use in heating homes and businesses also gives it a lower carbon footprint than many other countries.” The report proceeds to question why policymakers underplay the potential role for gas in the future: “Our view is that a deliberate policy to reduce gas’ share of the energy mix represents a flawed pathway for society to progress towards decarbonisation. Policymakers should present an unbiased set of technologies to market investors including gas CCS, CHP, district heating and biomethane. By doing so, markets will be able to choose the mix of technologies and energy sources that best ameliorate the risks and uncertainties of meeting the long term carbon targets in the most secure and affordable way for consumers.”

An Energy Networks Association’s report concurred (“Gas Future Scenario Project”, 9 November 2010) pointing out that an all electric “solution” to decarbonisation over the period 2010 to 2050 would cost £700 billion more than a “Green Gas” solution—that is equivalent to £20,000 per household or £10,000 per person. The report proffered an alternative route: “Pathways with ongoing gas use could offer a cost-effective solution for a low-carbon transition relative to scenarios with higher levels of electrification”. There is value in continuing to enjoy the sunk costs in the gas mains: “The costs of maintaining the existing gas transmission and distribution networks are relatively small in comparison to the other system costs associated with a low-carbon transition.” This solution offered “consequential benefits for consumers, the economy, and the competitiveness of GB industry”. The Green Gas/biomethane solution is not necessarily reliant on CCS, and the Committee has left this potential pathway out of their consideration. As Pöyry states, gas could not just be a transitional technology, it could be the “endgame”: We have seen that a gas-based solution adds more flexibility to the power generation mix, requires less infrastructure expansion as we can rely on the existing network, improves conversion efficiencies using mature technologies (CHP, CCGTs and condensing boilers) and delays the need for major “investment”.

**A Role for Distributed Generation**

Given that there is going to be a need for unabated gas generation as part of the price we pay for massive investment in wind, which does not blow all the time, is there a further way of mitigating our need to build gas on standby?

There is indeed, and it accords with Government policy:

“This Government wants to see distributed generation become the norm not the exception...That way we can literally bring power to the people, to communities, to local businesses,” Greg Barker MP, Minister of State for Energy and Climate Change, 25 November, 2010.

**An Alternative to Expensive Centralised Distribution for Peak Generation**

National Grid projections1 show that by 2050 they expect the 31 coldest days of the year to account for 20% of the UK’s annual demand for heating (Figure 1). This actually reflects the current situation in 2010 and highlights the “peaky” nature of heat demand. It also sets Government a significant challenge as heat demand is difficult to shift—when it’s cold it’s cold—and climate change will lead to more extreme winters and even greater heat spikes. Only last December we at Calor Gas delivered 50% more gas than we do in an average year—we would have delivered even more if the roads had been clear! Therefore we believe 20% significantly underestimates the potential spike under changing climatic conditions.
This is in the context of the National Grid expecting far less heat to be supplied by natural gas, and proportionately far more by electricity. This reflects the Government’s energy policy: “Decarbonisation will require an increased use of electricity in domestic and industrial heating and transport, which…will outweigh increases in energy efficiency, potentially leading to a doubling of electricity demand by 2050”.

This 20% has to stand idle for the rest of the year. It is intended that this peak demand for electricity will be met by unabated gas generation (carbon capture and storage cannot be used on standby plant). Because a gas fired power station is a very big investment, and it has to stand idle for 334 days a year it would mean that the plant would need to sell its electricity at a very inflated price or it would have to be compensated in some other way (eg contracts for differences—CFD). Either way this boils down to a very expensive way of generating electricity for the consumer and/or taxpayer. If, as certain climate change scientists believe, we are going to be facing more extreme winter variations in future, the demand for heat could be even more spiky, in which case the demand for standby generation would be even greater, and the costs consequently greater. Might there be a cheaper, more efficient way of providing heat in the home for the 31 coldest days of the year?

The most modern CCGT gas fired generating plant does not yet achieve 60% efficiency in generating electricity. A further loss is occasioned through the transfer of the energy over the GB electricity transmission system and is typically of the order of 2% of the energy transferred across the network. An Energy Networks Association’s report, “points out that an all electric ‘solution’ to decarbonisation over the period 2010 to 2050 would cost £700 billion more than a ‘Green Gas’ solution”—that is equivalent to £20,000 per household or £10,000 per person. The report proffered an alternative route: “Pathways with ongoing gas use could offer a cost-effective solution for a low-carbon transition relative to scenarios with higher levels of electrification”. There is value in continuing to enjoy the sunk costs in the gas mains: “The costs of maintaining the existing gas transmission and distribution networks are relatively small in comparison to the other system costs associated with a low-carbon transition.” This solution offered “consequential benefits for consumers, the economy, and the competitiveness of GB industry”. Heat does not have to come from expensive electricity, wastefully centrally generated by unabated gas.

Besides, projects are underway to decarbonise gas in the home (deploying biomethane or biopropane in urban and rural areas respectively) so this should not be seen as a transitional solution but a permanent solution. Meanwhile we can make gas work harder by deploying micro-generation for distributed rather than centralised generation. Micro-CHP (mCHP) involves the use of gas using a fuel cell boiler boasting 80–90% efficiency ratings to generate both heat and electricity. It is a technology that is available now. It is a low cost, low carbon solution delivering secure low carbon electricity. One possible component of the domestic heating scenarios contemplated in DECC’s “Pathways Analysis” is mCHP—reaching up to 90% of the technology mix in one illustrated case, and with a maximum penetration of 36 million households by 2050. There are high efficiencies in generation and no losses in transmission.
Why doesn’t the Government cost this Pathway and compare it with the cost of maintaining central unabated gas generation to cater for peak needs for but 31 days of the year?

A study by Delta Energy and Environment, “Micro-CHP Savings in the UK” (September 2010) confirmed the green benefit of the solution. It found that natural gas mCHP saves carbon until well after 2030 when compared to a decarbonising electricity grid and until 2030 on LPG. If anticipated improvements to mCHP technology materialise, and the natural gas network/LPG is decarbonised, this window extends further—towards 2040 and beyond. In addition, as a consequence of mCHP generating electricity, electricity from fossil plants is displaced—this will reduce the level of capital investment required in centralised generating plant due to the load-following ability of fuel cell mCHP technology.

Fuel cell mCHP units can reduce total household energy bills by 25% (a figure confirmed by Oxera) and provide cost-effective carbon emission reductions. Owners of compliant mCHP units can sell electricity back to the grid. So, mCHP will lower, not raise household energy bills—unlike most other strands of current energy policy. Indeed, because the potential energy cost savings are so significant, a mass move to mCHP could be an antidote to fuel poverty.

Sources:
1. “Meeting 2050 Climate Targets 2050” published by the National Grid. August 2010 projects the demand for electricity for heat at peak to be 3,000GWhrs; by the 31st coldest day that demand will have fallen to approximately 2,400GWhrs—slide 10 refers.
2. Ibid. slide 9 refers.
5. “Gas Future Scenario Project” (9 November 2010).

March 2011

Memorandum submitted by Dr. Vlasios Voudouris

INTRODUCTION

1. This evidence is presented to the Select Committee to provide a perspective in terms of the threats, vulnerability and consequences of the UK Energy Supply System within a global-national context characterized by unprecedented uncertainties and increasingly complex intertwines. This contribution is based upon the ACEGES project (www.aceges.org). ACEGES stands for Agent-based Computational Economics of the Global Energy System. The ACEGES models the energy demand and supply of 216 countries.

2. The aim is not to present another set of quantifications for policymaking, as there are a number of reports and papers published in recent years. Rather the aim is to provide a coherent overview of i) the assumptions of the energy models used to produce the published quantifications and ii) the approach used to develop energy scenarios for the assessment of the UK’s Energy Supply.

3. I am a specialist in the modelling of fuzzy phenomena and complex adaptive systems such as the Energy System. My research work aims to support evidence-based energy policy by means of controlled computational experiments. Currently, I am the Deputy Director of the Centre for International Business and Sustainability.
(CIBS) at the London Metropolitan Business School. I am also the organise of the “UK Energy Day: Sustainable Supply” which is part of the European network of events led by the Intelligent Energy Europe (IEE) agency of the European Commission (EC).

4. It is evident today that the long-term sustainability of the UK’s energy system is under acute strain. Therefore the comments that follow mainly deal with the need to enhance:

(a) The existing energy models to assess the sensitivity of the UK’s energy supply.
(b) The way of developing multidimensional global-national continuous scenarios for long-term assessment of the resilient of the UK energy system to international events.

I will start with the latter.

**Energy Scenarios**

5. Energy scenarios are empirical frameworks that provide summaries of possible futures. Scenarios should reflect past history (eg, political, social, economic, technical) and should be based on informed views about past history. Scenarios also need to reflect current realities and not reflect naïve views based on fashion or hope. Scenarios shed useful light on future possibilities as far as the country is concerned and should incorporate “low (subjective) probability” futures where these may have significant impacts on the country. Scenarios aim to assist policy makers making long-term energy (and environment) related policies. These policies frequently involve investments with long payback periods, or investments of such a large size that basic uncertainties, which have been overlooked, can prove very costly.

6. Conventionally, scenarios are based on a sequence of events—meaning that discontinuities happen one after the other. However in times of unprecedented uncertainties and increasingly complex intertwines, scenarios should be based on networks of events—meaning that discontinuities happen almost simultaneously. A recent example is the current geopolitical events in MENA (the Middle East and North Africa).

7. Conventionally, global and national energy scenarios attempt to portray future possibilities using the concept of “representative country” and conceptualise the country-specific energy systems as consisting of several identical and isolated components. This means that based on, for example, historical oil production of key producers (eg, the US), the world oil production is assumed to have (more or less) the same production characteristics. This is effectively the attribution of properties to a different level than where the property is observed.

8. Conventional scenarios attempt to assess the pathways and impact of global and national drivers using the concept of “multi pathways”. Selecting specific values for the most uncertain and important driving forces does this. An example of this is given in Exhibit 1 below.

9. Exhibit 1 demonstrates that by:

(a) Fixing two of the key uncertainties (growth at 2% and reserve/production at 10 based upon the US experience),
(b) Taking three different estimates of ultimately recoverable oil reserves,

three different pathways are plausible.

10. A key problem, for policy making, of the approach shown in Exhibit 1 is that it fails to emphasise the inevitable uncertainty around the outlooks for energy supply. It also fails to provide an assessment of the balance of risk between the different pathways. At a more technical level, the uncertainty is reduced to finite sets of certain values.
11. To emphasise the inherent uncertainty of the future outlook of energy supply and to avoid oversimplifying the heterogeneity of the energy system, a new approach has been develop by the ACEGES project at the Centre for International Business and Sustainability at the London Metropolitan Business School. This new approach suggests the use of continuous scenarios that emphasise the uncertainty and give an assessment of the balance of risk. Exhibit 2 demonstrates this approach, which adopts the approach used by the Bank of England for its “Inflation Report”.

CONTINUOUS SCENARIOS FOR EVIDENCE-BASED ENERGY POLICY

12. Exhibit 2 provides probabilistic pathways associated with world oil production. The use of probabilistic pathways avoids suggesting a degree of precision that would be spurious and are appropriate when exactitude is elusive (while being approximately right is still helpful for policy making). If required, I am happy to provide further and more specific continuous scenarios to the Select Committee. These types of (both global and national) scenarios should be developed at regular intervals to reflect “forces in the pipeline”. Using a flexible decision-support tool such as the ACEGES tool (www.aceges.org), the anticipated overheads should be minimal.

13. To assess, for example, the exposure of the UK’s Energy Security of supply to international events, both global and national scenarios are required. In particular, the national scenarios should not only include the
main energy trading partners of the UK. This is because events that are not directly related to the exposure of the UK’s Energy Security of supply can affect the exposure of the UK’s Energy Security through secondary and tertiary routes.

14. For example, taking Europe as a single entity, 90% of oil is imported from the Middle East, North Africa, West Africa and Former Soviet Union. For the UK in 2010, 58% of gas was imported from Norway (98% was transported with pipeline) and 75% of all imported gas was transported with pipelines. These realities can change as we move towards 2050 given the increasing demand for electricity and transport fuels for the UK and other European countries.

15. Qatar (with substantial export capacity) might start to play, for example, a very important role by means of LNG imports to the UK, if home-grown energy sources for electricity generation and transport fuels are not well targeted. This reality clearly can have significant implications for the UK’s Energy Supply as diversification of resources (oil and gas) could lead to over concentration for energy imports on specific countries (eg, over reliance on OPEC countries for oil and gas) and the need to update the UK’s infrastructure for imported energy.

16. The implications can become even more important if a “low (subjective) probability with significant impact” scenario is developed to explore the threat, vulnerability and consequence of extended OPEC to include gas: The Organization of the Petroleum and Gas Exporting Countries (OPGEC). Similar risks and hedging strategies should be assessed if “renewable energy projects” (eg, DESERTEC Concept) are located in countries that already dominate the energy market.

17. Exhibit 3 shows country-specific conventional (cheap—also termed the Gucci oil by traders) oil productions (left column) and their corresponding export capacity (right column). For conventional oil production:

   a) The green colour means no production.
   b) The grey colour means production less than 1 million barrels per year and greater than zero.
   c) The darkest colours represent, the higher production of conventional oil.

For conventional oil export capacity:

   d) Grey represents no export capacity (net importing countries).
   e) The darkest colours, the higher the conventional oil export capacity of the country.

18. It is important to emphasize that these results are the output of a single simulation rather than the summary of a specific energy scenario. The aim of presenting them is to demonstrate the type of scenarios needed to assess the UK’s Energy Supply. The Select Committee can experiment with additional simulations using the ACEGES tool from www.aceges.org.

19. Given the outlook of the UK’s oil and gas production and the increased demand for flexible energy services of the potential energy trading partners is demonstrated in a visual way to assess the UK’s Energy Supply in terms of fossil fuels (a similar figure can supplied for gas). Note that although MENA accounts for more than one-third of the world’s oil production, their share of world’s oil export capacity (eg, domestic production minus domestic demand) is substantially higher, particularly as we move towards 2050.
20. Given the geographically concentrated production of cheap oil and gas, the exposure of the UK's energy security of supply to international events will be substantial after 2030 (possibly earlier) unless a significant acceleration of home-grown energy production for electricity and transport fuels starts soon with a realistic evaluation of the speed of the diffusion of new technologies and their claimed capacity for energy supply. This should be checked against the UK's energy demand and the need for a sustainable energy import policy. This will have the combined benefits of improving energy security and resilience, addressing climate change and improving the sustainability of the UK's trade balance.

21. Assessing the robustness of the UK’s energy policy and identifying plausible but unanticipated issues that can challenge the level of robustness of the UK’s energy policy requires further evidence based upon an understanding and informed view of the past and a systematic exploration of the significance of the “driving forces in the pipeline”. This requires a rethinking of how to support the UK’s Energy Policy. It requires an exploratory and iterative energy policy supported by controlled computational experiments. This will allow policy makers to rehearse the future and use the computational experiments as “early warning systems”.

22. To the best of my knowledge, this exploratory and iterative approach to assess the “threat, vulnerability and consequence” to the UK’s energy policy has not been fully employed. The ACEGES offers a way forward by allowing UK policy makers to simulate an artificial energy system under different UK policy scenarios and quantitatively explore how likely is the energy system to react under different policies or international events (eg, geopolitical unrest south of MENA and/or north-east of MENA).

23. A country-specific tool to meet the UK’s targets for greenhouse gas emissions reductions for public use is HM Government’s 2050 Pathways Analysis. The ACEGES is a global-national decision-support tool to assess the UK’s energy supply within a global-national context as it models the demand and production of 216 countries around the world (Exhibit 4).

24. I argue that a country-specific representation of the world energy demand and supply system using the concepts from complexity science (see “Energy Models” below) can substantially support the UK’s energy policy in:
   (a) Assessing where the UK Energy Policy might be out of alignment with emerging megatrends.
   (b) Assessing the effectiveness of any hedging strategies for the UK’s Energy Supply System.
ENERGY MODELS

25. For energy policy, energy supply modelling techniques can be classified into two broad categories, namely i) Resource-constrained models and ii) Econometric models. The most widely used models for long-term policy are resource-constrained models. Resource-constrained models are of two classes, namely a) curve-fitting models and b) heuristic models. Exhibit 1 shows the results of a heuristic model. The most popular curve-fitting model is the Hubbert curve or the oil mountain in the form of a normal distribution. The majority of publicly available evidence for the UK’s Energy Policy (particularly oil and gas outlooks) is based on the curve-fitting models.

26. Conventional energy models use computation for the empirical analysis of observational data and the calculation of the equilibria of systems of equations approximating (poorly) the energy system. They conceptualise the energy system as consisting of several identical and isolated components from which the solution is obtained by a simple summation of least-cost optimization through the operation of the Walrasian Auctioneer. These conventional models have a sorry history in terms of anticipating discontinuities because they are successful as long as things stay more or less the same. These models assume a perfect world, and by their very nature rule out crises of the type we are experiencing now.

27. It is important to make a distinction between models that assess the potential profit and the risk of individual trades or investments and the models that aim to assemble heterogeneous pieces and understand the behaviour of the whole national energy system within a multidimensional global-national environment. Conventional models can be useful for the former rather than the latter.

28. Fortunately, there is a better way: Agent-Based Computational Economics (ACE) models based on complexity science. ACE is the computational study of systems modelled as dynamic networks of interacting and heterogeneous agents with bounded rationality. Agents operate in an environment on which they live and with which they interact. Thus, the main building blocks of ACE are: i) the agent (eg, country, multinational energy companies, national energy companies), network of agents (eg OPEC) and the Environment (eg, Estimated Ultimate Recovery of fossil fuels).

29. ACE models do not rely on the assumption that the energy supply system will move towards a predetermined equilibrium state, as other models do. Instead, at any given time, each agent acts according to its current situation (eg, domestic energy production and demand), the state of the world around (eg, net demand for electricity and transport fuels) it and the rules governing its behaviour (these rules are primarily defined by policy initiatives).

30. To the best of my knowledge, the only ACE model of the global-national energy system is the ACEGES model. The ACEGES model has been developed to support iterative and exploratory energy policy by means
of continuous energy scenarios. The ACEGES laboratory is a “wind tunnel” that allows regulators to test policies and explore their emergent effects on the energy system. As a result, policymakers can use a computational laboratory to rehearse plausible futures and use it as an “early warning computational system”.

**Summary**

31. I hope I have convinced you that the UK’s Energy Policy should be supported by controlled computational experiments simulating increasingly complex intertwinings within a multidimensional global-national environment. The UK’s Energy Policy should not rely on evidence based upon over simplified models that assume that the energy supply system will move towards a predetermined state or profile (eg, Hubbert curve or a variant of an oil mountain).

32. The history of energy supply is complex, and the interplay of climate, economy, investment, geopolitics, and many other factors defies simplistic analysis for evidence-based policy. A creative and organized modelling of energy resources is urgently required to better support evidence-based energy policy, regardless of future climate change.

33. In seeking to explore the indirectly and uncertain, and in some respects unknowable, future, the use of scenarios offers a solution. However, the UK’s Energy Policy needs to move away from discrete scenarios that fail to emphasise the inherent uncertainties and the balance of risk. Assessment of the UK’s Energy Supply needs to move towards continuous scenarios satisfying the “generative explanation” as a new way of i) explaining the past and the present and ii) structuring the uncertainties of the future. Only then policy makers will be able to realistically assess where the outlook of the UK’s Energy Supply might be out of alignment with emerging megatrends, particularly in relation to electricity generation and transport fuels.

34. Given the current state of knowledge, there is an urgent need to rethink the balance of home-grown energy and energy imports (in relation to transport fuels and electricity generation) to improve energy security, address climate change and improve the sustainability of the UK’s balance of trade.

35. I should emphasize that diversification of energy sources (eg, oil, gas and clean energy from desert) does not necessarily lead to an improved energy system if these diversified energy sources are located in a small number of countries. This still results in reduced market diversity in terms of production capacity. This might also lead to a new and more powerful organization such as the Organization of the Energy Exporting Countries (OEEC) as opposed to the Organization of the Petroleum Exporting Countries (OPEC). The creation of the OEEC will add a substantially higher geopolitical risk premium in the energy market.

36. I should also emphasize that spare production capacity for fossil fuels might run out without a war, say in the Arabian Gulf, as evidenced in 2008. Therefore, the UK’s Energy Supply is interlinked with national and bilateral political relationships, particularly in periods of squeezed production capacity. The UK’s Energy Supply should be assessed within an environment of increasingly complex intertwinings rather than within an environment characterized by sequential events.

37. Furthermore, local patterns of supply and demand can generate price spikes within price spikes as exemplified by the price differential between Brent crude and West Texas Intermediate (WTI) in 2011. These local patterns of supply and demand emerge in situations where the opportunities for substitutions between qualities of, for example, oil will be fewer (eg, Saudi crude oil by its heavier and more sulphurous quality, in general, is more suited to the Asian market than those of Europe). This implies that the UK’s Energy Supply needs to be assessed within a global-national multidimensional environment, as regional and national coordination is a key issue towards increased opportunities for substitutions in the energy market.

38. Diversification of energy supply needs to take into account the increasing energy demand for flexible energy services, particularly electricity generation and (land, air and sea) transport fuels.

39. Demand growth for flexible energy services should be checked against the excessive placing of wind turbines where mean wind speeds are relatively low, lack of overall cross-border plan for electric cars, lack of support for ultra-high voltage direct current transmission and inadequate efforts to promote second-generation biofuel technologies to name a few.

40. This emphasises that to effectively support the UK’s Energy Policy, scenarios should be developed in ways that encapsulate rational and sub-optimal decision-making rather than assume that all the future decisions will be optimal (bounded rationality is part of reality).

41. As a matter of extreme urgency to address short-term energy challenges, the UK’s Energy Supply policy must certainly include a “global depletion study” for oil and gas to:

(a) Assess at what rate over time can the oil and gas from geographically dispersed nations be supplied to the marketplace.

(b) Develop a sustainable trading strategy for the UK’s Energy Supply System.
Fossil-fuel-based electricity generation for base load and oil-fuelled (land, air and sea) transport systems will play a dominant role in the UK’s Energy Mix as we move towards 2030. 

March 2011

Memorandum submitted by Gerry Wolff

EXECUTIVE SUMMARY

The UK is over-dependent on fossil fuels and its economy is vulnerable to disruption via rises in prices of those fuels arising from “peak oil” and conflict in countries like Libya.

For that reason, and also because of the urgent need to cut emissions of CO$_2$, there should be substantial increases in investment in renewable sources of power and conservation of energy.

There is good evidence from reputable sources that renewables, with conservation of energy, can provide all of the UK’s present needs for energy (not just electricity) and anticipated needs in the future. There is also good evidence that renewables can provide robust and resilient supplies of energy without the need for power from fossil fuels or nuclear plants.

For political reasons, the nuclear industry is vulnerable to events like the nuclear crisis at Fukushima in Japan. For that reason, and several others, nuclear power should be phased out in the UK.

1. Introduction

Although I am Coordinator of Desertec-UK,$^1$ of the Energy Fair group,$^2$ and of the Kyoto2 Support Group (K2S),$^3$ this is a personal response to the enquiry.

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

Given the heavy dependence of the UK on fossil fuels, increases in the cost of those fuels could be very disruptive.

The cost of uranium is a relatively small part of the cost of nuclear power, and nuclear power provides only a small proportion of the UK’s energy, so any increase in the cost of uranium, within limits, is not likely to be very disruptive.

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

To reduce our dependence on fossil fuels (and cut emissions of CO$_2$), substantially more investment is needed in renewable sources of power, conservation of energy, and associated infrastructure.

3.1 There are more than enough renewable sources of power to meet our needs

There is good evidence from reputable sources that there are more than enough renewables to meet the UK’s current needs for energy (not just electricity),$^4$ and anticipated needs in the future.$^5$ For example:

- The Offshore Valuation Group has shown that for five offshore electricity generating technologies—wind with fixed and floating foundations; wave; tidal range; and tidal stream—the full practical resource, estimated to be 2,131 TWh/year, is nearly six times current UK electricity demand.
- A report from the European Environment Agency has shown that the “economically competitive potential” of wind power in Europe is three times projected demand for electricity in 2020 and seven times projected demand in 2030. Offshore wind power alone could meet between 60% and 70% of projected demand for electricity in 2020 and about 80% of projected demand in 2030.
- A report from the Tyndall Centre has shown that photovoltaics (PV) could generate about 266 TWh/yr in the UK—about 66% of the UK’s present electricity demand.
- Geothermal company EGS Energy estimates that there is potential in the UK (mainly in Cornwall) to produce over 35 TWh/yr by enhanced geothermal systems (EGS)$^6$—almost10% of the UK’s electricity demand.$^6$

\[ ^1 \text{http://www.desertec-uk.org.uk/}. \]
\[ ^2 \text{http://www.energyfair.org.uk/home}. \]
\[ ^3 \text{http://www.k2support.org/}. \]
\[ ^4 \text{Electricity may be used for such things as transport by road and rail where liquid fuels dominate at present. This is likely to mean an increase in the demand for electricity but not as much as one might think (see Section 6). There is likely to be a continuing need for liquid fuels for such things as air travel but that need may be met by biofuels or synthetic fuels (see Section 6).} \]
\[ ^5 \text{See http://www.energyfair.org.uk/pren and http://www.mng.org.uk/gh/scenarios.htm.} \]
\[ ^6 \text{See http://www.egs-energy.com/resource/uk-and-europe.html.} \]
The Welsh Assembly Government has stated that renewables can provide twice the electricity that Wales is using.\(^7\)

Although the UK and Europe could be entirely self-sufficient in renewable energy, as outlined above, the Desertec Industrial Initiative aims to provide 15% of Europe’s electricity by 2050, with potential benefits both for Europe and the “desert” countries.\(^8\) One advantage for Europe is that it is likely to help hold down the price of power throughout Europe, as described in detail in the “TRANS-CSP” report from the German Aerospace Centre.\(^9\) As a source of “power on demand”, concentrating solar power in desert regions with heat storage and backup sources of heat can also make a useful contribution to balancing supplies with demands across the grid.

In research published in the journal *Energy Policy* and reviewed in the *Scientific American*, Mark Jacobson and Mark Delucchi show that renewable sources of power can provide 100% of the world’s energy, not just electricity, and that it is feasible to make the transition by 2030. In this connection, they make the interesting point that, although 51% of the world’s power in their scenario would be provided by 3.8 million large wind turbines, and although that number may seem to be a great challenge, it looks rather modest compared with the 73 million cars and light trucks that are produced in the world, every year.

There is now a large number of reports from reputable sources showing how to decarbonise the world’s economies using renewable sources of power. Details, with download links, may be found at: http://www.energyfair.org.uk/pren and http://www.mng.org.uk/gh/scenarios.htm.

### 3.1.1 Costs

There is good evidence from a variety of sources that nuclear power is one of the most expensive ways of generating electricity.\(^1\) We do not yet know the cost of carbon capture and storage because no commercial-scale plant has yet been built. It is likely that, when the several distortions of the energy market have been removed,\(^12\) renewables will prove to be the most economical sources of power. Connie Hedegaard, the European climate commissioner, has said recently that offshore wind power is cheaper than nuclear power.\(^13\)

It is widely assumed that decarbonising the world’s economies will be much more expensive than business-as-usual. But two recent reports suggest otherwise:

- An economic model conducted for the *New Scientist* suggests that radical cuts to the UK’s emissions will cause barely noticeable increases in the price of food, drink and most other goods by 2050.\(^14\)
- A report from the European Climate Foundation found that in several scenarios, including the generation of electricity from 100% renewable sources, the future cost of electricity is comparable to the future cost of electricity under the current carbon-intensive infrastructure—and supplies would be at least as reliable.\(^15\)

### 3.2 Transmission

If “security” is interpreted as robustness and resilience, then, with regard to electricity supplies, there are many advantages in integrating the UK transmission grid into an HVDC “supergrid” spanning a large area, as

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\(^6\) See the Desertec Industrial Initiative (http://www.desertec-uk.org.uk/reports.htm) has shown that solar and wind power in places like the Sahara could easily supply all of Europe’s needs for energy, not just electricity, now and in the foreseeable future. The DII’s goal of supplying 15% of Europe’s electricity supplies by 2050 (not total energy) is realistic, achievable, and provides for the integration of “desert” electricity with a wide range of other renewable sources of power across the whole of Europe, the Middle East and North Africa, thus safeguarding the overall robustness and resilience of the energy supply system in the region.

\(^7\) It is to be hoped that current political protests are resolved in favour of democracy but even if they are not, Desertec can be a substantial benefit for local people by providing jobs, earnings and plentiful supplies of clean electricity. The amount of desert that is required is tiny compared with the amount that is available and it is likely that Desert projects can go ahead successfully in several of the countries in the region.

proposed in the Desertec concept,\textsuperscript{16} by Friends of the Supergrid,\textsuperscript{17} and others,\textsuperscript{18} and now endorsed by our own Prime Minister.\textsuperscript{19}

Even without storage, a shortfall in any area can normally be made good, via the supergrid, with supplies from one or more other areas. But, in addition, hydropower and pumped storage in places like Norway and the Alps can serve as a giant battery for the whole system.

There are several other potential benefits from such a grid, including smoothing out variations in supply and demand, avoidance of wastage by allowing a surplus in any one area to be transmitted to one or more other areas where it is needed, providing access to large but remote sources of renewable power (such as the EGS resources of Iceland), reducing the need for “plant margin”, facilitating the workings of a single market for electricity across Europe and beyond, and more.\textsuperscript{20}

If “security” means military security in the face of hostile neighbours, then the UK or Europe may be tempted to pull up the drawbridge and try to become a self-contained energy fortress. Even in those terms, there are potential advantages in staying connected:

— Solar and wind power from the Middle East and North Africa may help Europe to avoid over-dependence on gas supplies from possibly-unreliable sources such as Russia.

— Despite the import of “desert” electricity into Europe, the Desertec scenario would mean an overall reduction of energy imports into Europe, an increase in the diversity of sources of energy (from a range of renewable sources across the whole of Europe, the Middle East and North Africa), and a corresponding increase in the security of energy supplies compared with what we have now.\textsuperscript{21}

— By providing opportunities for win-win collaboration, the Desertec concept can help to improve relations amongst different groups of people, thus improving security for everyone.\textsuperscript{22}

— Since the UK has clear potential to become a net exporter of renewable electricity (see Section 4), it will need good connections to other countries and regions to take advantage of that potential.

### 3.3 Storage: tidal lagoons

In the UK, there appear to be limited opportunities for further development of pumped storage schemes such as the pumped storage plant at Dinorwig in North Wales. However, tidal lagoons, which are normally seen primarily as a source of power, may also serve as pumped storage devices, thus helping to match supplies of electricity with constantly-varying demand. This is achieved by the use of tidal lagoons in groups of 3 or more, together with clever computer systems to manage the interplay amongst tides, the generation of electricity, and the pumping of sea water to store power at opportune times.\textsuperscript{23} Since there are many places around the UK where tidal lagoons may be developed, this technology could provide a valuable means of smoothing out peaks and troughs in supply and demand for power.

### 3.4 Other means of matching supplies of electricity with varying demands

Apart from pumped storage and the use of tidal lagoons for storage (Section 3.5), and the provision of a large-scale supergrid (Section 0), there is a range of techniques for matching supplies of electricity with varying demands (see http://www.desertec-uk.org.uk/elec_eng/supply_demand.html). These include:

— **Renewable sources of power that can provide power on demand.** These include EGS power, hydropower, thermal power plants fired by biogas, tidal lagoons\textsuperscript{24} and concentrating solar power with heat storage and backup sources of heat. With the provision of an HVDC supergrid, we can draw on such load-balancing resources not only from within the UK’s borders but, in addition, from as far away as Iceland (EGS power), continental Europe (hydropower and EGS power), or the Sahara (concentrating solar power).

— **Vehicle-to-grid technologies**, using batteries of electric vehicles to store power.\textsuperscript{25} This option will become increasingly attractive and important with the roll out of electric vehicles and plug-in hybrid electric vehicles.

— **A range of methods for managing demand**, including “dynamic demand”, “interruptible service”, “time-of-use billing”, and reductions in demand from air conditioners by the use of excess electrical power to create ice, and systems for reducing demand in combined-heat-and-power plants by storing excess electrical power as heat.


\textsuperscript{17} See http://www.friendsofthesupergrid.eu/

\textsuperscript{18} See http://www.desertec-uk.org.uk/elec_eng/grid.htm.


\textsuperscript{21} See also “Desertec: security of energy supplies”, http://www.desertec-uk.org.uk/resources/desertec_security2.pdf.

\textsuperscript{22} See http://www.desertec-uk.org.uk/csp/bonuses.htm.

\textsuperscript{23} Peter Ullman of Tidal Electric (http://tidalelectric.com/index.html), personal communication.

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— The provision of spare capacity or “plant margin”.
— Prediction of, for example, increases or decreases in wind speed in a given area.

A demonstration of the way that renewables can provide a comprehensive and robust source of electrical power is the “Combined Power Plant” which links and controls 36 wind, solar, biomass and hydropower installations spread throughout Germany. It has proved to be just as reliable and powerful as a conventional large-scale power station.

It is sometimes suggested that nuclear power is needed because it provides “base load” power. This is misleading for two main reasons:
— Nuclear power stations can and do fail (see Section 3.5, next) and their capacity factors are normally well short of 100%.
— Nuclear generation is an inflexible source of power because it cannot easily be turned up or down according to need. For balancing supplies and demand, nuclear power is much less useful than the renewable generators that can provide power on demand, mentioned above.

3.5 Intermittency

Contrary to what is sometimes suggested, all sources of electricity are intermittent because all kinds of generators can and do fail. When a nuclear or coal-fired power station fails, it is particularly disruptive because it removes a relatively large amount of capacity from the grid and it normally does so quite suddenly and without much warning. By contrast variations in wind power are much more gradual and there are normally several hours warning.

The disruptive effect when a nuclear power station fails is described in "Exclusive: Will wind farms pick up the tab for new nuclear?"27

In a report published in 2009,28 independent consultant David Milborrow says that electricity transmission networks in the UK are already designed to cope with variability arising from the failure of power stations and from variations in consumer demand, and that, for a small additional cost, wind power could provide up to 40% of the UK’s electricity. Further increases in the level of wind penetration are feasible and do not rely on the introduction of new technologies.

3.6 A flat calm with an increase in demand?

It is sometimes suggested that a flat calm over the UK and neighbouring countries, coupled with an increase in demand, would be a problem if we were to rely on wind power.29 If we were to rely exclusively on wind power, that would be true. But:
— Apart from wind power, there is a wide range of renewable sources of power available to us which would not be affected by a drop in wind speeds. These include EGS power, tidal streams, tidal lagoons, wave power, power from biomass, photovoltaics, and concentrating solar power.
— There is a range of techniques for matching supplies to demand, outlined above.
— As mentioned in Section 0, there is now a large number of reports from reputable sources showing how to decarbonise the world’s economies using renewable sources of power.30

The weight of evidence is that renewable sources of power, with conservation of energy, can provide robust and resilient supplies of power even in the scenario outlined above.

3.7 “Nuclear plants are mutual hostages: the world’s least well-run plant can imperil the future of all the others”31

Politics provides the main reason why nuclear power is a threat to energy security in the UK. The current nuclear crisis in Japan may not in itself lead to the closure of nuclear plants around the world—although Germany has already decided to close older plants, at least for a time, and the European energy commissioner, Günther Oettinger, has raised the prospect of a nuclear-free future for Europe.32 But it is likely that any repetition, anywhere in the world, of a nuclear crisis like that at Fukushima, would make it very difficult, politically, to continue running nuclear power stations in the UK and elsewhere. This is a good reason, but not the only reason, why the Government should not permit the building of any new nuclear power stations and should close down existing plants as soon as possible. Other reasons include:

29 See, for example, “Will British weather provide reliable electricity?”, James Oswald et al., Energy Policy, 36(10), 4005–4007, 2008.
— The fact that nuclear power stations, and trains and ships carrying nuclear fuel and nuclear waste, are vulnerable to bombs or missiles from terrorists or enemy forces.
— The fact that most of the nuclear sites around the UK are vulnerable to flooding and will become increasingly vulnerable with rises in sea level from climate change.
— The high cost of nuclear power, draining resources from renewables and conservation of energy where the money would be better spent.33
— Incompatibilities between nuclear power and renewables, holding back the development of renewables.34
— The fact that most renewable sources of power can be built much more quickly than nuclear power stations.35
— The still-unsolved problem of what to do with nuclear waste that will be dangerous for thousands of years.
— And the several other problems with nuclear power detailed on http://www.mng.org.uk/gh/nn.htm.

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

Electrification of the transport and heat sectors will increase the demand for electricity but not as much as one might think:
— Complete electrification of road and rail transport in the UK is likely to increase the demand for electricity by about 50%.36 Although the demand for electricity may increase by 50%, it is likely that a smaller increase in generating capacity will be required. This is because it is likely that electric vehicles will be charged mainly at night when there is likely to be surplus power available from wind farms, wave farms and the like, and because the use of vehicle-to-grid technologies will reduce the need for plant margin.
— With “zero-carbon eco-renovation” of the UK’s stock of buildings,37 the need for electricity to drive heat pumps or other sources of heat, would be small.38

As we saw in Section 0, there is good evidence that there are more than enough renewable sources of power to meet the UK’s needs, now and in the future.

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

Energy efficiency, especially zero-carbon eco-renovation of buildings (see Section 4), makes good sense but, as outlined in Section 4, it is probably not necessary for the UK to meet its needs for energy, now and in the foreseeable future.

Although the superabundance of renewable sources of power available to UK might tempt us to continue in our profligate ways, it would be prudent, and probably cheaper, to take advantage of the many opportunities that are available to reduce wastage of energy.

In this connection, it is pertinent to mention that a recent report from the Department of Engineering, University of Cambridge39 estimates that 73% of global energy use could be saved by practically achievable design changes to passive systems. This reduction could be increased by further efficiency improvements in conversion devices.

An interesting point is that, in the research by Mark Jacobson and Mark Delucchi, detailed in Section 0, they argue that a transition to renewables is likely to mean that the anticipated world demand for power in 2030 is likely to be 11.5 terawatts, compared with 16.9 terawatts if we were to stick with conventional sources of energy. This is because a transition to renewables would dramatically reduce the gross inefficiencies in power generation and in road transport that currently exist with conventional sources of energy.

33 See http://www.mng.org.uk/gh/nn.htm#subsidies.
34 See, for example, “Slash renewables target to protect nuclear, says EDF”, ENDS Report Bulletin, 2009–03–12, http://www.mng.org.uk/gb/resources/ends_report_bulletin_2009–03–12.html. In a world powered by renewables, the inflexibility of nuclear power is a problem. Much more valuable are the renewable sources of power that can deliver power on demand.
35 In 2010, Germany installed 8.8 GW of photovoltaic panels, producing about the same amount of electricity as a 1GW nuclear power station—but the nuclear power station would take about 7 years to build. In general, renewables can be rolled out much faster than nuclear power. They provide a much speedier solution to the urgent problem of cutting emissions of CO2.
36 See Appendix 8 of “Energy UK”, http://www.mng.org.uk/gb/resources/energy_UK3.pdf. This seemingly modest increase in demand is because electric vehicles are very much more efficient than vehicles power with the internal combustion engine.
38 It appears that, at present, the Government’s policies on the ecorenovation of buildings is based on the document Element Energy: The uptake of energy efficiency in buildings, a report to the Committee on Climate Change (2009, http://downloads.theccc.org.uk/docs/Element%20Energy_final_efficiency_buildings.pdf). I believe the main shortcoming of this document is that it fails to recognise the urgency of the need to cut emissions from buildings and it fails to recognise the potential of “super” insulation and other measures for making deep cuts in the need for heating or cooling of buildings.
6. 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?

There is good evidence, outlined in Sections 3, 4, and 5, that renewable sources of power, with conservation of energy, can provide all the energy we need now in a robust and resilient manner, and anticipated needs in the future.

The UK is particularly well endowed with renewable sources of power and is likely to become a net exporter of renewable energy in the future. Even if we were surrounded by hostile neighbours, we could meet all our needs for energy from within our own shores and territorial waters.

But otherwise, “fortress UK” would not be a good policy. There are substantial advantages, outlined in Section 3.2, for the UK’s energy supply system to be integrated with others across Europe, the Middle East and North Africa.

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

Given that supplies of gas are apparently plentiful, and likely to remain so for some time, and that the price of gas has apparently become decoupled from the price of oil; and given that gas-fired power stations are relatively quick and cheap to build, it will be tempting for electricity supply companies to invest in gas-fired generation of electricity. There would be the added attraction that gas-fired generation is a flexible source of power that can help balance supplies of electricity with variable demands.

In terms of energy security, a dash-for-gas is likely to mean increased dependence on imports with corresponding implications for security of supplies.

There would be the added problem that, although gas-fired electricity (without carbon capture and storage) produces about half the CO\textsubscript{2} emissions as coal-fired generation, it does still emit substantial quantities of CO\textsubscript{2} and would be a hindrance in the urgent task of bringing down emissions of greenhouse gases.

For those two reasons, it would be best for the UK to avoid another dash for gas. One way to discourage it would be to require that all power plants than burn fossil fuels, including gas, should be equipped with fully-effective carbon capture and storage.

As described above, there are more than enough renewable sources of power to meet our needs, and there is a range of techniques for balancing supplies and demand. If there was a real prospect of shortages of power then, as a stop-gap measure, gas-fired plants could be built quite quickly. But most renewable sources of power can also be rolled out fast, so there is really no need for us to go down the gas-fired route.

8. How exposed is the UK’s energy security of supply to international events?

At present, the UK is heavily dependent on oil for transport by road, rail, air and the sea, for some space heating and other applications. Since most of that oil is imported, international events may disrupt supplies and raise prices. Apart from the rebellion in Libya, the main worry now is that the world is at or past “peak oil” and that prices could rise steeply in the future.

The UK also depends heavily on imports of gas and coal. Although supplies may be less vulnerable to disruption and rising prices, the pressing need to cut emissions of CO\textsubscript{2} means that we should wean ourselves off all fossil fuels as soon as possible.

9. 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?

The UK is far too dependent on fossil fuels and the UK economy is vulnerable to disruption via increases in the prices of those fuels. Here, in brief, are some of the steps that can be taken to improve energy security for the UK and, at the same time, help to solve the urgent problem of cutting emissions of CO\textsubscript{2}:

— Vigorously promote the development of the full range of renewable sources of power, both within the UK and elsewhere in Europe, the Middle East and North Africa.

— Take steps to promote and develop technologies that can help to balance supplies of electricity with variable demands, including:
  — EGS power and other renewables that can provide power on demand.
  — Take steps to promote and develop technologies that can help to balance supplies of electricity with variable demands, including:
    — EGS power and other renewables that can provide power on demand.

40 Although the Japan nuclear crisis appears to have produced a spike in the price of gas.
41 An analysis published recently by the “Royal Society” suggests that despite high-level statements to the contrary, there is now little to no chance of maintaining the global mean surface temperature at or below 2°C; and that “the impacts associated with 2°C have been revised upwards, sufficiently so that 2°C now more appropriately represents the threshold between “dangerous” and “extremely dangerous” climate change.” (see “Beyond “dangerous” climate change: emission scenarios for a new world”, Kevin Anderson and Alice Bows, Philosophical Transactions of the Royal Society A, 369 (1934), 20–44, January 2011.
42 As noted earlier, Germany installed 8.8 GW of photovoltaic panels in 2011, producing about the same amount of electricity as a nuclear power station that would take about 7 years to build.
43 See, for example, http://en.wikipedia.org/wiki/Peak_oil.
44 The Government may like to consider becoming a partner in the Desertec Industrial Initiative.
— Tidal lagoons, the HVDC supergrid, and other technologies for the storage of power and balancing the grid.

— Vigorously promote zero-carbon eco-renovation\(^{45}\) of the existing stock of domestic and public buildings throughout the UK, and ensure that all new buildings are zero-carbon with minimal need for heating or cooling, and without the use of carbon offsets.\(^{46}\)

— Build on present policies to promote the electrification of transport by road and rail. Promote traffic-calming "home zones,"\(^{47}\) cycling and walking, and public transport.

— Promote research into the synthesis of fuels using clean sources of power,\(^{48}\) to meet the need for energy where electricity cannot be used (eg air travel).

— To help create an appropriate framework of incentives for these developments:

— Work to create a robust and effective successor to the existing EU Emissions Trading System via “upstream” reform of the system.\(^{49}\) In accordance with the “Kyoto2” proposals,\(^{50}\) part of the money from the auctioning of permits in the reformed system may help to bring forward early-stage renewables and the conservation of energy.

— Work to remove all subsidies for fossil fuels in the UK and elsewhere around the world,\(^{51}\) and, because nuclear power is a long-established technology that should be commercially viable without subsidies, and because unfair competition from a subsidised nuclear industry may divert funds away from renewables and the conservation of energy, withdraw the several subsidies currently enjoyed by the nuclear power industry.\(^{52}\)

— For the reasons given in Section 3.7, prohibit the building of any new nuclear power stations in the UK and close down the existing plants as soon as possible.

March 2011

Memorandum submitted by B9 Coal Limited

About B9 Coal

1. B9 Coal is developing game-changing projects in the field of carbon capture and storage, combining coal gasification with highly efficient alkaline fuel cells from AFC Energy to create first-of-a-kind Integrated Gasification Fuel Cell (IGFC) power stations.

2. AFC Energy’s alkaline fuel cell achieves 60% electrical efficiency and operates at low temperature and low pressure. The system has been designed for commercial application and is therefore low-cost (the company has eliminated the need for precious metals) and easy to manufacture and maintain. In addition, the use of hydrogen allows the system to load follow to meet peak energy demand.

3. With hydrogen as a feed-stock, fuel cell power stations are not only highly efficient and flexible in output, but they are also fuel flexible. The system has the ability to switch between and mix hydrogen produced from coal, gas, biomass and electrolysis sources. Such characteristics offer strategic energy security benefits in terms of utilising potential UK coal resources as well as the ability for grid balancing and back-up for intermittent sources of renewable electricity.

4. B9 Coal’s pursuits have been underpinned by a strategic partnership undertaken with Linc Energy, the world leader in underground coal gasification. UCG technology potentially gives access in the UK to an extra 17 billion tonnes of coal without the major environmental impacts of conventional mining.

5. In October 2010 B9 Coal announced a partnership with Powerfuel Power Limited, outlining plans to incorporate AFC Energy’s alkaline fuel cell at Powerfuel’s Hatfield site. The Hatfield project is among the most advanced CCS projects in Europe and has been entered for the European Union’s NER 300 funding mechanism for new renewable and CCS projects.

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\(^{46}\) Associated with this, there appears to be considerable potential for the use of inter-seasonal heat stores (see, for example, http://www.howeddell.herts.sch.uk/eco_issues/sustainable_elements.pdf).

\(^{47}\) See, for example, http://en.wikipedia.org/wiki/Home_zone.

\(^{48}\) See, for example, http://www.desertec-uk.org.uk/csp/synthesis.htm.

\(^{49}\) See ““Upstream” reform of the EU Emissions Trading System” and “Turn off greenhouse gases at source” which may be downloaded via links from http://www.k2support.org/.

\(^{50}\) See www.kyoto2.org.

\(^{51}\) In 2004, the New Economics Foundation estimated that, worldwide, subsidies for fossil fuels amounted to about $235bn and there seems not to have been much change since then (see “Fossil fuel subsidies “must end!”, BBC News, 2004–06–21, http://news.bbc.co.uk/1/hi/sci/tech/3818995.stm).

\(^{52}\) Those subsidies, and the way they may be withdrawn, are described in some detail in the “Nuclear Subsidies” report from the Energy Fair group which may be downloaded via http://www.energyfair.org.uk/. See also “Nuclear power: still not viable without subsidies” (Union of Concerned Scientists, February 2011, http://earthtrack.net/documents/nuclear-power-still-not-viable-without-subsidies). A formal complaint has now been made to the European Commission that subsidies for nuclear power in the UK are unlawful state aid under EU competition law (see http://www.energyfair.org.uk/actions).
EXECUTIVE SUMMARY

6. B9 Coal believes the issue of energy security is of paramount importance in the evolution to a low-carbon energy sector in the United Kingdom. This issue is complex and will require collaboration across Government and industry to ensure it is adequately addressed in the coming years.

7. B9 Coal believes the key elements of this debate are:
   — The projected increase in global energy demand by 40% in 2030 (BP Energy Outlook 2011);
   — the intermittent and unreliable nature of renewable energy sources, and hence the need for efficient load-following CCS power plants to adjust output and meet peak energy demands;
   — the UK’s dependency on fossil fuel imports and the impact unforeseen events (natural disasters/political unrest) can have on this supply;
   — the need for investment in new technologies such as CCS (including B9 Coal’s IGFC model), UCG, Enhanced Oil Recovery (EOR) and the UK’s hydrogen infrastructure to ensure adequate developments are in place to ensure energy supplies are maintained and secure in a low-carbon energy mix.

8. UK electricity demand is due to increase in the next 20 years (2010, DECC, Electricity Market Reform), underpinning the need for a complete overhaul of the UK’s energy sector and a reassessment of consumer needs and behaviour. Events in recent years have highlighted the susceptibility of the UK and EU energy supplies to political events and natural disasters and the need to address the issue of supply security. This susceptibility will increase in the transition to an energy sector with high dependence on intermittent renewable energy sources.

9. Recent events have also demonstrated how unexpected and unpredictable geopolitical and meteorological events may have major consequences for the supply of energy to the UK and across the European Union. Gas disputes between Russia and the Ukraine in recent years have resulted in supplies being partly or in some cases entirely cut off to up to 18 European countries, highlighting the need for internal energy security mechanisms to cope with future energy shortage scenarios. Furthermore, cold spells in winter 2010 highlighted the UK’s dependency on imported energy sources, with gas supplies reaching worryingly low levels in December. With increasingly harsh winters becoming the norm this will become a regular occurrence without policy and industry intervention to address the issue.

10. The future energy infrastructure will also have to account for consequences stemming from a decarbonised electricity sector. Renewable energy sources are inherently unreliable in nature, necessitating an enhanced back-up system to ensure capacity when wind, solar and wave power cannot meet base-load demand levels.

11. There must be a system in place during this transitional period to ensure the lights stay on and the disastrous consequences of blackouts can be avoided. The 2003 blackout on the US east demonstrates the impact such events can have for industry; a quarter of businesses surveyed after the blackout reported losses of $50,000 per hour during the blackout (2004, Mirifex).

12. B9 Coal’s proposition for fuel cell power stations offers a secure supply of low-carbon energy with the ability to adjust output efficiently to meet demand and address the problems posed by unreliable renewable energy sources. The IGFC model being put forward by B9 Coal also has multi-fuel potential and when coupled with hydrogen storage will ensure secure supplies of cleanly generated electricity.

13. This game-changing technology is currently restricted by the lack of financial incentives available and the uncertain policy landscape surrounding the green energy sector. While the UK Government has committed to funding four CCS demonstration projects, without long-term clarity and commitment the UK will not maintain its position at the forefront of developments in alternative energy technologies.

QUESTIONS

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

14. In the coming decades fossil fuels will play an increased role in the UK’s energy mix. The Department of Energy and Climate Change’s 2050 Pathways (2010; DECC 2050 Pathways Analysis) scenarios all show CCS constituting a large proportion of the energy mix, confirming the UK’s reliance on fossil fuels far into the latter half of the 21st century. This in turn means that fossil fuel price fluctuations are due to be reflected in retail electricity prices to a similar or even greater extent than at present.

15. Huge increases in fossil fuel prices can be avoided by ensuring an uninterrupted, secure supply. New technologies such as underground coal gasification (UCG) and enhanced oil recovery (EOR) are examples of pioneering technologies which will permit the sourcing of previously inaccessible fossil fuels in the UK and EU. These technologies can be combined with carbon capture and storage to provide clean energy at a manageable cost, while reducing our reliance on imports from abroad.
How sensitive is the UK's energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?

16. The UK's energy infrastructure is currently largely dependent on fossil fuelled power generation. Government targets intend for the electricity system to be almost entirely decarbonised by 2050, therefore necessitating significant transformations in the next 20 years. This overhaul of the electricity generation, transmission and supply networks will need significant investment, without which the system will almost certainly fail to function properly.

17. Effective policy is a vital tool to underpin the transformative process, and will provide the necessary guarantees and confidence needed to incentivise investment in this fledgling sector.

18. The B9 Coal proposition will generate electricity cleanly and efficiently by passing hydrogen through AFC Energy's alkaline fuel cells. This highlights the potential of a hydrogen economy, and the need for investment in the necessary infrastructure for this to become a reality. The various options for green hydrogen generation must be developed and incentivised in order to underpin the evolution to a hydrogen economy alongside other alternative energy initiatives such as CCS and UCG.

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

19. Electrification of the heat and transport sectors will significantly increase levels of electricity consumption in the UK. While this will be a welcome transition on the road to a low-carbon energy sector, it will require generators to devise low-carbon solutions for large-scale, reliable power generation.

To what extent does the UK's future energy security rely on the success of energy efficiency schemes?

20. It is vital to link electricity supply with demand, and for this to happen a greater emphasis must be placed on innovative technologies which allow us to use our resources not only cleanly but significantly more efficiently.

21. The B9 Coal model will employ forward-looking technologies such as coal gasification and alkaline fuel cells which maximise the calorific value of feedstock.

22. CCS projects are traditionally hampered by the related reduction in efficiency; however the B9 Coal IGFC model differs in this regard through its unique blend of technologies which ensure efficient output of clean electricity. Ensuring efficiency from large-scale generators will be vital in in the fight to tackle over-consumption of fuel, and supply security in general.

23. Smart grid technology and the digitisation of the UK's electricity supply infrastructure will also be a vital tool in the electricity sector throughout the 21st century. However, it must be noted that there is a limit to the effect greater energy efficiency can have on power consumption levels, and therefore these measures must be coupled with significant action across the board to ensure a positive outcome from such efforts.

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. The UK's legally binding emissions reduction targets are the most ambitious in existence. Either rapidly reduced consumption is required or an overhauled low-carbon energy sector. The Department of Energy and Climate Change has also projected that while meeting emissions reduction targets will be an expensive process, climate change and its associated effects would result in significantly higher costs if no action is taken to reduce global warming. Charles Hendry, Minister for Energy outlined this point in February 2011 when he noted that CCS has an "important role in balancing the electricity system. Without CCS, halving emissions by 2050 will be 70 % more expensive" (2011, DECC).

25. International cooperation is an important factor in the development of global clean energy projects, and while other Governments have expressed the impetus for change they have not signed up to such ambitious goals. This state of play leaves the UK open to the risk of "going it alone" in power sector overhaul, and while this may provide some key benefits it will also pose restrictions on knowledge-sharing and innovation across borders, and force decarbonisation before sustainable, secure alternative supplies are readily available. UK targets for greenhouse gas emissions reduction will require rapid action on the part of Government both at home and in a global setting.

26. Renewable energy is intermittent in nature increasing the need for responsive back-up capacity. CCS projects can provide this capacity, alongside 19% of emissions reductions, but only if the necessary incentives and investment are in place.

27. Fossil generators currently adjust output to meet peak capacity, however this system is inefficient and will be called upon increasingly with the proliferation of intermittent renewable energy sources in coming decades. The B9 Coal IGFC model can adjust output quickly and efficiently to meet demand, as opposed to other traditional power plants that operate at reduced efficiency when output is reduced. The B9 Coal model
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can also be coupled with hydrogen storage and other technologies such as underground coal gasification to ensure a secure supply of power when other sources of energy are not an option.

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

28. A dash-for-gas would be an extremely risky energy scenario and would result in other forms of low-carbon electricity and CCS being disincentivised, alongside an increased fossil fuel dependency for the UK and in turn increased carbon emissions.

29. B9 Coal supports the introduction of an Emissions Performance Standard (EPS) as part of the Government’s Electricity Market Reform package in order to disincentivise the construction of unabated fossil fuel power stations. However, the current model’s level is too high and will serve to encourage the development of unabated gas power stations and discourage investment in Carbon Capture and Storage projects. B9 Coal would therefore favour the introduction of an EPS set at a level low enough to include restrictions on gas power stations, in addition to coal. The proposed model as it stands runs the risk of jeopardising the UK’s ability to meet emissions reduction targets and leaving the UK reliant on imported gas. B9 Coal suggests the introduction of an EPS with a sliding scale to 2030 in line with CCC national emissions trajectories to 2030 and beyond. The EPS policy would have specific emissions limits for individual power stations set at the time of planning consent and “grandfathered” over operational lifetime or through significant upgrade.

30. The B9 Coal process is equally applicable to natural gas and coal projects; it has recently been partnered with Calix Endex carbon capture technology as part of the Powerfuel Power NER 300 funding application to develop a gas CCS project at Hatfield.

How exposed is the UK’s energy security of supply to international events?

31. At present the UK imports a large proportion of the fossil fuels consumed here each year, making the energy system inherently reliant on foreign imports and in turn international events. UK coal imports currently account for approximately 70% of total coal consumption (2008, Association of Coal Importers), while oil and gas are also imported in significant quantities.

32. There are examples throughout history of how geopolitics has impacted on fuel prices and supplies, with conflicts in fossil fuel-rich regions of the world becoming commonplace in the 21st century. The most recent example is in Libya where international forces are currently intervening. This current crisis has seen oil prices increase dramatically. Western Europe is also highly reliant on Russian gas exports, with cross-border disputes impacting on the security of this supply to the EU.

33. These events emphasise the need for adequate national energy supplies to ensure security during uncertain times. Pioneering technologies such as underground coal gasification and enhanced oil recovery can provide sourcing opportunities for fossil fuel stocks that were previously inaccessible. UCG alone could potentially give access to an additional seventeen billion tonnes of coal in the UK and employing the B9 Coal model in this process would ensure this coal is used cleanly and efficiently to maximise supply security, while maintaining low emissions levels.

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?

34. Winter 2010–11 posed significant questions as to the resilience of the UK’s energy security when fuel supplies reached worryingly low levels. These challenges will increase as we move further into the 21st century and towards an electricity system dependent on a significantly higher proportion of energy sources such as wind, wave and solar power.

35. Given the projection that electricity demand is due to increase significantly in the next four decades it is vital that the policy regime is given an overhaul as soon as possible in order to prepare for the uncertain future ahead, and to highlight barriers and hurdles before it is too late.

36. Current Government policy has been unreactive and uncertain in the field of low-carbon energy, and has had the effect of disincentivising investment and development in this field.

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

37. Carbon Capture and Storage technology is a rapidly developing field offering the opportunity to meet energy demand in the transition to a low-carbon electricity sector.

38. Other forms of low-carbon electricity generation are necessary to ensure a diverse future energy mix in the UK; however it is evident from DECC projections that the wide-spread adoption of CCS will be crucial in order to meet increased energy demand throughout the 21st century.

39. B9 Coal feels that the IGFC model will help to address some of the key challenges of energy security. The B9 Coal IGFC model can adjust output quickly and efficiently to meet demand, as opposed to other traditional power plants which operate at reduced efficiency when output is reduced. The B9 Coal model can
also be coupled with hydrogen storage and other technologies such as underground coal gasification and enhanced oil recovery to ensure a secure supply of power when other sources of energy are not an option.

REFERENCES

Association of Coal Importers; 2008; http://www.coalimp.org.uk/3.html


Memorandum submitted by ReSus Technology Ltd

EXECUTIVE SUMMARY

The “Security” and “Independence” of the UK’s energy supply are not mutually inclusive factors; in fact the only one of these terms that is essential is “Security”. If the UK’s energy supply is secure then “Independence” is of secondary importance as this becomes primarily an economic factor relating in the main to cost of imports. Conversely if we have “Independence” of supply without security then it is of limited worth.

In any event, Energy Independence is no guarantee of Energy Security; the only certain way of achieving this is through international social and political stability. We have only to look to Iraq, a country awash with independent energy, whose energy infrastructure was destroyed in days and yet years later they are still struggling to restore it and who knows what the international political landscape will look like by 2050.

The reality of the current situation is that we do not have guaranteed “Security” or “Independence” of energy supply but we rely on diversity of supply sources and sourcing from “friendly” countries to maximise supply security, this is equally true for uranium as fossil fuels. Accordingly the main focus of this response is on supply security in an energy scenario that is sustainable.

Whilst on the topic of terms used in renewable and sustainable energy solutions, I believe the terms “low carbon” & “de-carbonisation” should be qualified because the fundamental problem is not the carbon but its origins, ie fossil fuels, personally I think these terms are inappropriate and should be replaced with something along the lines of “low fossil” or “de- fossilisation”, because in principle there is no fundamental reason why an energy infrastructure cannot be based on carbon, the proviso being that it must be sustainable in the broadest meaning of the word. Moreover I strongly believe that “green carbon”, by which I specifically mean synthetic carbon (green coal) and carbonaceous fuels and generally not biomass, has the potential to address one of the key challenges of a renewable energy economy, namely that of energy storage, particularly for electricity generation.

Additionally, to maximise the chances of reaching the renewable and de-fossilisation targets it is important to consider our entire energy infrastructure in conjunction with environmental policies because much of our waste contains significant amounts of recoverable energy.

Key requirements to achieving our targets within the desired time frame are:

1. Maximise the efficiency of energy generation.
2. Maximise the efficiency of energy distribution.
3. Maximise the efficiency of energy use.
4. Minimise costs in order to accelerate uptake.
5. Provide of substantial long term energy storage.

The first three elements effectively reduce the amount of sustainable energy required, in general the less we need the faster we can provide the infrastructure to provide it, the third accelerates its implementation and the fifth improves security.
Ev w26  Energy and Climate Change Committee: Evidence

NOTES ON RESPONSES

I have split my response into two parts, the first (below) commenting on the specific questions in the terms of reference where I consider I am able to do so. The second part is a presentation of a scheme for a “Sustainable Integrated Energy Infrastructure” incorporating substantial energy storage technology, primarily by the incorporation of a “CCC” (Closed Carbon Cycle—see separate PowerPoint attachment “SustainableEnergyCycle+CCC.ppt”). The underlying concepts of the integrated energy infrastructure are given diagrammatically with supporting notes as this conveys the principles far more easily than trying to do so in words only. Please note; copies of this part of my response has been shown and/or given, to a few people but it has never been officially presented or published.

RESPONSES TO QUESTIONS

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

Nuclear power for electricity production has to be seen as a better alternative to coal and oil, particularly if the new thorium and/or fusion technologies can be brought on stream. However I do not believe that renewables can provide a better alternative that can be economically viable and that the main driving force for nuclear is political which is bolstered by the current uncertain political environment in many countries that are rich in solar resources.

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

Energy storage is critical when large amounts of intermittent RE from solar or solar derived (wind, wave etc.) sources are included in the energy mix. Long term stable energy storage, several weeks or more, could also be a major contribution to energy security. The only current storage mechanisms that meet these criteria economically are chemical fuels, ideally in solid or liquid form. In a non fossil based energy economy these would need to be created either biologically or synthetically. One such mechanism for achieving this is the “CCC” (see attachment “Sustainable Integrated energy infrastructure”) where the CO2 produced during energy conversion is captured and recycled back into synfuels or biofuels.

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

Substantial electrification of transport could very significantly reduce the amount of energy required, the less energy we need the greater the chance of providing it which translates to improved security.

To give an example of the possible energy reduction; an internal combustion engine car running at 45mpg (which is better than current typical UK performance) consumes about 1,000Wh of energy per mile, by comparison well designed electric vehicles consume less than 250Wh of energy per mile (eg Tesla Roadster about 230Wh/mile) a fourfold energy requirement reduction or more.

Electrification of heat, at least for space and water heating, I would suggest is of little or no benefit and because heat production from chemical fuels, particularly gas, is generally very efficient (modern condensing boilers can achieved about 90% efficiency and absorption heat pumps would go well above 100%) electrification of heat may well increase our input energy demand and thus reduce energy security. A far better approach would be to add solar thermal heat collection and storage to space and water heating systems, which are (or should be), lower cost and more efficient than solar PV.

In the overall scheme a move to electric vehicles and a redirection of biomass from biofuels for cars to bio-methane for efficient space heating would make a much better use of our natural bio-energy resources. Liquid biofuels should be reserved for applications where electrification is inappropriate, such as air travel.

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

Anything that reduces our energy demand has to have a positive effect on energy security.

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?

No comment.

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

This could be beneficial if it were a “dash-for-biogas” or grid injection biomethane. A significant proportion of the UK’s gas requirements could be met from energy recovery from municipal organic waste, that is currently either composted, incinerated or sent to land fill, by the use of bio-digesters. The waste from these digesters can also provide a useful fertiliser. Furthermore, there are projects exploring the possibility of harvesting seaweed for bio-fuel. Aberystwyth University has, and may still be, researching the use of seaweed as a
biodiesel source for bio-ethanol production for transport, I strongly believe that bio-methane production would provide far better utilisation of such a resource.

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

No comment.

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?

The only indigenous secure long term energy supplies we have are renewables, particularly wind, and coal. An energy strategy based around recycled carbon using solar energy to regenerate carbon (green coal), or other carbonaceous fuels, from CO2 and using DCFC (direct carbon fuel cell) technology for electricity generation could supply rapid supply response to mitigate renewables’ intermittency. There are thermo chemical processes that are well established for converting CO2 to carbon fuels (the Bosch, Sabatier and Fischer-Tropsch reactions) which if combined with the right solar technologies might be economically viable, though as far as I am aware there is no current research in this area apart from the very limited amount I have done myself. One big advantage of carbon is that being a solid it could be easily stockpiled in order to cover supply fluctuations and in extreme cases it should be possible to supplement or replace it with fossil alternatives.

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?

No comment.

March 2011

Memorandum submitted by Jonathan Cowie

SUMMARY

1. Energy (certainly oil) has an elastic price and there are variations between nations. However, markets are sensitive to sharp changes in supply. Meanwhile the UK markedly reduced investment in energy infrastructure from the mid-1980s to throughout the 1990s and so now relies on much foreign business and resources to manage and ensure its energy supply. Energy efficiency measures have seen some considerable success but are subject to the law of diminishing returns and Jevons paradox. Furthermore, there are perceptual dimensions to energy efficiency that (now that many of the basic energy efficiency measures are in place) that need to be considered. Yet energy security requirements do largely chime with those of reducing greenhouse emissions. There are difficulties with proceeding ahead of economic competitors and this necessitates reducing energy intensive industries (focusing on lower energy and high added value innovative industries) to ensure a strong economy; a strong economy is required to pay for the transition to a low-fossil, high energy society: this last, though, tends to incur fossil carbon leakage. While a second dash for gas might be tempting, it would not be a substitute for investing in a low-fossil transition now (or deferring this investment under the specious guise of gas being a “transition” energy source). This is because not only is the UK, with its high dependence on fossil fuels and increasing reliance on fossil imports, becoming more exposed to energy security risks, but because the whole world itself has “cheap” fossil fuel security issues (notwithstanding greenhouse concerns) against a backdrop of increasing climate change already in train. Speed to abandon fossil is essential for medium-to-long term economic competition even if political perspectives (five-year election cycle) are short-term. Currently the UK is very exposed to a lack of energy security in the coming decades. Failing to address this (real material resource) issue will make the current financial sector crisis (based on notional banking values) seem trivial.

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

2. Despite fossil carbon concerns (energy security and climate change) fossil fuels still make up over 90% of UK primary energy supply, and here oil accounts for some 37%. With regard to the latter’s long-term prices, between 1950 and 1973 crude oil prices remained constant in cash terms but declined in real terms by over 30%. October 1973 saw the oil crisis with OPEC crude rising from $1.77 a barrel to around $7.00 in three months. The longer-term smoothed trend (taking out daily/weekly market fluctuations) saw Dubai crude rise from $1.90 in 1972 to $10.41 in 1974. This caused a profound shock to economies around the world that did not have domestic oil reserves: those that did had an economic advantage.

3. One important energy security matter to note from the 1973 crisis was that it was politically induced through OPEC marginally restricting supply combined with its cartel imposing a unilateral price hike. However, the Middle East oil cut in supply at the time only represented less than 10% of global production yet the price the market was prepared to pay increased by four-fold: the fossil fuel market therefore seems to be supply sensitive and price insensitive.

4. What we are faced with in the early 21st century are twin threats. (i) potential short-term political disruption of supply combined with medium-term manipulation of the market. (ii) the advent of peak oil (or...
table top oil might be a better description) and the longer-term decline in the global availability of oil cheap to mine.

5. However the question the Select Committee poses is carefully worded in asking how resilient is the UK energy system to future changes in prices. There have already been marked long-term differences between nations in prices end-users pay for fossil fuel. This is illustrated by comparing station court petrol prices between the US and UK. (See table below.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Automobile fuel</th>
<th>Price in UK (London)</th>
<th>Price in USA (east)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>1 US gallon</td>
<td>£1.75 ($3.24)</td>
<td>$1.30 (£0.74)</td>
</tr>
<tr>
<td>1992</td>
<td>1 UK gallon</td>
<td>£2.10 ($3.88)</td>
<td>$1.56 (£0.84)</td>
</tr>
<tr>
<td>2005</td>
<td>1 US gallon</td>
<td>£3.50 ($5.95)</td>
<td>$2.04 (£1.20)</td>
</tr>
<tr>
<td>2005</td>
<td>1 UK gallon</td>
<td>£4.20 ($7.14)</td>
<td>$2.45 (£1.44)</td>
</tr>
</tbody>
</table>

Note: fluctuations in the exchange rate mean that caution is advised when making strict comparisons and hence an allowance of around ±5% is advisable. Nonetheless, this price comparison between nations is fairly representative.


6. Yet despite such long-term differences between nations, both the US and UK economies continue to function.

7. So it is sharp changes in fossil fuel price to which nations tend to be less resilient than actual prices per se even if users (such as the UK road transport sector) complain bitterly.

8. With regard to energy security, the Central Electricity Generating Board (CEGB) in its 40 years up to the 1990s took the long-term strategic view. This was particularly enhanced by political instruction in the 1980s so as not to be too dependent on any single fuel and particularly coal whose supply was at that time threatened by industrial action. Ironically, it was in part this redundancy in generating capability that was one of the major political reasons for citing the CEGB to be inefficient and so a raison d’être for the privatising of the industry (nuclear for a while being part excepted).

9. True, the UK gained with this privatisation cheaper energy supply, but it lost the more strategic longer-term build of new more efficient power stations: new plant was constructed but at a lower pace. The UK also lost further development of its then embryonic 3rd nuclear (PWR) programme as well as much of its R&D capability that underpinned innovation of all fuel plant types.

10. The loss of the 3rd nuclear programme meant that we also lost much domestic technical ability and today we must largely import this expertise.

11. Meanwhile with regards to nuclear’s contribution to energy security due to changes in uranium prices, the advantage of fissile material is that it is energy dense and this facilitates storage (hence the potential ability to use stores to ride out short and even medium-term market blips). The disadvantage is that the UK supply of radioactive material that could be ultimately used in fission is not all in a suitable form and conversion costs are not cheap. What this means is that UK is capable of maintaining a stock of nuclear fuel so nuclear power is reasonably resilient to short-term market blips in uranium prices but not to medium-term changes in the uranium market. I am not familiar with the current situation but note that the Nuclear Decommissioning Authority’s Uranium and Plutonium: Macro-Economic Study (2007) suggests limited medium-term generating capability from the UK materials stock then currently held. He recent A Low Carbon Nuclear Future David King report points to processing current waste as providing decades worth of UK nuclear supply at current usage: note that this time period would be greatly reduced with an expanded nuclear programme (as is envisaged) and further reduced taking into account increased electricity demand as we switch away from fossil carbon.

12. The Nuclear Energy Special Interest Group of the Energy Institute (made up of those currently in the industry) and the Institute of Physics (who in the 1990s were concerned as to the loss of related physics training) are better placed to inform the Select Committee with further detail than myself should it be required.

13. Renewables are, of course, not prone to market vagaries in either fossil fuel or uranium price change, however the contribution renewables make to UK primary energy demand is still very small with much kit having to be imported. Many comparatively small companies (together with renewable wings of a few of the giant energy companies) make up the renewable sector that is valiantly trying to grow despite current cheaper fossil fuel availability (which of course will not last). Mechanisms such as the feed-in tariff do critically help. The Renewable Energy Association is better placed to inform the Select Committee with further detail on these points than myself should it be required.
How sensitive is the UK’s energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?

14. Investment in the grid is required to facilitate the more disparate energy production of renewables. Connection to the grid is presenting challenges for some renewable schemes.

15. With regards to natural gas, there are two levels of concern. (i) Of short term concern, extra volume gas storage is required if the UK is to be able to ride out a month or two of interruption in supply (the Ukraine incident of January 2009 being an example) or a particularly marked market episode. (ii) Of long-term concern, the global supply of “cheap” natural gas will only last a matter of decades at current rates of consumption. However, in the short term at least, global demand for natural gas is likely to rise and the UK further adding to this would not be prudent.

16. With regards to nuclear, lack of investment since the halting of the PWR programme that began in the 1980s and the selling off of the state-backed CEGB, has meant that foreign investment has been required. Potential investors in nuclear might argue that the conditions (and long-term assuredness) under which they are expected to make investments have not been attractive. (Long-term market regimen stability concerns also apply to renewables.)

17. With regards to coal, the supply of domestic cheap coal will only last a decade or two at current rates of use. However the supply of more expensive UK coal is far more extensive

18. Provided the UK is prepared to pay the price (both for fuel and the energy production method) carbon capture and storage may well be a meaningful option to increase UK energy security. However, commercial-scale carbon capture and storage has yet to be proved in the UK.

19. Finally, there is the time factor. The delays in investment in energy infrastructure and delays in implementing mechanisms mean that we run the risk of not achieving energy security goals for our economy ahead of our competitors. These delays have an additive effect. To get from where we are now (with high fossil dependence) to an energy secure future we need to make many changes to technology, infrastructure and market, so there will be a transition period involving up-front investment. Yet many of these stages each seem to be blighted with delays of months if not years. Add all these together and there is considerable lag in Britain moving forward. Current examples include delays in infrastructure/market in getting individual renewable projects connected to the grid and delays in initiatives such as the renewable heat initiative. (The Renewable Energy Association can tell you more.)

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

20. In the medium-to-long term it is clear that the UK is to going to have to substantially increase the electrification of its transport and heat sectors if it is to wean itself off of increasingly scarce, and climate-impacting, fossil fuel use.

21. However the laws of thermodynamics are such that there will be energy losses as energy is both converted to electricity and (for transport) stored in electrochemical charge form be it as a more conventional accumulator or hydrogen cell. These inefficiencies will serve make the UK less energy secure (in that more primary energy will need to be produced to deliver the same amount of energy at the point of end-use) unless the UK develops the capability to harness a considerable amount of non-fossil fuel energy. In the event of the latter, the UK will become more energy secure and so this is the only long-term sustainable route to take.

22. The policy difficulty comes with the afore transition period (paragraph 19) especially as political time frames do not match the transition time frame.

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

23. This is a more contentious subject than many concede. Regarding energy efficiency, there are four main difficulties and two points of perception to bear in mind.

24. The first difficulty is that it is true that there is much that can be done to improve energy efficiency in the UK. But equally it is true that much has already been done to improve energy efficiency in the UK. However there is a law of diminishing returns: it is easier to save the first 10% of energy wasted than the second to last 10% of energy wasted (and thermodynamically impossible to be 100% energy efficient). At some point one needs to know when to stop improving energy efficiency: when continuing the game is not worth the candle.

25. The second difficulty, in energy security terms, is that the benefit of improved energy efficiency may not necessarily be taken in the form of reduced energy consumption but improved service or goods delivery/use. For example, improving heat insulation may not see a consumer reduced energy demand but a chance to have a house warmed to a degree that prior to improving the dwelling’s energy efficiency would simply have been unaffordable. This is a variation of Jevons’ paradox (or the Jevons effect) and was explored in relation to energy by a number of academics and subsequently popularised in academic circles as the Khazzoom-Brookes postulate.
26. The third difficulty is that our technologically based society continues to develop (which is something we all want). What this means, for example, is that while in the 1950s most British households had radios, in the 1960s it was mono-TVs and, even though the energy efficiency of these mono-TVs improved, in the 1980s we saw many households acquire more energy-demanding colour TV. Today we have widescreen, high-definition systems that operate often simultaneously in combination with DVD players and hard drive computation. And so while each individual technology becomes more energy efficient within its own time frame of use, new technology comes along and more often than not this incurs a higher energy demand. (Another example would be the evolution of fridges and the transition to fridge freezers.)

27. Another energy-related property of increasingly technologically based societies is that they continually find new ways to increase energy demand (as opposed to the afore evolution of existing technology). And so in the early 1980s some of us had BBC Acorn Computers, a monochrome monitor and a printer. Then in the 1990s we had the first of the modern PCs. From then on not only did their processing power and memory capacity increase (hence power demand) but the add-ons were not just confined to a printer and monitor but other items that had never been domestically used before such as a scanner, router etc etc. Yet today we have computer processing at a far greater energy efficiency (Joules per bit processed) than the Acorn but this is completely offset by both greater bit processing and accessory usage.

28. The fourth and final difficulty is that energy efficiency is sometimes undermined by the way the market is structured. For example, domestic users of energy pay more for initial energy usage and less per unit of energy with further usage. This does not encourage energy saving. Furthermore, it penalises the energy poor. Taking a hypothetical average family household (DECC and the industry can tell us who these are in reality) suppose that a proportion (say a third) of their initial energy is cheaper and their subsequent remaining portion (two thirds) more expensive then swapping these so that the first two thirds of energy use was cheaper and the final one third more expensive would be cost neutral: the energy bill would be the same. However for those using less but needing energy (such as the elderly living alone) would find it cheaper, and those who use energy in a profligate way would find it more expensive anyway so consider being more energy efficient than they do now and so be more encouraged to reduce their demand. Domestic consumers’ initial energy for basic requirements needs to be cheap and after that further (more profligate) energy use needs to be more expensive: ie the reverse of the system we have now.

29. Then there are the two perceptual points with regards to energy efficiency and energy security. The first is that what may seem inefficient may not actually be inefficient. Using cheap (and with low energy of construction) hot filament and low efficiency light bulbs in a living room in winter in not an inefficient use of energy as both the bulb’s light and heat are used by the occupants especially as living room lights are on for longer in the winter and less in the summer. The heat contributed this way by appliances is called a “free heat gain” in Gerald Leach et al “A Low Energy Strategy for the United Kingdom” (1979). Conversely, a front door porch light clearly does necessitate high-energy efficiency as waste heat is lost to the outside. So the question remains as to whether it is best for UK PLC to have all lights with high-energy efficiency and high energy of construction or a mix with lower light efficiency, heat loss and cheaper (resource) cost of construction?

30. The second issue of perception to note is that there is no point of having high energy efficiency unless there is something about which to be efficient. Energy efficiency is not a goal in itself as it is nothing unless set against energy consumption and production. As such improvements in energy efficiency by itself can never replace the need for energy production.

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?

31. Aside from the afore electrification transition problem, the impact on energy security of trying to meet the UK’s targets for greenhouse emission reductions are quite favourable. In the main, meeting energy security concerns chime with those of reducing greenhouse gas emissions. This has been known for a while even over a decade ago when there was more climate scepticism (cf. Cowie, J, (1997) Climate and Human Change: Disaster or Opportunity? Parthenon, London & New York).

32. Of course, the devil is in the detail. For example, a biofuel programme (often considered “greenhouse friendly”) would necessitate fertiliser use that would increase agricultural greenhouse gas emissions, but then irrespective of the biofuel question, the UK is going to have to look to meeting its food security concerns as the global population increase towards the middle of this century who will go after the imports we currently take as being secure.

33. Furthermore, if energy security is defined, not simply as ensuring that the UK is provisioned with energy but, as provisioned with cheap energy (and some might define energy security that way for international competition reasons) then moving towards a low fossil carbon economy before other nations do will make our energy intensive industries less competitive. (This medium-to-longer term view may be difficult for politicians with short-term five-year electoral horizons to consider.) Yet we require a strong economy so as to pay for a switch to becoming a low-fossil and a high energy security nation. The trick therefore is therefore to both balance long and short term considerations and with the latter to ensure that the UK focuses on high-value industries that do not require prodigious quantities of energy until we (and our competitors) have been weaned of fossil fuels.
34. Another key point here being that addressing energy security is should not simply the province of DECC but other Government departments too (such as those responsible for business and industry). This matter is in the hands (or not as the case may be) of our politicians.

**What would be the implications for energy security of a second dash-for-gas?**

35. Not good. Domestic supplies and production of natural gas are declining. And though while the medium-term supplies of imported gas are theoretically there (hence the potential for short term economic and political seduction), imported gas supplies are subject to potential disruption and will almost certainly be the focus of competition from other nations hence medium-to-long-term price increases. Furthermore, a short-term dash for gas would not in anyway substitute for the long-term need for investment in sustainable non-fossil energy resources: all that would happen is that the latter investment would be delayed to a time when natural resources were more expensive in real terms due to increasing global population and diminished “fund” resources (any resource of which there is a fixed raw (as opposed to recycled) supply). A second dash for gas would be a fool’s economy. Having said that, some limited new gas supplies will be required to ease the transition. The trick will be to keep dependence on imported gas low and temporary.

**How exposed is the UK’s energy security of supply to international events?**

36. Very. It has been known since the Jay Forrester World Models (1971)—and has recently been popularised in policy circles by the Government’s Chief Scientific Advisor John Beddington with his “Perfect Storm” (2009)—that global population will peak (along with food and water demand) and cheap fossil fuel dwindle a few decades away, around the middle of this century, and that these demographic crunches will be set against a backdrop of increasing climate change stress worldwide.

37. A back of the envelope approximation suggests that annual global energy demand will double in the 2040s from what it was in the first decade of the 21st century. How will this extra demand be met (especially given the increasing absence of cheap fossil fuel)?

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**Present & Likely Future Global Energy Demand**

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Per capita Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964 AD</td>
<td>3.27 billion</td>
<td>1 toe</td>
</tr>
<tr>
<td>2004 AD</td>
<td>6.37 billion</td>
<td>1.6 toe</td>
</tr>
<tr>
<td>2044 AD</td>
<td>8.7 billion</td>
<td>~2.3 toe</td>
</tr>
</tbody>
</table>

Fig 8.6


38. Given that, the 21st century will see dwindling supplies of cheap fossil fuel (hence fossil fuel will be more expensive), and notwithstanding greenhouse concerns, the world will somehow need to double its energy production. Nations with well-above-the-global average of energy consumption per capita will be exposed to extreme energy security pressure unless they are energy self-sufficient and low fossil fuel reliant. Yet at the moment the UK, with its high dependence on fossil fuels and increasing reliance on fossil imports, is becoming more exposed to energy security risks both our own and internationally. This generic picture translates into specific episodes of energy security concern be they the Ukrainian gas pipeline incidents or the current Middle East political transformations.
Ev w32  Energy and Climate Change Committee: Evidence

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?

39. No. The UK is far from being able to deal with uncertainties and risks inherent in all of the above areas? Strict (very strict) commitment to a medium-to-long term energy strategy and investment thereof is required.

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. The UK has energy leakage (fossil carbon leakage) in that we rely on imported goods that require others to expend energy on our behalf. If we want to continue to rely on these imports then we need to ensure those on whose imports we depend are energy secure too.

41. Population is a key driver of energy consumption, hence energy in-security. More people means more energy demand. I fully realise that population size is an issue that politicians find uncomfortable, but that is no excuse for not addressing it. Current UK population growth of around 2.7% between 2005–09 makes for a trend that if continued would see the UK population double before the century’s end. Western Europe is one of the most densely populated areas of the world. We really do need joined-up Government Departmental thinking and work to lower the UK population both for energy and food security as well as other reasons (such as lowering teenage pregnancies, housing shortage, communication congestion, or whatever…).

42. Their may be concern as to nuclear fission’s safety following the Japan tsunami as the transition energy source to a low-fossil renewable/fusion future. First, I understand that the more modern reactors in the earthquake/tsunami zone were resilient and are a testimony to modern nuclear’s safety. Second, it is highly likely that history will show that the earthquake and tsunami will have killed far more (by orders of magnitude) than any radiation release from the damaged reactors. However this does demonstrate the need to over-engineer nuclear plant and cover waste processing costs and so nuclear is not a cheap option. We are coming to the end of the era of cheap energy.

43. Fusion has been delayed due to both real-term under-investment (compared to the original envisaged programme decades ago) and also (unnecessary) bureaucratic hurdles. Yet fusion remains one of the better long-term sustainable energy options.

44. One final thought to lend a sense of perspective. Energy security is a vitally important issue that the UK has largely ignored due to copious domestic fossil fuel availability for much of the latter half of the last century and political brinkmanship its last quarter. Yet the hurdle we face in the first half of this century makes the current banking crisis-induced recession completely trivial by comparison. The banking crisis was not triggered by the loss of any natural resource: no blight affected crops, no mine collapsed or oil well ran dry, to trigger the crisis. The crisis instead was due largely to erroneous notional valuation of financial goods (sub-prime mortgages). Conversely, with energy security we face the real depletion of cheap fossil fuel against a backdrop of actual global population growth and genuine climate change (Beddington’s “Perfect Storm”). The banking crisis is nothing compared to the need to get energy (and food) security issues clearly resolved. I mention this in the hope that it encourages the Select Committee’s report to be clear and firm, to the point of being blunt, so as to ensure incisive Governmental response.

Jonathan Cowie has spent a number of decades working in science communication (policy, publishing and promotion) with scientific learned societies. His previous academic background concerned environmental aspects of energy use and he has written two undergraduate textbooks on the subject, the second of which has just had a revised and expanded edition commissioned. Some of his science activities are summarised on the Concatenation Science Communication website—http://www.science-com.concatenate.org .

March 2011

Memorandum submitted by The Crown Estate

1. Executive Summary

The Crown Estate welcomes the opportunity to provide written evidence for the ECCC’s inquiry into the security of the UK’s energy supply.

As outlined in the Terms of Reference for written evidence, we have addressed some of the questions posed as well as provide further information of relevance to the inquiry. This is outlined in more detail below but the summary points are:

— The Crown Estate is commenting from its unique position as steward of the UK marine estate which includes over half of the UK’s foreshore and vast majority of the seabed out to territorial 12 nautical mile limit and vested rights for the development of renewable energy in the UK Continental Shelf.
— A mix of energy sources is essential to ensure the UK’s energy supply is secure. Renewable energy, in particular offshore wind, could make a significant contribution to the UK’s energy supply mix and mitigate the impact of the retirement of fossil fuel and nuclear generating capacity, while at the same time supporting the UK Government in achieving its carbon reduction and renewable energy targets. The offshore renewable energy programmes being promoted by The Crown Estate are also creating employment and business development opportunities in the UK.

— The UK is signed up to the EU Renewable Energy Directive and has the most challenging targets of any EU member state: the Government needs to ensure continued commitment to the development of renewable energy industries in order to achieve these targets and ensure energy security.

— The UK is entering a critical period of development for the offshore renewable sector where the ability to deliver the targets for 2020 and beyond will be dictated by market decision making and the policy which influences this over the next two to three years.

2. THE CROWN ESTATE REMIT AND RESPONSIBILITIES

The Crown Estate manages an estate worth £6.6 billion, which contains extensive marine assets, including over half of the UK’s foreshore and the vast majority of the seabed out to the 12 nautical mile territorial limit. Under The Crown Estate Act 1961, The Crown Estate’s permission, in the form of a lease or licence, is required for the placement of structures or cables on the seabed; this includes offshore wind farms and their ancillary cables and other marine facilities. In addition to this, by virtue of the Energy Act 2004 (and Energy Act 2008) it has the rights vested in it for the development of renewable energy within the Renewable Energy Zone and to the UK Continental Shelf for development of natural gas and carbon dioxide storage.

In carrying out this duty, under the core values of commercialism, integrity and stewardship, The Crown Estate is concerned to deliver the maximum renewable energy potential of the marine estate, in line with government policy and consistent with the requirement to oversee the estate in accordance with the principles of good management.

In its role as steward for the marine estate The Crown Estate is working with the grain of government to develop this new energy mix through several programmes of work including offshore wind, wave and tidal, carbon capture and storage and natural gas storage.

It has instigated major Rounds of offshore wind leasing, the most recent being Round 3 with a target delivery of up to 32GW of electricity generating capacity as well as a Round in Scottish Territorial Waters with potential generating capacity in the region of 5 GW. The Crown Estate recently announced offshore wind and tidal leasing rounds in waters off Northern Ireland. The Crown Estate has entered into agreements for wave and tidal projects in the Pentland Firth and Orkney Waters: the world’s largest Wave and Tidal programme, with potential capacity of 1.6GW and opened a subsequent tender for projects of up to 30 MW installed capacity in connection with the Scottish Government’s Saltire Prize.

In addition, The Crown Estate is facilitating investment in and identifying areas suitable for carbon dioxide storage. The Crown Estate intends to award an exclusive lease option to the winner of the current DECC CCS competition, which commenced in 2007. The Scottish Power Longannet consortium is the sole bidder remaining in the competition and a decision is due during 2011.

In addition, The Crown Estate will award a lease option to any recipient of the European Economic Recovery Plan (EERP) funding for CCS. As of January 2011 a consortium developing the Hatfield project has received such funding. Discussions are ongoing with the selected storage operator for this project. It is waiting for the sifting process being conducted by DECC in selecting the projects that will be eligible to apply for NER300 funding; again the “winners” will be able to discuss how to obtain a consent from The Crown Estate for use of the porous space.

Another offshore activity that The Crown Estate is involved in relates to natural gas storage. In 1983 it granted a lease to British Gas for the Rough Field and this is still operational. Natural gas storage takes place in depleted gas fields or in engineered caverns in subsurface salt domes. In 2007 The Crown Estate signed an Agreement for Lease with Gateway Storage Company Limited for their salt cavern project in the East Irish Sea. Similarly in October 2010 it signed an Agreement for lease with ENI for the Deborah field off Bacton. Negotiations continue with other potential storage developers, with the aim of utilising the offshore space to meet UK government aspirations for storage.

The marine environment has ample capacity to provide sufficient varied electricity sources to meet and exceed future national need, and this will be possible while continuing to deliver its more established roles with oil & gas, marine minerals dredging, fishing, shipping, cables and pipelines etc. This is provided there is proper approach to Marine Spatial Planning, use of resources, interactions, consenting and is dependent on expanding energy sources being able to achieve acceptable relative Cost of Energy.

The Crown Estate’s revenue surplus is paid to HM Treasury on an annual basis and it is important that the nation secures the benefit of the UK seabed being utilised for commercial purposes.
The Crown Estate’s unique perspective on the UK offshore energy sector and programmes outlined above allows us to comment under a few of the focus areas requested in the inquiry, as shown below:

3. **Sensitivity of the UK’s Energy Security to Investment (or Lack of Investment) in Energy Infrastructure, Including Transmission, Distribution and Storage**

   — The Crown Estate is working to deliver programmes of renewable energy, in line with government policy, in order to achieve the sustainable and secure future energy mix required in the UK.

   — The Electricity Market Reform [EMR] comes at a pivotal time for commitments in development and construction of renewable energy projects as well as investment in the supply chain. The EMR provides an opportunity to address one of the key challenges of the programme: ensuring the economics of the projects are sufficiently robust to attract the required long term investment. At the same time, the other programme challenges (grid, supply chain, consenting, managing construction risk etc) will require continued focus. Practical solutions to these challenges should be developed in parallel with EMR solutions and the solutions should not unwittingly add to the challenges in these areas.

   — To date, the offshore wind industry has responded to government policies and signals. This response is evidenced by the substantial pipeline of projects currently at various stages of development. This pipeline is sufficient to deliver new capacity up to the National Grid’s ambitious ODIS “Sustainable Growth” trajectory to 2025. There is now great momentum behind the programme, presenting a considerable opportunity for the UK for developing new technologies, creating new businesses and inward investment, resulting in new jobs.

   — Wave energy and tidal energy are two further forms of offshore renewable energy with significant potential for development in ways which could benefit security of UK electricity supplies. DECC has indicated they could make a “significant” contribution to achieving the UK’s 2050 carbon reduction target.

   — Compared to offshore wind, wave and tidal energy are at relatively early stages of development. The emerging industry is currently focusing on testing and demonstration projects, as well as preparing to install in the Pentland Firth and Orkney waters later this decade. The Crown Estate is actively assisting these activities and working closely with DECC, the Scottish Government and the other parts of government on key challenges facing development—including the need to attract greater capital to technology development and manage high fixed costs and technology risks in initial projects.

   — With regards to CCS, as highlighted above, The Crown Estate is working with companies subject to UK and EU funded projects (and therefore external deadlines). Conclusion on the first DECC competition is anticipated in 2011.

   — Whilst uncertainty currently surrounds the outlook for the natural gas storage sector in the UK due to the supply in international natural gas and LNG markets, The Crown Estate has signed agreements with two potential developers for offshore projects.

   — By 2015 required gas storage capacity in the UK is forecast to be about twice present capacity. Forecasts of natural gas storage capacity required by 2020 to ensure security of gas supply during peak demand winter months vary widely, but a value of about four times current developed capacity is not unreasonable.


   — The Crown Estate supports the Government’s continued commitment to develop renewable energy industries in the energy sector at an increasing scale. This commitment is affirmed by the Energy Acts of 2004 and 2008 and the leasing activities that we have put in place alongside them.

   — The UK has signed up to the EU Renewable Energy Directive, which includes a UK target of 15 percent of energy from renewable sources by 2020. This target is equivalent to a seven-fold increase in UK renewable energy consumption from 2008 levels: the most challenging of any EU Member State. It is therefore important for Government to maintain commitment to the development of renewable energy industries in order to ensure security of supply.
5. OTHER COMMENTS RELATING TO THE SECURITY OF THE UK’S ENERGY SUPPLY

— The deployment of certain low carbon energy types presents opportunities for job generation and business and economy stimulation in the UK and as such, ensuring a robust, sustainable, secure and diverse energy supply from the UK is important.

March 2011

Memorandum submitted by Food and Drink Federation

SUMMARY

— This submission is made by the Food and Drink Federation, the trade association for food and drink manufacturing. Food and drink is the largest manufacturing sector in the UK (about 15% of total manufacturing output) turning over almost £73 billion per annum; creating GVA of around £22 billion; employing around 440,000 people; and contributing around 2% of the UK’s total GDP.

— The sector comprises some 7,000 enterprises which between them consume around 50TWh of primary energy per annum split almost equally between electricity and fuels used on site for heat raising and as input to Combined Heat and Power. In the coming decades, as ever tighter carbon budgets lead to a lower carbon economy, we anticipate that a significant part of that heat demand will have to be met by the electrification of heat supply and that this electricity will need to be generated from low or zero carbon sources.

— Our sector plays a key strategic role in respect of the nation’s future food security. As the recent Foresight report on the Future of Food and Farming highlights, we are faced with the challenge of producing more food from fewer resources and with less impact on the environment. We agree with the report’s conclusions that sustainable food production needs to be a key strategic priority for Government in its own right. We see secure energy supplies, and specifically, a low carbon electricity market in the UK and access to low carbon heat energy as key to our sector helping deliver secure and sustainable food in the future.

— We are, however, having to deal with these challenges in the face of an unprecedented combination of cost pressures, from global commodity price increases through to transport fuel and energy costs.

ANSWERS TO SPECIFIC QUESTIONS

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

1. We believe energy efficiency has a very important role in ensuring future energy security and Government needs to provide the appropriate policy and financial mechanisms for supporting energy efficiency.

2. For food and drink manufacturers, Climate Change Agreements (CCAs) have been the main policy aimed at improving energy efficiency. Since 2000 participants in the FDF CCA has reported an improvement in energy efficiency of 21% (energy/tomme of production) and has saved over 800,000 Te of CO2 emissions against a background of growth of around 20% in GVA. We believe that CCAs are a particularly effective instrument in that they provide a reduction in the Climate Change Levy for a required energy efficiency and emissions reduction outcome. This ensures that CCAs participants fully factor the market cost of carbon into their savings as well as increased penetration of renewables in the energy sector?

3. Combined Heat and Power (CHP) is a highly efficient method of simultaneously generating electricity and heat at or near the point of use and an important energy efficiency measure and contributor to energy supply security. The food and drink manufacturing sector is a major user of Combined Heat and Power with around 500MWe installed capacity. The Government provides a number of policy mechanisms to support CHP which includes Climate Change Levy exemption for fuels used in Good Quality CHP plant. In its planned reform of the Climate Change Levy to provided a carbon floor price, Government must ensure that current support levels are maintained, and, indeed, extended if the aim is to promote the further take-up of this technology

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?

4. We noted the comments in the recent DECC consultation on Electricity Market Reform that, to date, the UK electricity market has provided affordable and secure energy since the 1990’s. However, it is clear that current market arrangements have not provided the long term price, regulatory and investment signals needed to replace ageing nuclear capacity, to replace coal generation (due to be phased out as a result of the
Large Combustion Plant Directive) and to deliver further capacity to meet growing UK demand—whilst at the same time placing the electricity generating sector onto a path towards meeting UK carbon budgets and the 80% 2050 emissions reduction target. We understand it is the absence of long term regulatory and carbon price signals that now necessitates a more interventionist approach to ensure supply security as well meeting the UK’s carbon budgets.

5. In taking forward its plans, Government needs to take into account the full impact of cumulative policy costs on manufacturing industry—particularly at a time when the Government Growth Review and the Advanced Manufacturing Review\(^{58}\) seeks to introduce the best conditions for business and private sector growth and to maintain the competitiveness of UK industry in global markets.

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

6. We also recognise that industrial consumers, amongst others, could have a role to play in maintaining electricity supply at times of peak demand by helping achieve short term balancing of supply and demand. All food and drink manufacturing plant needs electricity to operate. But the idea of stopping production of food and drink products that are often perishable and part of a highly integrated food supply chain tends to preclude most manufacturers from considering a voluntary demand reduction option. This is not to say that, with greater awareness of the issues, the advent of a “smart grid” and increased on-site generation being installed in the coming years, that suitable opportunities for food and drink manufacturers to participate in demand side response to ensure wider supply security could not be developed. In its response to the Electricity Market Reform consultation, FDF has proposed to DECC its willingness to explore how to best take this issue forward.

March 2011

Memorandum submitted by Ofgem

INTRODUCTION

Ofgem is the Office of the Gas and Electricity Markets. Protecting the interests of current and future consumers is our first priority. This includes helping to secure Britain’s energy supplies by promoting competitive gas and electricity markets—and regulating them so that there is adequate investment in the networks.

In 2009, we launched Project Discovery, a comprehensive review of Britain’s security of supply prospects. In February 2010, we concluded that significant energy market reforms are needed to secure supplies and meet climate change targets.\(^{59}\) We also published four scenarios on the risks facing energy security, looking at how security of supply and progress towards climate change targets would be affected by the rate of recovery from the worldwide recession and the rate of concerted global environmental action. We estimated that the cost of the investment needed to secure energy supplies and meet Britain’s climate change targets could be as much as £200 billion between now and 2020. Even though the short term outlook is relatively benign, the scale of this investment, as well as other challenges facing the GB energy markets, caused us to have concerns about the ability of the current market arrangements to deliver security of supply in the longer term. These concerns sit behind our Gas Security of Supply Significant Code Review and also mean that we welcome that security of supply is a key element of the Energy Market Reform.

Ofgem and the Department for Energy and Climate Change report annually to Parliament on security of supply. On gas, the July 2010 report,\(^{60}\) found that outlook is broadly benign in the near term but that it is not risk-free; there are risks, both in the short term, and towards the second half of the decade, when some uncertainties remain. On electricity, the report highlighted that the coming decade will see many changes in the electricity markets, including the closure of fossil fuel and nuclear plants. While new capacity is planned to replace the capacity due to close with cleaner technologies, it also noted that in practice projects might slip, and not all of this capacity might come forward on schedule.

We welcome the opportunity to contribute to this inquiry and have taken each of the questions posed by the Committee in turn and sought to provide information where it is within Ofgem’s remit and expertise.

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

This table shows the current UK generation mix using data from DECC’s digest of UK energy statistics (DUKES). UK energy generation is currently heavily dependent on fossil fuels, with over 70% from coal, oil and gas. A further 19.4% comes from nuclear generation.

\(^{58}\) http://www.bis.gov.uk/policies/business-sectors/manufacturing-and-materials/manufacturing

\(^{59}\) Project Discovery—Options for delivering secure and sustainable energy supplies, Ofgem, February 2010.

Energy and Climate Change Committee: Evidence

DECC DUKES

<table>
<thead>
<tr>
<th>2010</th>
<th>2025</th>
<th>2025</th>
<th>2025</th>
</tr>
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<tr>
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<td>Green transition</td>
<td>Discovery scenarios</td>
<td>Green stimulus</td>
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<tr>
<td></td>
<td>Green transition</td>
<td>Dash for energy</td>
<td>Slow growth</td>
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<td>0.0%</td>
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<td>39.0%</td>
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<td>Other fuels</td>
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<td>0.3%</td>
<td>3.4%</td>
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<tr>
<td>Total</td>
<td>100.0%</td>
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Source: Digest of United Kingdom Energy Statistics, Department for Energy and Climate Change, 2010 and Project Discovery, February 2010 (as above)

Under all four of the scenarios modelled by Project Discovery we predicted that nuclear would provide less generation in the future because of the high costs of this technology, which would in turn improve our resilience to changes in uranium prices. However, the financial position of nuclear may be affected by DECC’s EMR proposals.

All the Discovery scenarios show a similar decline in coal-fired generation but gas fired generation will continue to be a significant part of our energy mix, thus exposing the UK to gas price movements that reflect changes in demand and supply. It should be noted that higher energy prices are necessary to stimulate investment and demand side response, such as the capacity that is necessary at peak times of demand, for example “peaking plant” that typically relies of fossil fuels. If environmental action is rapid, as shown by the green transition and green stimulus scenarios, our resilience will be improved as our dependence on fossil fuel and nuclear generation falls.

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

Project Discovery predicted that substantial investment would be necessary in energy infrastructure until 2025. Growing exposure to a volatile global gas market and ageing power plant nearing the end of its life, along with the need to tackle climate change, are the central challenges the country faces. Our scenarios show that gas and electricity supplies can be maintained to customers provided the market participants respond adequately to market signals—but each scenario comes with real risks, potential price rises and varying carbon impacts. Our estimates indicate that 2016 and 2024 will be particularly challenging years because of the lower electricity generation capacity available caused by plant closures associated with the Large Combustion Plant Directive, Industrial Emissions Directive and natural ageing.

The table below shows the investment figures for the four different scenarios that we estimated were necessary to maintain energy supplies and represented a range of investment from £129.4 billion to £236.1 billion. Discovery also concluded that leaving the current arrangements as they are is not in the interests of consumers and that there is a window of opportunity over the next two to three years to put reforms in place. Taking action in this window could avoid the need for more costly action being taken later.

<table>
<thead>
<tr>
<th>Cumulative investment, £billion, 2025</th>
<th>2025</th>
<th>2025</th>
<th>2025</th>
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<td>Green stimulus</td>
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<td>Slow growth</td>
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<td>12.8</td>
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<td>CCS</td>
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<tr>
<td>CCGT</td>
<td>4.4</td>
<td>4.3</td>
<td>20.9</td>
<td>17.3</td>
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<td>Distribution</td>
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<td>26</td>
<td>26</td>
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<td>Offshore transmission</td>
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<td>19</td>
<td>17.3</td>
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<tr>
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<td>7.9</td>
<td>7.4</td>
<td>4.3</td>
<td>3.7</td>
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<td>0.5</td>
<td>0.5</td>
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<td>16</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Renewable heat</td>
<td>52.8</td>
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<td>10</td>
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<tr>
<td>LNG terminals</td>
<td>0.9</td>
<td>0.6</td>
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<tr>
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<td>1.1</td>
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<tr>
<td>SCR</td>
<td>1.2</td>
<td>0.6</td>
<td>1.2</td>
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<tr>
<td>Total</td>
<td>236.1</td>
<td>230.6</td>
<td>149.1</td>
<td>129.4</td>
</tr>
</tbody>
</table>

Source: Project Discovery, February 2010
Within our own remit as regulator of the energy networks Ofgem is working to reduce the costs of investment to consumers. This is important as we have estimated that network investment accounts for between £34–39 billion of investment needed in UK energy to 2020. This is a massive challenge for an industry worth £43 billion today, representing an increase in value of 75%—and a doubling of the rate of investment from the previous 20 years.\(^{61}\)

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 encourage the growth of smart grids. We are fully aware that over the next few years, this investment will take place in difficult financial conditions and one of the many benefits of this model is the greater certainty that the longer eight-year model delivers.

Ofgem estimates the RIIO model could cut the cost of investment to consumers by £1 billion compared to the previous regulatory framework in the next 10 years.

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

Electrification of heat and transport will increase demand for electricity and will change how and when consumers use energy, for example, charging electric cars overnight. Smart meters will give consumers the option to shift some of their electricity use to off-peak hours. However, there will be challenges with this transition, including the likely increased overall demand for electricity and possibility of greater demand peaks. The security of supply implications will depend on the extent of the electrification and the sources of decarbonised/low carbon heating and transport. Increased demand side response could mitigate security of supply issues created by electrification of heat and transport.

A key objective of our £500 million Low Carbon Networks Fund is to help to address increasing use of low-carbon heat and transport technologies. Last year we announced the results of the first annual competition, which included projects to monitor the effect of increasing connection of heat pumps and electric car charging points to the network. Trials and projects will ensure that the knowledge gained today can be applied at a larger scale tomorrow, keeping costs as low as possible for consumers across Britain.\(^{62}\)

A diverse energy mix is essential for developing secure and sustainable supplies. Electricity generation itself offers some diversity of renewable, low carbon and fossil-fuel options. In addition, renewable heat and combined heat and power technologies, with the appropriate heat network infrastructure, would also help to mitigate the security of supply issues that could accompany the electrification process. For example, capturing the waste heat from power stations could reduce the demand for electricity to power heat pumps, and heat storage could help to smooth local and national electricity demand.

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

The success of energy efficiency schemes is essential for limiting the extent to which consumer bills will rise in the future, and can provide a cost-effective source of carbon reduction. 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. The uptake of these schemes will depend on customer awareness/uptake, fossil fuel prices, and the strategies of energy suppliers and energy services companies. If this demand-side reduction does not deliver, consumer bills will rise without increasing security of supply.

Energy efficiency faces an additional challenge as it is the only part of the EU 2020 Green Package that does not have a legally binding target.

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 table below provides information from our assumptions in Discovery about the extent to which different technologies are generally available (the de-rating factor) and their costs.

<table>
<thead>
<tr>
<th>De-rating factors</th>
<th>Capital costs (£/KW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCGT</td>
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</tr>
<tr>
<td>Coal</td>
<td>0.9</td>
</tr>
<tr>
<td>Nuclear</td>
<td>0.7</td>
</tr>
<tr>
<td>Hydro</td>
<td>0.4</td>
</tr>
<tr>
<td>Biomass</td>
<td>0.4</td>
</tr>
</tbody>
</table>

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\(^{61}\) RIIO—a new way to regulate energy networks—factsheet, Ofgem, April 2010

\(^{62}\) Low Carbon Network Fund, Ofgem website
<table>
<thead>
<tr>
<th>De-rating factors</th>
<th>Capital costs (£/KW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onshore wind</td>
<td>0.15 1,200</td>
</tr>
<tr>
<td>Offshore wind</td>
<td>0.15 2,800</td>
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</table>

*Source: Project Discovery, February 2010*

As the table shows, low carbon technologies tend to have more variable availability and higher investment costs for generating electricity than fossil fuel ones. To ensure security of supply, it is critical that there is sufficient flexible plant, or appropriate demand-side response arrangements, to backup intermittent generation such as wind. The incentives faced by investors to invest in each technology depend on how it fits within the overall mix. For example, it will be very important that the features of the flexible plant can readily accommodate the intermittency of wind.

Having said that, there are a range of possible technologies that can be used to decarbonise the UK’s energy system (with a range of flexibility characteristics), and if used in appropriate combination, there is no reason per se why these technologies might pose risks to security of supply. Nonetheless, affordability remains an important issue, depending on learning effects that will occur in the future and the stability and level of the carbon price over time. This also applies to the development of carbon capture and storage for conventional gas and coal-fired generation, which has the potential to complement intermittent generation while meeting our carbon targets. Again, however, affordability is a key issue, as CCS technology is not yet proven or commercialised, and is dependent on finite resources with security of supply implications.

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

In the first dash-for-gas, Great Britain mainly relied on the UK continental shelf (UKCS) for its supply of natural gas, but production from the UKCS has passed its peak and is projected to continue to decline. In a second dash-for-gas, the UK would have to rely far more on natural gas arriving through interconnectors and LNG terminals which exposes the GB to a range of additional risks that may undermine security of supply. This dependence on international markets increases the risk that GB might be more exposed in the future to political considerations overriding the economic decisions of gas production and the free flow of energy from international markets.

For a number of years, Ofgem has expressed concerns with the ability of the current market arrangements to deliver secure gas supplies over the longer term. These issues primarily concern the emergency arrangements, though changes to these arrangements alone may not fully alleviate our concerns. In January 2011, in light of these concerns Ofgem launched a Gas Significant Code Review to assess whether reforms to the current gas market arrangements are required to improve security of supply, and if so, what these reforms should be. We are particularly concerned with improving incentives and/or obligations on shippers to deliver secure gas supplies in the long term.63

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

As the UK becomes more reliant on sources of energy that are external to it, so it becomes more exposed to international events. However, the increasing range of energy sources that the UK is drawing on provides diversity and resilience to any given international event.

Project Discovery highlighted that the security of GB’s energy system is vulnerable to some international events under certain scenarios, including the re-direction of LNG supplies, a Russia-Ukraine dispute and electricity flowing out of the UK through the interconnectors because of higher prices in Europe during a peak demand day.

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?

We welcome the Government’s Electricity Market Reform consultation as a positive step forward in looking at electricity security of supply. We are committed to working with the Government to deliver EMR objectives at the best possible value for consumers. We will be providing constructive and expert input to the design process and anticipate having a significant implementation role. Properly functioning energy markets remain central to the Government’s proposals and, in accordance with Ofgem’s duties, we shall be concluding our work to improve electricity market liquidity in the Spring, to align it with DECC’s wider reform package. As discussed above we are also taking forward reform proposals to ensure electricity and gas wholesale prices properly reflect the value of security of supply and will be advising DECC on issues such as generation capacity.

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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 light of the unprecedented levels of investment that need to be made in our energy system over the next 10–15 years, we are particularly concerned with delivering this investment in a way that delivers the policy goals at the most efficient cost to consumers. We have concerns about the affordability of energy in light of the need for increased investment, and whether the customers most benefiting from this investment are the ones that are paying for it.

The Committee could also consider how flexibility in demand might develop. In our demand-side response (DSR) discussion paper, we qualitatively assessed the benefits that DSR could deliver in terms of delivering secure and sustainable energy supplies. Increasing DSR could reduce the amount of peaking plant capacity needed to meet demand in the short term. DSR is also likely to have an impact on security of supply where real-time pricing tariffs encourage demand to shift or reduce in response to market signals to help balance the system or overcome constraints. Finally, as intermittent generation increases its share of our energy mix, DSR could become increasingly valuable by displacing plant otherwise needed to generate during periods of low wind output, as well as high demand.

March 2011

Memorandum submitted by British Geological Survey

EXECUTIVE SUMMARY

1. Britain should consider more onshore and offshore gas storage in depleted gas fields and salt caverns, and more options for compressed air energy storage, but the geology for these may be specialised and will need specialist survey.

2. Shale gas, of which Britain may have considerable resources, might be an important guarantee of secure gas supply into the future.

3. Britain should consider developing independent strategic intelligence about oil and gas supplies in the Middle East and Russia, as well as long term monitoring of global uranium production and trade to support the proposed UK nuclear new build.

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

1. Underground Gas Storage. Britain’s energy security is closely bound up with how much gas it stores. Surface storage in the form of tanks exists, but underground gas storage (UGS) provides significantly greater volumes and meets differing strategic requirements and delivery rates. At present our country does not have the UGS volumes of comparable countries, despite having suitable geology or both salt cavern and depleted field storage.

2. Introduction. Until recently, abundant offshore gas reserves have meant that swings in UK demand could readily be taken up by increasing, or decreasing, output from North Sea and East Irish Sea gasfields. However, UK offshore fields in particular are rapidly depleting and the UK became a net importer of gas during 2004. Consequently, offshore gasfields will no longer provide this flexibility and the UK is becoming increasingly dependent on imports from the global gas market. Government predicts that over 80% of UK gas supply will be imported by 2020. Figures from National Grid suggest that current usage led to imports levels of 40% in 2009, indicating that the predicted import levels of 2020 may be reached sooner rather than later. Security of supply will become a matter of growing national importance.

3. Current UK annual gas consumption is around 103 billion m³, but storage capacity of approximately 4.6 billion m³ is only 4% of annual consumption; much less than many European countries (Figure 1; Table 1). This storage volume is equivalent to about 14 day’s supply, which is again much less than many European countries and the USA (Table 2). A report by Cedigaz in 2009 found that 638 underground gas storage (UGS) facilities operate worldwide, providing a total working capacity of 328.9 billion cubic metres (bcm) (10.7% of global gas consumption). Of these, 446 are located in America (395 in the United States). Europe ranks second with 129 underground gas storages, with more than half located in three countries: Germany (47 sites), France (15 sites), and Italy (10 sites). The Cedigaz report found 199 new storage facilities or expansions of existing ones that are either under construction, under development, or planned. Of these, Europe has the most with 123 projects, representing more than 75 bcm of additional working capacity, compared to the current 82 bcm available. Tables 3 & 4 illustrate the relatively small number of proposed developments that exist in the UK compared to planned European projects.

64 Demand Side Response Discussion Paper. Ofgem, July 2010
Figure 1

COMPARISON OF EUROPEAN GAS STORAGE CAPACITY AS A PERCENTAGE OF NATIONAL DEMAND

Sources: Gas Infrastructure Europe, CIA World Fact Book 2009, National Grid and International Energy Agency

Table 1

NATIONAL DEMAND, STORAGE CAPACITY AND PLANNED NEW STORAGE CAPACITY OF EUROPEAN COUNTRIES

<table>
<thead>
<tr>
<th>Country</th>
<th>National demand (bcm)</th>
<th>Storage Capacity (bcm)</th>
<th>Storage capacity as % of National Demand</th>
<th>Planned new capacity (bcm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>8.44</td>
<td>4.2</td>
<td>50</td>
<td>3.2</td>
</tr>
<tr>
<td>Belgium</td>
<td>17.4</td>
<td>0.63</td>
<td>4</td>
<td>0.08</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>3.5</td>
<td>0.35</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>8.62</td>
<td>3.1</td>
<td>36</td>
<td>0.9</td>
</tr>
<tr>
<td>Denmark</td>
<td>4.6</td>
<td>1</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>France</td>
<td>42.7</td>
<td>12.3</td>
<td>29</td>
<td>1.8</td>
</tr>
<tr>
<td>Germany</td>
<td>101</td>
<td>20</td>
<td>20</td>
<td>9.5</td>
</tr>
<tr>
<td>Hungary</td>
<td>13.4</td>
<td>3.72</td>
<td>28</td>
<td>2.3</td>
</tr>
<tr>
<td>Italy</td>
<td>84.9</td>
<td>14.34</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>Netherlands</td>
<td>46.4</td>
<td>5.1</td>
<td>11</td>
<td>4.5</td>
</tr>
<tr>
<td>Poland</td>
<td>16.4</td>
<td>1.58</td>
<td>10</td>
<td>1.23</td>
</tr>
<tr>
<td>Romania</td>
<td>17.1</td>
<td>2.69</td>
<td>16</td>
<td>2.35</td>
</tr>
<tr>
<td>Slovakia</td>
<td>6.22</td>
<td>2.75</td>
<td>44</td>
<td>0</td>
</tr>
<tr>
<td>Spain</td>
<td>34.4</td>
<td>4.14</td>
<td>12</td>
<td>5.59</td>
</tr>
<tr>
<td>UK</td>
<td>104</td>
<td>4.3</td>
<td>4</td>
<td>11.7</td>
</tr>
<tr>
<td>Ukraine</td>
<td>66.3</td>
<td>32.13</td>
<td>48</td>
<td>0</td>
</tr>
</tbody>
</table>
4. The UK has an ageing stock of nuclear and coal-fired power stations, of which about one third will need replacing by 2015. If these plants are not replaced by new build, then it seems likely that much of the new capacity will be provided by conversion of plants to gas-firing, further increasing demand. In the event of supply disruption the lack of storage and increased consumption leaves the UK more vulnerable. Whilst a number of underground storage facilities are in various stages of planning or construction (Tables 3 & 4), these will not be available for a number of years during which time imports will rise.

5. Britain’s largest gas storage facility is the depleted Rough Gasfield lying offshore in the southern North Sea. The construction of salt caverns in offshore regions has also been proposed, with one site in the East Irish Sea (the “Gateway” project) having been granted the first offshore storage license in 2010. Construction will not begin until late 2011 at the earliest. Other sites might be available in the Zechstein (Permian) salt structures of the Southern North Sea.

6. Onshore storage facilities would provide capacity closer to market demand, but such facilities are strongly opposed by local residents. If it is decided that more UGS is required onshore in Britain then it must be recognized that it is only possible to develop these facilities in certain geological strata or structures, which occur in only a limited number of locations. Onshore, six UGS facilities are in operation: two depleted fields and four salt cavern sites, one of which comprises only one cavern. A number of gas storage projects have gained planning consent and are currently under development/construction, but the majority of proposed facilities are held up by the current planning regime.

7. The following sections outline the areas onshore Britain most likely to attract interest. The technology involves the injection of gas from the National Transmission System (NTS) into the pore spaces of the aquifers, depleting hydrocarbon reservoir rocks or salt caverns during periods of low demand and its withdrawal during periods of high demand. For pore storage injection is generally during the late spring, summer and early autumn months with withdrawal during the higher demand winter months. Salt caverns can be filled and emptied more rapidly and so can accept or deliver gas more readily. Pore storage facilities therefore offer more strategic and longer-term seasonal storage, helping to balance long term requirements and complement the medium to shorter term, higher deliverability function offered by salt cavern storage.
### Table 3

**OPERATIONAL UNDERGROUND LNG AND GAS STORAGE FACILITIES IN MAN MADE CAVERNS**

<table>
<thead>
<tr>
<th>Area</th>
<th>Site</th>
<th>Owner/operator</th>
<th>Storage capacity (Mcm)</th>
<th>Number of caverns</th>
<th>Approx. depth of storage (top-bottom if known—m)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational facilities—Chalk caverns</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Lincolnshire</td>
<td>Killingholme</td>
<td>ConocoPhillips and Calor Gas</td>
<td>0.1 (liquid = 60,000 tonnes of LPG)</td>
<td>2</td>
<td>180-7210</td>
<td>Two mined caverns in Chalk c. 180 m below ground level, operational since 1985.</td>
</tr>
<tr>
<td><strong>Operational facilities—salt caverns</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheshire Basin</td>
<td>Holford H-165</td>
<td>IneosChlor (formerly operated by NG (Transco), now Ineos)</td>
<td>0.175</td>
<td>1</td>
<td>350-420</td>
<td>Planning approval granted 1983. Ten-year inspection completed 2006. One of number of abandoned brine cavities with ethylene &amp; natural gas storage since 1984.</td>
</tr>
<tr>
<td>East Yorkshire</td>
<td>Hornsea/ Atwick</td>
<td>Scottish &amp; Southern Energy</td>
<td>325</td>
<td>9</td>
<td>1,730-1,830</td>
<td>Planning permission granted 1973, operating since 1979</td>
</tr>
<tr>
<td>Teesside</td>
<td>Saltholme</td>
<td>Sabic (formerly IneosChlor/Huntsman)</td>
<td>Up to 0.12-0.2</td>
<td>18 (plus 9 redundant)</td>
<td>350-390</td>
<td>Development in 1950s, storage started 1965–1982. 18 ex ICI caverns in operation. One “dry cavity storing nitrogen”; 17 &quot;wet&quot; storage cavities containing hydrocarbons ranging from Hydrogen to Crude Oil; nine redundant storage cavities; 75 redundant brine wells/cavities never used for storage; five in service brine wells.</td>
</tr>
<tr>
<td>Area</td>
<td>Site</td>
<td>Owner/operator</td>
<td>Storage capacity (Mcm)</td>
<td>Approx. depth of storage (top-bottom if known)</td>
<td>Number of caverns (Chalk &amp; salt storage)</td>
<td>Comments</td>
</tr>
<tr>
<td>------------</td>
<td>---------</td>
<td>----------------</td>
<td>------------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Teesside</td>
<td>Wilton</td>
<td>Sabic (formerly ICI)</td>
<td>Up to 0.04</td>
<td>650–880</td>
<td>5</td>
<td>Eight caverns leached, five operational cavities in total reached for storage purposes: four cavities storing Ethylene, one cavity storing Mixed C4's. Three cavities redundant or never in service for storage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sembcorp/BOC</td>
<td>Not available</td>
<td>650–880</td>
<td>2</td>
<td>Two ex ICI cavities storing nitrogen (for BOC Nitrogen).</td>
</tr>
</tbody>
</table>
### Table 4

**UNDERGROUND GAS STORAGE FACILITIES PLANNED OR UNDER CONSTRUCTION IN SALT CAVERNS OR OF TYPE AS YET UNKNOWN**

<table>
<thead>
<tr>
<th>Area</th>
<th>Site</th>
<th>Owner/operator</th>
<th>Storage capacity</th>
<th>Number of caverns</th>
<th>Approx. depth of storage (top-bottom if known—m)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planned facilities—salt caverns</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheshire Basin</td>
<td>Byley/Holford (southern end of Holford Brinefield—Drakelow Lane area)</td>
<td>Scheme initiated by Scottish Power, sold to E.ON UK plc 2005</td>
<td>160–170 (working volume)</td>
<td>8</td>
<td>630–730</td>
<td>May 2004 Deputy Prime Minister and Secretary of State reversed Public Inquiry decision. Decision upheld by High Court Dec 2004. Under construction. Salt caverns to be leased from Ineos who own the salt &amp; will construct the caverns that will be approximately 100 m high by 100 m in diameter.</td>
</tr>
<tr>
<td>Cheshire Basin</td>
<td>Hill Top Farm (Warmingham Brinefield)</td>
<td>Energy Merchant (EDF Trading)—formerly British Salt</td>
<td>10 existing brine caverns: c. 2994 new caverns: c. 115 (11 new caverns: c. 317)</td>
<td>10 existing brine caverns &amp; between 4 (possibly 11?) newly constructed caverns</td>
<td>240–300</td>
<td>Planning permission gained for conversion of 10 existing brine caverns and between four and 11 new caverns by British Salt in May 2008—this figure could include the Parkfield Farm caverns (7). Storage volume expected to be: 0.69 Mcm (22,400 tonnes/29.9 Mcm) for each existing brine cavern and 0.6 Mcm (21,600 tonnes/28.8 Mcm) for each new cavern. Interests sold to Energy Merchant (EDF Trading) July 2009. EDF Energy now plans to develop the project alongside EDF Trading using a revised planning permission designed to take advantage of synergies with the adjacent Hole House Farm gas storage facility.</td>
</tr>
<tr>
<td>Cheshire Basin</td>
<td>Parkfield Farm (Warmingham Brinefield)</td>
<td>Energy Merchant (EDF Trading)—formerly British Salt</td>
<td>c. 201</td>
<td>7</td>
<td>240–300</td>
<td>Planning permission gained for seven new caverns by British Salt in May 2008. Storage volume expected to be 0.6 Mcm (21,600 tonnes/28.8 Mcm) for each new cavern. Interests sold to Energy Merchant (EDF Trading) July 2009. EDF will not develop new caverns but use the Parkfield site to support operations at the adjacent Hole House (operational) and Hill Top (approved) storage facilities.</td>
</tr>
<tr>
<td>Area</td>
<td>Site</td>
<td>Owner/operator</td>
<td>Storage capacity (Mcm)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Number of caverns</td>
<td>Approx. depth of storage (top-bottom if known)</td>
<td>Comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Chalk &amp; salt storage</td>
<td>(m)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheshire Basin</td>
<td>Stublach (Holford Brinefield between Drakelow Lane and Lach Dennis)</td>
<td>Ineos Enterprises Ltd</td>
<td>540 (storage volume)430 (working volume)</td>
<td>28</td>
<td>&gt;500 &gt; planning application December 2005, permission received late 2006. Under construction in two phases with initially 8–10 caverns constructed. Expected to be operational for about 40 years.</td>
<td></td>
</tr>
<tr>
<td>Cheshire Basin</td>
<td>King Street (Holford Brinefield)</td>
<td>King Street Energy (NPL Estates)</td>
<td>c. 263 (storage volume)160 (working volume)</td>
<td>10</td>
<td>&gt;400 Proposed construction of ten caverns. Planning application turned down Dec 2008, decision appealed by applicant and Public Inquiry held July-August 2009, with the Secretary of State granting permission on 9 December 2009.</td>
<td></td>
</tr>
<tr>
<td>East Yorkshire</td>
<td>Aldbrough South—Phase I</td>
<td>Scottish &amp; Southern Energy and Statoil</td>
<td>420</td>
<td>9</td>
<td>1,800–1,900 Planning permission granted 2000, two sites with three and six caverns initially—Scottish &amp; Southern Energy and Statoil combine ownership and development. Under construction, with storage commencing in 1st two caverns in 2009, with capacity in another three caverns expected to become available by the end of 2010 and full commissioning of the Phase 1 operations expected in 2012.</td>
<td></td>
</tr>
<tr>
<td>East Yorkshire</td>
<td>Aldbrough South—Phase II</td>
<td>Scottish &amp; Southern Energy and Statoil</td>
<td>420</td>
<td>9</td>
<td>1,800–1,900 Consent sought for extension to phase 1 development. Permission to increase storage capacity granted by East Riding of Yorkshire Council in May 2007. Final size of Aldbrough facility will be 18 caverns</td>
<td></td>
</tr>
<tr>
<td>NW England</td>
<td>Preesall</td>
<td>Canatxx Gas Storage Ltd</td>
<td>c. 1700 (storage volume)1200 (working volume)</td>
<td>up to 42</td>
<td>245–510 Significant public objection to proposals. Public Inquiry held (late 05-early 06), with planning permission refused by Secretary of State (DCLG), October 2007. Second planning application submitted Feb 2009 and refused by County Council January 2010.</td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td>Site</td>
<td>Owner/operator</td>
<td>Storage capacity (Mcm)</td>
<td>Number of caverns (Chalk &amp; salt storage)</td>
<td>Approx. depth of storage (top-bottom if known—m)</td>
<td>Comments</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>------------------------</td>
<td>------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Wessex-Weald Basin, Dorset</td>
<td>Isle of Portland</td>
<td>Portland Gas Ltd.</td>
<td>1000</td>
<td>14</td>
<td>2,100–2,300</td>
<td>Planning permission granted by Dorset County Council 16th May 2008. Struggling to raise investments to commence project, which began with site construction at end July 2009. Drilling is expected to commence towards the end of 2010.</td>
</tr>
<tr>
<td>Islandmagee, Larne, N Ireland</td>
<td>Larne Lough</td>
<td>Portland Gas Group/ Islandmagee Storage Ltd)</td>
<td>500 (working volume)</td>
<td>Not available</td>
<td>1,500</td>
<td>Planning application submitted Mar 2010</td>
</tr>
<tr>
<td>Planned facilities—salt mines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheshire</td>
<td>Northwich</td>
<td>Consortium</td>
<td>Not available</td>
<td>Not available</td>
<td>&gt; 250 m</td>
<td>Proposals put forward in November 2009 to convert and use former ICI salt mines in the north Cheshire Basin area. Included in National Grid’s 2009 review of underground gas storage developments and proposals. No details available.</td>
</tr>
<tr>
<td>Offshore Bacton</td>
<td>Southern North Sea</td>
<td>Stag Energy</td>
<td>1500</td>
<td>Not available</td>
<td>Not available</td>
<td></td>
</tr>
</tbody>
</table>
8. **Natural gas storage in depleting oil/gasfields.** Many UK onshore basins are now at a mature stage of exploration. Nevertheless, they continue to attract interest and large areas remain licensed for production and continued exploration (Figure 2). With improving technology modest onshore discoveries continue to be made. However, depleting oil and gasfields also have the potential to provide significant volumes for underground gas storage. During gas storage operations, some remaining natural gas will also be produced and consequently a production licence will be required.

**Figure 2**

PROSPECTIVE ONSHORE SEDIMENTARY BASINS AND SIGNIFICANT OIL AND GASFIELDS. LICENCE AREAS ALSO SHOW AREAS OF COAL MINE AND COAL BED METHANE PROSPECTIVITY

Source: BGS
9. **Salt caverns.** Former brine caverns created by solution mining of salt have been used to store hydrocarbon products for many years. At Billingham (Saltholme) and Wilton on Teesside storage of gases, which include methane, nitrogen and hydrogen, commenced in the late 1950s. This included the Northern Gas Board’s use of a solution-mined cavity on Teesside to store town gas in 1959. There are about 30 caverns currently in use. Completed solution cavities in Cheshire are also used for ethylene and natural gas storage.

10. However, these former brine caverns are not ideally shaped or spaced for natural gas storage and today specially designed caverns are engineered. Gas storage in salt caverns is covered by British (and European) Standard (BS EN 1918–3:1998). Salt caverns are advantageous because salt is impermeable and under most engineering and relevant geological conditions (increased temperatures and pressures at proposed storage depths), deforms in a ductile manner (creeps or “flows”) rather than by brittle fracturing or faulting. Fractures due to faulting in the geological past are, therefore, likely to have been “annealed” and sealed.

11. In the UK a number of proposed schemes are at varying stages in the planning and construction process, including (Table 4): an extension to Hole House and at Bycle, Stublach and King Street near Holford in Cheshire; the Isle of Portland in Dorset and at Islandmagee near Larne in Northern Island Pressall in Lancashire was rejected by the Secretary of State (DCLG) in late 2007, following a Public Inquiry that ran from October 2005 to May 2006 and a further planning application in January 2010 was refused by Lancashire County Council. The developer is now preparing to seek planning permission through the Infrastructure Planning Commission (IPC).

12. **Compressed Air Energy Storage (CAES).** Wind power generation is set to increase in the UK. At lower levels of installed wind capacity, studies have shown that the intermittency of wind is unlikely to create a problem. The aggregated output from wind farms distributed around the country is unlikely to ever fall to zero and the short term variations of wind generation are small compared to the corresponding variations in demand. However, as wind generating capacity rises beyond about 20% the requirement for back-up generation or energy storage increases. In addition at times of excessive wind generation the power cannot be accepted onto the grid leading to “constraint costs” that raise the cost of wind generation; energy storage can therefore utilise all of the available wind energy. Wider dispersion of wind farms, possibly including super grid connections between countries, will help to smooth wind generation, but does have security of supply issues. Increased wind generation is likely to need some energy storage, although this may only need to be a percentage of the installed generating capacity.

13. Compressed air energy storage (CAES) and pumped hydro energy storage have been demonstrated as the only technologies that could have the capacity for large scale energy storage within an electrical power grid. However pumped hydro can only operate onshore and is restricted by the number of available hillsides where a scheme could be constructed. CAES needs to be located above suitable geology for either aquifer storage or cavern storage. There are competing demands for aquifer storage, especially offshore, from CO₂ sequestration, conventional gas storage and direct use geothermal. Cavern storage is ideally created within salt deposits, but onshore there are competing demands from conventional gas storage.

14. Compressed air energy storage is being considered in many countries, including the UK. The basic concept of CAES is more than 30 years old and involves using off peak electrical energy from renewable sources such as wind, or excess output of power plants, to compress air, which is then stored under pressure underground. The compressed air is then released through a gas turbine to generate electricity during periods of peak demand.

15. Storage can be in porous rocks (aquifers or depleted oil/gasfields) or, more commonly, in large voids such as salt caverns or former mine workings. The first CAES facility using salt caverns was created in the Huntorf salt dome near Hamburg in Germany in 1978. A second plant near Mobile in Alabama, USA was constructed in 1991 and others are being planned around the world. CAES facilities are being developed in large (unlined) limestone caverns in Ohio, USA and in an aquifer to be jointly used for gas storage (Iowa, USA). Similar CAES facilities could be developed in the UK in impermeable rocks of suitable quality (eg salt beds or “hard rocks”) in conjunction with, for example, near shore wind farms. CAES feasibility studies were undertaken in the UK during the 1980s by, the Central Electricity Generating Board (CEGB). However, no development has yet taken place.

16. Similar proposals, but using rock caverns to store water at different levels for closed loop pump storage, have been suggested for Scotland.

17. If renewable energy is to become an important element of the energy mix, then options for energy storage, including CAES, may have to be considered. This might be facilitated by distributed generation and microgrids, in which small CAES plants distributed around the UK could play an important role in the storage of off peak renewable energy.

**Question:** What would be the implications for energy security of a second dash-for-gas?
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supply and energy issues. Immediate UK requirements are thus likely to be for increased storage volumes of various types, including salt caverns and depleted fields. However, an increased awareness of alternative, unconventional gas sources like shale gas and environmentally acceptable methods of exploitation would be advantageous.

19. Organic-rich shale contains significant amounts of gas held within fractures and micro-pores and adsorbed onto organic matter. Shale gas prospectivity is controlled by the amount and type of organic matter held in the shale, thermal maturity, burial history, micro-porosity and fracture spacing and orientation. In the UK licences have already been taken up by forward-thinking companies and the interest will be high for the next licensing round.

20. It is too early in exploration of UK shales to be certain about the contribution which shale gas production could make. In the US, shale gas extracted from regionally extensive units such as the Barnett Shale currently accounts for ~6% of gas production. Comparisons with the US suggest that there will be some production in the UK and all organic-rich shales in the UK are likely to be tested for their resource potential.

21. The lowest risk exploration is where source rocks have accompanying conventional hydrocarbon fields, which in the UK include the Upper Bowland Shale of the Pennine Basin, the Kimmeridge Clay of the Weald Basin and possibly the Lias of the Weald Basin. Deeper Dinantian shales should also be tested in the Pennine Basin and possibly in the Oil-Shale Group of the Midland Valley. Higher risk is attached to the Upper Cambrian source rock on the Midland Microcraton, which although it has not been severely tectonised, has not sourced conventional fields that have been preserved. The highest level of risk is attached to black shales within the Caledonian and Variscan fold belts, which have high organic carbon but are tectonised (affected by thrusts, intruded by igneous intrusions and converted to slates) and also have no overlying fields.

22. British shale gas might be regarded as “stored gas” if reasonable assessments of the potential can be made.

23. BGS reports on Worldwide Shale Gas and UK prospectivity are on the DECC Promote website: (https://www.og.decc.gov.uk/upstream/licensing/shalegas.pdf)
Figure 3

MAIN POTENTIAL SOURCE ROCKS AT OUTCROP, IN RELATION TO THE CONVENTIONAL GASFIELDS AND GAS DISCOVERIES

Note: Larger subsurface extents of the source rocks are excluded from this simplified map. Lower Palaeozoic, higher risk prospects not all shown and partly underlie Mesozoic formations.

Question: How exposed is the UK’s energy security of supply to international events?

24. Britain has long term interests in obtaining oil and particularly LNG from the Middle East. The events of the “Arab Spring” in the last few months have highlighted the fragility of the system that delivers oil and gas. 80% of the world’s oil reserves are located in the Middle East, 62.5% coming from the “Arab 5”: Saudi Arabia, UAE, Iraq, Qatar and Kuwait and most of this is controlled by national oil companies (NOCs) like Saudi Aramco, Kuwait Oil Company and ADNOC. NOCs may become even more dominant as oil production dwindles in areas which are open to all comers, such as the North Sea and the Gulf of Mexico. Much new oil is likely to be found in the NOCs’ territory, precisely because it is largely out of bounds to multinationals such as Shell and BP, and so has not yet been thoroughly explored. Therefore future oil and gas production may be even more concentrated in the hands of the national firms of Russia and the Gulf, most of which do not publish details about reserves or prospects. Currently consultancies such as IHS and McKinsey collect data on basins and regions in the Middle East and worldwide, but these are primarily aimed at investors, not governments and policy makers (Eg IHS “Basin Monitor”: http://www.ihs.com/products/oil-gas-information/basins-data/monitors.aspx). The only long term strategic survey of worldwide petroleum prospects, including the Middle East, is that of the USGS’ World Petroleum Assessments (http://energy.cr.usgs.gov/oilgas/wep/products/dd60/wpdata.htm) which are essentially long term and strategic hydrocarbons “intelligence” about the region. It may be worthwhile for Britain to begin collecting information about Middle East reserves and prospects, so that it has an independent view of this vital economic area.

25. In addition to oil and gas, many renewable/low carbon energy technologies (including wind turbines and electric vehicles) rely on small, but critical amounts of key metals for their manufacture. Almost all of these metals are sourced from outside the EU and the supply of some is subject to significant geopolitical
vulnerabilities (such as rare earth metals from China or cobalt from Democratic Republic of Congo). The current Commons Science and Technology Committee inquiry into “Strategic Metals” and the European Commission “Raw Materials Initiative” are addressing this issue, but it is important to understand that security of supply applies to key metals as well as oil and gas.

26. The UK is wholly reliant on imported uranium to fuel its nuclear generating plants. Determining the ultimate country of origin of uranium imports to the UK from published statistics is problematic. In 2010, Uranium metal enriched in U-235 was imported into the UK from Germany, France, the Netherlands and Russia. Of these countries, only Russia has mines producing uranium.

27. Global demand for uranium for electricity generation is currently much higher than mine production. At present the shortfall is met by reprocessing, from stockpiles and by conversion of weapons-grade uranium into fuel. However, global mine output is increasing, with production in 2009 at the highest level since 1981. The top four global producers are Kazakhstan, Canada, Australia and Namibia. Uranium occurs in economic quantities in a range of geological environments across the world. As such, the geological and geopolitical constraints on supply are not as severe as those relating to some other metals and fossil fuels. Increasing demand is prompting the development of new mines in a number of countries and production from these is likely to reduce the current shortfall of supply considerably. However, concerns related to the Japanese nuclear disaster notwithstanding, global demand for the low carbon energy which nuclear power provides is burgeoning. The success of the proposed UK nuclear new build will depend on securing supply of uranium fuel in the face of increased competition from other consumers around the world. Long-term monitoring of global uranium production and trade are a vital part of this process. For more information see the BGS Mineral Profile on uranium at: http://www.bgs.ac.uk/downloads/start.cfm?id=1409

March 2011

Memorandum submitted by The European Azerbaijan Society

1. EXECUTIVE SUMMARY

This submission considers the importance of energy security for the UK, and the vital role that the South Caucasus, Azerbaijan in particular, plays in achieving this aim.

Gas power for electricity generation is destined to remain one of the main pillars in the energy security mix for the UK. The situation after the Japanese earthquake and resulting problems at the Fukushima nuclear plant have resulted in many countries, such as Germany, scaling back nuclear generation projects. This is likely to further raise demand for gas as the only alternative clean energy source.

As was seen in the Russia—Ukraine disputes of 2009, the UK gas market is inextricably linked to that of the EU. Unease that 40% of the EU’s gas imports originate from Russia has led to the EU Commission implementing a strategy aimed at achieving diversification. Central to this aim is establishing a southern corridor to lessen dependence on Russia. Nabucco is currently the front running project and Azerbaijan is essential for the success of any such scheme.

1. Submission of evidence to the Energy and Climate Change Committee inquiry on The UK’s Energy Supply: security or independence?

Submission by The European Azerbaijan Society (TEAS)

1.1 The European Azerbaijan Society (TEAS) is headquartered in London but also has offices in Brussels and Berlin. The Society regularly organises events across Europe in order to raise awareness of Azerbaijan. TEAS also operates as a networking centre, focusing on such areas as business development, diplomatic relations, culture and education, thereby promoting greater understanding and co-operation between the UK, Europe and Azerbaijan.

1.2 This submission is specifically structured to address points 6 and 7 from the terms of reference specified for the inquiry:

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

7) How exposed is the UK’s energy security of supply to international events?

1.3 The instability in the Middle East has already caused energy prices to new highs and the nuclear emergency in Japan has had a direct effect on gas prices. Many countries are now scaling back or delaying their nuclear programs, with the direct consequence of higher demand for gas, currently the only viable alternative to nuclear in terms of low carbon emissions. Germany in particular is looking likely to reverse its nuclear

65 REUTERS—Germany’s nuclear program in the balance http://www.reuters.com/article/2011/03/25/germany-nuclear-election-idUSLDE72O0F420110325


programme and close power stations ahead of time. This can only result in more demand for gas from Russia, with resultant price hikes.

1.4 European reliance on Russian gas has been called into question for many years, but it was not until the gas disputes of 2008–09 that energy security emerged as a priority. In January 2009, disagreements between Russia and the Ukraine resulted in supply disruptions with 18 European countries reporting major falls or cut-offs of their gas supplies. Although at this time, the UK was not receiving supplies direct from Russia it was still affected by the resultant spike in gas prices. Potential repercussions in the future are set to rise as the UK’s dependency on gas imports increases and as the UK is set to start receiving Russian gas through the soon to be complete Nord Stream pipeline.

2. The UK Position

2.1 A recent Chatham House report stated: “By 2020, around 20–30% less natural gas will be available from UK production. This means that imports are likely to rise from a third to around 70% of gas consumption.”

2.2 The UK is facing a challenge in securing reliable energy supplies for the future, particularly in respect to natural gas. It currently imports around 30% of its gas, with this figure being predicted to rise to around 70% by 2020. Increased reliance on gas imports will further link UK energy security needs to those of the EU as a whole.

2.3 At present, only three countries supply the vast majority of EU gas imports—Russia accounts for 40%, Algeria 30% and Norway 25%. In the past the EU has had no clearly defined unified energy policy, however in recent years concrete steps have been taken to address this shortcoming. The Southern Gas Corridor is designed to address this by opening a new supply route for gas from Caspian and Middle-Eastern regions to Europe.

2.4 Europe’s total gas imports in 2007 amounted to 300 billion cubic metres (bcm) Together, the Southern Corridor projects could provide the necessary capacity to annually deliver 60–120 bcm of Caspian and Central Asian gas to Europe, amounting to between 20–40% of overall imports. This would amply meet the EU’s targets for supply diversification and also help ensure the UK’s own energy security needs.

3. Azerbaijan

3.1 Azerbaijan is already supplying both oil and gas to the EU. Since the Shah Deniz natural gas field was inaugurated in 2007, Azerbaijan has become a gas exporter, shipping increased amounts of natural gas via Turkey to Europe. Operated by BP, the Shah Deniz gas field holds 600bcm of natural gas and 101 million tonnes of condensate. It could potentially hold reserves amounting to one trillion cubic meters (tcm) of gas and 400 million tonnes of condensate. BP is the biggest foreign direct investor in Azerbaijan.

3.2 Azerbaijan supplies gas to the EU through the only current gas pipeline that avoids Russian territory. The South Caucasus Pipeline (SCP), also known as the Baku—Tbilisi—Erzurum (BTE) pipeline, transports natural gas from the Shah Deniz gas field in the Caspian Sea to Turkey. Running parallel to the SCP is another Azerbaijani pipeline, the Baku–Tbilisi–Ceyhan (BTC) oil pipeline, which opened in July 2006. This exports oil from Azerbaijan, and up to 600,000 barrels a day from Kazakhstan, running along a 1,040-mile route from Baku to the Turkish Mediterranean port of Ceyhan and on to Europe.

3.3 The UK is already the largest foreign investor in the country through BP. On 7 October 2010 BP and SOCAR (The State Oil Company of the Republic of Azerbaijan) announced a major new production sharing agreement (PSA). This gives BP 30 years of rights to exploration and production rights over the Shah Deniz Asiman Structure. Reserves are said to estimate 500 bcm of gas and 65 million tons of condensates, this alone could supply the Nabucco pipeline running at full capacity for 16 years.

3.4 Azerbaijan is an essential element of any of the plans supported by the EU. The Caspian and Middle East region are estimated to have in excess of 88 trillion cubic metres (tcb) of reserves, dwarfing Russia’s reported estimates of 43 tcb. The International Energy Agency (IEA) reported in its 2010 World Outlook report that Caspian natural gas exports are expected to more than triple during the next decade. Producers including Turkmenistan and Azerbaijan are expected to export almost 100 bcm of gas in 2020, compared with less than 30 billion last year. Even setting aside political considerations, Russia simply does not have enough reserves for the long-term supply of Europe’s energy needs. Production from its largest three fields has already begun.

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70 Chatham House Repot, Investing in an uncertain future: Priorities for UK Energy and Climate Security, Nick Machey, July 2010

71 Euractiv: Geopolitics of EU energy supply - http://ecfr.eu/content/energy/geopolitics-eu-energy-supply/article-142665

72 European Council on Foreign Relations. The EU and Russia’s Gas http://ecfr.eu/content/entry/commentary_the_eu_and_russias_gas/

73 BP in Azerbaijan: http://www.bp.com/content/dam/bpacom/en/sectiongenericarticle.do?categoryId=9015374&contentId=7028018

to fall\textsuperscript{75} while at the same time internal consumption is going up. For these reasons any long term solution for the UK must include access to the massive resources of the Caspian and Middle East.

4. NABUCO

4.1 Nabucco is the preferred project to bring gas to the EU and increase diversity of supply. The cost has been estimated at €7.9 billion and an intergovernmental agreement between Turkey, Romania, Bulgaria, Hungary and Austria was signed on 13 July 2009. The pipeline is expected to be operational by 2015 and when complete it will carry up to 31 bcm of natural gas per year.

4.2 Widely regarded as a competitor for Russia’s South Stream project, Nabucco has the advantage of having lower overall build costs than South Stream, but has been hampered by disjointed European policy and lingering questions over supply. However, despite scaremongering, mainly from the South Stream lobby and Russian Prime Minister Vladimir Putin, studies suggest that supplies would not be a problem and could be sourced from Azerbaijan and other Middle Easter producers such as the Kurdistan region of Iraq.

4.3 Azerbaijan is well placed to cover the initial 8 bcm phase of the project through expansion of its Shah Deniz gas field. It is expected that when the project moves into its second phase the Kurdistan region of Iraq will provide supply to cover the remaining capacity needed to fill the pipeline at 31 bcm. Additional supply could be sourced from Kazakhstan and Turkmenistan with Azerbaijan acting as a conduit. This could be undertaken utilising existing infrastructure, connecting Azerbaijani and Turkmen offshore platforms in the Caspian Sea, these are barely 70 km apart.

4.4 The Kurdistan Regional Government (KRG) Minister of Natural Resources, Dr Ashti Hawrami, announced in June estimates of gas reserves of between 100 and 200 trillion standard cubic feet. This would be more than enough to meet all domestic requirements and to generate substantial revenues for Iraq from the sale of excess gas to Turkey and Europe.

4.5 RWE, one of the partners in Nabucco, has already signed a Cooperation Agreement with the Kurdistan Regional Government. Under the agreement, RWE will provide assistance to the KRG in the development of a gas distribution network and training aimed at increasing the necessary technical skills of the citizens of the region.

4.6 Both Azerbaijan and Kurdistan are integral to the project and both have declared their interest in being involved. The key to securing these supplies will however be decisive UK and EU action in pushing the project forward. Azerbaijan will then have the confidence to invest in expanding the Shah Deniz field while the KRG can work on developing its infrastructure towards export.

5. RUSSIA’S “GREAT GAME” PLAY

5.1 South Stream is a Russian supported project to transport Russian and Caspian gas to Europe via the Black Sea. Combined with Russia’s Nord Stream pipeline, the two will only serve to increase the EU’s dependence on Russian gas.

5.2 With Nord Stream scheduled to be operational by 2011 it is hard to see why Russia would be so intent on promoting this South Stream if it were looking to Russian gas supplies alone. Critics say that Russia is simply pushing South Stream in order to derail Nabucco. By so doing, it would retain a virtual monopoly of distribution, not just of its own supplies but of most supplies from the Caspian and Central Asia. These theories have been given credence by Russian Prime Minister Vladimir Putin’s efforts to talk down Nabucco’s chances of success, while making it clear Russia would not entertain any thought of convergence or collaboration between the two pipelines despite the obvious economic advantages.

6. RECOMMENDATIONS

(a) The UK’s dependence on external energy sources is set to increase dramatically by 2020 with imports of natural gas set to rise to 70% of requirements. Although Norway will provide part of this increase, the UK is still vulnerable to price fluctuations and restriction of supply on the European market. The UK therefore has a vested interest in ensuring the EU has stable and diverse supplies of energy.

(b) The EU’s dependence on Russian gas has received a lot of attention, mainly due to political considerations. The 2008 war in Georgia and the Ukraine gas disputes of 2009 have shown that these worries are not without foundation, but there are also practical reasons for the EU to increase its diversity of energy sources. Russia simply does not have enough reserves for the long term supply of Europe’s energy needs; production from its largest three fields has already begun to dwindle;\textsuperscript{76} internal consumption is going up; and increasing supplies could be diverted to China. For these reasons any long term solution for the EU must include direct access to the massive resources of the Caspian and Middle East.

(c) The “Southern Corridor” is the best way for the UK and EU to achieve diversity of supply. Nabucco

\textsuperscript{75} European Council on Foreign Relations—Beyond dependence, How to deal with Russian Gas—http://ecfr.3cdn.net/c2ab0bed62962b5479_ggm6banc4.pdf

\textsuperscript{76} European Council on Foreign Relations—Beyond dependence, How to Deal with Russian Gas—http://ecfr.3cdn.net/c2ab0bed62962b5479_ggm6banc4.pdf
is currently the favoured project but along with any other proposals it can only succeed if the support of Azerbaijan is secured. It is earmarked as a supplier for all the projects promoted by the EU but more importantly it also holds the key as a transit route for further supplies from Kazakhstan and Turkmenistan.

(d) If the EU and UK are not successful in securing these supplies the likely outcome is that Azerbaijan and other Caspian producers will be forced to sell the energy to Russia who will in turn sell it to the EU at a higher market price. The key to securing these supplies will be decisive UK support and EU action in pushing the EU Southern Corridor projects, Nabucco in particular, forward.

March 2011

Memorandum submitted by E.ON

SUMMARY OF KEY POINTS

— The electricity market faces significant investment challenges as we replace aging infrastructure and plant closes as a result of environmental legislation. In their 2010 Statutory Security of Supply Report DECC and Ofgem estimate closures of around 12GW of generation capacity by 2016 as a result of the Large Combustion Plant Directive (LCPD) and up to 7.4GW of nuclear capacity by 2020. At the same time the UK energy system is decarbonising which could result in more intermittent plant and a more decentralised generation structure. To ensure security of supply Government policy needs to consider not only the direct low carbon infrastructure but also the investment challenges for the supporting infrastructure, including peaking plant and improved networks.

— Decarbonisation of the energy system is also likely to dramatically change demand characteristics through electrification of heat and transport and energy efficiency. Predicting these changes and developing the capability to manage them (through demand side management) will be crucial.

— Fossil fuels are likely to remain an important part of the UK’s energy system for the foreseeable future as carbon capture and storage technology develops and through their role in providing peaking capacity when required.

— Diversity of the UK’s energy system is crucial to reduce the risk of both supply shortages and fuel price volatility. Government policy should encourage investment in a wide range of energy sources.

— We believe the UK is unlikely to experience physical supply shortages of fossil fuels used for electricity generation and heating but price volatility could remain high.

— Policy uncertainty could lead to a hiatus in investment. Given the challenges the UK faces and the long timescales of many infrastructure developments, policy certainty including further development and finalised proposals from the electricity market reform (EMR) process should be a priority for Government.

The Committee’s specific questions are addressed below.

Q1. How resilient is the UK energy system to future changes in fossil fuel and uranium prices?

1. The UK energy market is competitive and any long-term, fundamental changes in wholesale market fuel costs will ultimately be passed on to energy consumers. Industrial consumers generally prefer more market reflective pricing so may therefore be more susceptible to short-term changes in fossil fuel costs.

2. We believe fossil fuelled plant running at low load factors will remain an important part of the future low-carbon energy mix in the UK in order to meet peak demand when renewable generation is low (for example when the wind doesn’t blow). Fossil fuels could also play a role in baseload supply with carbon capture and storage technology. Therefore the UK is likely to be sensitive to fossil fuel prices to some degree for the foreseeable future. The long term relationship between the prices of different fossil fuels is also significant as it could drive switching between fuels used for generation.

3. As the UK energy market decarbonises, fossil fuel prices could have less influence over the electricity price; the extent of this depends on the uptake of carbon capture and storage technology and the role of fossil fuels in providing marginal capacity.

4. In order to manage future volatility in fossil fuel prices it is crucial that investment in UK energy infrastructure facilitates a diverse range of energy sources both in terms of electricity generation technologies and interconnection, and gas import and storage capability.

5. E.ON is developing its electricity generation mix in the UK through development of Combined Cycle Gas Turbine (CCGT) plant, renewables projects such as the London Array wind farm and nuclear generation through Horizon Nuclear Power. We welcome DECC’s recognition of the need for diversity in its EMR consultation but how effective the policy will be can only be judged when proposals are more certain.

6. A diverse gas infrastructure is emerging in the UK and DECC’s Statutory Security of Supply Report concludes that, should the currently planned import and storage capacity proceed, the UK will be well-served
in the coming years. E.ON’s gas storage business is investing in UK gas infrastructure with the Holford project which is expected to begin commercial operations in Q4 2011 and the Whitehill project which is in development.

7. The cost of uranium is a relatively small element of the total cost of nuclear power; therefore fluctuations in its cost have a limited impact. Uranium is a relatively abundant resource which is mined in a diverse mix of countries. It is widely accepted that significant uranium resources exist which could become economic to mine if supply shortages pushed prices up. Uranium can also be relatively easily stored which provides opportunities to manage price volatility.

Q2. 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 energy infrastructure often involves significant capital and takes time to complete. In the current economic environment potential investors with limited funds are making investment decisions on a global basis. The industry cannot react quickly to price signals in wholesale fuel markets, for example the timescale from initiation of a CCGT or Open Cycle Gas Turbine (OCGT) project to commissioning can be up to nine years. The UK needs a stable and predictable policy framework to attract the investment it needs within the necessary timescales.

9. Effective and timely implementation of planning reform is crucial. Delays to infrastructure projects as a result of planning issues could have a major impact on energy security. The National Policy Statements (NPS) provide a coherent and practical framework within which the decision maker can assess future planning applications for energy infrastructure. The NPSs should be ratified by Government as soon as possible as they are central to the new planning regime being effective.

10. The pre-application requirements of the new planning system introduced by the Planning Act 2008 could introduce additional risks for investors. To ensure investment is not delayed or deterred the system should be clear and transparent, allowing developers to work with the Infrastructure Planning Commission and Major Infrastructure Planning Unit to understand requirements early in the process.

11. Investment in transmission and distribution networks is important to maintain the quality of electricity supply in the UK and facilitate continued demand and generation access while the industry decarbonises. Most of the current network infrastructure was built in the 1950s and 60s and so will become less reliable without the continuing increase in investment started in the last two price control periods. As we move to a low carbon generation model, networks will need to support an increasingly decentralised generation infrastructure. The network industry also needs to establish how greater and more widespread demand side management can be achieved. We believe demand side response will be one of the most crucial elements needed to support security of supply in a low carbon future. The Government needs to ensure Transmission and Distribution Network Operators, suppliers, generators and, importantly, customers understand their roles in enabling demand side management. Investment in smart technology and a smart grid will help the UK to maximise the use of the current network infrastructure.

12. We welcome Ofgem’s recognition of the investment challenge the network industry faces with its announcement last year of new price controls to help deliver efficiently the estimated £32bn of investment over the next ten years. Ofgem has also recognised the need for investment in the transmission network through the Electricity Networks Strategy Group. This investment is crucial to avoid the network infrastructure becoming a barrier to other developments needed to achieve a secure, low carbon electricity supply.

13. The UK needs to ensure a diverse mix of generation technologies is developed and investment in back-up or peaking plant is just as important as low carbon plant. Any feed-in tariff model introduced by the Government should ensure a functioning market remains and incentivise a range of technologies; the proposed contract for difference model could achieve this if designed appropriately.

14. A wrongly designed capacity mechanism could distort the efficient mix of peaking plant the market would otherwise incentivise. We believe that, wherever possible, energy only markets combined with functioning balancing markets should be used to incentivise investment in capacity. If a capacity mechanism is introduced, the most efficient approach is to create a market for capacity where all generation (or demand side response) providing firm capacity (or an equivalent reduction in demand) is rewarded at the same value. The analysis we have undertaken suggests that a system of capacity credits is the mechanism which is most market-based and would involve least disruption to the existing UK market structure.

15. Investment in any infrastructure relies heavily on the wider supply chain providing both materials (such as turbines, reactors and so on) and skills. Security of supply is very sensitive to the availability of these.

16. Investment in interconnection could help balance the risks of generation intermittency and demand peaks across Europe. A period of low wind and cold temperatures in the UK could well extend to other areas of Europe; in these conditions interconnection can only play a limited role in ensuring security of supply. We believe an efficient and integrated EU wide market is crucial as it will provide price signals that ensure that electricity flows are received by the tightest markets, but interconnection should be just one part of a diverse mix of energy sources.
17. The UK gas market has a well proven track record of delivering even under extremely tight and challenging circumstances. The Ukraine gas crisis in 2009 was well managed without any intervention and the 2010 Pöyry report “GB Gas Security and Future Market Arrangements” states:

“Experience of the 2009/10 winter with sustained high demand confirms that the market has delivered and is working fine.” and that “our general conclusion is that there is no need to fundamentally change the market. If it is allowed to work effectively, then the pricing signals can be expected to drive the necessary investment”.

18. In their 2010 Statutory Security of Supply Report DECC and Ofgem predict the UK will have a large and diverse range of gas import sources, provided planned import and storage capacity comes forward.

Q3. What impact could increased levels of electrification of the transport and heat sectors have on energy security?

19. Electrification of these sectors will undoubtedly increase overall levels of demand for electricity. Forecasting the timing and level of this increase is extremely challenging. As outlined above, investment and development of energy infrastructure takes several years so a short-term, unexpected increase in electrification could bring security of supply risks. Poor infrastructure could become a barrier to electrification and a move to a low carbon economy.

20. Without demand side management, the electrification of heat and transport could have significant consequences for the UK energy system. The impacts on generation capacity and networks (particularly the lower voltage networks) could be particularly severe. Electrification needs to occur alongside improvements in demand side management technology and appropriate incentives for customers. Increases in demand can then be managed or substituted into periods of low demand. This will allow the UK to make the best use of its existing infrastructure, minimising the investment needs and could even provide significant electricity storage opportunities.

21. As well as reducing carbon emissions, electrification of these sectors could help reduce the UK’s reliance on fossil fuels such as gas and oil. However, this will only be achieved if investment in a diverse, low-carbon and secure electricity generation mix occurs.

Q4. To what extent does the UK’s future energy security rely on the success of energy efficiency measures?

22. Energy efficiency will help reduce the overall levels of average demand in the UK. This could help offset some of the expected increases in demand from electrification of heat and transport. Achieving long term carbon reduction targets will be very difficult without significant improvements in energy efficiency.

23. Energy efficiency alone is unlikely to reduce capacity requirements significantly: many energy efficiency measures involve reductions in non-essential energy use which often occur outside of peak times. On its own, it therefore has a limited impact on one of the key challenges in the development of a low carbon energy infrastructure of ensuring energy security at times of generation intermittency.

24. As with electrification of heat and transport, the extent to which energy will be used more efficiently is difficult to predict. This has consequences for investors and could lead to over- or under- investment if demand doesn’t reduce as expected. In the EMR proposals there are many assumptions about energy efficiency, the Government needs to consider the impact of limited policy success.

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?

25. Policies designed to achieve these targets in the UK will distort the current operation of the market with energy security implications. Some market intervention is necessary in order to correct the market’s failure to accurately reflect the cost of carbon (the EU ETS aims to achieve this) and incentivise low carbon generation given the UK’s opportunity to replace its closing generation fleet.

26. Nuclear can provide high and consistent levels of baseload power, helping to maintain sufficient margin at peak times. Increased renewable generation could lead to lower load factors for non renewable plant, requiring this plant to make a return from higher revenues over shorter periods. In the current market, prices would need to rise to exceedingly high levels, which might attract regulatory or political scrutiny, in order to reward peaking capacity. This creates a more difficult environment in which to attract the required investment in peaking capacity.

27. The change to a low carbon economy could have a significant impact on the demands placed on the UK’s networks and the way in which they are planned, designed, built and operated. We therefore welcome Ofgem’s Low Carbon Network Fund introduced for electricity distribution and proposed for gas and transmission businesses.
Q6. What would be the implications for energy security of a second dash-for-gas?

28. The International Energy Agency’s World Energy Outlook published in November 2010 predicts a glut in global gas supply. Production of shale gas in the USA has led to an increase in LNG supply to the rest of the world. As the UK’s LNG infrastructure develops, the UK becomes more open to the international gas market.

29. Since 2009 the UK power generation market has already seen an increase in gas capacity, we expect this trend to continue until at least 2014 given current CCGT and OCGT plant in operation or under construction. If further planned or consented gas capacity comes online this will continue even further into the future.

30. Recent events in Japan have shown how an unexpected event can dramatically change the economics of a commodity very quickly. The German Government’s decision to temporarily take Germany’s seven oldest nuclear power plants offline has resulted in increased gas and coal prices based on expectations of future demand. An over reliance on gas based on current availability and price expectations could increase our energy security risk.

31. We believe a diverse energy mix is crucial and the UK Government should encourage this. Reliance on any single fuel through a generation investment cycle could have consequences in terms of volatile prices and limited ability to balance these by switching to other fuels in the short term.

32. Through the EMR consultation the Government has recognised the risk of reliance on gas. We support the proposed contract for difference (CfD) based feed-in-tariff model which could promote a diverse energy mix; further consultation is needed on the design of this policy to ensure its effectiveness.

Q7. How exposed is the UK’s energy security of supply to international events?

33. In terms of physical availability of energy the UK is relatively well insulated against international events. Global availability of gas and coal is relatively good and sources are relatively diverse so the UK is highly unlikely to experience long-term supply shocks.

34. International events could have a significant impact on price given the global nature of commodity markets. As outlined in our response to question 1, price increases will eventually pass through to energy consumers which could have significant consequences for the UK economy. Recent events in Japan and also last year in the Gulf of Mexico have shown us how sensitive commodity prices can be to disruptions.

35. Investment in a diverse energy infrastructure will help to reduce reliance on a single fuel or fuel source and in turn help stabilise prices for consumers.

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. The UK has previously relied on the market to provide sufficient capacity margins and has been successful at doing so. We recognise the changing risks to security of supply as the Government intervenes in the market to promote low carbon development. EMR could result in fundamental changes to the energy industry so security of supply risks will not be clear until policy is more developed. Further development of the EMR proposals and finalised reforms should therefore be a priority for Government to ensure certainty for investors. These investors will spend their money elsewhere if the regulatory framework in the UK is uncertain.

37. Demand side response and energy storage should be considered as a means to manage energy security risks before intervention in the form of capacity markets.

38. The emissions performance standards (EPS) proposals in the EMR consultation could significantly affect investment decisions for generation plant that could be crucial in maintaining security of supply. If introduced, the EPS should remain at a level that allows crucial fossil fuelled peaking plant to operate before CCS is fully developed. Enforcing future retro-fit of CCS technology could distort current investment as the technology is so uncertain.

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?

39. In paragraphs 9 and 10 above we outline our concerns around effective and timely implementation of planning reform. Planning is a crucial element of any infrastructure investment project and could have a significant impact on energy security. The NPSs should be ratified by Government as soon as possible and pre-application requirements should be clear and transparent.

March 2011
Memorandum submitted by Royal Society of Chemistry

The Royal Society of Chemistry (RSC) welcomes the opportunity to respond to the House of Commons Energy and Climate Change Select Committee inquiry into “The UK’s Energy Supply: security or independence?”

The RSC is the largest organisation in Europe for advancing the chemical sciences. Supported by a network of over 47,000 members worldwide and an internationally acclaimed publishing business, its activities span education and training, conferences and science policy, and the promotion of the chemical sciences to the public.

This document represents the views of the RSC. The RSC has a duty under its Royal Charter “to serve the public interest” by acting in an independent advisory capacity, and it is in this spirit that this submission is made.

Overview

The UK has ambitions of changing its energy mix to one which includes more renewables and more low-carbon energy. In order to meet an EU target of 15% renewable energy by 2020, it is estimated that between 30–40% of electricity would need to come from renewables—in 2009 renewables accounted for 6.7% of electricity generation, up from 2.5% in 2000. The EU 15% target would still leave 85% of energy to come from non-renewables, including gas, coal, oil and nuclear power. Each of the fuels for these forms of energy supply has a different provenances and geopolitical implications, both of which will experience change in the coming decades. Beyond 2020, the Committee on Climate Change recommended that electricity generation should be largely decarbonised by 2030 if the UK is to meet its commitments under the Climate Change Act 2008 of an 80% reduction in greenhouse gas emissions by 2050.

Terms of Reference

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

The UK is vulnerable to increases in fossil fuel prices and supply issues, because increasingly fossil fuels are imported as North Sea reserves are gradually becoming depleted, and UK coal production declines. The situation is exacerbated as the penetration of renewable technology is low, and there is no clear strategy for the widespread adoption of renewable power.

By some estimates, global peak oil is predicted to occur within the next 20 years and the peak for natural gas production (excluding that from shale gas deposits) is projected to occur 20–30 years beyond peak oil. World coal reserves could last a few hundred years at current utilisation rates and as fossil fuels continue to increase in cost, more of these reserves will become economically recoverable so peak production is difficult to predict but is likely to be many years ahead.

Fossil fuel availability is not yet affecting price volatility, as actual reserves are not likely to run out over the next 20 years. However, price volatility is increasingly affected by external factors. These include political instability, such as that caused by current conflicts and civil unrest in the Middle East. As an importer, the UK is also sensitive to strategic decisions on exports from other economies and transport availability. Prior to the start of the present economic downturn, demand in the Asian steel and power sectors was placing significant restrictions on the availability of coal for export and on the availability of shipping. Similarly, the situation in Japan has raised gas prices due to the increased demand for LNG.

There are no economically viable deposits of uranium in the UK, therefore supply is sourced from outside the UK. If the large number of planned new nuclear power stations around the world are indeed built, then this will place an additional strain on uranium supplies, leading to increased prices.

However if the recommendations from the Smith School of Enterprise and the Environment report “A low carbon nuclear future: Economic assessment of nuclear materials and spent nuclear fuel management in the UK” to use reprocessed nuclear waste as fuel for reactors are adopted, then that would lead to a considerable improvement in the security of supply of energy from nuclear sources.

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

The initial focus for investment should be on the adoption of currently available technologies (photovoltaics, wind, etc), along with substantial investment into technologies that will deliver results in the medium to long term.

In order for electricity from renewable sources to be fully exploited significant investment in storage technologies, or clean peak generation capacity will be required to cover periods when the renewable sources are not online. Currently there is almost no provision for electricity storage in the UK and generation with the flexibility to balance intermittent renewables does not exist in the capacity required. In the short term this leads to the risk of older, less efficient plant being relied upon for peak generation. This is because the market is unlikely to be able support investment in state of the art technologies that operate for such short periods.
Research into novel storage technologies is urgently needed to identify novel, economically viable materials and methods to store energy generated by renewable sources, such as novel battery technologies like lithium air or high temperature thermal storage. Alternatively, there is an urgent need to identify lower cost approaches to ensuring high flexibility and acceptable environmental performance from peak generation plant. The chemical sciences can assist in developing many of the solutions required.

Smart grid technologies in conjunction with wide scale deployment of Smart appliances in homes for example, will have a significant role to play in smoothing out supply and demand in a scenario where a greater proportion of electricity is sourced from renewables.

The proportion of power coming from existing coal plant in the UK will diminish in the short term due to plant station closures. This trend may continue in the longer term as availability of gas decreases. This may lead to the need to reinforce the National Grid. The addition of renewables will compound this problem, since many areas where renewable energy will be generated do not have sufficiently strong grid connections, and connecting them to the grid backbone is likely to prove costly. It would be desirable to use the new materials to help in reducing grid losses but the requirement for extension of the grid could be so high that it will prohibit the use of the best available technologies. Research into this issue is urgently required and should seek to balance technology choices with the level of investment required.

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

The effects of electrification of transport and heating are very different.

Until 2020 the distribution network is expected to handle the gradual rollout of electric vehicles. In the longer term technologies that use vehicle batteries to smooth out peaks in supply and demand may be implemented. There will be a need to manage supply and demand and introduce other peak storage or generation technologies.

Distribution is not the key issue affecting use of electric vehicles. The main concern is that if the current primary mix of power generation (coal, gas, and nuclear) stays the same, and there is no move to increase the proportion of electricity from low-carbon sources, then the electrification of transport will increase overall energy demand without having any significant impact on emissions of carbon dioxide, which is the main reason for implementing this technology.

An additional factor to take into account is the Department for Transport’s position regarding biofuels, which states that biofuels should be targeted on sectors where alternatives to biofuels are not available, such as aviation and road haulage. They state that cars should, where possible, be electric. If this situation comes about then the demand for electricity for cars will grow at a much faster rate than currently envisioned, and will require a larger generating capacity to compensate. This generating capacity will need to come from low carbon sources such as nuclear and renewables.

Conversely, the heating sector is very energy intensive and increasing the use of centrally generated power for heating is unlikely to be a viable option for many decades. In the short term electrification of heating would place a massive strain on generation demand and the distribution network. Alternative methods of supplying heat locally from low-carbon sources would be far more effective both practically and economically. Such measures could include maximising the use of solar thermal heating, local combined heat and power, and ground source heat pumps. These measures could be implemented without any adverse impact on the security of energy supply for the UK.

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

Reducing demand for electricity has a key role to play in managing security of supply. The main issues to be considered are efficiency of end use and efficiency losses in generation and distribution.

Improving end use has the biggest role to play and is affected by a mix of technology availability and choice and user behaviour. There is scope for significant improvements in each of these areas and ultimately policy and fiscal measures may prove the only way to influence them.

Inefficiencies in generation and distribution will become less significant as old generation capacity, already scheduled for closure, is phased out. The scope for efficiency improvements in state of the art technology is limited, so the focus must be on ensuring that the best available technology is employed, in line with current policy. However, investment in new technologies is still valuable, especially in central generation technologies, as small improvements can have a significant effect on energy consumption. However, when reserve capacity is limited there must always be a compromise between efficiency and reliability.

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?

It is technically feasible for the UK to produce a substantial proportion of its energy from renewable sources but it is not currently economically viable to achieve this and it is unlikely to be so for many tens of years. This is because of the high investment premium of these technologies and the sheer volume of plant and
distribution infrastructure that would have to be added or replaced. It should remain a goal to progress to 100% renewable energy but this change can only be implemented over several generations.

The adoption of an energy mix with a larger proportion of the supply coming from renewable sources will lead to a reduction in greenhouse gas emissions as these are in general low carbon technologies. As these energy sources are not based on fossil fuels a move to an energy mix with a higher proportion of renewables will therefore also lead to greater energy security. However, if these renewable sources are intermittent, as in the case of wind and solar, then there are still risks of power shortages unless technology (such as energy storage devices and smart grids) is in place to meet peak demand.

Balancing technologies will need to be increasingly deployed to cater for periods when the availability of renewable power is less than the demand, both on a national and local (distribution restricted) basis. Technologies capable of meeting this requirement include:

- Pumped storage.
- Electrochemical storage.
- Hydrogen storage.
- Compressed Air and Flywheels.
- Peak generation technologies.

During periods where there was a shortage of supply, a form of energy storage would be the preferred means of boosting supply to the grid in the longer term, when renewable capacity reaches significant levels. In the short to medium term, low-cost but clean and efficient peaking plant will remain the most feasible option of smoothing the gaps in the supply of power from renewable sources.

Some of the above technologies are still at an early stage in their development and will require significant investment in order to take them from research to full deployment.

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

With the decline in North Sea gas, an increase in gas use (unless it is sourced from anaerobic digestion) would be met from outside the UK, so a second dash-for-gas is likely to have a negative impact on energy security due to the increased potential for interruptions in supply from other countries.

In the short term, significant use of low cost gas may reduce the incentive for investment in, and uptake of, renewable energy technologies. In the longer term, energy security would be best served by more rapid investment in electricity from renewable sources, so continued measures are needed to encourage this.

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

The UK’s energy supply is highly exposed to international events. The situations that have arisen recently as a result of instability in the Middle East and events in Japan have led to increased prices for oil and gas.

The only viable option to minimise the exposure of the UK’s energy security to international events is to move to an energy mix that is based on indigenous sources—the most feasible low-carbon options for the UK are solar, wind and tidal power. Nuclear and biomass energy sources will continue to depend on imports, though there is potential for significantly increasing biomass production in the UK.

The developing situation and debate concerning Japan’s Fukushima nuclear plant must not derail the UK’s strategy to build new nuclear power stations. The issues in Japan could not be repeated in the UK. The natural phenomena that gave rise to the situation could not occur to the same extent in the UK, or elsewhere in Europe for that matter. Moreover, lessons can be learned from the experience at the Fukushima plants to ensure that safe approaches to future operation in the event of similar but less severe events are incorporated into planning at the design stage.

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?

There is the potential to work with our European neighbours and support their adoption of similar national strategies. In so doing we would be able to trade excess energy generated by renewable sources in the UK with our neighbours, via the proposed European Supergrid. Likewise if for some reason the UK was short of supply we would be able to purchase surplus power from our neighbours. A strategy of investment in renewable technologies is in line with other EU countries and will ensure a continuous supply of electricity is available while reducing our dependency on non-renewable, fossil resources.

Carbon capture and storage (CCS) has a significant role to play in ensuring security of supply. The UK has large reserves of coal and CCS could make it viable to exploit these reserves. The implementation of CCS technology is far more advanced than many proposed alternatives as a means of generating large amounts of power with minimal emissions of carbon dioxide. However, it has not been demonstrated at commercial scale and requires investment entailing some commercial risk. Certainty in the carbon price is needed to justify this investment. The Government’s commitment to subsidise costs if the price of carbon is below a threshold will...
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pave the way for CCS installations to be constructed, once the technology has been shown to be technically feasible at commercial scale.

There is a close interrelationship between energy production, water, and food production. Instabilities in energy production will lead to problems with water supply, and food production. Conversely a shortage of water due to climate change for example will impact electricity generation. This was seen in recent summers in France where several power stations needed to be powered down as there was not sufficient water available to cool them. There is also a concern about land use for energy crops versus food production.

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?

The UK Government should ensure that the UK has sufficient workers skilled in Science, Technology, Engineering and Mathematics (STEM) to enable the move to a low-carbon and resource-efficient economy. In addition investment in supporting the teaching of and research in the area of nuclear sciences will be needed to support the resurgence of nuclear power that will be needed to meet the energy needs of the country while at the same time reducing carbon emissions.

UK science holds the key to delivering a “green collar” workforce for the low-carbon industries of the future. A robust skills pipeline with strength in STEM will be able to react rapidly and flexibly to the specialist demands of emerging sectors.

Greater support for education in our schools and universities must be provided to generate a steady supply of talented, highly-skilled individuals who will become the next generation of scientists and engineers and members of a wider, scientifically literate workforce.

A strong two-way relationship between academia and industry is essential for ensuring that the low carbon skills pipeline is healthy and fulfilling its intents and purposes. This will put the UK in the best position to take advantage of the opportunities that will arise from the move to a low carbon and resource efficient economy.

It is vital that our universities continue to attract students of international calibre students and that our high technology industries continue to attract foreign investment, if we are to make the UK a global marketplace for the development of low carbon skills.

Sources:
zerocarbonbritain: an alternative energy strategy.
The ECOFYS Energy Scenario.
Sustainable Energy Without the Hot Air: Prof D MacKay.
Chemical Sciences and Society Summit Report, Royal Society of Chemistry.
March 2011

Memorandum submitted by RWE Npower

1. RWE welcomes the opportunity to respond to this inquiry. We are responding on behalf of RWE companies operating in the UK:
   — RWE npower owns and operates one of the largest and most diverse portfolios of power generating plant in the UK with over 9,000 megawatts (MW) of large gas, coal and oil-fired power stations and cogeneration plant. Our retail arm, npower, is one of the UK’s leading suppliers of electricity and gas with around six million customers.
   — RWE npower renewables, the UK subsidiary of RWE Innogy, is one of the UK’s leading renewable energy developers with an operational portfolio in the UK of 535MW and a potential UK development portfolio of over 8,500MW, including wind farms, hydro plant and biomass generation to produce sustainable electricity.
   — RWE Supply & Trading is one of the leading companies in European energy trading and is responsible for all of RWE’s activities on the international procurement and wholesale markets for energy.
   — Our joint venture with E.ON UK, Horizon Nuclear Power, is developing up to 6GW of carbon free nuclear power.

2. We provide detailed answers to the questions, below but first have a number of high level points:
   — Efficient markets are required to ensure that the consumer pays the least cost for the delivery of secure supplies of the energy they use.
   — The scale of investment required to deliver the Government’s low carbon ambitions is indeed difficult, if not impossible, to fund from utility balance sheets alone. UK Government is keen to make investment in low carbon attractive to a wider range of investors to address this restriction.
— To ensure that energy security is not compromised will require that the electricity market produces efficient price signals. These provide the incentives for investment and also for parties to balance and feed into forwards markets allowing for the development of the demand response.

— The introduction of capacity mechanisms into the wholesale electricity market will dampen price signals which in turn will stifle the development of energy services and make the deployment of SMART meters a white elephant, severely compromising the goal of secure, affordable low carbon energy supplies.

— Energy efficiency measures represent not only an improved energy balance but a step towards a cultural and economic change that will engender demand flexibility (delivered both by behavioural change and smart meters and devices and potentially by storage of heat and power).

— The existing market arrangements have evolved to meet challenges along the way and there is a very strong case for a minimalist approach to reform which would address the issues relating to high capital cost, low carbon generation (ie offshore wind and nuclear), and leave the rest of the market arrangements as they are today. This will provide the signals that will in turn create the investment needed to deliver security of supply.

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

3. Efficient markets are required to ensure that the consumer pays the least cost for the energy they use. In the UK we have access to world wide markets for gas, coal and oil which ensure that our energy is supplied at competitive prices. As we decarbonise our electricity industry the amount of energy produced by coal and oil will reduce and in the medium term we are likely to see the gas share of the market increase.

4. There is a global market in LNG and there are significant reserves of shale gas which are well diversified. The European market is becoming more liberalised and the GB market has a well diversified infrastructure with a deep and liquid traded market making it well placed to supply the gas we need at competitive prices until the low carbon share of the market increases.

5. Uranium can be stockpiled and represents about 10% of the overall plant running costs. The UK is not a Uranium producer but deposits of Uranium are widely dispersed across a number of countries. The potential sources include those countries that we do not currently rely on for fossil fuels and there are considerable resources available in OECD countries.

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

6. We recognise that the scale of the investment challenge facing the energy sector is huge. Significant capital investment in new electricity generation capacity will be required over the next two decades to deliver the Government’s decarbonisation and renewable energy aspirations. The EMR estimates a capital requirement of £70–75 billion in low carbon generation by 2020 alone, and high rates of capital investment in generation infrastructure will need to be sustained into the 2020s.

7. The scale of investment required to deliver the Government’s low carbon ambitions is indeed difficult, if not impossible, to fund from utility balance sheets alone. UK Government is keen to make investment in low carbon attractive to a wider range of investors to address this restriction.

8. Ensuring the right market structure is the crucial first step in delivering future investment. To make the investment more attractive to new investors, who are not used to taking electricity market price risk, there are two key issues:

— that the returns are stable and predictable and commensurate with the risks that are being taken, and

— that the investment can be compared to other opportunities investors have to deploy similar amounts of capital in large infrastructure investments.

9. In the last decade there has been a 500% increase in the UK’s gas import capacity which is capable of importing around 125% of annual gross demand. Taking National Grid’s view of the likely storage construction the UK is expected to be able to store about 11% of its expected annual demand by 2020–21.

10. The most cost effective way to develop the transmission system such that it can accommodate the move to low carbon, is to maintain the locational signals in the charges for both generation and demand. This will ensure that generation gets built in efficient effective locations and will save the consumer up to £21 billion in extra energy costs, losses and transmission assets when compared to a system that socialises costs across the country.

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

11. These are not changes that will have an impact before the next decade and then there is uncertainty surrounding the impact of these new technologies.
12. To ensure that energy security is not compromised will require that the electricity market produces efficient price signals. These provide the incentives for parties to balance and feed into forwards markets allowing for the development of the demand response.

13. The introduction of capacity mechanisms into the wholesale electricity market will dampen price signals which in turn will stifle the development of energy services and make the deployment of SMART meters a white elephant severely compromising the goal of secure affordable low carbon energy supplies.

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

14. Efficiency measures reduce the gross demand for heat in homes and non domestic buildings, and thence reduce the demand for peak capacity in power generation, and gas and power infrastructure. This improves the overall long term adequacy of the energy system. The effect on the resilience of the electrical system depends on which plant is left at the margin.

15. Efficiency measures represent not only an improved energy balance but a step towards a cultural and economic change that will engender microgeneration (which reduces the net demand for networked energy) and demand flexibility (delivered both by behaviour change and smart meters and devices and potentially by storage of heat and power). Regardless of the overall gross demand for energy, demand flexibility has a substantial effect in improving both the adequacy and resilience of the gas and power system. Therefore, even if efficiency benefits are taken as comfort rather than reduced energy use, the take up of efficiency measures serves in the long term to improve system adequacy and resilience.

16. Efficiency and demand response both require price signals, behavioural change, and stimulation of consumers. The introduction of a capacity mechanism is likely to dampen price signals which could foreclose the energy efficiency option and make achieving government targets much more difficult.

**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?**

17. It is worth noting that the present market arrangements have delivered on security of supply, low prices and reducing emissions, it has:
   — delivered the almost 30GW of gas generation currently in operation and maintained an adequate capacity margin;
   — resulted in electricity prices which have been comparatively low and fairly responsive to movements in fuel costs;
   — supported the deployment of increasing amounts of renewables from 3.1GW in 2002 to 8GW in 2009; and
   — reduced greenhouse gas emissions by more than 25% compared to 1990 levels.

18. The existing arrangements have already evolved to meet challenges along the way and there is a very strong case for a minimalist approach to reform which would address the issues relating to high capital cost, low carbon generation (ie offshore wind and nuclear), and leave the rest of the market arrangements as they are today.

19. For example, the current renewables support mechanism is fully compatible with the existing trading arrangements. We believe a further evolution of the RO into a “Low Carbon Obligation” could have helped to move the UK towards its decarbonisation objectives with minimum disruption to the delivery of investments and the market. The Government has decided against this approach seeing greater potential merit in a more targeted revenue support mechanism to attract new investors.

20. We recognise that the scale of the investment challenge facing the energy sector is huge. Significant capital investment in new electricity generation capacity will be required over the next two decades to deliver the Government’s decarbonisation and renewable energy aspirations. The EMR estimates a capital requirement of £70–75 billion in low carbon generation by 2020 alone, and high rates of capital investment in generation infrastructure will need to be sustained into the 2020s.

21. The scale of investment required to deliver the Government’s low carbon ambitions is indeed difficult, if not impossible, to fund from utility balance sheets alone. UK Government is keen to make investment in low carbon attractive to a wider range of investors to address this restriction.

22. Ensuring the right market structure is the crucial first step in delivering future investment. To make the investment more attractive to new investors, who are not used to taking electricity market price risk, there are two key issues:
   — that the returns are stable and predictable and commensurate with the risks that are being taken, and
   — that the investment can be compared to other opportunities investors have to deploy similar amounts of capital in large infrastructure investments.
23. The UK has pioneered competitive and open energy markets and these have served the UK well in terms of timely investment to deliver secure and affordable energy.

24. Maintaining market integrity and efficiency should be a primary goal of EMR, including ensuring full consideration of interaction of supply with demand side, to ensure that Government objectives are met in the most economically efficient manner possible and at least cost to consumers.

25. One of the concerns expressed relates to that of the intermittency of wind and would there be enough flexibility from the supply and demand side to manage this. This is not likely to be an issue that needs resolving for the next 10 to 15 years so we should not try to second guess the energy mix. Putting in place a mechanism now is likely to result in a poor solution that will need fixing again in the future. We believe that the market is best placed to meet this requirement, Generation currently on the system will invest to make it flexible as long as the market signals are allowed to come through, as will the demand side with the introduction of SMART meters.

We note that there are proposals in the EMR consultation to introduce a capacity mechanism, we have concerns that a broad-based capacity mechanism, could dilute and distort significantly the price signals in the market by remunerating all plant that remains on the system regardless of its characteristics with respect to the flexibility required to balance intermittent low carbon generation. This could have an impact on the efficient operation of the market by reducing the signals required to ensure full participation in the market by both the supply and demand side. This could have implications for security of supply.

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

26. As we have described in our answers to the other questions there will be an increasing role for gas in our energy mix in the short to medium term. The GB market has demonstrated that it can produce the signals required to deliver not only the required infrastructure but also the molecules. As long as these signals are not dampened by energy policy, then there is no reason to believe that the market will not develop to deliver future requirements.

27. We should also not forget the potential of unconventional gas as a recent study by IHS Cera has noted.77

28. Unconventional gas in Europe is likely to make significant contributions to supply in the next 10 to 15 years, the report says. IHS CERA estimates production levels ranging from a minimum of 60 billion cubic meters (Bcm)—less than half of current shale gas production in North America—to 200 Bcm around 2025.

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

29. The Government plans to decarbonise the energy industry will in the long term reduce our dependency on imported fossil fuels. In the short to medium term there will still be an increasing role for fossil fuels, particularly gas, in our energy mix.

30. Import dependence does not of itself create energy insecurity; diversification of source, routes and types of energy can support a robust energy system.

31. We have a track record of delivering gas infrastructure as demonstrated by recent improvements:
   — The Interconnector and Bacton-Balgzand pipelines (BBL).
   — The Langeled pipeline.
   — The Teesside, Isle of Grain, South Hook and Dragon LNG terminals.

32. Based on National Grid’s current base case projections (which includes all storage facilities that are currently under construction and those that they believe are well advanced in terms of securing planning, financial backing and have commitments from major players) the UK’s storage capability could more than double the UK’s storage space and increase deliverability nearly three fold over this decade.

33. This has and is being delivered as a response to market signals which demonstrate that efficient markets are the best means of delivering security of supply at least cost to the consumer. In the GB we have a deep and liquid market with access to markets in Europe and around the world to source our gas requirements. Ensuring that these markets are as open and transparent as ours should be a priority for government.

34. We share the views of Poyry Energy Consulting expressed in their exhaustive reports on all aspects of security of gas demand78 when they say “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”.

77 The Study: Breaking with Convention 9 March 2011
78 Three reports commissioned by DECC and published 12 July 2010 “GB gas security of supply & options for improvement”, Security of gas supply: European scenarios, policy drivers and impact on GB and “Global gas and LNG markets % GB’s security of supply”
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 it be improved?

35. As stated above the UK has pioneered competitive and open energy markets and these have served the UK well in terms of timely investment to deliver secure and affordable energy.

36. Maintaining market integrity and efficiency should be a primary goal of EMR, including ensuring full consideration of interaction of supply with demand side, to ensure that Government objectives are met in the most economically efficient manner possible and at least cost to consumers.

37. The EMR should retain the exposure of all generation to the market to ensure the efficient siting, operation and maintenance of plant. It is crucial that this is delivered in the detailed design. Low carbon generation should be fully exposed to the price signals in the traded electricity market to ensure that parties have the incentives to minimise imbalance cash out. However, we note that the proposals to introduce a capacity mechanism, particularly if a broad-based capacity mechanism, could dilute and distort significantly the price signals in the market by remunerating all plant that remains on the system regardless of its characteristics with respect to the flexibility required to balance intermittent low carbon generation.

38. The primary issue for the EMR to address is to see investment in Round 3 offshore wind projects and the first wave of nuclear as soon as possible, as well as CCS retrof to demonstration projects in due course. However we do not think it is sensible to try to second guess what the market will look like in 2025 and beyond. The new low carbon support mechanism (whether CfD or PFiT) should make these large scale low carbon investment projects attractive to new sources of finance by providing stable, predictable and transparent rates of return over appropriate payback periods and commensurate to the level of risk.

39. There is a need to ensure that whichever mechanism is implemented, it is flexible enough to accommodate the needs of both large scale and smaller scale projects, with the design of the mechanism being proportionate to the scale and complexity of the project and the risks and costs associated with different types of projects.

40. The reforms should be defined so as to provide the minimum set of interventions to allow investment in the first wave of investments to happen, rather than trying to encompass everything at once, which will inevitably result in unforeseen outcomes.

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?

41. The UK currently has a more stringent gas specification than some other European countries. Whilst the European Commission is currently undertaking a project to harmonise gas quality across the EU, any resulting changes are likely to take considerable time to implement. In the interim period the differing gas qualities prevailing elsewhere in Europe may, on occasion, prevent the UK from fully utilising its pipeline import capacity. This could lead to supply shortfalls, which in periods of peak demand could be critical, and greater regulatory attention should be given to this issue.

42. We note the events that are unfolding at the Fukushima nuclear power plant in Japan. It will be some time before we can fully understand the implications for the UK and energy diversity. There will be a need for a balanced perspective to ensure we don’t undermine security of supply and unduly push up costs for consumers etc.

March 2011

Memorandum submitted by Statoil (UK) Limited

THE UK’S ENERGY SUPPLY: SECURITY OR INDEPENDENCE?

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

The degree to which UK energy systems are resilient to changes in fossil fuel and uranium price varies between product, supplier, and the nature of pricing between wholesale and retail markets. If the energy markets are well functioning then the prices should determine the relative competitiveness of different energy carriers. For example if coal prices rise relative to gas then more gas can be delivered to use in power generation. As global energy demand increases the UK should seek to ensure that it can compete for these resources by having an easily accessible and transparent market.

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

There are at least two dimensions to energy security, one physical and one economic.

There is a significant investment challenge in the UK electricity sector going forward. Both old coal and nuclear power stations will need to be replaced over the next decade. It is therefore essential that new power
generation capacity is brought on line in a timely fashion. Yet there is a great deal of uncertainty in the policy frameworks which are designed to encourage the delivery of this investment.

By contrast the gas market, up until the recent changes generated by the Electricity Market Reform, has seen a period of relative stability in energy policy. This was set in the 1990’s and subsequent changes have focused on amending market structure to meet the realities of physical production and supply rather than undermine the basic concept of market based competition. As a consequence there has been significant investment in UK infrastructure in the natural gas market, with three new LNG regasification terminals capable of supplying an additional 25% of current UK gas demand, new interconnection from Norway which is now supplying about 30% of UK gas demand, planned new interconnection to the Netherlands which is going to provide 17–20bcm/yr additional capacity by 2012, with the ability to deliver significant new volumes to the market from continental Europe and further beyond.

The issue that presents itself for the gas market now is not if there is capacity to deliver but if government policy will allow for gas to maintain its role in the energy mix and provide a cost effective solution to reducing carbon dioxide emissions by 80% in 2050. This will require additional upstream investments in production on the UKCS, the Norwegian Continental Shelf and around the world. It will also require the UK maintain an attractive and well functioning market for the delivery of gas. Statoil are concerned that changes to the electricity market under the Electricity market reform process could have consequences for the gas market by changing the way gas fired generation would operate in the UK.

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

As regards the heat sector, the fuel that provides the best security of supply is certainly natural gas; electrification of the heat sector may have several other benefits, but not that of improving supply security, as the risks of disruption of electricity supply are higher than that of gas supply.

In a study recently developed by the European Gas Advocacy Forum, which Statoil is a member of, a gas-based pathway to achieve the European 2050 GHG reduction targets has been developed. This pathway would safeguard the robustness of the power system and security of supply. Through a lower reliance on intermittent technologies, a 25–40% lower build-up of transmission capacity would be required. Security of gas supply can be ensured: proven reserves are abundant, and as a result of current and planned construction of new LNG capacity and pipelines, there is ample supply capacity and diversification of the supplier base.

4. *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?*

Statoil believes that it is possible to deliver the governments ambitious targets and increase the penetration of renewable energy in the generation mix. However, the impact on energy security of trying to meet the UK’s targets for GHG reductions will very much depend on the pathway that is chosen in order to achieve such reductions.

As part of the Government’s exercise “2050 Pathways” we have highlighted that all the initially proposed pathways had an important drawback, in that they made it much more expensive to satisfy the forecast levels of demand—hence putting energy prices and affordability (ie economic energy security) at risk—and at the same time none of those pathways addressed in a satisfactory way the “indigenous” energy security risks that will be faced by a future energy mix dominated by intermittent generation sources and very inlexible base load, with no significant amount of generation that would be able to provide flexible response. The new pathways proposed by DECC recognise these issues and include examples (Pathway 15) of how the presence of natural gas in the energy mix for 2030 and 2050 could dramatically improve the energy security of the system. This solution would at the same time halve the infrastructure costs, a fact that we still wait to see confirmed in DECC’s expected cost analysis that should be conducted as part of the next step of the pathways exercise.

The increased penetration of renewables in the energy sector is aimed at diversifying the portfolio of sources and therefore improving the physical energy security on its “indigenous” dimension. At the same time, and on the same dimension, it is very important to note that penetration of intermittent renewables will require flexible balancing tools. This can be successfully offset by a parallel investment in flexible response resources such as natural gas.

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

Statoil believe that utilisation of gas as an electricity generation fuel will have a number of positive implications for the UK. Natural gas is a subsidy-free economically viable, abundantly available fuel. It is also the fuel which offers the best balance between affordability and a low carbon future. Therefore, the main implication of a “dash for gas” would be an unambiguous improvement in terms of the economic dimension.

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of energy security, and one which would also keep the UK well within its trajectory to reduce GHG emissions by 20% in 2020, 55% in 2030 and 80% by 2050 (with CCS).

On the physical side, natural gas would require much less investment in infrastructure, compared to all other sources, in order to maintain the “inherent” element of energy security. It would most successfully address the problems related to the increased inflexibility/intermittency of the electricity system going forward, thereby addressing the “indigenous” element too. Finally, on the “external” component of energy security, compared to all other imported fuels (coal, uranium), natural gas provides undoubtedly a secure solution for the UK’s import dependency: Norwegian gas is readily available, abundant, close to the UK’s shores and infrastructure is already in place that can cater for the long term needs of the UK energy market. 80% of the world’s gas reserves are located within 5000 km of Europe and there are sufficient reserves globally to maintain current gas demand levels for 250 years.

6. How exposed is the UK’s energy security of supply to international events?

The UK imports uranium, gas, coal and oil and all of these commodities are subject to international events impacting price and availability. Key to managing this risk it to have diversification of routes and supplies. As such the UK has comparable energy security as other EU nations.

7. 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?

The UK’s energy security policy is robust, which was also the conclusion of Poyry’s 2010 report commissioned by DECC on this subject. “the GB gas market is becoming more resilient to security of supply risks and able to withstand most foreseeable problems, and that no major changes to current policies are required”. However, it must be added that the most recent developments lack one important element of perspective, in that natural gas is not yet considered as the most important strategic investment towards 2030 and 2050, while there is no other alternative to maintain the current levels of UK energy security in the future when the UK moves on to implement its own climate targets, which are as shareable as they are ambitious (see question 5).

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

Statoil sees the UK as one its most important gas markets both due to its proximity and the effectiveness of liberalisation. If the right signals are sent via UK policy to the Norwegian, UK and global gas developers, we feel that security of gas supply to the UK (in terms of volume and price stability) is likely to remain highly favourable. Significant gas reserves remain to be developed in UK and Norwegian waters with infrastructure already in place. The UK gas market is currently a well functioning and liquid trading point, there has been considerable investment in capacity and it has maintain relative security through a period of significant change. The UK needs to give unambiguous signals that gas is a key fuel in the energy mix. Such recognition would improve market confidence in the longer term which will improve prospects for supply security.

March 2011

Memorandum submitted by EEF

1.1 EEF is an employers’ organisation and the representative voice of manufacturing businesses with a growing membership of over 6,000 companies employing some 900,000 people. All our members are energy consumers. For some, like those in energy-intensive industries such as steel, a secure and affordable supply of energy is crucial to the competitiveness of their business.

1.2 We have limited our submission to the three questions where we feel we have the knowledge to contribute.

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

1.3 Using energy more efficiently is important; it makes homes more affordable to heat and businesses more productive. Continuous re-investment in energy efficiency has been a core business strategy in many manufacturing industries for decades. This is reflected in the fact that the energy-intensity of UK industry has fallen by two-thirds over the past 40 years.

1.4 Looking ahead, the combination of depleting fossil fuel resources, ever-growing environmental awareness and increasingly aggressive climate policy will mean that focusing on energy efficiency remains more important than ever.

80 IEA “World Energy Outlook” 2010
1.5 However, whilst the economic and social importance of energy efficiency is clear, we are sceptical that it can be a significant factor in future energy security and would be extremely concerned if policy was developed on that basis.

1.6 There is little or no historical evidence to suggest that increasing energy efficiency will significantly reduce energy consumption. Arguably, the reverse, that improvements in efficiency will stimulate demand for energy, is more likely. Improving efficiency makes using energy less expensive and encourages economic growth, both of which stimulate energy consumption. Increasing energy efficiency is a valuable and an important policy objective in its own right, but not the basis for an energy security strategy.

1.7 The recent economic history of the UK illustrates the point. Between 1970 and 2007, UK energy consumption rose 9% despite the overall energy intensity of the economy, the amount of energy used per unit of output, dropping by more than 50%. This covers a period when the UK economy underwent significant change. The share of energy-intensive industries shrank and energy efficiency increased across all sectors of the economy. Yet despite these trends, energy consumption continued to rise.

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?

1.8 Cutting carbon dioxide emissions is vital to limit the impact of climate change and also represents a major business opportunity. However, we need a balanced approach to “decarbonising” our economy. We need to cut emissions without placing unnecessary burdens on hard-pressed households, undermining the competitiveness of our businesses or compromising energy security.

1.9 A secure and reliable supply of low-carbon electricity needs a balanced mix of different generation technologies. Nuclear power is a vital component of that mix—it is safe, proven and reliable. For the foreseeable future, the UK has no alternative to nuclear power with which to generate significant volumes of baseload low-carbon electricity.

1.10 However, EEF is concerned that two central elements of current government policy—the UK’s 2020 renewable energy target and the recently introduced carbon price floor—could actively undermine rather than enhance energy security.

THE 2020 RENEWABLE ENERGY TARGET

1.11 The UK has committed to sourcing 15% of energy from renewable sources by 2020, despite the fact that the target has never been subject to robust cost-benefit or feasibility analysis. EEF is not convinced that an arbitrary and technology-specific target is the right approach to decarbonising the UK economy. It could have a number of unintended and unwelcome consequences. For example, it risks imposing unnecessarily high and volatile energy prices on consumers for little or no environmental benefit if large volumes of expensive, intermittent and unpredictable wind power are relied on to achieve it.

1.12 For manufacturers, energy security is a function of price as well as physical availability. Stable and affordable energy prices allow businesses to plan and compete in global markets. High-levels of wind power, due to the inherent intermittency and unpredictability of its output, are likely to make wholesale electricity prices more volatile. This in turn will make wholesale gas prices more volatile. Gas demand is likely to fluctuate with the wind because gas-fired power stations are likely to be amongst the most important sources of backup power to wind farms.

THE CARBON PRICE FLOOR

1.13 The recently introduced carbon price floor is another policy with a highly questionable economic rationale that, based on current plans, will undermine not only the competitiveness of industry but also potentially energy security.

1.14 For example, by unilaterally raising the cost of fossil fuel based power generation in the UK, it could encourage higher carbon electricity generation to be sited elsewhere in Europe to supply our market via interconnectors. This would make the UK increasingly dependent on limited interconnection capacity and other EU electricity markets that often operate according to very different rules—eg regulations that prioritise domestic consumers in the event of disruption or shortfall.

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

1.15 EEF shares energy regulator Ofgem’s concern that current gas market arrangements will not deliver long-term security as the nature of UK supply continues to undergo significant change.

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83 See (2008), UK Energy Sector Indicators, BERR
1.16 Growing dependence on imported gas is exposing the UK to an increasing range of potential supply shocks. These include the failure of import infrastructure (e.g., pipelines and LNG terminals) and reliance on overseas gas markets in which political considerations override economic ones (e.g., regulations that prioritise domestic consumers over exports in the event of a disruption). Such events can, and have already, led to localised disconnections of manufacturers and sustained price spikes causing significant damage to energy-intensive industries.

1.17 The market needs to provide better insurance against this range of emerging issues threatening future UK gas supply. For example, compared to many continental European gas markets, the UK market has significantly lower levels of storage capacity relative to demand and fewer long-term supply contracts. A "second dash-for-gas" would exacerbate this issue by accelerating the UK's already rapidly increasing dependence on imported gas.

March 2011

Memorandum submitted by EDF

Preface

1. It would be inescapable to talk about energy security and independence issues without referring to and taking due cognisance of the recent events in Japan. It is right that the impacts of the earthquake and tsunami on the Fukushima nuclear plant should trigger close attention and concern. The situation continues to evolve each day and we need to continue to monitor the events carefully and objectively.

2. Events of such magnitude demand leadership and that leadership has been in evidence in many quarters here in the UK—from the Secretary of State for Energy, the Prime Minister, and the Leader of the Opposition and in comments made by many MPs in front of this Committee. All have shown clear-headedness in their response, avoiding knee-jerk reactions.

3. EDF Energy welcomes the mandate given to the Chief Nuclear Inspector, Mike Weightman, who represents a credible, independent and strong safety authority, to report on the facts, to analyse them and to draw lessons from them. We are determined to support Mike Weightman and play an active role in the lessons learnt exercise. We continue to operate our nuclear fleet to the highest standard but have also set in place an immediate action plan which includes establishing formal arrangements to ensure that any learning from Japan is fed into our safety processes. "Safety-First" remains an integral part of our culture as we seek to achieve continuous improvements and refuse to be complacent.

4. We do not believe that recent events in Japan change the need for new nuclear generation capacity in the UK as set out in the draft National Policy Statements (NPSs). The critical task in front of us today is to deliver a secure, clean and affordable energy mix. EDF Energy will not prejudge the outcome of the Weightman Report and we recognise the need to accommodate the findings of this report in due course.

Introduction

5. EDF Energy plans, with its partner Centrica, to build up to four nuclear reactors, with the first unit, at Hinkley Point, being commissioned by 2018. We are also actively developing our portfolio of renewable generation assets and completing construction of a 1300MW Combined Cycle Gas Turbine (CCGT) and a gas storage facility in Cheshire. Our final investment decisions for new nuclear generation are reliant on receiving the necessary consents and on a robust investment framework being in place.

6. It is important that the transition to a low carbon economy is progressed efficiently and without undue delay, to ensure that the competitiveness of UK energy supplies is maintained. It is also crucial that the three overarching objectives of energy policy, namely the decarbonisation of the economy, security of supply and affordability, are considered in a holistic manner in order to maintain consistency of reform.

7. Recent events, from political tension in the Middle East and North Africa, through to the unprecedented earthquake and tsunami in Japan, have had a big impact on energy commodity prices, and have highlighted the interdependent nature of the global energy system. The events have reinforced the need for a diverse low carbon energy mix that should include nuclear, renewables, and, if they can be proven at a commercial scale, Carbon Capture and Storage (CCS) technologies.

8. The events in Japan are an extraordinary human tragedy and our thoughts are with those who have endured and suffered much as a result of the earthquake and the tsunami which followed. EDF Energy welcomes the mandate given to the UK Chief Nuclear Inspector, Dr Mike Weightman, to report on the lessons that may be learned by the UK nuclear industry.

9. All of EDF Energy’s nuclear power stations are protected against natural hazards, including storms, earthquakes or tsunami, that have a frequency of less than 1 in 10,000 years. These measures are detailed in approved safety cases which are tested and agreed with the Nuclear Installations Inspectorate (NII), and Periodic Safety Reviews enable us to include the most recent data against which these risks can be assessed. For example, at Sizewell B, in Suffolk, the plant is designed to withstand a wave of 7.5 million—which is more than 5m higher than the worst case scenario even if a storm surge and tsunami combined.
10. The same principles apply to our new nuclear build developments at Hinkley Point, in Somerset, and Sizewell, which are designed to cope with a very wide range of external hazards. The safety case for the European Pressurised Reactor (EPR) plant, which is based on our worldwide experience from current construction projects in both France and China, will also be scrutinised in detail by the NII.

RESPONSE TO SPECIFIC QUESTIONS

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

11. The “resilience” of the UK’s energy system to changes in fossil fuel/uranium prices can be considered from the perspective of price stability and the consequent impact on economic activity.

12. Price stability depends on the duration of the price change experienced. Shorter-term fossil fuel price increases may be mitigated by the UK’s fossil fuel storage capacity. Gas storage capacity is only sufficient to supply around 5% of the UK’s annual demand, and much of this capacity is used to manage seasonality. Hence these facilities can only be used to mitigate short-term price spikes and not long-term changes. Gas fired generation represents around 45% of the UK generation capacity, and is often the price-setting technology, and in the heating sector gas is the most important fuel source. Therefore the resulting impact of movements in fossil fuel prices on UK energy prices would be relatively direct.

13. Major electricity producers’ stocking facilities at coal fired power stations provide larger storage capacity as a proportion of fuel consumed at each individual station (in excess of 50%), and are therefore better able to mitigate within-year price changes. However, coal fired generators would still be exposed to year-on-year fluctuations in input costs.

14. Faced with longer-term fossil fuel price shocks, the UK could benefit from its indigenous coal and gas reserves. However, these are in decline or becoming difficult to access, leading to a greater level of import dependency, and prices are becoming increasingly linked to global markets. All things being equal, the UK will become more exposed to global commodity prices as reserves decline.

15. An important factor in improving resilience will be diversification of supply away from fossil fuels. The drive to decarbonise will assist diversification and improve stability as:

— Nuclear fuel costs account for about 8% of the total cost of low-carbon electricity from nuclear, with uranium itself only 3%, in contrast with electricity from gas fired CCGTs where the cost of gas accounts for two thirds or more of the cost of generating electricity. In the case of nuclear, even if we see very large movements in the uranium price, the relative impact on the unit cost of electricity from nuclear would be relatively small.

— Renewable generation such as wind and marine power draws on the UK’s natural resources—and is therefore not linked to global markets for fuel. However while these sources can help mitigate economic security of supply risks by reducing exposure to the volatility of fossil fuel prices, they do increase the physical security of supply risks due to the intermittent nature of the energy output.

Uranium Supplies

16. Nuclear power stations require supplies of uranium to make the fuel to be used. It is also possible to use a mixture of plutonium and uranium in the manufacture of what is known as “mixed oxide fuel” but none of the UK’s existing fleet uses this type of fuel, and there are no plans as yet to do so in any new plants.

17. Uranium is a heavy metallic element widely distributed in the earth’s crust, and is about as abundant as more familiar metals such as tin. The largest known reserves of uranium are in Australia, Canada and Kazakhstan. Economically recoverable reserves are also found in many other countries including South Africa, Niger, Namibia, Brazil, Russia and USA.

18. The history of exploration for uranium is relatively short. There are substantial areas worldwide which have good prospects for uranium reserve identification and have yet to be fully explored. As a result it is almost certain that if further prospecting were carried out, then more reserves would be found. This is borne out by history.

19. The International Atomic Energy Agency (IAEA) and the OECD Nuclear Energy Agency publish a regular review of uranium resources, production and demand. The most recent review, published in July 2010, estimated that uranium resources worldwide amount to around 5.4 million tonnes, which are economically recoverable at prices up to $130/kg. At 2008 rates of use, this is sufficient for around 80 years of supply. It is important to stress that mining companies will only carry out prospecting and exploration for new reserves if the market conditions favour such actions.

84 Based on total gas consumption in 2009 and total UK gas storage capacity at 31 March 2010, as reported in Digest of United Kingdom Energy Statistics (DUKES) 2010
85 DECC, Digest of United Kingdom Energy Statistics (DUKES) 2010
86 Mott MacDonald, UK Electricity Generation Costs Update, June 2010.
20. There is an open and competitive market for uranium oxide ("yellowcake"), the raw material for fuel manufacture. The spot price for yellowcake has been volatile recently, and over the last six months has traded in the range $105–190/kgU.

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

21. We believe that the optimal UK low carbon electricity mix, which will play a key role in ensuring that the UK can meet its carbon reduction commitments, should be both geographically and technologically diverse. Maintaining adequate investment in electricity transmission infrastructure is therefore critical to continue to ensure that low carbon generation can reach the major centres of UK demand.

22. Strategic electricity transmission investment for renewable and other low carbon generation was identified by the Energy Network Strategy Group in their report of 2008–09. The report has been taken forward by Ofgem to provide funding for work where the identified investment will deliver value for money for the UK consumer.

23. The existing gas transmission network similarly plays a critical role in delivering secure energy to the UK consumer. It is anticipated that, as the power generation and heat sectors move towards other lower carbon energy sources, the nature of the gas transmission network may need to be reviewed.

24. Furthermore an efficient gas transmission network is essential to ensure that flexible gas-fired power stations can provide electricity to balance the intermittency of other low carbon generators. An appropriate balance of investment in generating capacity and development of the network might be required to deliver these secure supplies to a changing customer base.

25. Smart Grids and distribution networks are likely to have an important role to play in optimising future investments and ensuring that the system is run as efficiently as possible. The suite of solutions that comprise smart grids and demand side management will involve both passive and interactive measures. Some will be based on low impact automated responses, others will include consumers actively responding to price signals and some may even require significant behavioural or lifestyle change. We believe that a number of reasonably well established concepts for improving the performance of distribution networks and facilitating demand side response merit further consideration. This is an area of rapid technological change and further investigations are needed to understand and quantify the contribution that smart grids and smart demand can make. This will in turn inform important decisions on the optimal future mix of generating plant.

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

26. It is widely recognised by a number of stakeholders that in order to meet the UK’s climate change targets, the UK must significantly decarbonise its power sector by 2030. Depending on the choices of the low carbon energy mix, a decarbonised energy supply will have additional benefits in terms of affordability and security of supply: reducing dependence on volatile fossil fuel prices and energy imports.

27. Low carbon electricity will in turn provide solutions to decarbonise the heat and transport sectors, both of which are currently heavily reliant on fossil fuels. It is estimated that electricity demand could double from today’s levels by 2050 as a result of additional demand for the increased electrification of heat and transport. It is therefore important that adequate consideration is given to the development of the electricity transmission and distribution systems over the next two decades.

28. Building networks that are more reliable and responsive to demand can help reduce potential system peaks, and the need for grid reinforcements. A study by Imperial College and the Energy Networks Association suggests that there could be considerable potential to reduce both the electricity system peak demand and the need for system reinforcement by optimising responsive demand.

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

29. Currently, the UK’s homes are responsible for approximately 14% of our greenhouse gas emissions, with a large proportion of consumption being used for heat (81%) derived mainly from fossil fuels. Therefore, there is significant scope to reduce energy use and emissions by both improving the fabric efficiency of buildings and by decarbonising the heat that they use, in conjunction with wider policy efforts to decarbonise energy supplies.

30. It is important that energy efficiency of buildings is also considered alongside policies to decarbonise heat. We support the Government’s aims to reduce energy and carbon emissions in homes, through key policies such as the Green Deal, and the Renewable Heat Incentive, to encourage the uptake of renewable heat.

87 HM Government, Carbon Plan, March 2011
88 Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks, Summary Report, April 2010, Imperial College, ENA
89 HM Government, 2050 Pathways Analysis, July 2010
31. One of the key success factors for the Green Deal will be creating strong demand for energy efficiency measures to drive wide scale uptake. The policy should provide a commercial solution to providing energy efficiency measures that is attractive to all consumers, whatever their property type or demographics. We are working with Government on the design of the programme and are committed to making it a success.

32. Energy efficiency will also be important in future-proofing the housing stock, through robust standards for the buildings regulations in terms of fabric efficiency and heat use through policies such as zero carbon homes. However, there should be a balanced approach between energy efficiency, low carbon heating solutions and decarbonised energy supplies.

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?

33. EDF Energy believes it is important to distinguish between the different renewable technologies because not all of the renewable technologies raise security of supply risks or cause additional costs elsewhere in the system. Electricity generation from landfill gas, the production of bio-gas from anaerobic digestion and heat pumps represent technologies that do not create additional security of supply risks. However a very deep penetration of wind farms exceeding 25% of total electricity demand would in our view create significant challenges and incur additional costs in balancing electricity supply and demand.

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

34. Towards the end of this decade the UK is facing a shortfall in its generation capacity as a result of plant closures and running constraints linked to age and environmental policies such as the Large Combustion Plants Directive and Industrial Emissions Directive. Furthermore, as intermittent renewable generation capacity increases, there will be an increase in the requirement for supporting reserve capacity. There is a risk that this gap could be filled by the lowest-cost new-entrant technology, which is currently gas CCGT (at higher load factors). This second “dash for gas” is likely to increase the percentage of gas generation in the UK, as it will replace ageing coal plant as well as gas, and fill the supply gap as demand continues to grow. In turn, this will increase the UK’s overall exposure to gas supply and price risk.

35. We believe that further investment in CCGT plant, beyond the minimum that is required to bridge the gap to transition to low carbon technologies, will reduce the medium term potential for decarbonising the electricity sector and increase the risk that the UK’s long term emissions reduction targets will not be met, as the carbon emissions from these new assets will be “locked in”.

36. The first “dash-for-gas” saw a build rate of approximately 2.5GW per year for gas CCGT in the 1990s. This was predicated on replacing existing coal-fired generation with new gas-fired generation, rather than through significant increases in low carbon capacity. Such fuel-switching now is insufficient on its own if the UK is to meet its climate change targets and steps must be taken to encourage the latter. We therefore welcome the Government’s proposals for electricity market reform, which we believe can be developed into a robust market framework that is capable of delivering the low carbon investment the country requires.

37. The Committee on Climate Change (CCC) has stated that delivering the 2050 target is likely to require the power sector to be almost, if not completely, decarbonised by 2030, suggesting a carbon intensity of around 50g CO\(_2\)/kWh by this date. Given that modern CCGT plants have emissions of around 350g CO\(_2\)/kWh, the CCC’s analysis concludes that investing in gas-fired plant rather than low carbon technologies “will result in a deviation from the path towards meeting long-term targets”.

38. We also note that the UK is now much more heavily reliant on imported gas than at the time of the first dash-for-gas in the 1990s, and this reliance is only forecast to increase as domestic reserves decline. Hence there is a greater potential risk to the UK’s energy security than in the original case. While the UK has recently benefited from a global oversupply of gas, which has curbed the recent increases in gas prices, the lack of sufficient indigenous resources creates a net risk for the UK economy. In addition to the risks presented by volatile fossil fuel prices, the UK should also recognise the potential risks that could arise from carbon price shocks if the UK fails to decarbonise its energy supplies.

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

39. Geopolitics and international events are currently key drivers behind the price of oil, and this is a phenomenon that has existed since world oil markets began. In fact, the UK’s energy security of supply is highly interdependent with respect to both global wholesale markets and in terms of its reliance on other producers of primary fuels. Using gas as an example of both a primary fuel used for domestic heating and a secondary fuel for electricity generation, we find that world production has been concentrated outside of the OECD countries from 2008 onwards (table 1). These countries are often viewed to be politically more volatile and hence more likely to be the focus of an international event.

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90 We note that at high gas prices, nuclear plant becomes the most competitive new entrant.
91 Committee on Climate Change, Meeting Carbon Budgets—the need for a step change Progress report to Parliament, p24, October 2009.
Table 1

NON OECD COUNTRIES PROJECTED AND ACTUAL WORLD NATURAL GAS PRODUCTION 1980-2035

<table>
<thead>
<tr>
<th>Year</th>
<th>1980</th>
<th>2008</th>
<th>2020</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of world gas production</td>
<td>42%</td>
<td>63%</td>
<td>69%</td>
<td>71–75%</td>
</tr>
</tbody>
</table>

*Source: IEA World Energy Outlook 2011, p189*

40. At the same time as non-OECD world production has increased, UK gas production has significantly declined over the last four years to around half the production at the beginning of the decade.

41. Focusing on Europe as a region, we find a high degree of reliance on imported gas from Eastern Europe and Eurasia in 2008, and this is forecast to increase by the International Energy Agency (Table 2). Imports from the North Africa are set to rival Russia in terms of volumes imported into Europe. We have also seen the rapid political realignment of these gas exporting countries and so we face very different forms of risk. Events such as those in Libya have demonstrated their propensity to create volatility in the oil futures markets, with prices moving by an average $3/bbl daily. By mid-March 2011 benchmark crude oils were trading at $10–15/bbl above average February levels, with Brent oil trading at around $114/bbl and West Texas Intermediate trading at around $100/bbl.

Table 2

GAS FLOWS INTO EUROPE FROM NON OECD COUNTRIES PROJECTED AND ACTUAL 2008–35 (IN BCM)

<table>
<thead>
<tr>
<th>Region</th>
<th>2008</th>
<th>2020</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Europe Eurasia</td>
<td>154</td>
<td>174</td>
<td>215</td>
</tr>
<tr>
<td>Africa</td>
<td>83</td>
<td>98</td>
<td>138</td>
</tr>
<tr>
<td>Middle East</td>
<td>11</td>
<td>50</td>
<td>62</td>
</tr>
<tr>
<td>Latin America</td>
<td>5</td>
<td>N/A</td>
<td>8</td>
</tr>
</tbody>
</table>

*Source: IEA World Energy Outlook 2011, p94.*

42. It is important to make the point that not all events are the same in terms of their impact on wholesale market prices or on the UK’s economy. In a financial market, where traders do not expect to take delivery of the commodity, prices can often reflect sentiment or trading positions and not a fundamental threat to supply. As we increasingly diversify our sources of gas, we may expose ourselves to a wider range of political risks but may also be able to hedge this to an extent by sourcing gas supplies through existing relationships with producing countries.

43. With the development of European involvement in international energy policy (as endorsed by the European Council), it may make sense to maximise Europe’s negotiating positions on the world stage. Given our interdependent environment, this may be the most favourable outcome.

44. We conclude that we will be importing gas from all major continents and that any international event could potentially have an impact on the UK’s security of supply and the UK is also exposed to a number of other commodity markets.

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?

45. Much of the UK’s energy infrastructure assets are in private ownership and security of supply risks ultimately translate into investment risks. This is appropriate as long as the market frameworks are robust, and provide the right incentives for investment in long term capital assets such as power stations, network infrastructure and storage capacity.

46. The Government has recognised that the electricity market is in need of reform, and we look forward to the forthcoming White Paper and to contributing to the development of an appropriate framework to ensure that the future market frameworks continue to command the confidence of investors. It is imperative that the Government moves quickly in establishing the new market arrangements which will support the transition to a low carbon electricity system and help maintain security of energy supplies.

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?

47. We consider that there is a need for the UK to be aware of the ongoing scope of work being led by the EC and ACER. We specifically note the ECCC inquiry into a European supergrid in this respect and the
expectation that ACER and ENTSO-e will deliver, by June 2011, a baseline overview of policy considerations and constraints for the development of possible future technical grid configurations (as required by the North Seas Grid Initiative Memorandum of Understanding).

48. We consider that optimal investment in transmission and interconnection capacity could contribute to security of supply but that this may not be the primary objective of any such investments, and the UK needs to be fully engaged in this work to ensure that the objectives are clear and efficient investment choices are made.

March 2011

Memorandum submitted by InterGen

EXECUTIVE SUMMARY

1. InterGen welcomes the opportunity to respond to the Energy and Climate Change Select Committee’s enquiry.

2. InterGen believes that:
   — The increasing penetration of highly subsidised renewables is increasing the need for flexible generation to a level above that presently available;
   — However rising renewable penetration is reducing the amount of electricity needed from flexible generators. This is reducing the revenues of existing flexible generation, for which the economics are already marginal.
   — Flexible generation retirements and no replacement new build therefore appear inevitable under the present market arrangements.
   — If no action is taken this will lead to significant security of supply problems when renewables are not producing electricity or when nuclear plants are unavailable.
   — Assuming that present subsidies to renewables and proposed subsidies to nuclear remain, the only way that security of supply can be maintained is through some long term financial support to flexible generation.
   — The only practicable solution is a capacity payment targeted on flexibility, payable to both existing and new flexible generation.
   — Introducing a capacity payment targeted on new “peaking” generation will not solve the problem: rather it will exacerbate it through accelerated retirements of existing flexible plants.
   — The Government needs to be unafraid to commit to flexible gas fired generation as a crucial complement to wind and nuclear, providing flexibility with the lowest carbon emissions of any available flexible technology—otherwise the lights could go out.

3. We would like the opportunity to present our view in person to the Select Committee.

ABOUT INTERGEN

4. InterGen is the UK’s largest and most successful new entrant independent generator, having invested £1.4 billion in the UK since 1995. InterGen owns and operates three highly efficient gas fired power stations in the UK totalling 2,490MW and actively trades in the prompt and forward wholesale power and gas markets. InterGen is currently pursuing a number of development opportunities in the UK including two further 900MW CCGTs, representing a further £1.2 billion of investment. These developments have to compete with our international portfolio of opportunities, for which funding comes from our shareholders who are based outside the UK.

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

Resilience to fossil fuel and uranium prices

5. Exposure to international fuel prices is inevitable—whether directly through international purchase or through domestic fuel being sold at the international price. InterGen’s view is that the UK’s present and anticipated portfolio of generation to 2050 is not resilient to the credible range of fuel price scenarios. This reflects the lack of baseload and flexible power generation to support the likes of closure of nuclear plant (for example owing to fleet technical issues/uranium price rises).

6. InterGen’s view is that beyond 2015, compared to historical norms, there will be a lack of “capacity margin” to cope with unforeseen events. In recent years we have enjoyed the benefit of old flexible coal and oil plants providing back up margin such as during the coal strikes of the early 1980s and, more recently, when the UK has experienced very low wind conditions. This luxurious situation will not continue as this plant is decommissioned: many older flexible high emission coal plants will close by December 2015 (LCPD) and then, in all likelihood, most of the remaining old flexible coal plants by 2023 (IED). Present Government written policy focuses on renewables and new nuclear, despite public oral acknowledgement that existing and new flexible gas fired generation is critical to the UK’s transition to a low carbon economy.
Ev w76 Energy and Climate Change Committee: Evidence

7. Flexible gas fired generation is the only technology which assists with carbon reduction that is proposed to receive no subsidy. The impact of subsidised low carbon generation is that existing gas fired generation economics are marginal and new gas fired generation is no longer economic to build, giving rise to insufficient forecast flexible generation and a significant threat to security of supply. Consequently, while there will be resilience to extremely high gas prices on the basis that the Government continues with nuclear support, there will be insufficient gas plant to support a high uranium price or nuclear fleet issue scenario. Only two mitigants to this risk present themselves: either (1) a capacity mechanism; or (2) removal or reduction of subsidies to other technologies, though this second seems politically inconceivable. Hence InterGen strongly urges the implementation of a capacity mechanism for existing and new flexible generation, otherwise there is a very high risk of a UK security of supply issue.

Additional critical security of supply questions

8. Two further critical security of supply questions are:
   — How resilient is the UK energy system on days of low renewable production (with wind load factors of approximately 30%, this represents 70% of days)?
   — Are there diverse gas sources available such that global political issues do not interrupt fuel supply?

Resilience to low wind production

9. InterGen is very concerned that resilience to low wind production is a major UK security of supply risk. The targeted, new “peaking plant” only direction on capacity payments put forward by the Secretary of State to the Select Committee on 15 March 2011 fails to address critical existing fleet issues (with unsubsidised income reducing as wind penetration increases, resulting in flexible generation becoming uneconomic) and is likely to lead to substantial risk of material generation shortfalls. For example, with the closure of old coal and oil plants by December 2015, existing and new flexible CCGTs are unlikely to be able to produce sufficient electricity during periods of low wind, unless encouraged with a market-wide capacity payment targeted on flexibility. This is further addressed under Question 5 below.

10. Increased interconnection to the wider European grid is a component of the solution but systematic reliance on imported electricity would clearly not be a solution on which the UK could place full reliance: rather it is necessary to resolve the majority of the problem with domestic generation.

Diversity of gas sources

11. InterGen believes that the increased availability and use of LNG import facilities, LNG coming from a wide variety of countries and continents, gas interconnectors to the UK from Europe (eg from Norway), potential for coal bed methane and shale gas, and the potential for new gas finds in deep water (within UK territorial waters) have given the UK more than ample resilient gas fuel supply. In this view, InterGen agrees with DECC and Ofgem’s analysis in their November 2010 Statutory Security of Supply Report, section 4.6.2 “While production from the UKCS is projected to continue to decline, GB has an increasingly large and diverse range of import sources on which to draw. New import and storage capacity is identified at various stages of development and delivery. Should this come forward, the UK would continue to be well-served.”

We note the continuing scaremongering by some to develop a fear of a second “dash for gas”, which we consider based on the above to be ill-founded.

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

12. InterGen’s focus is on power generation infrastructure. This is covered in detail our response to question 5.

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

13. Over the medium term to 2020, InterGen foresees minimal impact from electrification of transport and heat sectors. Over the long term to 2050, material market penetration of electric cars and time shifting of charging of these cars to periods of low electricity demand (eg overnight) should increase rather than decrease energy security and also reduce reliance on oil.

14. DECC’s 2050 pathways analysis considers scenarios for the long term. InterGen backs the conclusion of that document—that a balanced strategy in which all technologies play a part will lead to acceptable security of supply and minimum cost for decarbonisation. As above, our current significant concern is that there is too much focus on renewables and nuclear and that essential flexible gas fired generation is being ignored in written policy documents and support mechanisms, despite public oral acknowledgement of its importance in our transition to a low carbon economy.
Question 4: To what extent does the UK’s future energy security rely on the success of energy efficiency schemes?

15. Energy efficiency schemes need to be economical and effective to reduce our carbon footprint, ensure the public is prepared for energy rationalisation (eg given the security of supply issues arising from the current policy direction) and keep consumer’s bills manageable.

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. InterGen supports the government’s and the EU’s low carbon agenda.

17. InterGen’s present focus is on flexible, high efficiency Combined Cycle Gas Turbine generation which is the lowest carbon form of available flexible generation.

18. InterGen is very concerned that flexible generation is an essential complement to renewable generation (and in particular wind) but that there will be insufficient flexible generation to maintain supplies when renewables are not generating.

19. This shortfall is illustrated in the chart below from the Oxera analysis supporting our Electricity Market Reform submission. The chart shows that forecast capacity will be sufficient but flexibility will not. The required level of flexibility is illustrated by the light grey line and the forecast level by the black line: these become too close for comfort after 2015 and cross to a clear shortfall after 2020.

20. Existing flexible fossil fired generation such as InterGen’s high efficiency CCGT fleet is needed to maintain flexibility and yet is only marginally economic at present market prices.

21. A key factor causing reduced revenues for fossil fired plants is highly subsidised renewable generation. In its simplest form, this is best understood by considering the situations when there is full and when there is zero renewable generation:

- When renewable generators deliver electricity, there is no need for flexible plant and hence flexible plant load factors are significantly reduced; and
- During periods of no renewable generation, the supply-demand balance is the same as if renewable generators did not exist and hence there is no natural uplift to market prices.

Hence to the simplest approximation and with the existing level of flexible generation, revenues would fall proportionately with load factor (proportion of time for which generation runs), given there is no compensating mechanism in the market to support fossil generation’s continued economic viability.

22. The chart below shows Oxera’s forecast declining load factors for flexible plants, highlighting (through the connection of load factor to revenues) the cliff-edge in flexible plant economics under the present market arrangements.

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93 Oxera report “GB capacity mechanism design: Meeting future flexibility requirements to secure a low-carbon transition” prepared for members of the Independent Generators Group 9 March 2011
23. Accordingly there is a need for long-term support for all types of flexible generation, not just traditional “peaking plant”. That support should apply equally to existing and new plants.

24. The capacity mechanism should:

— Address the issue of the intermittency of renewable generation by rewarding the provision of flexible capacity, rather than simply capacity;
— Provide long-term support for all types of flexible plant, not just traditional “peaking” plant. That support should apply equally to existing and new plant; and
— Give clear long-term price signals in order to support the financing needed by independent generators to construct new flexible capacity (via the likes of the EC’s proposed Project Bond or project financing).

25. The introduction of a capacity mechanism supporting only peaking plant rather than the existing fleet gas fired fleet as discussed by the Secretary of State at the Energy and Climate Change Committee of 15 March 2011 would not only be ineffective but would actually worsen the problem by reducing the level of flexible generation. As the economics of the existing fossil fleet decline, existing assets will be incentivised to retire early and be replaced by peaking plants with more attractive returns. This is not an economically efficient use of assets nor will such plants in many cases produce less carbon dioxide—in fact, traditional peaking plant produces around 30% more carbon dioxide than an existing efficient and flexible CCGT plant.

26. InterGen believes it to be crucial to security of supply that a capacity mechanism targeting new and existing flexible generation is introduced. Introducing any different type of mechanism will exacerbate the problem rather than solving it.

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

27. As of today there is no risk of a “dash for gas” due to its poor forecast economics. The issue is quite the reverse: there is more of a “dash for lack of security of supply”. The threat to security of supply in the coming decade is very significant. InterGen believes that existing and new gas-fired generation will play an increasingly important role by:

— Continuing to contribute to carbon emissions reduction targets by replacing more carbon intensive fossil-fired generation such as coal; and
— Providing clean, reliable and flexible generation capacity to support the increasing penetration of inflexible and intermittent low-carbon technologies in the UK, such as wind generation and new nuclear.

28. The transition to a decarbonised energy sector will require a change in the current arrangements to allow for the continued economic operation of flexible gas fired generation capacity in order to alleviate security of supply concerns.

29. Given nuclear baseload generation and intermittent wind, gas fired generation is the lowest carbon flexible technology available.
30. InterGen understands that present Carbon Capture and Storage technology does not support flexible plant operation. InterGen considers that for CCS to be truly useful, it must be developed to operate flexibly. Once this is the case, it can be retro-fitted to either CCGT or coal plants pre or post combustion. Up to that time, present generation CCGTs continue to provide a low cost way to save 50–60% of the carbon emissions of an equivalent coal power station—as well as giving flexibility.

31. The UK needs a balanced generating portfolio. Existing CCGT economics are presently marginal even for the most efficient plants and older plants are currently uneconomic (as evidenced by Centrica and GdF mothballing and recent comments from SSE about one third of existing CCGTs being loss making). New CCGTs will not be built owing to suppressed market prices and there being no long term (~25 year) bankable support mechanism to compensate for reduced load factors from renewable generation.

32. The current real and present risk is not of a second “dash for gas” but rather of insufficient flexible generation to complement intermittent wind generation, with material security of supply issues.

33. In addition, consumers need to be aware that fuel price rises are not necessarily the key driver to their household energy budget increases. Significant subsidies to renewables and nuclear are likely to have a much greater impact. InterGen is not suggesting that subsidies to renewables are inappropriate—rather that the public’s awareness of electricity price rises is growing and that renewable (and in future nuclear) subsidies have a very large impact on energy affordability for households.

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

34. This is considered in our answer to question 1.

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?

35. Overall, InterGen believes that UK energy security is reasonably robust to the credible range of scenarios with the single exception of the declining economics of unsubsidised flexible generation, without which there will be significant power outages when wind generation is low. The only solution which InterGen can see within the constraints of the BETTA market arrangements is to introduce a capacity payment targeted at existing and new flexible generation.

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?

36. Rather than the overall long term level of gas storage, InterGen believes that the Committee should consider the short term fluctuations in gas demand as CCGTs meet the increasing swing from wind generation. It is InterGen’s view that significant localised short term storage will be needed to facilitate such swings.

37. The UK uses a significant amount of gas for domestic heating and cooking. To lower the UK’s carbon footprint and further improve gas supply resilience, consideration should be given to accelerating the electrification of domestic heating and cooking (eg all new houses to use non-gas heating and cooking fuel). This would also improve domestic carbon efficiency.

Conclusion

38. InterGen believes that UK energy security is reasonably robust to the credible range of scenarios with the single exception of the declining economics of unsubsidised flexible generation, without which there will be significant power outages when wind generation is low.

39. InterGen believes it to be crucial to security of supply that a capacity mechanism targeting new and existing flexible generation is introduced. Introducing any different type of mechanism will exacerbate the problem rather than solving it.

April 2011

Memorandum submitted by ExxonMobil

We welcome the opportunity to provide this written response to the Committee’s review of UK Energy Security. ExxonMobil International Limited (ExxonMobil) is responding on behalf of its various UK affiliates: those involved in exploration and production of UKCS oil and gas assets; the owner and operator of Fawley refinery and CHP plant; and ExxonMobil Gas Marketing Europe Limited whose gas marketing activities involve the supply of up to 30% of physical gas sold through the UK wholesale hub. Our response may also reflect views gained through ExxonMobil’s global operations and our experience in exploring, developing, producing and delivering new supplies of natural gas to existing and new demand centres.

In the background section we address some perspectives on a range of topics that have a bearing on UK energy security and subsequently augment this with comments made in response to the specific questions that the Committee will be deliberating.
BACKGROUND

The Committee’s review of energy security is timely given the Government’s consultation on its Electricity Market Reform proposals, the Committee’s recent review of unconventional gas and its proposed review of a North Sea super grid.

1. IMPORTANCE OF FISCAL STABILITY

It also comes at a time when HM Treasury announced, to the surprise of the oil and gas industry, a 12% increase in the Supplementary Tax applicable to UKCS production, bringing the overall marginal rate of tax on some of our more mature North Sea producing assets to around 81%.

— Fiscal changes such as this seriously undermine investment confidence at any time and the further investments scheduled to both mature, and more technically challenging small fields have been brought back under review; earlier decommissioning of offshore infrastructure may add to the quantities of oil and gas that remain in the ground.

— The UK Government already enjoys the majority of the value of oil produced under the current fiscal regime. Whilst there is no guarantee prices will remain high the investments involved require many years before value can be returned to shareholders.

2. REFINED OIL PRODUCT SECURITY

There is a question of refined oil product security. Refining continues to be a challenged business in the UK as evidenced with seven of the eight major UK refiners either sold or up for sale. Fawley refinery being the only exception. UK refiners face cost pressures that global competitors do not and we estimate the combined impact of EU and UK legislation/proposed legislation would add about £35million per annum to our downstream operating costs by 2015. In the same way that fiscal instability risks sending investment capital elsewhere in the world, the growing downstream regulatory burdens are now forcing refiners to consider relocation of operations outside of the UK.

3. UK GAS AND POWER MARKETS

The cessation of self-sufficiency in gas should not be viewed as a prompt for dramatic changes to energy policy and the main challenges to any importing nation are to diversify its sources of energy, strengthen its relationships with energy exporting nations, and develop and use its indigenous resources more efficiently. Meeting these challenges effectively will enhance its energy security for many years to come.

— The UK enjoys a gas market framework that has attracted significant investment in the development of a diverse gas import infrastructure, both in the form of pipelines and liquefied natural gas (LNG) terminals. This infrastructure has increased connectivity to supply regions such as Norway and the Netherlands and, with three major LNG import terminals, access to the global LNG market.

Government has an ongoing role to encourage and facilitate major privately funded projects but presently we believe it has to regain investor confidence by providing a stable and predictable fiscal, legislative and regulatory framework.

— The Electricity Market Reform proposals are promoted as the platform for securing the confidence of the investment community to provide very substantial investments required in the power sector. As a package of significant market interventions, we believe it will have a small effect and possibly even a negative impact on the investment decisions that need to be taken today to meet long term future energy demands.

— Power and gas markets are inter-related through a 30% dependence of power on gas as a generation fuel and we are urging Government to consider the consequences of EMR on the gas market (as well as the power market) so that its actions can be judged against all of the potential impacts on energy security

— We are urging Government to do all that it can to ensure its energy policy and measures are non-discriminatory, allowing all fuels to compete on a level playing field, free of the market distortions that arise when subsidies are granted to any particular energy supply type or source.

4. GAS—GLOBAL INTERDEPENDENCE; GAS AND POWER IN EUROPE

European and global gas markets are growing in their interdependence and suppliers have an increasing choice of markets in which to invest and deliver their product. Price signals remain an essential aid to assist in this choice. Policy decisions which effectively place constraints on the operation of these market mechanisms or provide trigger points at which intervention may take place are open to a broad range of interpretations by market players risking an inefficient outcome including a reduction in security of supply.

Consistent implementation of the Gas and Power Directives and Regulations across Europe will facilitate energy security in the UK through timely and efficient redistribution of supplies to demand centres according to unconstrained price signals.
5. UK Import Dependence

Co-dependence of importers and exporters and the nature of international markets are not reasons to fear import dependency. Many of the major interruptions of the UK energy system in the past three decades have arisen from miners’ strikes, domestic fuel blockades, fires in gas storage facilities and occasional power cuts rather than from foreign supply dependence.

6. Diversity and Flexibility

ExxonMobil holds the view that the world’s energy needs are such that all potential sources of energy should be pursued and will be needed in the long term, as it is impossible to predict with confidence the specific sources of insecurity in energy systems.

Natural gas can improve diversity in the power generation mix and allow Government to maintain a pathway to long term CO₂ emissions reduction targets. Whether or not natural gas will make a larger contribution to power output than the approximately 30% it currently contributes depends very much on the success or otherwise of alternative investments that the Government is promoting.

This winter (December 2010) the UK experienced an extended period of high pressure with little wind across the UK, widespread snowfall and very low temperatures. We understand that national wind power load factors were well below average for extended periods of time. If this indeed was the case this should be a signal for further work to ensure that energy security can be maintained in the dash to the 34% renewable capacity target.

— Renewable intermittency currently has to be supported by gas generation flexibility and it is important that Government and industry understand if and how this is achievable.

Any circumstances of growth in gas fired generation may be more a case of dash for energy security rather than simply a dash for gas.

7. ExxonMobil Responses to Specific Questions of the Committee

Q1. How resilient is the UK energy system to future changes in fossil fuel and uranium prices?

— The UK’s energy system can continue to be resilient to future price changes as long as the UK wholesale energy markets are allowed to provide clear price signals for supply and investment requirements.

— In its EMR consultation Government describes as “vital to the work started by Ofgem and National Grid to improve arrangements for the balancing of the system and to increase levels of liquidity in the wholesale (power) market. These will provide important benefits to the wider operation of the GB electricity market, including improving signals for investment in new capacity, and therefore security of supply”. We agree that this work is vital but it would be somewhat undermined if the multiple interventions proposed under EMR were to be implemented.

— The UK wholesale gas market is by contrast a liquid, fully functioning market that commands confidence amongst those buying and selling through it and has provided reliable price signals to attract gas supplies and major new investment in gas infrastructure to ensure that the UK’s gas demand continues to be matched.

— January 2010 and December 2010 posted several of the highest gas demand days on record for the UK and despite import dependence of some 50% the UK remained well supplied. The UK gas system could become less resilient to future changes in prices if confidence in the market falls, liquidity levels deteriorate and the reliability of the UK price signal is questioned. The EMR consultation did not consider the extent to which interventions in the power market might have negative consequences for the effective operation of the gas wholesale market; this should be of concern to the Committee as the power generation sector will continue to rely on base load, and increasingly, peak gas supplies for the foreseeable future.

— Ofgem is engaged in a 12 month program with industry participants, exploring the extent to which gas shippers and suppliers might be more efficiently incentivised to provide reliable future supplies of gas and avoid supply emergencies. This is an important program with many interconnected considerations including the safety of network gas operations, but we are encouraged that so far the options are being tested in terms of whether they work with the grain of the market.

Q2. How sensitive is the UK’s energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?

— Patterns of energy supply to the UK gas and power networks are shifting and the uncertainty in future demand for gas and power is probably as high or higher now than it has ever been. These features may well contribute additional risk to UK energy security from either a lack of or delay to investment in infrastructure that turns out to have been required or misdirected investment in areas not required.

— The challenges for network operators and regulators are significant in these circumstances—to minimise risks of inefficient investment or premature abandonment of existing infrastructure.
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— The Government’s EMR proposals and Green Deal initiative are programs designed to manage the UK’s energy mix to meet binding CO₂ emissions and renewables targets or pathways whilst also making a step change in energy efficiency. The pace of new investment required to achieve these targets is picking up as deadlines approach; dependence on new technology to provide alternate electricity or heat sources, and to reduce usage, is also increasing; significant new transmission investments are required to support the future planned power generation mix. In our view the risk to energy security increases as the pace of change in supply patterns and new technology content increases.

— Some companies exporting gas to the UK are expressing concern about the deterioration in UK gas demand certainty. To the external investor UK energy demand uncertainty may slow or hamper decisions to invest in increased production for export to the UK although this may be a less significant factor when new supplies are organised to meet global market requirements. Liquidity and the effective functioning of the UK wholesale energy markets will be the significant driver for supplies and investment.

Q3. What impact could increased levels of electrification of the transport and heat sectors have on energy security?

— Electrification of the transport and heat sectors increases demand for power and reduces demand for fossil fuels including natural gas. There may be an overall lowering of fuel and technology diversity involved in this but the real risk to energy security is likely to emerge from delays encountered in transmission and distribution infrastructure upgrades that would be core to the success of such programs.

Q4. To what extent does the UK’s future energy security rely on the success of energy efficiency schemes?

— Government energy efficiency initiatives are to be welcomed and of course these will contribute to improved energy security once the efficiencies are delivered.

— It is important however that Government considers carefully the consequences of producing forward gas demand forecasts that reflect an overly optimistic view of energy efficiency contributions or an unrealistic pace of investment in non fossil fuel power generation.

— ExxonMobil is continually assessing the opportunities for improved energy efficiency in its own operations.

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?

— The Government is bound to do everything it reasonably can to comply with its legally binding environmental obligations, but we anticipate that it will continue to address the reasonableness of its plans in terms of the prejudice to energy security and affordability objectives. It may be necessary to make compromises if all three objectives are to be reasonably fulfilled.

— Medium-term GHG emissions and renewables targets are set for achievement by a specific year, 2020. Beyond 2020 carbon budgets continue with average emissions targets to be achieved over five year periods forming a pathway to the 2050 CO₂ emissions reduction target of 80%. Whilst we accept that we live in a world of targets, we do believe there is greater risk to achievement of targets for delivery within a tight timescale—the five year approach of the carbon budgets seems to us a rather more practical one.

— As a gas marketer we are concerned on a practical level about whether gas transmission flexibility and flexible gas generation will be available and sufficient to deal with gas demand variations of up to 60 mcmd that National Grid[^4] have indicated will be required should renewables content in power generation approach the target set for 2020.

— Assuming gas will be the flexible generation fuel, we believe Government needs to be sure that sufficient new flexible gas fired generation can be built fast enough to be ready to cope with demand changes of this magnitude.

— From an external supplier relations perspective Government may also need to be ready to acknowledge the day to day volatility in gas prices that may be caused by wind intermittency.

Q6. What would be the implications for energy security of a second dash-for-gas?

— As long as the investments in lower carbon generation are subject to delays and uncertainty it seems Government has little alternative but to consent additional gas fired power in order to plug the gap and keep the lights on. In that sense we believe any dash for gas must actually be viewed as a dash for energy security.

[^4]: National Grid Gas 2010 Ten Year Statement
Q7. How exposed is the UK’s energy security of supply to international events?

— A shortage of or export limitation on precious metals imported from China for use in UK wind turbines may be as important an event for the UK power industry as a disruption in gas supply for power generation. Importers and exporters do have a co-dependence and threats to energy security are more nuanced than portrayed in the simple expression of concerns about import dependence.

— Exposure to international events can be mitigated by promoting effective liquid wholesale markets that provide clear price signals to attract supplies, and building strong political dialogue between importing and exporting countries.

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?

— Difficulties in quantifying energy security are no easier today than they have ever been. But, in our view there are now internally induced threats to the UK’s energy security, exemplified by the proposed multiple market interventions of the EMR consultation.

— We hope Government will proceed cautiously embracing an evolutionary approach to stimulation of low carbon investment in the sector, constantly measuring its actions against potential negative impacts in both gas and power wholesale markets.

We trust that this written evidence will be of help to the Committee in its deliberations.

March 2011

Memorandum submitted by ESTA

ESTA Energy Services and Technology Association

ESTA is the UK Industry Body representing suppliers of products, systems and services for Energy Management. The 120 members cover Energy Consultants, meter, AMR and controls manufacturers through to full Energy Services/Contract Energy Management.


ESTA members are key to the realisation of a low carbon, secure and affordable energy future. Our members provide equipment, systems and services for energy management to reduce energy demand at source and including renewables.

Our response is a majority consensus of the members involved. Where ESTA members respond directly, they may offer differing opinions on some issues which we respect as expressing their own definitive view.

KEY POINTS:

— ESTA welcomes the inquiry into the UK’s Energy Supply and the opportunity to respond to a call for written evidence.

— ESTA encourages Government to include demand-side organisations/participants on a continual basis to provide input into market inquiries.

— It is ESTA’s view that demand-side energy efficiency and management measures impacts significantly on energy security. Reduced consumption through efficiency measures reduces the need for generation to provide the same, and more securely. In addition to the benefits of less consumption, there are no associated outage issues as there is no plant needed for that saved capacity, there is no network reinforcement investment required and there is no impact of global events for that capacity which has been reduced.

The UK’s Energy Supply: security or independence?

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

1.1 The UK has a diverse supply mix and so is better placed than most countries to weather the affects of a particular fuel spike or shortage. The UK’s gas system has several delivery options and going forward should provide the underlying security required until successful CCS has been delivered.

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

2.1 Infrastructure investment to allow for micro, macro and community generation projects is a must to assist with localised capacity constraints with current estimated demand increases. Demand-side projects require adequate investment channels and drivers to provide a more fragmented generation source which will reduce security of supply concerns.
2.2 Localised projects negate to some degree geographic weather patterns that would affect larger single installations. Although large projects are still a requirement to meet the targets set out, the need for a smart grid to cope with this new wave of thinking will provide additional resilience and must not be underestimated in future energy policy when considering returns on investment and capacity from grid infrastructure investment.

2.3 Electricity storage is an area that requires significant investment in R&D. With increased renewable generation, pumped water storage is not a 21st Century solution to 21st Century technology. Storage, particularly capacitative storage is required if smart grids are going to realise their potential and so we would recommend a greater political interest is taken in funding and investment for storage technologies from a security of supply point of view.

2.4 Demand side projects and storage will provide a more secure and robust electricity supply as an estimated increase in consumption, specifically in electric transport will add to localisation capacity issues.

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

3.1 Electrification of the transport system could over the next decade impact on localised capacity; how capacity is controlled at a domestic level therefore is an important issue. Smart meters and revised tariff structures will help in alleviating capacity constraints. In tight areas overnight charging of cars for example could see a premium tariff being sought with a postcode lottery in terms of grid infrastructure. Otherwise, reduced capacity similar to broadband could be an option to reduce localised blackouts should an area exceed the capacity it was designed for.

3.2 This situation highlights the need for localised capacity grid reinforcement to cope with the currently expected doubling of demand anticipated up to 2050. Lessons should be learned from the roll out of broadband in the telecoms industry so that best practice procedures should be undertaken.

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

4.1 Demand side energy efficiency schemes must be taken ever more seriously when talking about energy security and the UK’s future energy scenario. Currently, there is not enough clarity as to how all the demand side initiatives will be taken up by participants and the estimated role that will play in our future energy outlook.

4.2 Particular concern surrounds the transition from reputational drivers to reduce carbon to the pure economics of energy efficiency measures as the grid continues on its path to decarbonisation.

4.3 Energy efficiency measures even with the forecast for consumption increasing will assist in prolonging grid infrastructure reinforcements and equate to several generating plant. Similar investment in efficiency measures on the demand side as opposed to supply side reforms would effectively add to and support renewables targets.

4.4 In pure security of supply terms, robust demand side energy efficiency measures in both domestic and the commercial sector could reduce current consumption by up to 30%. This reduction which would be fragmented across the grid would equate to a number of “waiting to be built” power stations. The measures would not be prone to outages for maintenance or incident, would increase localised capacity and reduce stress on the system. In short, demand side energy efficiency measures although not a silver bullet, increases security of supply.

4.5 It is also important for energy management to be seen as a key contributing factor and one which is not encouraged on a wide enough scale across either commercial or domestic properties. Behavioural change is at the far end of the energy security chain but impacts in its own unique way. Without this education at grass roots level, no amount of efficiency measures can compensate for poor use. Expected of course at a domestic level but also is evident throughout both public and private sector organisations.

4.6 Energy security policy must not place demand side efficiency measures as the poor relation and should encourage adequate support to demand side initiatives as it does to supply side initiatives.

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 decommissioning of fossil fuel plant without the necessary renewables and demand side measures in place to support it will have an impact on energy security in the short term. The generation gap envisaged mid-decade is still a possibility. And with full legislation for energy initiatives taking another 18 months to completely roll out, demand side participants are holding off on investment until government legislation is finalised. Taking the CRC as an example which has changed from its initial Carbon Reduction Commitment to CRC Energy Efficiency Scheme with no recycling payment shows the issues being faced.

5.2 Energy prices are currently at a level where efficiency measures make financial sense, however the price of carbon needs to be at a more realistic figure to encourage similar investment in renewable technologies which maybe the Electricity Market Reform alongside the HM Treasury consultation into the carbon price can put in place. Again however the lion's share of the work involved will need to take place in the second half of
this decade, putting pressure on the industry to deliver end of decade emissions targets. However a higher carbon price puts pressure on gas fired generation as well as coal which needs to be carefully balanced. Gas plays an important role in the UK's energy security and shouldn't be sidelined in order to reach targets which can be obtained with its inclusion.

**What would be the implications for energy security of a second dash-for-gas?**

6.1 The UK is perhaps better placed than most countries in terms of gas supply. Apart from our own reserves, stable supplies are brought in from Norway and LNG from Qatar provides a further supply avenue. Further supplies can also be considered from biomethane resources and other renewable projects.

6.2 In addition, the UK has perhaps one of the best implemented networks with the majority of homeowners having access to gas.

6.3 To increase security in this area demand side efficiency measures again could impact significantly, to the degree that if a second dash for gas was to take place it would be unlikely to have significant effect. The 3rd energy package is reinforcing cross-border cooperation of member states and so gas security in terms of supply can only increase in that regard.

**How exposed is the UK's energy security of supply to international events?**

7.1 With the UK being a net importer of gas, concern is raised over price particularly with LNG. However, efficiency measures would help to reduce the UK's exposure.

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

8.1 A greater understanding of the role demand side measures and efficiency schemes will have in future security needs is recommended. How demand side measures can relieve pressure on supply side objectives can assist in lengthening investment programmes.

March 2011

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**Memorandum submitted by Professor Alan Riley**

**Executive Summary**

- Policymakers have not yet caught up with the impact of the unconventional gas revolution—they are still developing energy security and climate change policy on the basis that gas is a scarce, premium fuel with significant energy security problems. This is no longer the case.

- Unconventional Gas resources have strong energy security values in terms of both the enormous scale of the resource base and variety of locations ie the numerous locations where unconventional gas is found.

- The energy security implications of unconventional gas are underpinned for Britain and Europe by the realisation that there is according to energy analysts CERA up to 173tcm of unconventional gas in place in Europe (the total Russian conventional reserve is only 47tcm).

- Unconventional gas is reinforcing our energy security by reinforcing energy liberalisation: There are now alternative sources of gas and alternative suppliers that can take advantage of gas liberalisation rules. A more complete single market in gas increases our energy security.

- Europe’s principal importer: Russia is being forced to ensure greater security of supply through liberalisation and support the rule of law in energy markets again enhancing our energy security.

- A world of radical gas liquidity will also remodel the climate change agenda with a greater focus on radical CO₂ cuts and efficiency rather than renewables. The real environmental danger here is for “gas complacency” to set in.

**1.0 Introduction**

The received energy policy view is that gas is a fuel that raises significant energy security concerns. This view has gained considerable traction as a result of declining gas reserves within the European Union and the impact of the Gazprom-Ukraine gas disputes. However, this received view does not take account of the impact of the unconventional gas revolution. That energy revolution has transformed the energy security status of gas. Gas has gone from being a fuel with significant security liabilities to a fuel that provides the United Kingdom and the rest of the European Union with a security of supply guarantee. In part this is the sheer scale of the resource base of unconventional gas with Algeria alone reporting up to 30tcm, India reporting at least 8tcm.
Ev w86  Energy and Climate Change Committee: Evidence

(300 times greater than previous conventional resources) and perhaps as much as 59tcm,96 the United States, up to 90tcm,97 China at least 76tcm98 and Russia 150tcm99 (by contrast the total Russian gas reserve, supposedly the world’s largest gas reserve, is ‘only’ 47tcm).100 This scale of resource base also leaves the existing LNG global supply largely to Europe and Japan and shale will also add to a growing LNG supply.

This enormous diversity of supply which will ensure the high energy security value of gas is underpinned by a number of other factors. First, Europe’s own resource base. A recent major report from Cambridge Energy Research Associates examining the scale of the gas resource base in Europe estimates that the unconventional gas in place is up to 173tcm.101 This is an enormous figure which if even if only 10% is recoverable provides Europe with a gas reserve that amounts to one-third of the total Russian gas reserve of 47tcm. Second, a diversity of new gas suppliers makes rapid completion of the European gas market much more tenable again further underpinning European energy security. A third factor is that the only credible commercial Russian response to radically liquid gas markets is to adopt its own liberalisation model and access its own unconventional gas resources. To effectively open up those resources Russia will need access to foreign capital and knowhow forcing the Russian government to reconsider its attitude to transit regimes and investor protection. A more positive Russian approach to both liberalisation and investor protection will further enhance European and British energy security.

This abundance and variety of gas supplies to and within Europe is going to substantially enhance European supply security over the next few years. That abundance is also going to generate additional positive supply security effects both on the gas market liberalisation process and on our most significant external gas supplier, the Russian Federation. The reality of this security of supply will in addition have a powerful knock on effect on British and European energy policy encouraging a major switch to gas from coal. It will also affect climate change policy by delivering a less financial cost than initially estimated than via renewables replacement. Radical gas liquidity is also likely to more broadly reshape how Britain and Europe decarbonises the economy between now and 2050.102

This memorandum is divided into five parts. Part two considers the received view of gas as an insecure fuel source; part three looks at the impact on European energy security of the global unconventional gas revolution; part four examines the factors underpinning European energy security; part six offers a conclusion

2.0 THE RECEIVED VIEW: GAS AS A SECURITY LIABILITY

The received view of gas is that it is a fuel with significant security liabilities. This view gained hold for three principal reasons. First, domestic European production from principally the United Kingdom and the Netherlands was viewed as a declining resource which would increase imports of pipeline gas from Russia, Norway and the Middle East.

Second while global production of Liquid Natural Gas (LNG) would expand it was unlikely that it would be able to add significantly to European supply diversity due to the growing demand for LNG in the United States, China, India and the rest of South-East Asia. In particular, Europeans expected significant competition for LNG sourced from Trinidad & Tobago, Algeria, Nigeria and Qatar with the United States.

Third, the Gazprom-Ukraine disputes in 2006 and 2009103 where Europe, caught in the middle, had suffered supply cut offs raised serious energy security concerns in respect of Russian gas supplies. These concerns were

96 This is based on an analysis by Schlumberger who are undertaking an assessment of the Indian unconventional gas resource base for the Indian national energy company ONGC. Shale Prospects Encouraging for India, Natural Gas for Europe, www.naturalgasforeurope.com
97 Verrastro & Branch, Developing America’s Unconventional Gas Resources: Benefits & Challenges, CSIS (Washington, 2010). This paper gives several figures. The Potential Gas Committee gives a figure of 1800tcf of technically recoverable gas and a research paper of CERA in 2010 estimates 2000tcf but estimates that the further development of the resource plays will reveal a resource base of 3000tcf, that is approximately 90tcm. See http://ciss.org/files/publication/101209_Verrastro_UnconventionalGas_Web.pdf
98 The Chinese figures are based on full assessment of coal bed methane resources but only a partial assessment or assessment by analogy. Hence the figures given are probably very conservative. Xinhua, Status and Development Prospects of China’s Unconventional Gas Exploration and Exploitation, Ninth Sino-US Oil and Gas Forum, (Quingdao, 2009)
100 The non-Russian figures are also in place resource figures and not recoverable figures. However, if we take an extremely conservative view of what is recoverable, say 10% we still arrive at recoverable reserves which add enormously to the global resource base. The Russian figure of 47tcm is for recoverable gas, although a significant proportion of Russian gas may be technically but not commercially recoverable.
102 The Tyndall Centre have recently produced a paper arguing that replacement of coal by gas and consequent radical CO2 cuts is not likely as additional gas production will just add to capacity and not result in any switch. The Tyndall paper does not however recognise two extremely powerful switching factors. First, the direct pollutions and poisons generated by coal are extremely unpleasant and damaging to human health. That fact alone provides a major incentive to switch from coal to gas. In particular, most of the global growth in coal consumption comes from China which has been grappling with immense public concern over the public health consequences of coal burning. It is therefore very attractive for the Chinese authorities to switch rapidly from coal to gas improving air quality and reducing public concern over this issue. Second, a significant number of the states import coal. Domestic gas production from unconventional gas is much more attractive than importing coal. Such domestic production increases tax revenue and employment and is either neutral or adds to the balance of payments. Coal imports do not generate additional taxes or employment and carry with it for many nations significant import costs on the national accounts. For the contrary Tyndall view see: Wood & others, Shale Gas: A Provisional Assessment of Climate Change and Environmental Impact, Tyndall Centre, (Manchester, 2011).
reinforced by research undertaken by the Swedish Defence Research Agency which identified 40 politically motivated cut offs between 1991–2004 undertaken by Russian state owned or controlled energy companies.\textsuperscript{104}

This concern regarding Russian energy security was reinforced by evidence that the far greater Russian supply security question centred around Gazprom’s ability to maintain gas exports to Europe at all. The issue here concerned the depletion of the existing Nadym Pur Taz supergiant fields and the lack of investment in new fields which raised the prospect of a significant supply crunch mid-decade.\textsuperscript{105}

In this context with the prospect of 84% of European gas coming from external sources by 2030 there were serious concerns for European energy security.\textsuperscript{106} Gas as a major fuel source raised hard energy security concerns; scarcity concerns and consequent price concerns. Indeed Ungerer referred to gas as the “Achilles heel of European energy security.”\textsuperscript{107} It is not surprising therefore that policymakers began to seek to minimise the role of gas in the development of European and British energy and climate change policy.

3.0 THE GLOBAL IMPACT OF THE UNCONVENTIONAL GAS REVOLUTION

The story of the sudden arrival of unconventional gas onto the US market is now well known and does not need to be repeated here. It is sufficient to say that in 2009 the United States replaced Russia as the world’s largest gas producer; unconventional gas reserves are of the order of 90tcm\textsuperscript{108} and causing a significant LNG supply diversion to Europe resulting in falling gas prices on European spot markets.

From a European and British energy security perspective the greatest impact of the American unconventional gas revolution is the transfer of unconventional gas technology and know how worldwide. The United States government particularly has encouraged rapid global development of unconventional gas by entering into technology transfer agreements with a number of states including China, India and Ukraine.

The incentives to develop this unconventional gas worldwide are very powerful. First, there is the hard energy security issues surrounding fossil fuels and the prospect of energy cut offs. Take for instance China. One major issue national security issue for China is that most Chinese oil and some gas and coal is shipped in across the Pacific. The US Navy controls the Pacific. From a Chinese national security perspective being able to source substantial sources of gas domestically is very attractive as it reduces its energy dependence on American power. This is reinforced by the recognition that in extremis gas can be converted to oil using gas to liquid technology.

Second, there is the impact on balance of payments. Domestic gas production can replace gas imports. In addition, it can also replace coal imports by switching from coal to gas\textsuperscript{109} fired turbines. This brings a triple benefit. Significant cuts in CO\textsubscript{2} emissions; significant cuts in a range of poisons caused by burning coal and a better trade balance as coal imports are replaced by domestic gas production. This is in addition to the simple economic plus factor of increased tax revenues and employment that unconventional gas development brings to an economy.\textsuperscript{110}

These security and economic factors provide compelling incentives to ensure relatively rapid scaling up of unconventional gas production worldwide over the next decade and a half.

This scaling up has major consequences from a British and European energy security perspective. As this scaling up gets underway it causes continuing demand destruction for LNG. This leaves the European Union and Japan\textsuperscript{111} as the two principal remaining LNG customers worldwide.

This LNG effect is reinforced by the capital already committed to LNG liquefaction production which will take global production from 240bcm in 2008 to 410bcm in 2014.\textsuperscript{112}


\textsuperscript{105} Riley, \textit{The Russian Gas Deficit:Consequences and Solutions}, CEPS, (Brussels, 2006).


\textsuperscript{107} \textit{ibid}

\textsuperscript{108} \textit{op cit}

\textsuperscript{109} The United Kingdom estimate is approximately a one-third cut in CO\textsubscript{2} emissions by direct replacement of coal for gas.

\textsuperscript{110} In Pennsylvania unconventional gas development was estimated to generate $13.5 billion in economic value each year in addition to $1.4 billion in local and state tax revenues and almost 175,000 jobs by 2020. See CSIS, \textit{op cit 4}, for a discussion of a Penn State University report on the economic impact of the Marcellus Shale.

\textsuperscript{111} It is worth raising the question here of the impact of the recent earthquake and nuclear power problems in Japan on the gas liquidity argument. The short answer is as this point it is difficult to say. On the one hand we know that a significant amount of power capacity has been permanently eliminated: That is the four nuclear reactors at Fukushima. On the other hand there has been significant destruction of industrial plant which may or may not be replaced, which will reduce overall demand. Japan has a significant amount of installed LNG gasification capacity in reserve which would allow it to relatively easily increase LNG imports. A significant upward tick in Japanese demand would probably cause some tightening in supply and upward pressure on spot markets (over and above the immediate price increases triggered by market speculation). Over and above the short run any medium to longer term Japanese demand will be able to be accommodated by the scale of unconventional gas development now underway; the ramping up of conventional global LNG production and the development of unconventional gas as LNG.

\textsuperscript{112} World Energy Outlook, EIA (Paris, 2009).
Liquefaction production is likely to be further increased by the economic incentives to sell LNG into the high priced European market from the US. Already two shipments of shale gas LNG have been made into the UK market. The US authorities have recently given national security clearance for shale gas to be exported as LNG. Given the economic incentives between low priced US gas and much higher priced EU gas there is a compelling economic argument export of shale gas sold as LNG into the European market between 2015 and 2020.

Due to the United Kingdom having significant LNG gasification capacity it is likely to become the principal destination point for US sourced shale gas as LNG. This will both enhance British energy security and increase revenues resulting from dispatch and transit into continental Europe.

In addition, Russia itself has enormous unconventional gas resources a considerable proportion of which is near its existing infrastructure. Ultimately the compelling economic logic of developing those resources than the more expensive and problematic conventional resources of Yamal and Shtokman will win out.

As a consequence even without any development of unconventional gas in the United Kingdom or any other part of the European Union unconventional gas will have a significant impact on our energy security. The worst case scenario is an increasing competition for the European market between LNG and LNG shale; existing conventional pipeline deliveries and new pipeline deliveries from Russian unconventional resources. Britain and all Europe therefore will be faced with significant gas market liquidity derived from a variety of sources fulfilling the Churchill standard for energy security.

4.0 IMPACT ON EUROPEAN ENERGY SECURITY OF UNCONVENTIONAL GAS

What will further underpin British and European energy security is the reality of substantial quantities of unconventional gas available domestically. According to a recent extensive study by Cambridge Energy Research Associates (CERA) unconventional gas in place in Europe is up to 173cm. The CERA report goes on to predict gas production of between 60 and 200bcm in Europe by 2025.

Substantial domestic quantities of gas production combined with supplies from a variety of foreign importers will provide Britain and the rest of Europe with a very high level of supply security.

This supply security is reinforced by two other factors. First, a variety of suppliers of LNG from new and traditional supply sources, together with access to domestic unconventional gas supplies will reinforce the liberalisation of the European gas market. One of the difficulties of ensuring market liberalisation in Europe and a single European gas market is that gas supplies have been scarce. Either gas was produced by the domestic incumbent or it came from the domestic incumbent’s foreign partner on a long term supply contract. In either case the market was largely foreclosed and very little gas would be sold across national borders. In addition, none of the incumbents had any incentive to build cross-border infrastructure.

The third energy package and the Commission’s antitrust prosecution of energy companies has begun to reduce the power of incumbents and force unbundling in some cases. The difficulty however remained that gas was scarce. If Gazprom provided most of a state’s gas supply liberalisation would not make that much difference, there would be still one gas supplier and no alternative physical infrastructures to carry a non-existent alternative source of supply. Furthermore, technical liberalisation, even ownership unbundling, would not physically open up the energy markets. It is true that with ownership unbundling the economic incentives of the unbundled network owner are much greater to increase capacity where there is economic need rather than just increasing prices and minimising capacity. However, where there is no alternative source of gas supply and no expectation of any additional supply even an unbundled network owner will not invest in new capacity.

The arrival of growing quantities of LNG and the prospect of significant supplies of domestic unconventional gas transforms that market dynamic. Large quantities of LNG and unconventional gas at often lower prices than pipeline gas create real economic incentives to increase capacity. As a result of domestic unconventional gas production additional capacity may well be built in Poland to deliver gas into the German market. Equally, LNG shipments into the UK may well see an increase in the laying of new supply pipelines across the Channel and onward west-east pipelines into the European market.

113 First LNG Cargo from US to UK in 50 Years arrives at Grain LNG, Platts, (London, November 2010)
114 Total UK LNG gasification capacity is currently 53bcm providing already significant additional capacity for regasification for onward dispatch to continental Europe the BBL and UK interconnectors.
115 IEA, op cit
117 CERA, op cit
118 Both E.ON and RWE have been forced under threat of competition law prosecution by DG Competition to unbundle and sell of their electricity and gas networks. The Commission has now launched over a dozen antitrust prosecutions against major energy incumbents following the 2005 Sectoral Inquiry into the electricity and gas sectors. It is this prosecution drive that has really begun to open up the European gas market. However, the third package contained in Directive 2009/73/EC will allow DG Comp and DG Energy to pile further pressure on the energy companies by forcing unbundling or a very high degree of surveillance over network operators.
The interaction between EU liberalisation and antitrust rules and the entrance of LNG suppliers and unconventional gas producers into the European market bodes well for European energy security. These suppliers are likely to incentivise network owners to physically reinforce the single market in gas with new pipeline connections across national borders. In addition, LNG suppliers and unconventional gas producers will be able to rely on EU rules to ensure market access. Incumbents faced with well funded corporate actors who can rely on EU liberalisation rules and can call on the full force of the Commission’s Marianne, DG Competition, with their powers to undertake unannounced raids on corporate HQs, issue market access orders and impose heavy fines if new entrants have their route to market blocked.

This interaction between EU rules and LNG suppliers and unconventional gas producers is likely to ensure the completion of the EU’s single market in gas reinforcing Europe’s supply security.

A second factor is the impact on the Russian gas market. Notwithstanding increasing quantities of LNG supplies and the prospect of unconventional gas production Russia has the potential of remaining a major gas supplier to Europe and adding to European energy security.

Although there has been concern at the prospect of politically motivated cut offs, especially after the incidents in 2006 and 2009 the deeper concern over security of supply has focused on the overall fall in Russian gas production. The great supergiant fields in the Nadym Pur Taz region where 80% of Russian gas is produced are depleting. The critique of the International Energy Agency has been that rather than investing in new fields Gazprom has been investing downstream while neglecting its fundamental productive capacity.119

From Gazprom’s perspective this reluctance to invest is not entirely unreasonable. The capital costs for developing the Siberian Yamal fields and the Shтокman field in the Arctic Sea are upward of $100 billion.120 Given European gas market liberalisation Gazprom can legitimately question the safety of investment in these fields if it cannot rely on secure long term supply contracts to pay for the development of Yamal and Shтокman.

The development of unconventional gas provides Gazprom with a solution to its investment conundrum. Gazprom and other Russian energy companies have substantial quantities of unconventional gas around their existing energy infrastructures. There is no need to heroically and expensively develop Yamal and Shтокman. For much smaller investments Gazprom can begin to develop their own unconventional gas resources.

This however, poses two major difficulties for Gazprom and the Russian government. First, unconventional gas production is much more a manufacturing process which requires a much greater focus on efficiency in order to be profitable.121 The existing Gazprom dominated Russian gas market which puts little premium on efficiency and which allows Gazprom an export and pipeline monopoly combined with dominance of the exploration, production, wholesale and retail markets is unlikely to be able to easily generate the efficiencies necessary to make unconventional gas production profitable.

However, the prospect of LNG and unconventional gas supplies cheaper than gas that can be produced in Yamal and Shтокman arriving in very large quantities into European markets threatens Gazprom’s market share. This market share is very important to Gazprom. While it represents only one-third of Russian gas supplies by value it is two-thirds of Gazprom’s income122 and more than 12% of Federal tax revenue.123

Faced with the prospect of the loss of revenue and the loss of political and economic influence it is difficult to see how the Russian government will not consider some form of liberalisation of the Russian gas market.

It is not necessary for the Russian government to adopt a European model of liberalisation. The focus would be to ensure efficiency whilst maintaining state surveillance and control. It is possible to envisage a Russian approach to liberalisation which unbundles the pipeline network into one state company and then create a series of baby Gazprom production companies some state owned, some Russian private owned and some foreign owned to introduce the necessary degree of knowhow, technology transfer, capital and efficiency into the Russian gas market.

However, in order to encourage foreign capital and knowhow the Russian state will have to reconsider its approach to investor protection. Signals such as withdrawing from the Energy Charter Treaty in October 2009 undermined incentives for firms to invest in the Russian energy sector.124

The second major difficulty for the Russian government and Gazprom is their current pipeline strategy. If we have gas to gas competition in Europe it is imperative that Russian gas is delivered as cheaply as possible into the European market if market share is to be maintained. This requires not only some form of efficiency focused liberalisation at home but an entirely different external pipeline strategy.

The current pipeline strategy involving the delivery of new pipelines particularly Nordstream and Southstream significantly increases the cost of gas delivery. These costs can be carried in closed national

121 Unconventional gas production does not simply require one off drilling to maintain flow rates drilling and fracking have to be repeated and to be profitable great attention to detail as to the means of driving costs down while maintaining the gas flow.
122 Pirani, Russian Natural Gas Production and Exports-the Outlook to 2020 Baltic Rim Economies (Turku, 2010).
markets where Gazprom has long term supply contracts which effectively foreclose the market and there is no alternative source of supply. Effectively the costs are passed on to the consumers. This however becomes increasingly difficult to maintain in markets which are being liberalised where new sources of supply are coming on stream.

Nordstream is now too late to stop as the capital has been committed. However, Southstream is not yet at that stage and can be stopped. In order to ensure Russian gas remains competitive the Gazprom and the Russian government have to rethink their pipeline strategy.\footnote{It may well be that the Russian government is rethinking its strategy given that the Prime Minister Putin recently announced an investigation into the prospects of replacing Southstream with an LNG liquefaction terminal on the Black Sea coast.}

In a liquid European market with gas to gas competition and spot markets price is fundamental. To keep the cost of transit down there is no alternative for Gazprom but to seek to extend and develop the Ukrainian pipeline network. It is much cheaper to refurbish than to develop Southstream and the Ukrainian network has a maximum throughput capacity of 180bcm, far greater than Southstream.\footnote{Pirani, Ukraine’s Gas Sector OIES (Oxford, 2007).}

The difficulty lies in the well known risks of Ukrainian transit. The Russian Federation and the European Union came close in 2006 to agreement on a Transit Protocol under the Energy Charter Treaty. There is a compelling argument for the Russian Federation to reopen negotiations. Given the difficulties with Ukrainian transit there is a compelling Russian argument for a very tough ECT Transit Regime. This would include including a distinct international legal regime for transit; a secretariat to supervise the transit system and a supranational tribunal to ensure enforcement of the regime.\footnote{Westphal makes a compelling argument for a revised Energy Charter Treaty Plus with Russian participation in the ECT. As he points out the ECT is the only multilateral energy investment and transit treaty we have. A revised ECT Plus could both assist in delivering energy security to the EU and Russia but also open up its territorial scope to the Middle Eastern states of the Arab Spring. See Westphal, The Energy Charter Treaty Revisited, SWP (Berlin, 2011).}

In essence in order for Russia to remain competitive and maintain a significant market share of the European gas market it has to follow to introduce a significant degree of legal security and market liberalisation into its gas market and its domestic gas market policies. This is partly about domestic liberalisation law and partly about returning to the Energy Charter Treaty regime for investor and transit protection purposes.

From a British and European perspective a Russian Federation focused upon gas market liberalisation and seeking liberalisation of the European transit system would be a welcome development. Unconventional gas would be delivering energy security to the European Union by encouraging Gazprom to develop its own such resources. No longer would Europeans be so worried about Gazprom running short of gas supplies. In addition, the prospect of liberalisation of the gas market and liberalisation of the transit regime would reinforce European energy security by encouraging production and ensuring effective transit.

The triple impact of significant EU domestic unconventional gas supplies; completion of the European single gas market and a Russia compelled by market circumstance to liberalise to produce unconventional gas would significantly underpin British and European energy security.

5.0 CONCLUSION

Too many policymakers are still wedded to the gas insecurity and scarcity narrative which is no longer true. Half a decade ago a strong case could be made that gas was a premium, scarce fuel which carried significant energy security risk. No longer. The unconventional gas revolution is in process of transforming British and European energy security. The ability to access unconventional gas resources across the planet easily and relatively cheaply will result in the upturning of energy and climate change policies in every major nation. There are two key points to recognise in respect of unconventional gas resources first, the sheer scale of the resource base. It is several times of the order of magnitude of existing conventional resources. Second, the variety of locations where unconventional gas resources are found across the planet reinforces its energy security value.

In addition, unconventional gas production directly and indirectly, actually and prospectively is enhancing European energy security through reinforcing liberalisation and the attitudes of our principal importer. EU gas market liberalisation is being reinforced as new energy actors selling unconventional gas and LNG enter the market. These actors are able to deploy EU rules on liberalisation and create the incentives to build the necessary physical infrastructure to link up the European gas market.

Equally unconventional gas is beginning to make Russia gas importers to Europe rethink their commercial strategy. There is now a compelling commercial logic coming into place which is pushing Gazprom and the Russian government in the direction of liberalisation and the creation of an effective rule of law system in the energy sector. This is not due to Western pressure but instead commercial logic. It is in the Russian state’s own best interest for unconventional gas development to take off. That requires some elements of market liberalisation. The same commercial logic requires binding rules of international energy law to be put in place to encourage investment and ensure transit. Both these developments reinforce British and European energy security by making Russia a much more reliable gas supplier.
Given the scale and variety of locations where unconventional gas can be found combined with the relative low cost nature of the fuel; the low cost and speed of installation of gas turbines gas the incentives for a very significant expansion in Britain, Europe and round the world are compelling.

In addition, there is a significant climate change benefit. Major reductions in CO₂ emissions can be obtained as coal fired power stations are switched off and replaced with gas.

By contrast current climate change policy is in danger of failing due to the high costs of developing renewables to meet ambitious EU targets at a time of economic crisis.

The Unconventional gas revolution may well remodel British and European climate change policy. That policy is likely to shift to cutting CO₂ via switching from coal to gas and energy efficiency rather than renewables. It will also create a problem for policymakers. How to ensure that gas is a bridge fuel to a low carbon future rather than a destination fuel? One of the major difficulties, and perhaps the real environmental issue with unconventional gas, is the temptation to stop with gas. In a world of plentiful, relatively cheap gas supplies, which permits significant CO₂ cuts there is a tremendous temptation to not push on with decarbonisation. Policymakers will have to adjust climate change policy to that reality and the requirements of a progressive carbon tax to ensure we do not end up in gas complacency.

For the United Kingdom there is a powerful case for seeking a leading role in the development of European unconventional gas. Encouraging rapid development of our unconventional gas resources would enhance our energy security and help build up a British industry with export potential. UK policymakers could also lead European remodelling of energy and climate change policy to take account of a world in which there is radical gas liquidity. We could help ensure Europe did not fall into gas complacency and focussed instead on ensuring we continued to move down the path of effective and progressive decarbonisation.

Professor Alan Riley  
City Law School, City University, London, and  
Associate Research Fellow, Centre for European Policy Studies, Brussels  
March 2011

Memorandum submitted by SSE

Given the increasing reliance of the global economy on energy over the last century it has been important for countries to ensure that their energy supply—for generating electricity, producing heat, and powering transport is:
- secure;
- stable; and
- affordable.

With fossil fuels—oil, gas, and coal—meeting the vast majority of global energy needs delivering all three of these ambitions was, until recently, relatively straightforward as energy supply capacity outstripped demand; prices were relatively stable; and withholding fossil fuel supplies was rarely used as a way to exert political influence.

However the economic growth of many developing countries has increased demand for fossil fuels, leading to increased, and more volatile, prices particularly for oil (and gas which has historically been linked to the oil price). These increases have been compounded by the fact that:
- Fossil fuel reserves are being depleted at a faster rate than new reserves are coming online;
- The rate at which these reserves can be exploited (ie the speed at which oil and gas can physically be removed from the ground) is limited; and
- The stability of the countries exporting large amounts of the world’s supplies has been called into question.

This is not to say that the supply of fossil fuels will not improve—the introduction of shale gas for example has increased the amount of gas available and consequently reduced the price. However the trend of higher, and more volatile, prices resulting from increased demand and limited reserves means that ‘energy security’, and in particular ‘fuel security’, is now an increasingly prevalent political issue globally. Governments are therefore examining different ways in which they can maintain secure, stable and affordable energy supplies.

**ENERGY SECURITY VS ENERGY INDEPENDENCE**

It has been suggested that the best way to be truly energy secure is to be energy independent ie the ability of a country to produce enough energy domestically to meet demand.

However whilst increasing self sufficiency is one way in which energy security can be maintained, achieving complete energy independence is extremely difficult unless a country has significant natural resources. It may also be extremely expensive, and therefore unrealistic/unappealing for many governments.
As such whilst most countries, including the UK, do seek to increase their self sufficiency they also pursue a number of additional options. These include ensuring that a country is not overly reliant on one fuel source, and that its imported fuel comes from a diverse range of sources, thereby exposing it less to major supply disruptions. In addition working to maintain a secure global energy market for all participants (both producers and consumers) will help to ensure that price and supply volatility is reduced.

ENERGY SECURITY IN THE UK

The UK's oil and gas reserves, whilst still significant, are no longer sufficient to meet domestic demand and it is therefore increasingly exposed to the volatility of the global fossil fuel market. This has, in recent years, increased prices for electricity (mainly generated from burning coal and gas), heating (mainly produced from gas, but also oil), and transport (mainly powered by oil).

Both the previous and current Governments recognised this problem and have sought/will continue to seek to ensure that:

— The UK’s supplies come from a diverse range of sources (including maximising North Sea output);
— The potential for interconnection with European neighbours is fully explored;
— The UK has greater storage capacity;
— The amount of import facilities, particularly for LNG, has increased; and
— The UK’s demand for fossil fuels is reduced, thereby reducing overall exposure.

ELECTRICITY SECURITY IN THE UK

However, in addition to managing concerns about the rising costs and reduced security of imported fuel supplies, the UK also has to consider how to ensure that it can generate enough electricity domestically to meet demand. Currently the UK has around 80GW of electricity generating capacity. This gives it a “capacity margin” (the difference between what is needed to meet peak demand and what it actually has available) of above 20%. This capacity margin is needed to ensure that in extreme situations—ie power station failures, sustained periods of high demand—the UK has sufficient reserve capacity to keep the lights on.

A significant proportion of the UK's current electricity generation capacity is due to come offline in the next decade as older plant reaches the end of its life, and other plant is forced to close as a result of environmental directives. All of this capacity is “firm capacity”—ie it is almost always available when needed.

The UK will therefore need to replace around 25% of its firm capacity over the next decade if it is to continue to meet demand, and ensure security of supply, by maintaining an adequate capacity margin.

WHERE WILL THIS CAPACITY COME FROM?

Given this need to replace and build a significant amount of firm capacity over the next decade, an important question to consider is what type of generation plant can provide this at scale?

Unabated coal is not an option because of its environmental impacts; CCS is not yet proven at scale; nuclear will take too long to build; and renewables can not provide firm capacity at the scale needed. Therefore the only technology which can provide firm capacity at scale, and be built in the timescales required, is gas.

There are concerns that this might result in a “dash for gas” in the UK which will result in large numbers of unabated gas plants operating into the 2030’s and 2040’s—this could make it extremely challenging to decarbonise the power sector by 2030.

However whilst a “dash for gas” might result in unabated gas plant being built in the next ten years SSE does not believe that these new plants will have an adverse impact on the UK’s 2030 ambitions. This is because:

— Any unabated gas operating in 2030 is likely to have extremely limited running hours—it will only operate as peaking or back-up plant, with the vast majority of the power provided by renewables and nuclear.
— Therefore whilst there might be a significant amount of conventional plant on the system in 2030, it will only be able operate at full capacity if it has CCS fitted.

Carbon ambitions can therefore still be achieved, and the UK will also be able to maintain a sufficient capacity margin to ensure security of supply.

WILL ENOUGH CAPACITY BE BUILT?

In terms of gas capacity there is currently less than 2GW under construction, and 7–8GW with planning permission (although some of this is highly questionable). However these projects will only go ahead if they are deemed financially viable; and the electricity generation market is currently extremely unattractive for investors in gas.

As the level of inflexible plant on the system increases (ie wind and nuclear), these problems will be exacerbated, with flexible plant becoming increasingly reliant on infrequent and uncertain price spikes to pay
There is therefore a risk that not enough gas capacity will be built in the UK as investors seek more certain returns elsewhere. Government is therefore concerned that the UK will not have enough “firm” capacity over the coming decade to ensure that the UK’s electricity supplies remain secure.

What is the Government Proposing to do?

The Government is proposing to introduce a capacity mechanism, which rewards power stations for having capacity available, rather than for the amount of electricity they produce. Generators would therefore have a minimum revenue stream even if they do not generate, providing investors with certainty that they will receive a return in the 2020’s and 2030’s when the use of unabated fossil-fuel plant will be extremely limited. The hope is that these payments, together with the revenue they generate, should provide an economic case to build gas to come online as and when it is needed.

Capacity Mechanisms

What Type of Capacity Mechanism is it Proposing to Introduce?

In the EMR consultation the Government’s preferred option was to introduce a “targeted” capacity mechanism in GB. This would involve:

— A central Government body forecasting how much additional capacity would be needed in the future; ie in three, five, 10 years to maintain an adequate capacity margin;
— Putting contracts for the required amount of capacity out to a competitive tender;
— Different types of capacity (eg gas stations, demand-side measures) would submit their bids and the Government would make a final decision; and
— This capacity would then receive payments (the level of which would be decided during the tendering process) from Government for being available, in addition to its normal revenue streams.

This would mean that payments would only be made to those GB generators that provided the additional capacity that Government believed was needed.

Are there alternative capacity payment models which could be considered?

Yes there are. SSE believes that a general capacity payment to all firm capacity, including demand side resource, would be a better option. This payment (which SSE estimates to be £3–£5 per MWh), plus the returns it received from generating electricity, would enable plants to become economically viable.

What are the problems with the Government’s approach?

The major concern is that if Government was tendering for plant then market-based investment could stop (as investors would be concerned that their plant would not be used because of the amount of tendered plant on the system). Investment in capacity would therefore become incredibly risky as future returns, which are all already extremely difficult to predict, became even less certain; developers would therefore wait for tenders, or invest elsewhere.

This would lead to a situation where all additional capacity was tendered for by Government. The history of Government involvement in the electricity sectors illustrates that this type of centrally planned Government approach is generally significantly more expensive than a market based one.

So, will paying all capacity be cheaper than just paying specific amounts of capacity?

Yes it will. A general capacity mechanism, because it provides more certainty to investors than a targeted mechanism, would also result in a cheaper cost of capital thereby reducing overall prices for consumers. In addition the most cost-effective forms of capacity will often be existing plant—this would not be rewarded under a targeted mechanism (which would only be available to new plant), and would therefore be forced to close.

Finally there is a risk that the level of Government involvement in a targeted mechanism will discourage investors from even bidding for a capacity contract. This would result in Government having to offer extremely high payments just to ensure that the capacity margin was maintained, further increasing overall costs to consumers.

But won’t a general capacity mechanism just reward old, dirty power stations that we should be closing?

The general capacity mechanism does allow older stations to stay open. However, as noted above, it is significantly cheaper to do this than build new plant. (To build a new gas plant and keep it on the system costs £60/kWh per year, compared to £30/kWh per year to keep an existing plant on the system). In addition these plants will be generating very occasionally and therefore will not be producing large amounts of CO2 (which...
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is, in any case, already capped by the EU ETS). Building new plants will also be carbon intensive. As such it is logical to keep these stations open.

Wouldn’t a general capacity payment result in lots of unnecessary plant being built?

No it would not. As noted above the level set (£3-£5 per MWh) would mean that plant would still have to generate some electricity to be economic and therefore developers would still be making decisions based on analysis and risk. This would ensure that the amount of capacity built was appropriate to GB’s needs. In addition the Government could introduce a capacity “ceiling” which would mean that once the capacity margin of 20% was reached then payments reduced, thereby making additional generation investment unattractive.

SSE Responses to Specific Committee Questions

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

Whilst the UK’s energy system is currently extremely resilient to changes in uranium and fossil fuel prices, the move towards the UK becoming a “price taker” of energy, rather than a “price maker” (ie it is becoming more dependent on imports as North Sea production decreases), will mean that it feels the impact of price movements more keenly.

However the effects of future changes in fuel prices will largely depend on the electricity generation mix. The Government has stated that it does not want to be over reliant on one technology and this push towards a diverse portfolio will naturally mitigate the effects that fuel price changes will have.

However it is likely that gas will continue to play a significant role in the UK’s energy mix for some time. The UK will therefore have some exposure to price increases here, although this exposure could be relatively low if many of the gas stations will be acting as back-up for renewables, or used as peaking plant, and therefore run for short periods in the 2020’s and 2030’s.

Price increases can also be mitigated by increased use of gas interconnection and LNG terminals, both of which the Government is currently looking at, and the increased production of shale gas could also mean that prices reduce, whilst availability and security of gas supplies increase.

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

Investment in the transmission system is vital if the UK is to meet its renewable and carbon reduction targets, as well as maintain secure energy supplies. The current system needs to be upgraded to cope with:

— the increased amount of renewable generation that will be coming onto the system in remote parts of the country; and
— the increase in electricity production that will be needed to meet rising electricity demand (which could rise significantly if electricity is used to decarbonise heat and transport).

However it is important to note that these infrastructure projects have long lead times, and need to be built before generation projects to ensure that these can be connected as soon as they are built.

Without this investment the UK will not be able to meet both renewable/climate change targets and maintain secure electricity supplies, and a choice would therefore have to be made. Whichever route is chosen it is likely to be significantly more expensive than making the necessary investment in the transmission system now.

In terms of distribution there is a role for more effective and dynamic distribution networks that manage demand more effectively and enable a larger amount of decentralised energy to generate. These smart grids could have a major impact in terms of minimising new infrastructure costs by using assets as effectively as possible, whilst reducing overall demand thereby reducing the UK’s reliance on, and exposure to, imported fuels. Whilst it is difficult to quantify exactly how much of an effect these types of demand-side measures will have it is possible that they could be significant.

In terms of gas storage the UK has managed to maintain secure gas supplies without large amounts of gas storage capacity. This has been due to increased interconnection with Europe, an increase in LNG capacity, as well as use of the UK’s domestic resources. Continued focus on these areas is likely to ensure that gas supplies remain secure, and it should also be noted that the investment in gas storage is currently uneconomic.

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

Clearly any significant moves to electrify heat and transport in the UK will result in less reliance on oil and gas, whilst significantly increasing the demand for electricity. As electricity is likely to be produced from a diverse range of sources this move, together with the reduced dependence on oil and gas, could improve the UK’s energy security.
However, whilst the reduced reliance on fossil fuel imports is clearly desirable there is a question as to whether the necessary generation capacity needed to produce the volume of electricity the UK would need to meet this additional demand will be built in time. In order to ensure that this happens changes need to be made to the planning system, the grid needs to be upgraded, and the support mechanisms for low-carbon technologies and additional capacity need to be established. Smart grids could have a major impact here by minimising new infrastructure costs by using assets as effectively as possible while still allowing for significant electrification.

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

Put simply, the less energy the UK consumes the easier it will be to maintain secure energy supplies. This is because (a) the UK will be less reliant on external sources of fuel; and (b) energy efficiency, and other demand reduction measures, can help to ‘balance’ short-term differences between supply and demand.

However during periods of extremely high, sustained, demand (eg the middle of winter) energy efficiency cannot ensure secure supplies—these can only be maintained by having adequate amounts of electricity generation capacity and gas supplies available.

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 current electricity system is dominated by large power stations which can meet peak demand as and when required (coal, gas and oil); and operate constantly to meet the minimum level of demand (some coal and gas, as well as nuclear).

The Government’s legally binding renewables and carbon emissions reduction targets will see a significant change from this system to one which is increasingly dominated by intermittent renewable, and inflexible nuclear, generation, with traditional fossil fuel plant being used as back-up.

This move brings with it a number of challenges including the need to upgrade the electricity network to cope with, and better manage, this intermittency and the increased volume of electricity generated; and extend the network to connect renewables which will often be located in remote areas.

The largest challenge however will be ensuring that a sufficient amount of new gas plant is built to back up this intermittent renewable generation and run when renewables and nuclear output can not meet overall demand. As noted above the current market is extremely unattractive for gas developers and a number of projects have recently been delayed or cancelled as a result.\textsuperscript{129} The design of the capacity mechanism (discussed above) will therefore be crucial in ensuring that secure supplies are maintained.

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

It could be argued that a second dash for gas is already happening, albeit subtly. In the UK a number of the oil majors are beginning to concentrate more on gas, and a number of mid-size gas companies are being bought by large utilities. In addition there has been an increased demand for gas in developing countries, particularly in China and India.

The implications of this direction of travel are difficult to predict. Whilst increased global demand will theoretically increase prices, the exploitation of unconventional sources of gas (eg shale gas in the US), has kept prices relatively stable.

If prices do rise, and gas becomes scarcer, then the impact on the UK’s energy security will depend largely on the future electricity generation mix. If this mix is dominated by renewables and nuclear, with gas acting primarily as back-up plant (it might also regularly run at baseload with CCS) then, whilst there might be a dash to build gas power stations over the next decade this will be a dash for capacity, rather than a dash for gas as a fuel—overall demand for gas will therefore be lower.

However there is clearly still a need to ensure that the gas that is required can be sourced securely and affordably—increased interconnection and LNG capacity, together with a diverse range of sources for imported fuel (including using domestic supplies), could achieve this.

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?

The potential capacity shortfall that could result if not enough new “firm capacity” comes online this decade is clearly a serious concern, and the debate, outlined above, about how to best mitigate this risk through a capacity mechanism is certainly something that the Committee should be aware of.

March 2011

\textsuperscript{129} SSE recently announced the closure of its Fife gas-fired power station, as well as a delay to its development of a gas-fired plant in Abernedd, South Wales. Centrica also recently announced that it is postponing plans to build a new gas plant at Brigg, North Lincolnshire.
Memorandum submitted by the UK Hydrogen and Fuel Cell Association

This paper provides the response from the UK Hydrogen and Fuel Cell Association to the Committee’s examination of how the security of the UK’s energy supply relates to the UK’s energy independence, and the sensitivity of the UK’s security of supply to changes in various factors.

The UK Hydrogen and Fuel Cell Association (UK HFCA) aims to accelerate the commercialization of fuel cell and hydrogen energy technologies. Through the breadth, expertise and diversity of our membership, we work to trigger the policy changes required for the UK to fully realise the opportunities offered by these clean energy solutions and associated elements of the supply chain. The UKHFCA also makes the fundamental distinction between hydrogen reformed from fossil fuels and that produced by electrolysis which is fossil-independent and emissions free.

1. Executive Summary

Fuel cells and hydrogen are “game changing” technologies providing low-carbon solutions across transport, stationary power and beyond. The growing industry is already bringing benefits that the UK cannot afford to miss: creating new jobs, supporting UK economic growth and improved competitiveness in the energy markets globally. Fuel cells provide a high efficiency alternative to conventional heat engines. Their increased use offers significant carbon emissions reductions across the power and transport sectors; with even greater emissions reduction potential when hydrogen itself has a low carbon footprint.

This response has been produced through consultation with our members and presents the Association’s response to those aspects of the consultation of most relevance to the sector. Our focus is on the needs of the future energy and technology mix, in an area which both supports and challenges the current status quo.

Because of the associated supply/demand matching, low transport costs, and wide process options, we see substantial potential for a hydrogen, generation infrastructure, and widespread deployment of fuel cells, as part of a reformed electricity market and even more critically in addressing the dependence on natural gas for heat and oil for transport. Realising this potential requires hydrogen to be produced at various scales within the energy system, including the potential role of electrolysis for managing and storing the increasing proportion of time-varying renewable power in the power system.

Fuel cells offer innovative help in a range of application otherwise dependent on fossil fuel combustion. Increasing potential exists across segments of the electricity industry to apply electrolyser and fuel cell technologies. This will help to deliver the whole spectrum of UK de-carbonisation, diversity and security of supply, and fuel poverty objectives.

The ability for hydrogen to allow fuel source shifting gives a unique opportunity for UK to diversify its industrial skills at the same time as addressing energy security across power, transport, and heat.

2. Detailed Response

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

We observe that only fossil fuel price is likely to remain most volatile, while the main alternative source of hydrogen—wind energy, will probably be much less volatile. Both distributed solar PV and wind power sources are expected to reach grid parity in the next few years (due to burgeoning market growth in the US, China and other parts of Europe) and so the indigenous security of the UK energy system can be improved provided these renewable sources are used to generate both power and hydrogen fuel.

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

There is a complete lack of distributed energy storage in the power system, which is fundamentally incompatible with the government’s targets to generate and utilise increasing amounts of renewable power. It is important to deploy energy storage and to view it not only as an electricity-in/electricity-out conversion, but also as an electricity-in/fuel-out process, where the fuel is hydrogen. This hydrogen may be generated at various levels within the energy system to help manage both the supply and demand side variations faced by the electricity industry, whilst providing green hydrogen for the Fuel Cell Electric Vehicles that numerous OEMs expect to launch in 2015.

We note that energy movement by pipeline is the most efficient transport method and that hydrogen gas is very similar to natural gas in that way. We also note that hydrogen generation at the points of use via electrolysis can often be applied to circumvent the large investments required to construct a national infrastructure similar to natural gas.

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

We consider that the problems of greater reliance on electricity to provide low carbon energy will be mitigated by inter-sector transfers and some storage of hydrogen. This becomes economic because of increased
carbon costs and the need to de-carbonise, leading to investment in pre-combustion carbon capture and storage (CCS) systems for both electricity and industrial use. Application of gasification techniques allows use of a wide range of fuels, including biomass, waste streams, natural gas and coal. This CCS process has hydrogen as an intermediate product, which is already used as an alternative to natural gas across the industry, including power, heat and chemicals. Like natural gas buffer storage is used to match supply and use for the hydrogen.

While hydrogen production from CCS is large scale in nature, other low-carbon hydrogen production techniques compatible with distributed generation, such as electrolysis, are available on the smaller scale.

Hydrogen power vehicles allow for gasoline-like range and refuelling time but are generally hybridised to allow regenerative braking. Fuel cells should be viewed as a complementary technology to battery electric configurations, with the latter more suited to smaller, low range vehicles in urban settings.

The fact that almost all major car OEMs committed in 2009 to launching FCEVs in 2015 should not be overlooked with respect to reducing the transport sector’s dependency on foreign oil post 2015. To facilitate this in the UK requires increased generation of renewable power, increased production of low carbon hydrogen and the deployment of hydrogen vehicle refuelling infrastructure.

The heat loads, even with CHP, will be difficult to address without use of hydrogen. Given CCS applied to biomass, natural gas or coal, the hydrogen can be piped to local CHP or heat loads without change to the size of local CHP plants without local storage and which is important to such plants in built up areas where most heat is used. In advance of a full hydrogen grid, local reformers could convert network gas to hydrogen for final distribution to homes in an intermediate stage, thus enabling a progressive rollout of domestic hydrogen conversion technologies, such as fuel cells, prior to a complete switch of the grid.

The 2013 and 2016 targets for low and zero carbon homes in the emerging UK Building Regulations are most helpful with respect to reducing the heat demand of the domestic sector. As these low energy buildings emerge there is much greater scope for meeting heat demands by local heat recovery from fuel cell and electrolyser systems working in conjunction with solar PV roofs. These zero-carbon solutions can be facilitated by engineering hydrogen systems for such mass produced markets without necessarily requiring a large national infrastructure solution.

The use of hydrogen as an intermediate and economic energy vector enables diversity of primary energy sources and will increase our energy security.

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

Attempts to reduce energy demand by energy efficiency have not resulted in significant reductions in fossil fuel consumption at existing unit price levels. We would expect energy efficiency to be more effective as prices rise and to be a key component of limiting demand growth to improve UK energy security.

We believe that the UK’s energy security issues can only be solved through application of a range of techniques and that rollout of new energy efficient technologies is essential. The efficiency of fuel cells is one of the drivers for their adoption, and generally higher efficiency is always sought as long as cost and the embodied carbon implied by extra investment is taken into account.

2.5 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 have argued, in our submission to the Government’s Consultation on Electricity Market Reform, that increased base load wind and nuclear power means more flexible generation of fossil fuel with CCS. Further to that if the incentives are correct it will be reasonable to capture CO₂ from biomass as well as the fossil fuels. To make CCS flexible the best technology is pre-combustion as it is possible and cost effective to decouple the gasification from the generation, because of the hydrogen used to transfer energy in this process.

The de-coupling is more efficient if an inter-sector transfer of energy (with the use of hydrogen) takes place. Beyond that line packing and buffer storage may be necessary to offset increased penetration of renewables.

In some cases, wind energy is best converted to hydrogen for transport and heat, and this could be very relevant to isolated communities and some electricity market conditions. For example one of the Danish electricity suppliers—Modström, is supplying wind electricity free of charge overnight. As wind and solar penetrations increase in the UK power system, and the availability of excess renewable power increases, the viability of generating hydrogen from renewables will reposition it to that of a significant mainstream pathway. Fundamentally it is risky to base our future energy security on overseas sources of gas, oil and coal and it is better to utilise indigenous sources of renewable power and hydrogen as the energy carrier.

We note that DECC’s latest energy statistics¹³⁰ highlight the following features of recent renewable generation:

- Renewables’ share of electricity generation fell from 6.7% in 2009 to 6.6% in 2010.
- Onshore wind generation fell by 7.7% due to low wind speeds in 2010, compared to 2009.

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— This was against the fact that onshore wind capacity increased by 14% (476 MW) between 2009 and 2010.

These data reinforce the importance of storage to enable us to better harness weather dependent renewable energy and allow its provision to provide zero carbon energy and fuel.

2.6 What would be the implications for energy security of a second dash-for-gas? No specific comment.

2.7 How exposed is the UK's energy security of supply to international events? No specific comment.

2.8 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?

UK energy security policy is focused on electricity. We expect this to evolve as security is added to cost concerns in other sectors, including reliance on imported biomass. The merits of hydrogen as a common energy vector will enable fuel shifting and make end user investments cheaper.

We note that the core technologies of fuels gasification for production of hydrogen, and electrolysis of water to make hydrogen, have been routinely used in industry for a long time and at all scales.

At the large scale, the major exposure will be if the Government does not progress and follow up the CCS demonstration projects with commercial plants, including the production of commercial scale, low cost, de-carbonised hydrogen. This will naturally occur with pre-combustion capture of CO₂ rewarded under a successful electricity market reform and adequate price for CO₂.

At the small scale, the major exposure will be if the Government does not progress the development of distributed hydrogen systems based on electrolysis. This is especially relevant to the refuelling of FCEVs which are the only option for meeting the range and rapid refuelling expectations of consumers. This requires recognition of this low carbon pathway and assistance with the demonstration and deployment of electrolyser and fuel cell systems in distributed applications.

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

Making the UK energy mix more resilient to external factors, including fuel price by valuing carbon reduction and enabling hydrogen as an intermediate energy vector, will show case UK climate change management and industrial skills. The importance of economies of scale for CCS means that support for the current CCS demonstration projects must follow through into support for CO₂ infrastructure and general deployment.

Energy storage and energy security are synonymous. The continued deployment of renewable power sources will soon require energy storage unless the renewables are to be wasted at times of low demand. It is important that the form of this storage facilitates decarbonisation of the transport and heat sectors and is not just confined to the boundaries of the power system. Sector export of renewable power as hydrogen is a major option for improving indigenous energy security. We should be wary of basing assumptions on business as usual energy prices; we need to invoke change and develop solutions at large and small scale, both at which hydrogen has excellent prospects.

The views expressed in this document have been developed through consultation across the UK HFCA membership; they do not necessarily reflect the views of individual members of the Association but reflect a general consensus within the Association.

March 2011

Memorandum submitted by Neil Crumpton

Evidence from Neil Crumpton, energy consultant to B9 Coal (developing fuel cell CCS power stations), ex Friends of the Earth energy specialist (16 years as staff member, including main anti-nuclear campaigner and energy campaigner), ex campaigner for Bellona Foundation (six months as UK representative supporting CCS technology). This evidence is given as an individual.

Summary

The main points of my evidence are:

1. the deployment of fuel-flexible, load-following energy generating carbon capture and storage (CCS) schemes and transmission infrastructure able to back-up very large deployments of intermittent renewable energy systems (RES);
2. the deployment of pre-combustion CCS technologies as they offer huge fuel-fleixibility and load-following capability—as their generating technologies can be fueled by syngas and synthetic natural
The rising global population is giving rise to increasing concerns about the availability and access to numerous global resources including food, water and energy. Global (final) energy demand is likely to roughly double by 2050 from about 98,000 TWh/y in 2009 to about 180,000 TWh/y in 2050 (estimates vary considerably). This assumes a global per capita demand averaging 20 MWh/y (55 KWh/day) per person including aviation and shipping and a global population of about 9 billion by 2050 (ie 20 MWh/y/capita x 9 billion = 180,000 TWh/y). Currently UK per capita demand is about 31 TWh/y excluding aviation and shipping and net imported goods. Given such global resource issues it is likely that UK energy security would only be significantly enhanced by the development and exploitation of the UK’s indigenous energy resources. Exceptions to this may be the wide global availability of shale gas in the medium term and desert-produced algae fuels, for possible carbon-negative energy generation in CCS infrastructure.

**Global Context**

The rising global population is giving rise to increasing concerns about the availability and access to numerous global resources including food, water and energy. Global (final) energy demand is likely to roughly double by 2050 from about 98,000 TWh/y in 2009 to about 180,000 TWh/y in 2050 (estimates vary considerably). This assumes a global per capita demand averaging 20 MWh/y (55 KWh/day) per person including aviation and shipping and a global population of about 9 billion by 2050 (ie 20 MWh/y/capita x 9 billion = 180,000 TWh/y). Currently UK per capita demand is about 31 TWh/y excluding aviation and shipping and net imported goods. Given such global resource issues it is likely that UK energy security would only be significantly enhanced by the development and exploitation of the UK’s indigenous energy resources. Exceptions to this may be the wide global availability of shale gas in the medium term and desert-produced algae fuels, for possible carbon-negative energy generation in CCS infrastructure.

**Fossil Resources**

All the UK’s conventional fossil resources are in steep decline following the exploitation of deep-mined and open-cast coal for over a Century, and high levels of oil and gas production in the North Sea and Irish Sea over the last 40 years. In the last decade the UK became a net importer of oil and gas following the peak UKCS production in both oil and gas production in 2001 -2005 period.. New technology and higher global oil and gas prices could result in new economically exploitable oil and gas resources mainly offshore. However, such technologies, including Enhanced Oil Recovery (EOR) and Enhanced gas Recovery (EGR) are only likely to slow indigenous decline and the increase in imports of such fuels to meet future UK demands over the next two to three decades.

In contrast, new coal production techniques, particularly underground coal gasification (UCG) could open economic access to some or much of the estimated 17+ billion tonnes (180,000 TWh of primary energy*) of hitherto unmineable coal seams under the UK and off the coast. For comparison, UK coal mining (deep and opencast) has been producing around 17+ million tonnes per annum (1,000+ times less than the “unmineable” coal resources) and has been consuming around 60 million tonnes of coal per year in recent years, of which about two thirds is imported. Coal use has fallen off to about 50 million tonnes per year in 2009. Most coal demand (about 85%) is used for electricity production at 37.7% gross electrical efficiency. In 2009 power stations generated 105 TWh/y of electricity, a record low, from 40.1 million tonnes of coal (containing 278.5 TWh of gross primary energy).
Consequently, if UCG is proves itself technically and economically in the UK’s thin and faulted coal seams then the UK would have huge energy security. The coal could be used in gasifiers to produce hydrogen for fuel cell power stations and or synthetic natural gas (SNG) for use in CCGT power stations, fuel cell power stations (after reformation to hydrogen) and via the gas distribution network to boilers and mCHP boilers in buildings.

* power station coal has a gross primary energy of 6.94 MWh per tonne (25.0 GJ per tonne). So 144,000 tonnes of coal contains 1 TWh of gross primary energy.

**Renewable Resources**

In terms of indigenous renewable resources, the UK has potentially a considerable natural resource, particularly marine, capable of supply much or indeed all of future UK energy demands (assumed to be about 1,400 TWh/y including aviation and shipping). However, the degree to which the various indigenous and imported natural/renewable resources could provide energy security depends on the development of technologies which achieve economic exploitation of such renewable resources, particularly offshore wind, tidal and wave technologies.

* Marine renewable resources: The indigenous offshore wind resource may be in the order of 1,950 TWh/y and another 150 TWh/y from tidal and wave sources (2010 Offshore Valuation Report: http://www.offshorevaluation.org/downloads/offshore_valuation_full.pdf). However some of this offshore wind resource is above deep water (ie over 50 meters), or further from the coast, which may lead to higher costs. Some of the offshore wind resource may be unexploitable due to the needs of other marine users and uses, including shipping channels and Ministry of Defence radar requirements. Ironically, the sea areas deemed necessary to date for clear radar cover for national security reasons potentially threatens access to sites with considerable offshore wind energy resources which would themselves be of benefit to national security. Technical improvements to long-range radar provision (eg anti-clutter software) and supplementary radar based on the wind turbine/ transformer structures themselves may help resolve this conflict.

The HM Government/DECC 2050 Pathways “Call for Evidence” publication has an offshore wind scenario (ambition level 4) of 140 GW generating 430 TWh/y (page 194). Note that this annual output equates to a “Capacity Factor” of only 35% (ie 140 x 8.76 x 35/100 = 430). However, some studies suggest that higher capacity factors would be achieved in many sea areas and the average offshore wind capacity factor could be around 40% in which case a deployment of 140 GW would generate nearly 500 TWh/y (140 x 8.76 x 40/ 100 = 490).

The amount of intermittent renewable capacity which could be integrated would depend on the reliable back-up capacity required, when intermittent output is low or essentially zero, to meet peak winter daily needs. In the analysis below this back-up capacity is estimated to be 210–290 GW, which could back-up marine renewables generating 700–965 TWh/y (at an average 38% Capacity Factor). More intermittent capacity could be built, for example to manufacture “green” hydrogen via electrolysis at times of high output (excess to instantaneous demand).

* Bio-energy : Indigenous biomass (primary energy) production is estimated to range between 60–500 TWh/y (DECC Pathways page 133). Imported biomass may be 140 TWh/y on an equitable basis (DECC Pathways, page 164) states:

> An estimate of the likely market share accessible to the UK was made on the basis of its relative population size, using 2050 population estimates of 9 billion globally, and 75 million for the UK. This calculation produces an estimated UK market share of these projected resources of 70 TWh of liquid transport fuels, and the same amount of solid biomass fuels for combustion.

In this analysis it is assumed that an equitable share is imported (140 TWh/y) and a similar amount is produced indigenously (140 TWh/y). There will be conversion losses to useable fuels assumed to be 30–40% for the sake of brevity in this analysis. Consequently, a overall final energy demand (including aviation bio-fuel and possibly shipping bio-fuel oils) supplied by bio-energy may reach 170–290 TWh/y. This would be sufficient to cover international aviation demand by UK residents (assumed to be about 140 TWh/y distributed at airports around Europe and the world) and shipping bio fuel-oils (30 TWh/y) with possibly some bio-fuels remaining for use in the power sector (assuming most surface transport switches to hydrogen, electric motive power). Alternatively, shipping could be powered by carbon-neutral green hydrogen (eg liquified) produced by water electrolysis using renewable electricity (at times of excess/peak production) or low-carbon “black” hydrogen from coal etc in CCS-gasifiers. This would help utilise peak intermittent outputs by manufacturing fuels which could then be used at times of low intermittent outputs and conserve storable biomass fuels for times of peak consumer demand.

* Heat pumps (air-source and ground-source) may harness up to 150 TWh/y (see below) but deployment practicalities may result in a significantly smaller annual supply, say 50 TWh/y.

* Energy from residual waste—declining amounts of residual waste would be available for so-called “slagging” gasifiers or hot-plasma treatment as recycling rates increase to say 70–90% of future arisings by 2050. The DECC 2050 Pathways analysis estimates a recycling rate reaching 80% by 2050 and energy from waste (ie gasified syngas, SNG, hydrogen) falling to 80 TWh/y by 2050 as a result. So for several decades
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residual waste may provide around 100 TWh/y if gasified in slagging gasifiers (possibly more with efficient fuel cells and configured in CHP mode) though falling as low as 50 TWh/y for very high recycling rates. Energy from residual waste from DECC 2050 Pathways consultation (page 157):

Trajectory C (Figure F7) represents a possible path to “zero” waste to landfill by 2050,249 achieved through zero waste growth between 2007 and 2050 (therefore implying a significant decoupling from economic and population growth) and ambitious recycling levels which reach 60% by 2020 and almost 80% by 2050. In 2050, emissions in Trajectory C are around 60% of those in trajectory B (Figure F3). Energy from biodegradable waste, landfill and sewage gas amounts to just under 80 TWh in 2050.

* Other intermittent onshore renewable resources include onshore wind, solar PV, solar thermal, hydro and geothermal, may provide between them in the order of 120 TWh/y of which 100 TWh/y would be intermittent (solar/onshore wind).

Summing the broad estimates above (see below) the renewable energy harnessed may amount to between 1,000 TWh/y to 1,400 TWh/y of which about 280 TWh/y (primary)/ 170 TWh/y (final) might be imported bio-energy, mainly aviation fuel (imported in the sense of for example being produced in deserts and available at airports around the world, a share of which would be attributed to flights by UK residents).

Minimum = 1,000 TWh/y = 730 intermittent marine /onshore wind/solar + 150 bio + 50 heat pumps + 50 residual waste + 20 hydro/ geothermal.

Maximum = 1,400 TWh/y = 930 intermittent marine /onshore wind/solar + 200 bio + 150 heat pumps + 100 residual waste + 20 hydro/ geothermal.

Saharan wind and solar electricity imports by HVDC SuperGrid could supplement renewable energy provision to address climate targets by possibly 100+ TWh (requiring perhaps 15 GW of inter-conectors). Indeed, imports from what may be considered unreliable regions/countries may well be acceptable because there is immediate indigenous back up (eg hydrogen from coal with CCS) if such Saharan imports are cut or disrupted.

UK Energy System Scenario Overview

The deployed infrastructure, might consist of about 210–290 GW of reliable energy generating and gasifier capacity (load-following power stations, industrial CHP, district-heating, domestic mCHP gas boilers, hydro). Much of this capacity could be based around load-following gas turbine and or fuel cell power stations (including CHP) and fuel cell mCHP boilers in building. Some fuel cell types would require hydrogen supplied via the gas network (eg NaturalHy is a 20% hydrogen mix with methane which could be separated out at the user end). This reliable capacity would be scaled to provide future UK peak winter day energy requirements assuming very low availability of intermittent renewable electricity.

For example, 250 GW of capacity could generate about 6 TWh per DAY (250 x 8.76/365 = 6). For comparison, daily UK energy demand in the cold-snaps in January 2011 from the electricity generating sector was 1.2 TWh per day, and about 5 TWh per day of heat via the gas network (to boilers in buildings etc, excluding gas to CCGTs). Heating demand off the gas network in rural areas would have been additional to this 6.2 TWh/d energy demand.

Perhaps future peak daily UK energy demand may amount to somewhere between 5–7 TWh per day considering energy efficiency improvements, increasing population and transport sector demands from hydrogen-powered or electric vehicles. This would require between 210 GW and 290 GW of reliable energy-generating capacity (excluding ground-source heat pumps, interconnectors, thermal stores, other energy stores).

Crucially, this capacity would also determine the amount of intermittent renewables that could be connected/integrated into the UK energy system as, even assuming zero intermittent renewable output at night in a windless anticyclone, there would be reliable back-up. So 210–290 GW of reliable capacity could back-up for example intermittent renewable energy schemes generating 700–965 TWh per year at an average 38% capacity factor (eg a mix of offshore windfarms at 40% CF and wave, tidal and onshore wind schemes at around 33% CF, eg 290 x 8.76 x 0.38 = 965).

Future UK aviation and shipping fuel demands (assumed to be 140 and 30 TWh/y respectively) could probably be met by sustainable bio-derived liquid hydro-carbon fuels (eg bio JET-A, algae oil) possibly mostly imported. If so then indigenous intermittent renewables plus bio transport (aviation/shipping) fuels could supply around at least 900–1,100 TWh/y out of an assumed final demand of 1,400 TWh/y. The remainder (300–500 TWh/y) would be mainly supplied by the standing capacity (210–290 GW) fueled by either fossil sources with CCS (eg UCG or North Sea gas, imported shale LNG), or additional bio-energy sources if available (eg, algae-oil, bio-LNG, Saharan HVDC electricity), hydro reserves, plus residual waste derived syngas/SNG/hydrogen. Heat pumps schemes may also make a sizeable contribution (and possibly geothermal).

Significant electricity imports via inter-connector and HVDC transmission links (EU SuperGrid) to Saharan wind and solar schemes may also be a possibility. However, “Saharan” electricity imports may not be energy secure so are optional in this analysis in the sense that while there is no reason not to import such renewable
electricity if available and competitively priced, an indigenous based back-up would be available to provide energy security.

The back-up in this case would be some of the reliable (210–290 GW) of energy-generating capacity (with CCS) fuelled by any available biomass (perhaps 30 TWh/y) and residual waste (estimated at 50–100 TWh/y) or indigenously sourced or stock-piled coal (gasedify to syn-gas, SNG or hydrogen). Note that bio-hydrogen produced from biomass in CCS gasifiers is essentially a strongly carbon-negative fuel (depending on the energy inputs to producing and transporting the biomass to gasifier). Another 20 TWh/y could be available from reliable hydro sources.

Air source heat pumps (ASHPs including exhaust air source) could provide considerable heat energy annually (but hardly during a severe cold snap) as could ground source heat pumps (GSHPs) if deployed at scale, which may be difficult in urban and sub-urban areas. The potential of ASHPs and GSHPs could be considerable, perhaps harnessing perhaps between 50–150 TWh/y (see Annex 1 below) if commercially viable, consumer-friendly and realistically deployable. So between 150–300 TWh/y of the 300–500 TWh/y might be supplied by heat pumps, biomass, hydro and “renewable” residual waste sources. Any other sustainable biomass sources available after the production of aviation and other bio-transport fuels could also be gasified as and when required for load-following duties.

Consequently, perhaps between 0–200 TWh/y in 2050 may need to be supplied to the CCS-fitted gasifiers from fossil sources (eg indigenous coal, UCG, CBM) if indigenous or imported renewable sources were not available in sufficient quantities. As regard meeting climate targets (ie at least 80% by 2050 and possibly 100+% required) even with some residual coal use (possibly only used in emergency fuel shortage/disrupted import situations) UK carbon dioxide emissions could be net carbon-negative depending on the availability of sustainable biomass sources (and the amount gasified in CCS gasifiers).

Note that even carbon dioxide emissions captured and stored during the aviation fuel manufacturing processes at CCS-fitted bio-refineries from the primary biomass resources count in reducing net UK emissions (conversion losses of 80–110 TWh/y are assumed in the above scenario). Direct air-capture devices, utilising reject heat from power generation could also significant add to net carbon-negative emissions. Alkaline fuel cell power stations would be ideal for such DAC technology as the reject hot water from the cells can be made available at an optimal 95 Centigrade without loss of their 50% HHV electrical efficiency.

LOAD-FOLLOWING CAPABILITY—KEY TO ENHANCING ENERGY SECURITY

As most of the indigenous renewable energy generated would be from intermittent resources (ie wind, marine) the UK system requires back-up that can load-follow quickly, widely, constantly and preferably without loss of electrical efficiency. Very fortunately, alkaline fuel cells (of the type being commercially developed by British company AFC Energy Ltd near Guilford) in particular have excellent, possibly unrivalled load-following capability. CCS-fitted pre-combustion power stations comprising stacks of AFC cells (IGFC) would have fast dynamic response (MW per unit time) and wide dynamic range (from 0 output to full output at essentially no efficiency drop-off).

In comparison with gas turbine (IGCC) pre-combustion technologies or post-combustion CCS fuel cells would have considerable advantages. In comparison with fuel cell and gas turbine power stations new-build (Generation III) nuclear power stations are very inflexible (see Annex 2 below). Inflexible baseload generation would increasingly cause major Grid conflicts (over and under supply) leading to system de-optimisation, additional costs and possibly brown/black outs.

The better the ability of an energy generating technology to load-follow essentially enables more of the UK’s abundant indigenous renewable resources to be harnessed thus improving energy security. For this reason fuel cell power stations would enhance UK energy security much more than new-build nuclear stations. Furthermore the hydrogen fuel for the cells can be produced from a variety of indigenous and storable sources and the energy output (electricity and hot water at a useful 95 Centigrade) would be “low-carbon” to “carbon-negative” in emissions per kWh. In contrast, uranium fuel has to be imported (possibly with armed escort in future times), and the electricity output (little CHP potential due to locations) would only be low-carbon (and possibly rising due to diminishing uranium ore content requiring increasing extraction energy required at mines).

New-build nuclear would not add to UK energy security and would actually detract from security into the 2020s at least due to its high up-front costs when equivalent spend on non-nuclear energy technologies would save or deliver more low-carbon energy. By 2018 only 1.6 GWe on new-build may be operating, generating just 12.5 TWh/y or less than 1% of UK (final) energy demand (ie 12.5/1,500). By 2020 it may be 4.8 GW generating 38 TWh/y or just 2.5% of UK energy demand. For an equivalent spend of nearly £ 16 billion (assuming nuclear build costs of £3.3 billion per GW) a similar amount of energy could be saved or generated by non-nuclear means.

Consequently, the marginal energy security provided by Generation III reactors by 2020 could be minimal if not negative. Yet by 2020 CCS will have either have been commercially proven or not and the potential for scale-up much better understood. Generation IV reactor designs may also be at the stage for demonstration by the 2020 and are claimed to be safer and can burn existing nuclear waste (plutonium, uranium, actinides from previous programmes).
As there is clearly no marginal energy security benefit afforded by a Generation III nuclear deployment (and possibly a dis-benefit) then the building of additional load-following CCS capacity rather than nuclear would enable more intermittent renewables to be Grid integrated in the 2020s. For this and other reasons the plans for a Generation III nuclear programme (National Policy Statements) should be recalled /amended to defer decisions on new-build until the 2020s and the UK’s CCS planned demonstration programme (four schemes of about 300 MW net each) should be expand and accelerated instead. A recent estimate by Doosan Babcock at a DECC conference (APGTF) recommended about 3 GWe per year deployment rate to meet CCC 2030 targets.

Note that AFC Energy fuel cells are being designed for mass-manufacturing techniques to facilitate rapid scale-up and build rates. This will potentially create many UK jobs and bring energy security in the form of UK manufacturing facilities and British construction skills at a time of increasing demands, bottle-necks and costs for energy infrastructure globally.

**AVIATION FUEL SECURITY**

Securing adequate imported aviation bio-fuels to UK airports/military bases in adverse global situations may be problematic but synthetic aviation fuel could be made by manufacturing synthetic Jet-A using captured carbon and green hydrogen, or hydrogen from indigenous coal. It requires about 3 kWh of renewable electricity to produce 1 kWh of "carbon-neutral aviation fuel to power the synthesis process (according to AFS Ltd). Coal-to-liquids processes even with CCS at the manufacturing plant would produce aviation fuel with emissions close to that of fossil aviation fuel (about 260,000 tonnes of CO2 per TWh).

**Annex**

1. **2050 UK HEATING DEMAND SCENARIO**

The future annual heat demand of urban and sub-urban buildings on the current fossil gas network could fall to about 340 TWh/y following cost-effective insulation schemes across the country within the next two decades. The table below gives estimates for heating demand in urban, sub-urban, rural and new-build homes. The domestic demand is then multiplied by 1.3 to account for other buildings in the area (ie offices, hospitals, schools etc).

<table>
<thead>
<tr>
<th>Category</th>
<th>Heating Demand (TWh/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7m gas-connected urban homes</td>
<td>12</td>
</tr>
<tr>
<td>4.2m flats</td>
<td>9</td>
</tr>
<tr>
<td>9.3m gas-connected sub-urban homes</td>
<td>15</td>
</tr>
<tr>
<td>6.3m rural homes</td>
<td>12</td>
</tr>
<tr>
<td>5.2 m new-build with heat need</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>500</td>
</tr>
<tr>
<td>Industrial process (high temperature process)</td>
<td>70</td>
</tr>
</tbody>
</table>

**Heat Pump Lock-Out**

If all the 340 TWh/y heat demand of existing urban and sub-urban buildings were met by heat pumps with a Coefficient of Performance (COP) of 3:1 the renewable heat harnessed from the local environment would amount to about 225 TWh/y (340 x 2/3). Ironically, the amount of heat produced by fuel cell mCHP boilers in providing electricity to power heat pumps could reduce heat pump demand to 186 TWh/y. Of this demand about two thirds (124 TWh/y) would be heat harnessed from the local environment by the heat pumps from air and ground at a COP of 3:1. So, fuel cell boiler heat could potentially lock-out up to 100 TWh/y of indigenous renewable heat, a significant amount. However, mCHP boilers would reduce the physical size, disruption and cost of domestic heat pump installations.

Note that rural buildings with a heat demand of 120 TWh/y in this scenario could also deploy heat pumps, which at coefficient of performance 3, could supply up to 80 TWh/y of low-grade heat using 40 TWh/y of Grid electricity.

Total heat pump potential may be in the order of 164 TWh/y (124 + 40).

2. **FUEL CELL VERSUS GAS TURBINE VERSUS NUCLEAR LOAD-FOLLOWING LIMITATIONS**

Fuel cells (eg alkaline fuel cells) are virtually instantaneously load-following (the time it takes to changing the hydrogen pressure) from 0 capacity to full capacity, and maintain their high electrical efficiency of about 50% HHV at any load. The best load-following gas turbines are aero-derivatives in combined cycle mode and may have maximum electrical efficiencies of 45–50%, fast response times but efficiency drops of at lower loads and they cannot generate below a certain point. So fuel cells are ideal for load-following and considerably
better than gas turbines. Nuclear “Generation III” reactors (eg EPR) have far less load-following capability in comparison to gas turbines, let alone fuel cells.

It appears that an EPR could ramp-up from 25% capacity at 5% per minute of its maximum output (1,600 MW) which would be 80 MW per minute over 1,200 MW (eg from 400 MW to 1,600 MW in 15 minutes) BUT ONLY by around 100 cycles per year (eg once every three days). Such a ramp capability may be useful to some utilities in the summer months—eg 3 summer months with full ramp-down at night would reduce annual output from 12.6 TWh/y at 90% load-factor by 1.3 TWh/y (90 nights at 12 hrs x 1.2 GW) to 81% load-factor.

Annual cycling between 60–100% (essentially 1 GW to 1.6 GW) may be more useful but there is no manufacturer’s data on that (no data on ramp-down times either). Perhaps the 60–100% ramp-up/down might even be repeatable up to say 365 times a year—or once per 24 hours—so a 10 GW EPR programme MIGHT provide a 4 GW two-shift per day capability at best. The loss of annual generation IF such a scenario is technically possible could be 2.6 TWh/y per EPR so a load factor of 71%. This could possibly still be within a business case if the EMR fiscal incentives were sufficient I guess.

In terms of load-following in a future UK energy system even 4 GWe of capability per 10 GW of nuclear capacity (or in anything eg CCS ) would be relatively inconsequential compared centralised gas turbine or fuel cell power stations or a de-centralised electrical generating system could do, ie in CHP mode a 100 GWe deployment of alkaline fuel cells becomes 180 GW of—because de-centralised generation tackles the PEAK heating demand.

**QUESTIONS**

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

   Investment in multi-fuel technologies could be key to UK resilience to future fuel prices. Resilience obviously very much depends on the future mix of fuels but also the ability of the UK’s energy infrastructure to switch between fuels. Those technologies which are fuel-flexible or multi-fuel, would have added value to the UK economy and security as they could achieve lower energy prices by switching the lowest cost fuels at any given time in a highly uncertain future. Future prices for fossil and uranium resources over the next 25–40 years, the life of typical gas or coal stations, or 60 years for Generation III nuclear stations could well be highly uncertain.

   Even by 2040, let alone 2080, there are likely to be major global resource issues and geo-political consequences arising due to global population growth (to over 9 billion by 2050) and increasing per capita energy consumption of much of that population. The increasing demand for water, food and energy resources has been described as a “Perfect Storm” by Chief Scientist Dr John Beddington and, in the absence of future low cost renewable technologies, fossil fuels would be extensively used.

   Indigenous resources of conventional gas and coal (eg North Sea) are now of limited availability and steep decline, which is already having an adverse effect on the balance of payments. Globally while conventional coal and gas resources would be available for a few decades at least their price is likely to rise given the increasing global demand. However, price increases may be moderated considerably by the production of unconventional coal and gas resources.

   In terms of fuel-flexibility pre-combustion Carbon Capture and Storage (CCS) technologies which gasify fuels offer significant advantages over post-combustion CCS technologies and nuclear power. Such fuel-flexible technologies could exploit price differentials between gas, coal and potentially emerging sustainable biomass resources (eg indigenous or imported algae oils/solids). Pre-combustion CCS technologies can gasify gas, coal, biomass and residual waste to make synthetic methane and or hydrogen which can be used energy schemes comprising gas engines, gas turbines and or fuel cells (hydrogen only).

   In comparison post CCS technology (ie super-critical coal, CCGTs) is far more limited in terms of fuel switching and essentially cannot switch between coal and gas. In terms of nuclear power Generation III technology is limited to uranium imports for 60 years of operation from the commencement of operation (probably 2018 at the earliest) and before Generation IV technologies become available (probably 2030 if technically achievable and economically viable)

   Note that coal and gas fuels would have a “low-carbon” electricity and heat output and biomass would have a “carbon-negative” output, as would residual waste which is deemed a zero-carbon fuel in policy terms. Significantly, hydrogen produced from the electrolysis of water using “excess” electricity from intermittent renewable energy schemes (“green hydrogen”) could also be utilised by fuel-flexible schemes and would have a very low carbon-content. The output from pre-combustion CCS schemes becomes increasingly carbon-negative the more biomass, green hydrogen, or residual waste that is used to supply the gas-turbines or fuel cells.
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Memorandum submitted by Drax Power Limited

EXECUTIVE SUMMARY

— The current, relatively comfortable, capacity margin enjoyed in the UK is largely an accident of history, and this will be eroded quickly and come under severe pressure if existing fossil fuelled plant is closed prematurely, before the required low carbon replacement plant can be commissioned;
— Increasing the deployment of intermittent wind and inflexible nuclear capacity towards 2020 and beyond will require a significant volume of complementary capacity that delivers responsive, flexible plant capable of maintaining security of supply;
— A broad capacity mechanism will be required to maintain security of supply and to ensure there are adequate returns for making both new and existing flexible capacity available to the market, thereby avoiding early and inefficient closure of existing plant which would otherwise exacerbate security of supply issues;
— Measures to address the low levels of medium term wholesale market liquidity are also required to provide efficient market signals for investment which will also help maintain security of supply;
— Drax currently plays a vital strategic role in providing the necessary flexibility and system support services to ensure the UK’s security of supply. That role will become even more important as the UK progressively decarbonises its generation mix; and
— Enhanced co-firing of biomass with coal and/or conversion of existing coal-fired power stations, such as Drax, to biomass could play a key role in the cost-effective transition to a decarbonised electricity system. Such stations would continue to provide the vital system support services which will be increasingly required to complement intermittent wind.

ABOUT DRAX

1. Drax is predominantly an independent power generation business responsible for meeting some 7–8% of the UK’s electricity demand. It also owns Haven Power, an electricity supplier serving the needs of business customers.

2. Drax is the owner and operator of the 4,000MW Drax Power Station in North Yorkshire, which is the largest, cleanest and most efficient coal-fired power station in the UK. It comprises six 660MW coal-fired generating units; the largest and most flexible in the country. This capability means that Drax is one of the most significant providers of flexible generation and system support services in the UK. It was the first thermal generator, and for a significant period of time the only thermal generator, to consistently tender for Firm Frequency Response (FFR) services with National Grid. In 2010, Drax provided FFR services from three of its units during the summer overnight periods (April through September) and two units during the daytime in the winter.

3. Drax is also highly active in the Balancing Mechanism (BM), providing National Grid with real-time balancing options (via BM Bids and Offers) throughout the year. In addition, the Black Start capability of the plant, using three onsite OCGT units, ensures further network resilience should the UK’s electricity supply be interrupted. It should also be noted that Drax currently has the capability of storing over two million tonnes of fuel on site. All of these factors highlight the significant, strategic role that Drax currently plays, and can continue to play, in ensuring the UK’s security of supply.

4. Drax is also committed to playing its part in reducing its carbon footprint and that of UK power generation. To this end, in summer 2010 the largest biomass co-firing facility in the world was commissioned at the power station.

5. With the capability to produce 12.5% of the station’s output from sustainable biomass—equivalent to the output of over 700 2MW wind turbines—Drax is by some distance the largest renewable generating facility in the UK. In 2010, Drax produced around 7% of the UK’s renewable power, more than twice that of the next largest renewable facility.

6. Drax is pleased to have the opportunity to respond to the call for evidence on security of supply. As one of the most significant providers of system support services and a very significant investor in renewable electricity generation from biomass, Drax believes it is well placed to comment.

INTRODUCTION

7. The UK electricity sector is facing unprecedented challenges if we are to meet our binding 2020 carbon emissions and renewables targets, and put the UK on a sustainable and credible path to its longer-term commitment to reduce carbon emissions by 80% by 2050. This will involve an estimated £200bn+ investment in the sector and will put the UK’s security of supply at significant risk if not appropriately managed.

8. Drax therefore supports the need for changes to the current market arrangements in order to deliver the Government’s key climate change, decarbonisation and renewables targets while maintaining secure energy supplies and minimising the cost to UK consumers. These objectives are best achieved by putting in place a
stable, enduring, credible and efficient framework to incentivise investment in low carbon generation; introduce a new market mechanism to ensure there is adequate generation plant margin and sufficient flexible capacity to complement and support the increasing volumes of intermittent wind and inflexible nuclear generation on the system; and promoting greater liquidity, competition and tenure of contracts within the electricity wholesale market.

INCENTIVES FOR FLEXIBLE CAPACITY TO MAINTAIN SECURITY OF SUPPLY

9. Significant generation investment is needed to maintain secure supplies and ensure we can meet future peak demand and flexibility requirements, despite relatively low forecast demand growth over the medium-term. At least 20GW of intermittent wind capacity is expected to be connected to the system by 2020, with the closure of around 18GW of fossil plant and 7GW of nuclear plant expected to occur over the same period. In addition, the availability of existing flexible plant is also expected to reduce over the next decade, as such plant has to comply with increasingly stringent environmental legislation. However, the need for flexible plant will actually increase because:

- typically, demand increases by up to 50% on a winter morning between the hours of 5am and 9am. This will not change and may actually increase; and
- by 2020, the extreme hour-to-hour changes in demand net of wind output could be as much as 17GW, which is a significant increase from the maximum variation of 5GW in 2009.

10. In these circumstances, security of supply will be at risk unless there are market mechanisms which recognise the critical importance of flexibility in maintaining security of supply in real time. This best done by ensuring there are adequate returns for making all flexible capacity available to the market, thereby avoiding early closure of existing flexible plant. In addition, provision of medium-term signals for investment in existing and new flexible plant and demand side measures is required. This would ensure the most efficient investment prevails, lowering the cost to end consumers. Neither of these is provided by the current energy-only market arrangements and it is therefore clear that a capacity mechanism of some kind is required.

11. In order to deliver efficient investment in flexible capacity and demand response, the capacity mechanism must provide signals to the market that allow both new and existing plant to compete both to meet peak demand, and for the provision of flexibility and system support services. DECC’s preferred approach to a capacity mechanism, the Targeted Capacity Mechanism (TCM), does not provide existing plant with the appropriate signals to deliver security of supply services. The proposal could threaten security of supply by forcing existing flexible thermal capacity to close prematurely, when such plant may well represent the most efficient investment option to provide peak demand and flexibility services.

12. DECC’s preferred solution focuses too narrowly and exclusively on meeting extreme peak demand scenarios (such as winter peak requirement), and fails to address the looming issue of flexibility in low demand periods. There will be increasing volumes of intermittent wind and inflexible baseload nuclear generation capacity coming on stream over the next decade. To maintain security of supply, it is therefore essential that the capacity mechanism addresses both seasonal capacity demand extremes and hour-to-hour flexibility requirements. The technical characteristics of certain plant, like Drax (i.e. the ability to quickly increase or decrease output) makes them more suitable for providing flexibility services than others. This needs to be reflected in the capacity mechanism.

13. Drax advocates a broader capacity mechanism that is available to all types of plant and demand measures capable of providing reliable flexibility services. It should be underpinned by clear investment signals either set by a central body or by a market mechanism. Competition should provide the most efficient and cost effective solution to incentivising investment in plant to meet both extreme peak demand and hour-to-hour variation in intermittent generation output.

14. A well designed capacity mechanism would also ensure that the value of both capacity and energy is transparent to all investors in the market, promoting a competitive and efficient wholesale market in which to invest.

WHOLESALE MARKET LIQUIDITY

15. A liquid, competitive wholesale market is also fundamental to promoting efficient investment by both independent incumbents and new entrants. Except in the very short-term, the current market has inadequate liquidity, competition and tenure of contracts. Inadequate levels of medium-term liquidity continue to have a detrimental effect on the development of efficient market price signals, which diminishes investor confidence in the GB wholesale electricity market. This has the potential to jeopardise future security of supply, increasing consumer costs and damaging the wider economy and needs to be addressed.

16. Drax considers that a (possibly time-limited) requirement for the six major vertically integrated players to trade a proportion of their future requirements transparently through the wholesale market would be a useful and potentially effective initiative. For example, on a rolling basis, they could be obliged to trade a minimum of perhaps 5% of their expected generation and supply requirements for year 5, 10% for year 4, 15% for year

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3, 20% for year 2 and 25% for the year ahead. This would not be an onerous requirement on them, but would create liquidity further out on the forward curve, which may stimulate more active trading.

**ROLE OF BIOMASS**

17. Biomass is currently burnt alongside coal in existing coal-fired power stations such as Drax. However, there is the potential to significantly increase the substitution of biomass for coal via enhanced co-firing of biomass and/or conversion of existing coal-fired power stations. This could play a key role in the cost-effective transition to a secure, decarbonised UK electricity system. Such options would make efficient use of existing generation and transmission assets and continue to provide the vital system support services which will be increasingly required to complement intermittent wind.

18. There is ample sustainable biomass available. For example, a recent AEA report for DECC\(^{132}\) concluded that by 2020 the UK could have around 20% of its primary energy demand met from biomass. The fuel itself also has relatively stable costs with low volatility compared to other fossil fuels (see Chart 1). The capital cost of enhanced co-firing of biomass alongside coal is a fraction of that of new offshore wind capacity.

19. Furthermore, biomass co-firing generation plant will have a higher availability/load factor than most other renewables and will not impose increased costs on the operation of the electricity system. In short, electricity generation from biomass can reduce the cost to the consumer of maintaining security of supply whilst making a vital contribution to meeting Government targets for renewables and CO\(_2\) emissions reductions.

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

20. Fossil fuel prices are set by global and regional markets. Hence the UK is vulnerable to changes in electricity price stemming from changes in fossil fuel input prices as the recent crises in Japan and Libya have demonstrated. Maintaining a broad spectrum of conventional and renewable generation technologies is one way of mitigating this risk. Thus, the current UK plant mix provides some protection, but the likely growth of gas and reduction of coal generation will see this diminish. Uranium prices are less critical, given the relatively very low marginal fuel cost of nuclear generation relative to other thermal generation.

21. The development of other technologies may also help. For example, for biomass, there is a relative low volatility in the global pulpwood market, and low correlation when compared to coal and gas on a GJ basis (see Chart 1)

**Chart 1**

![Comparison of Coal Market to Global Wood Market](chart.png)

**Comparison of Coal Market to Global Wood Market**

**Note:** The Global Pulpwood Index does not incorporate transportation and processing costs. Due to the water content of pulpwood this will significantly raise the actual cost per Gigajoule for electricity generation.

22. Thermal generators are essential for the provision of system flexibility in the event of rapid demand change, or unexpected loss of supply such as failure of a nuclear unit or unpredictable changes in the output of intermittent plant. Thermal plant are largely unabated today, but could in future consist of existing plant converted to burn biomass, new dedicated biomass developments or CCS (with either coal, gas or ideally biomass). Security of Supply will only be assured if both capacity and flexibility are properly valued; current market price signals do not reflect the value of providing these services. The reason for this is that the six vertically integrated companies which dominate the domestic supply market are able to optimise internally

\(^{132}\) UK and Global Bioenergy Resource—Final Report for DECC, AEA, March 2011
with little requirement to trade their generation output on the wholesale market. There is very limited liquidity in the wholesale market beyond 18 months.

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

23. Security of supply is extremely sensitive to the levels of investment in our energy infrastructure. Firstly, significant investment in generation infrastructure is needed to maintain secure supplies and ensure we can meet future peak demand and flexibility requirements, despite relatively low forecast demand growth over the medium-term. At least 20GW of intermittent wind capacity is expected to be connected to the system by 2020, with the closure of around 18GW of fossil plant and 7GW of nuclear plant expected to occur over the same period. In addition, the availability of existing flexible plant is also expected to reduce over the next decade, as such plant has to comply with increasingly stringent environmental legislation.

24. In these circumstances, security of supply will be at risk unless there are market mechanisms which incentivise investment by recognising the critical importance of flexibility in maintaining security of supply in real time. This is best done by ensuring there are adequate returns for making all flexible capacity available to the market, thereby avoiding early closure of existing flexible plant. In addition, provision of medium-term signals for investment in existing and new flexible plant and demand side measures is required. This would ensure the most efficient investment prevails, lowering the cost to end consumers. Neither of these is provided by the current energy-only market arrangements and it is therefore clear that a capacity mechanism of some kind is required.

25. Secondly, transmission investment is a key issue which the UK will have to address. It is targeted that a high proportion of the UK’s renewable power will be provided through wind power in remote locations both onshore and increasingly offshore. Investment to provide the connections for these developments will be critical. However, the overall transmission investment requirement could however be reduced through a greater use of other renewables in less remote locations, and the decarbonisation of existing generation assets. For example, it would be more efficient and cost-effective to meet a greater proportion of the renewables targets from new and co-fired biomass capacity than from offshore wind. Both of these would require relatively little, or no, additional grid infrastructure.

26. The UK need not become so sensitive to fuel storage (ie gas storage dependency), depending upon the mix of flexible technologies that are maintained and constructed (eg abated coal (biomass co-firing & CCS) and dedicated biomass technologies). CCS will require first-of-kind investment in carbon transportation and storage infrastructure, which is likely to require costly support.

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

27. Increased levels of electrification of transport and heat will have a potentially profound impact on both demand patterns and on distribution system operation and design. If the change is to decrease peak demand, thereby flattening overall demand, then the security of the system may be enhanced at a lower cost. If however peaks are increased and the demand pattern becomes more volatile, then the security of the system will be diminished, thereby creating a greater cost. Increasing overall demand would put pressure on energy security and hence capacity.

28. Upward pressure on the price of carbon, particularly with the introduction of UK-only Carbon Price Support, could actually disincentive increased levels of electrification. This is because non-electric domestic heating and transportation fuel prices are not affected by the proposed Carbon Price Support.

29. Increased electrification of heat and transport will require very significant investment in the distribution system if it is not adversely affect energy security. To ensure the resultant costs do not become prohibitive, it will be vital to achieve the correct balance of delivered investment in infrastructure, renewable/low-carbon technologies and flexible plant. Flexible plant will continue to perform a critical role in providing system balancing services due to the increase in use of intermittent technologies, regardless of the future daily demand profile. Using biomass for power generation is one of the most cost effective ways to provide flexible low carbon generation to meet new demand.

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

30. Energy efficiency measures will have a role to play. However, lower demand is likely to be offset by the increase in consumption from heat and transport sectors. More importantly, energy efficiency measures will not address the pressing matter of output variation from intermittent generation. As a result, flexible thermal generation such as coal, gas and biomass will retain its crucial role. Only a visible market valuation of capacity can protect future UK energy security; this will ensure that investment signals are visible to all investors, whether they are new entrants, existing independent generators or vertically integrated companies.
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?

31. A side effect of meeting the UK's targets for greenhouse gas emissions reductions will be high volumes of intermittent capacity connecting to the Grid. The implication is negative for energy security because such capacity cannot be relied upon. The extreme hour-to-hour changes in demand net of wind output could be as much as 17GW by 2020, which is a significant increase from the maximum variation of 5GW in 2009. On the other hand, biomass with the right incentives can deliver reliable, flexible, firm power from a broad range of sustainable biomass fuel sources uncorrelated to fossil fuel prices. By way of example, there is low volatility in the global pulpwood market, and low correlation when compared to coal and gas on a GJ basis (see Chart 1 ).

32. This extreme level of capacity intermittency has never before been managed anywhere in the world, but this is essential if the UK is to ensure energy security and meet decarbonisation targets. Energy security means offsetting the half hourly variations in demand net of wind, and meeting demand troughs; it is not just about meeting peak demand. To do this, plant such as Drax, which play a vital strategic role in providing the necessary flexibility and system support services, must be incentivised to decarbonise. The role of flexibility providers will become much more important as the UK progressively decarbonises its generation mix.

33. For UK security of supply to be maintained, a market mechanism which values capacity must be implemented. A serious shortcoming of DECC's proposed targeted capacity mechanism is that it focuses purely on reserve capacity to meet extreme peak demand. DECC's proposed targeted capacity mechanism neglects the importance of flexibility in securing supply. It also fails to recognise the considerable forecasting challenge required by such an approach. Only a broader market mechanism (utilising a range of technologies) will address these issues.

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

34. If the UK becomes even more dependent on gas for power generation, the power price volatility to which end users are exposed will increase. In other words, fuel switching opportunities from gas to coal are reduced. Seaborne coal and LNG are traded internationally, and will go to the highest bidder irrespective of the energy security requirements of any given country.

35. Over-reliance on a single commodity (within the fuel market) would expose the UK to risk of extreme price shocks and security of supply uncertainty due to global and regional demand or production pressures. In addition, there are concerns about the physical ability of the UK gas transmission system to respond to large and unpredictable variations in supply and demand. For example, in a scenario in summer with gas interconnector exports at maximum and storage injection at maximum, there would be nowhere to send the excess gas from decreased CCGT running, in the event of a spike in wind power output.

36. No single energy source will provide a security of supply solution for the UK. The solution will require a balanced and diverse energy mix which makes the most of all of the energy sources at our disposal, including biomass. Electricity generation from sustainable biomass is unique in that it is renewable, cost effective, reliable, and can respond to changes in demand.

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

37. The UK position as a large net importer of energy makes us fundamentally vulnerable to international markets. This has been illustrated by the recent volatility of prices in the wake of the events in Japan and Libya. We therefore need to mitigate the physical and geopolitical threats to our security of supply by maintaining a balanced mix of generation technologies. This should ideally comprise a range of low carbon and fossil technologies including domestic coal (ultimately with CCS), renewables, including biomass, and nuclear, as well as maximising the contribution provided by the demand side and energy efficiency measures.

38. Investors in low carbon generation are likewise able to invest anywhere in the world. For the UK to be attractive to investors, a robust and bankable incentive mechanism is required, ie the CFD Feed-in-Tariff. In addition, a UK-only carbon price floor certainly does not help security of supply. The UK must work with the EU in respect of global markets for power fuels and investment.

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?

39. The UK’s energy security policy is of questionable robustness today. This position may be weakened further if the correct incentives for flexible capacity are not implemented alongside Government’s policy to decarbonise the power sector. Many in the industry consider the present capacity margin in the UK power market to be an accident of history which will not continue into the future. This concern is primarily due to the intermittency of wind capacity, the inflexibility of new nuclear capacity and a medium term concentration of gas fired generation assets. Gas alone cannot be relied upon to respond to the increased volatility of wind output.

133 Green, R., (2010) "Are the British Electricity Trading and Transmission Arrangements Future-proof?", Utilities Policy

134 The construction of new inflexible nuclear plant will reduce the scope for management of flexible spinning reserve at times of low demand.
40. Today, coal plant such as Drax performs a strategic role providing essential flexibility and system support services, along with millions of tons of reserve fuel storage. In addition, the Black Start capability of Drax, using three onsite OCGT units, ensures further network resilience should the UK’s electricity supply be interrupted. Current UK and EU policies (for example the UK carbon price support, and the EU Industrial Emissions directive) will result in early closures of such plant, at a time when wind volatility and the closure of end-of-life plant will make the role they serve ever more important.

41. This situation could be improved, particularly during the vital transition period of 2016–2025, by incentivising low carbon investment in new and existing generation. Investment in decarbonisation of existing flexible thermal capacity via efficiency upgrades or enhanced biomass co-firing would ensure the UK retains the flexibility that is critical for the maintenance of the UK’s security of supply (and at a more acceptable cost to consumers). Similarly, incentivising the construction of new flexible renewable generation such as dedicated biomass would deliver new firm flexible capacity. Unlike wind, biomass-fired generation technologies can respond quickly to changes in electricity demand.

42. The incentives required could be best achieved via the introduction of CFD FiTs and a capacity mechanism. Improving medium-term wholesale market liquidity would also enable market prices to reliably stimulate the construction of new capacity. Absent of intervention, there might be insufficient incentive to invest in adequate flexible capacity.

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?

43. The majority of industry participants agree that there is a need for reform to the wholesale electricity market if the Government is to achieve its decarbonisation targets. Drax believes that a CFD Fit and a well-designed Capacity Mechanism would deliver the EMR objectives without the need for an EPS or Carbon Price Support.

44. Implementation of the Treasury’s carbon floor proposal could adversely affect security of supply. It will have an adverse impact on flexible coal plant and will not provide ‘bankable’ incentives for investment in new low carbon generation.

45. The coal-fired capacity which we have in the UK today is among the most flexible on the system, and as such is a perfect compliment to wind intermittency. In addition, it can be adapted to deliver secure reliable biomass-fired generation, which when coupled with high availability means it is there when it is required. However, without the right support this plant will be forced to close earlier than expected, well before low carbon replacement plant can be built. This will reduce the diversification of UK generation assets and increase risk to security of supply.

March 2011

Memorandum submitted by the RMI Petrol

1. EXECUTIVE SUMMARY

1.1 The road transport industry, reliant upon fossil fuels for the foreseeable future, remains the heartbeat of the UK economy and society at large and deserves much greater support from Government

1.2 The independent forecourt retail sector has borne the brunt of site closures since the OFT report in 1998 to the detriment of many neighbourhoods and locales, especially those in more rural areas.

1.3 With just 2,000 rural sites remaining and closure predicted at the rate of 200 a year, the UK risks becoming a “rural fuel desert” by the end of the decade.

1.4 This scenario will impact adversely on jobs, travel times and costs and being amenity deprivation to these already economically challenged rural areas.

1.5 Anti-competitive behaviour by some hypermarket chains and certain oilcos have exacerbated this rapid decline which is predicted to continue if left unchecked.

1.6 There is clear evidence of market distortion with the re-emergence of the two tier pricing phenomenon as independent struggle to achieve sustainable margins.

1.7 Ancilliary forecourt business streams have suffered margin shrinkage at the same time but for different reasons eg. unregulated hand car washes and convenience stores.

1.8 Government to date has failed to heed the warning calls from industry that future planning and regulation needs to address the support for our filling station network in order to provide a robust level of future energy resilience for the vital road transport industry.

1.9 DECC has been working with industry for several years through the Downstream Oil Industry Forum (DOIF) but their reports completed last year have yet to see the light of day. Can such a laissez faire attitude continue to be tolerated?
1.10 The introduction of biofuels under the RTFO scheme is contentious. With problems of handling, product contamination, increasing product cost, issues over sustainability, lower performance and reliability it must be time for a fresh and objective study into the direction ahead.

1.11 The Government should move the duty point from the terminal to the point-of-sale i.e. the forecourt dispenser as this would overcome many of the problems detailed in this briefing document and would also make duty cuts (including options for a future fuel stabiliser) easier to embrace.

2. OBJECTIVE

2.1 With some 32mn cars and 2mn HGV’s using our roads, the entire UK economy and society remains hugely dependent on fossil fuels to power these vehicles and will do so for very many years. It is estimated that over 80% of UK freight travels by road transport and some 80% of the working population commutes by car.

2.2 Thus it is imperative that we have a secure and stable source of road fuels both now and into the future. An essential ingredient in this mix is a robust and well-structured network of filling stations, not least across rural areas including our island communities.

2.3 This paper briefly highlights current and future issues that will affect our energy resilience in this vital sector.

3. SCOPE

3.1 RMI Petrol operates under the umbrella of the Retail Industry Motor Federation Ltd and is the sole trade association for the independent forecourt retailers across the UK. It was formerly known as the Petrol Retailers Association.

3.2 This report is intended as an initial briefing document to the Chairman and Members of the Select Committee for Energy and Climate Change to inform as to the principal issues affecting their market sector, especially from the standpoint of future energy resilience.

4. RECENT HISTORY OF PETROL RETAILING

4.1 Refineries

4.1.1 Refineries—from a peak of 19 refineries around the coast in the early ‘70’s, successive closures from market withdrawals has resulted in just 8 refineries being available at the present time as the Petroplus facility on Teesside has also been closed to production.

4.1.2 BP sold on their refineries at Coryton and Grangemouth to Petroplus and INEOS respectively over the last few years. These are highly leveraged “merchant” refiners without any downstream integration into the retailing sector. During the last year, several remaining multi-nationals also declared their refinery exit strategy with Shell (Cheshire), Chevron and Murco (Pembrokeshire) and Total (Humberside) available for sale. To date, Chevron has sold to another US refinery operator, Valero Energy Corp. and Royal Dutch Shell has completed the sale to Essar Energy, an Indian conglomorate.

4.1.3 This would leave just ConocoPhilips (Jet brand) and Esso as long-term integrated refiners to the UK market.

4.1.4 Such major changes are bound to impact on future supply arrangements across the UK, with negative prospects for the independent retailers but it is too early to be categoric about likely changes.

4.2 Wholesalers/distributors

4.2.1 With the decline of onshore refineries and the growth of diesel for road fuel use, independent wholesalers have been established with both storage and blending facilities.

4.2.2 Much of their base refined fuel is now imported both from the near continent and also further afield. One such company, Greenergy, has a major shareholding invested by Tesco, another Harvest Energy offers a national brand identity and is building long-term supply relationships with independent dealers. Mabanaft is also building supply relationships with the hyper sector.

4.3 Petrol Filling Stations

4.3.1 From a peak of over 35,000 forecourts and 20,000 as recently as 1990, there has been a continuing decline in numbers to less than 8,800 at the end of 2010. Whilst there has been site rationalisation by the major oilcos, the greater part of this reduction, averaging close to 500 sites/year, is accounted for by the independent sector. (See Appendix 1)
4.4 Retailers

4.4.1 As defined by Experian Catalist, there are three broad sectors, viz:

— Oilco—sites owned and operated by the oil company or commission operator under their direct management. (COCO = Company Owned, Company Operated. COMOP = Company Owned, Commission Operated and CODO = Company Owned, Dealer Operated)

— Hyper—sites owned and operated by the “big four” supermarkets being ASDA, Morrison, Tesco and Sainsbury

— Independent—all other sites embracing motorway service areas (MSA), convenience store chains (eg Co-op and SPAR wholesalers) plus those owned and operated by individual, private companies. The latter vary from multi-site groups to small, rural singletons. (DODO = Dealer Owned, Dealer Operated)

4.4.2 Over the last 20 years, there has been a surge in hypermarket development activity of forecourt operations such that today Tesco is the UK market share leader with over 15.0% eclipsing Esso, Shell and latterly BP who have all been leaders at some juncture.

4.4.3 Site numbers, average fuel volumes and market shares are provided by Experian Catalist (See Appendix 1)

4.5 Fuel taxation

4.5.1 Although the “escalator” principle for excise duty on road fuels was established by the Conservatives in 1993, there has been little consistency of policy since that time. Suffice to say that duty has been levied in a relentless manner, especially by the previous Government. (See Appendix 2) The result has been continuing inflation of prices at the pump, suppressing fuel demand and increasing cashflow problems for smaller retailers.

4.5.2 More recently, VAT has been increased from 15% to 17.5% from 1 January 2010 and from 17.5% to 20% on 4 January 2011.

4.5.3 Today, the total tax “take” is around 80 to 82ppl for ULP equivalent to some 60% of the total average UK price of 133.50ppl.

5. Current Issues Affecting the Independent Sector

5.1 Supply

5.1.1 One of the dramatic features of the reducing number of refineries and the change of ownership is the virtual cessation of the “product exchange” system. This enabled oilcos to provide supply to Dealers more or less across the UK irrespective of their own facility restrictions. As a result, there has been consolidation with oilcos focusing on geographical areas where they have compelling competitive advantage.

5.1.2 The outcome for the independents is that they now have limited supply options when it comes to re-signing five year supply contracts. For instance, in Scotland independents are limited to just BP and Shell amongst the major brands. Others including Conoco (Jet), Chevron (Texaco) and Esso will decline to quote. There are minor brands available but these do not have the pulling power of a major brand particularly when facing hypermarket competition.

5.1.3 Whilst not yet a monopolistic position, it is not ideal to have such limited competing supply options available in many regions of the UK.

5.1.4 This rapidly developing situation does not yet appear to be recognised by Government based on comments made by the Chief Secretary to the Treasury during Budget week.

5.2 Pricing/Competition

5.2.1 Most oilcos quoting for dealer business today will insist on supplying against Platts wholesale prices on a daily basis. Their mark-up (on-cost) is assessed after factoring in such details as actual and estimated fuel volumes, local area pricing, distance from the refinery or cold supply terminal and inclusion of part/all costs of card payments. This package is offered to the dealer as a Platts plus price. It is now virtually impossible to negotiate a weekly Platts plus price.

5.2.2 Additionally, both methods carry zero protection to the dealer from an oil company that ignores the Platts wholesale pricing structure eg an oilco building up tactical volume through COCO’s to sell their refinery at a better price or an oilco supporting their dealers to the lowest market prices with no regard to ROCE or an oilco establishing local market share with their COCO’s in selected areas where they want a presence. Such activities can place their prices several pence below dealers under the same brand. This confuses the consumer, financially disadvantages the dealer and must be questionable as a fair franchise agreement between oilco and dealer.

5.2.3 Several oilcos have their retail estate up for sale and appear to have been pushing volume at the expense of profit so as to get a better capital value for their respective portfolios.
5.2.4 And then there are the Hypermarkets. Previous investigations (Competition in the supply of petrol in the UK—Office of Fair Trading : May 1998) suggested that it was in the public interest for these companies to offer low prices. This report ignored warnings from industry that such unchecked pricing tactics could cause major damage to the retail fuels infrastructure and thus the UK’s overall energy resilience for road transport.

5.2.5 The facts speak louder than words : total forecourt numbers across the UK have reduced from 13,850 in 1999 to less than 8,800 in 2010. It is averred that this collapse of nearly one third of all petrol filling stations has been largely due to the anti-competitive pricing tactics adopted by the four major hypers and certain oilcos.

5.2.6 As an example, one of the oilcos has been selling at less than some dealers buying price in the last few weeks. (See Appendix 3) How damaging to the remaining retail network if this were to continue much longer ? Predatory selling by both oilcos and the hypers could potentially threaten our energy resilience by forcing closure of yet a larger swathe of the independent dealer market. Vital, secure underground storage being lost as has already been the case with 11,000 less forecourts since 1990.

5.2.7 These hyper chains have buying advantages due to their size which are believed to include duty deferment arrangements with HMRC, prices negotiated with a two week time lag, full compensation for “hot product” and headline buying levels at Platts minus rather than Platts plus.

5.2.8 The hypermarkets regularly use their store profit to cross-subsidise fuel by means of deeply discounted promotions, usually “spend £50 in store and get 5.00ppl off fuel”. This is yet another contentious and anti-competitive sales device which hits the indies as they have no means of retaliating.

5.3 Measured product and “hot” product

5.3.1 Independents have to accept the volumetric measurement of the supplying oil company as stated on their delivery note and invoice. The delivered fuel is not metered out into the tanks on site. Many dealers use fuel monitoring systems installed and monitored by respected and accredited companies, which show that short loads frequently happen but there is no way of obtaining compensation from the supplier. Dealers are unable to do anything about it, being contractually obliged to accept the supplier’s terms.

5.3.2 A serious financial issue is the well-researched phenomenon of “hot” product. (Temperature Compensation of Liquid Fuels 1999 : National Engineering Laboratory). Many deliveries, are made at temperatures significantly above those of the dealer’s tank temperatures. “Hot” product, delivered into colder underground storage tanks contracts when it is cooled (petrol cooling by 10oC shrinks by 1.2%) further disadvantaging the dealer as the “invoiced quantity” is not available to be sold. Some suppliers recognise this problem and offer modest “hot” product compensation arrangements.

5.3.3 There is also the issue of vapour returned to storage as part of the tanker loading process. A Department for Environment report (1995), in justification for stage 1b Vapour Recovery legislation, confirmed that up to 0.18% of the petrol loaded is taken back across the duty point. No allowance is given to the dealer for the product or the duty which could amount to £20 per 10,000 litres. Also, as part of the delivery process, vapour is taken from the dealer’s tanks and, again, no allowance is given by the supplier.

5.4 Duty

5.4.1 The retailer collects tax in the form of duty, now at 57.95ppl and VAT now varying between 20 and 23ppl at the 20% rate. However, there is real concern that HMRC does not agree to repay duty on the vapourised hot product element returned to the terminal by tanker and subsequently charged out again on another delivery.

5.4.2 Also HMRC does not allow duty reclaim on fuel theft from the site—this cost has to be carried by the retailer as most low level theft such as drive-offs is practically uninsurable. This unfair and unnecessary cost to industry is yet another financial burden to the retailer.

5.5 Allstar

5.5.1 This company appears to have a dominant share of the company fuel cards sector and individual retailers are unable to challenge their costs of business. Allstar charge the forecourts for taking the card and the retailer makes little, if any profit.

5.5.2 Independents do provide a full service to the vital HGV and commercial van sectors, unlike the hypers, with hi-speed standalone diesel pumps and other specialist facilities. This sector risks being seriously impaired should closure rates accelerate.

5.5.3 Diesel fuel is generally provided on a bunker basis at ultra tight margins but remains integral to independents through good shop spend.

5.5.4 The oilcos do not offer a discount to provide customer accounts. The scheme is not transparent. Who else benefits? Some suggest that Allstar is a hugely restrictive practice in which many of the oilcos have a similar practice with company fuel cards again at the expense of the independent retailer.
Ev w114  Energy and Climate Change Committee: Evidence

5.6 Other credit and corporate cards

5.6.1 As the fuel prices rise so card costs rise, as they are percentage based, which reduces independents margins yet further. This practice must be challenged but individual companies lack the leverage to address the issue with global players including VISA and Mastercard.

5.7 Margins

5.7.1 The independents are able to determine their own pump pricing but within parameters which, in theory, offer an optimum return on the supply agreement formulae from the oilcos. However, most pricing is driven by local competition from aggressive hypers or oilcos.

5.7.2 In reality, the independent is being forced to accept gross margins in the range 1.0 to 3.5ppl which is unsustainable given the increases to business rates, energy, employment, insurance, banking and other overhead costs for the site. The gross margin needs to be in the range of 4.0 to 5.00ppl for survival in most cases.

5.8 Shop

5.8.1 Many of the smaller sites still offer the old “kiosk” style forecourt shop which houses the payment point and a range of oils and car accessories. Others have embraced the CTN (confectionery, tobacco and newspapers) concept from slightly larger shop premises whilst the modern forecourt has invested in the fast-growing convenience store facility.

5.8.2 There are now several strong secondary “symbol” convenience brands available to the independents including Budgens, Spar, Mace, Londis, Costcutter etc which provide a good range of products and fresh produce both own brand and proprietary brand such as Heinz, Kellog and so on. IGD and other research consultancies advise that the convenience sector is growing at 6% per annum in real terms.

5.8.3 This explains the major shift by the hypers to take full advantage of this trend towards convenience shopping as their major out-of-town centres struggle to achieve real growth other than by extension of their product lines.

5.8.4 Gross margins between 18 to 24% can be achieved but only with significant investment, outstanding service and extended hours working. Over the last 20 years, there has been a huge swing in the source of forecourt income from fuel to shop and this has prevented yet a higher rate of closures.

5.8.5 The principal concern of the independent retailers is the anti-competitive business rating system being applied by the VOA (see para 5.10 below).

5.9 Car and jet wash

5.9.1 For many years investment in these ancilliary forecourt services provided an important alternative income stream to the independent retailer to help offset rapidly declining fuel margins. However, over the last five or so years, the market has been destroyed by the sudden emergence of the “unregulated” hand car washes spearheaded by the large out-of-town retailers offering such service in their large car parks.

5.9.2 Forecourt retailers estimate that up to 50% of their market has been lost from this dubious cash trade because of the lack of any Government intervention.

5.9.3 It is maintained that the unregulated hand car wash activity can breach many UK regulations including:

— Employment of illegal workers (HM Border Agency have recently had a number of successful raids on unregulated car washes)
— Disregard for local Planning Approvals
— Avoidance of business rates whilst operating on brownfield sites
— Avoidance of income and corporation taxes
— Contravention of PPG13 issued by DEFRA for the control of waste effluents

5.9.4 The independent sector, through the Car Wash Association, is seeking support from Government to provide committed monitoring and control of the “unregulated” hand car washes so that competition, based on level playing field terms, can be quickly re-established. Without such intervention, the financial plight of independents will continue deteriorating and lead to further unnecessary closures.

5.9.5 This is yet another example of the previous Government’s disinterest towards the independent petrol retailers, typified by the reluctance to provide proper enforcement of regulations.

5.10 Business Rates

5.10.1 Whilst the average increase for all commercial properties at the 2010 Revaluation Scheme was said to be 18%, the average for petrol filling stations was over 60% with many exceeding 400%. Thus Government increased the financial stresses on independent retailers from another angle.
5.10.2 Both Scotland and Wales withdrew their Transitional Relief schemes so increasing the financial plight of many small and rural sites. RMI Petrol led an industry wide challenge to the VOA which resulted in a number of concessions, especially related to the forecourt fuels element. The Scottish Assessors Association (SAA) adopted many, but not all, of these concessions into their Rateable Values implemented from 1 April 2010.

5.10.3 In England and Wales, these concessions are only now starting to be distributed in revised assessments to each site.

5.10.4 In negotiations with the VOA, their officials refused to concede ground on the key issue of the rating assessment methodology being employed for forecourt shops versus standalone shops.

5.10.5 The former are rated based on annual turnover whereas the latter are rated using the square area (ITSA) of the selling premises. This has produced extraordinary comparisons whereby a Tesco Express (estimated sales £4.0mn/year at 35% gross margin = £1.4mn) with the same floor area as an adjacent forecourt store (estimated sales £1.5mn at 22% gross margin = £330K/year) has a Rateable Value of just £26K/year compared to the forecourt at £85K/year.

5.10.6 This is considered to be unjust and unfairly discriminating against the forecourt operator.

5.10.7 RMI Petrol appointed Barber Wadlow, specialist property advisors, to investigate this anomaly and their report dated April 2010 is enclosed. (See Appendix 4). Note their findings that it would financially benefit nearly 500 forecourt operators to close their forecourt to fuel sales and to trade solely as a convenience shop.

5.10.8 It cannot be right that the VOA’s methodology leads to such bizarre decision-making which, in turn, would lead to job losses and withdrawal of fuelling facilities often in rural or semi-rural areas.

5.11 Biofuels

5.11.1 The introduction of both bio-ethanol and bio-diesel has been fraught with operational and performance difficulties, not least for the independent operator. (see Appendix 5)

5.11.2 Regulation is pushing refiners/blenders to consider introducing new grades of biofuel which would need to forecourts to offer additional grades to service all vehicle engines.

5.11.3 Most small and rural sites only offer a limited selection of grades and any addition would be difficult both financially and physically to accommodate. Will the Government provide capital grants? Will the Government provide operating subsidies? Without such moves, it is estimated that closures will accelerate.

March 2011
### APPENDIX 1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
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<td>1,205</td>
<td>1,193</td>
<td>1,174</td>
<td>1,150</td>
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<td>1,102</td>
<td>1,064</td>
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<td>1,021</td>
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<td>6,404</td>
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<td>2,221</td>
<td>2,229</td>
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<td>2,191</td>
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<td>2,414</td>
<td>2,801</td>
<td>3,115</td>
<td>3,764</td>
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<td>4,776</td>
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<tr>
<td>UK Total</td>
<td>8,841</td>
<td>8,921</td>
<td>9,264</td>
<td>9,430</td>
<td>9,526</td>
<td>9,968</td>
<td>10,475</td>
<td>10,933</td>
<td>11,707</td>
<td>12,305</td>
<td>13,107</td>
<td>-4,186</td>
<td>-32%</td>
</tr>
<tr>
<td>Av Vol ('000L/yr)</td>
<td>4,215</td>
<td>4,161</td>
<td>4,106</td>
<td>4,028</td>
<td>3,836</td>
<td>3,601</td>
<td>3,492</td>
<td>3,331</td>
<td>3,120</td>
<td>3,024</td>
<td>2,857</td>
<td>1,304</td>
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Net change Year on year

<table>
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<tr>
<th>Ownership</th>
<th>24</th>
<th>15</th>
<th>12</th>
<th>19</th>
<th>24</th>
<th>17</th>
<th>31</th>
<th>38</th>
<th>21</th>
<th>22</th>
<th>199</th>
<th>19%</th>
<th>199</th>
<th>19%</th>
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</thead>
<tbody>
<tr>
<td>HYPERMARKET</td>
<td>24</td>
<td>-397</td>
<td>-177</td>
<td>-83</td>
<td>-275</td>
<td>-137</td>
<td>-175</td>
<td>-163</td>
<td>-141</td>
<td>-290</td>
<td>-1,838</td>
<td>-25%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMPANY</td>
<td>-8</td>
<td>-343</td>
<td>-166</td>
<td>-96</td>
<td>-442</td>
<td>-507</td>
<td>-458</td>
<td>-774</td>
<td>-598</td>
<td>-802</td>
<td>-4,186</td>
<td>-32%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK Total</td>
<td>-80</td>
<td>-343</td>
<td>-166</td>
<td>-96</td>
<td>-442</td>
<td>-507</td>
<td>-458</td>
<td>-774</td>
<td>-598</td>
<td>-802</td>
<td>-4,186</td>
<td>-32%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on year end figures
**Market Share by Ownership**

The table below shows how the UK market is divided according to ownership.

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Number of open sites</th>
<th>Average volume per site (kl p.a.)</th>
<th>% Market share MF volume</th>
<th>% Outlet share</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPANY</td>
<td>2,216</td>
<td>4,687</td>
<td>28.5</td>
<td>25.2</td>
<td>1.13</td>
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<tr>
<td>DEALER</td>
<td>5,312</td>
<td>2,281</td>
<td>33.2</td>
<td>60.5</td>
<td>0.55</td>
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<td>HYPERMARKET</td>
<td>1,259</td>
<td>11,124</td>
<td>38.3</td>
<td>14.3</td>
<td>2.67</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8,787</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Definitions:**

Company: Owned by the supplying Oil Company whose name appears on the brand sign.

Dealer: An independently owned site usually supplied under an agreement with an Oil Company whose name usually appears on the brand sign. Also includes unbranded sites with no Oil Company Identification.

Hypermarket: Owned and operated by the multiple retailers (Hypermarket groups). Also includes sites that may be away from the main Hypermarket store but are owned and branded by the Hypermarket.
Market Development by Brand

The table below compares the number of open and under development sites by brand, for the current release of data and the same period last year. It also shows the percentage change in site numbers for each brand during the last 12 months to give a clear picture of which brands are expanding and which brands are reducing their site numbers.

<table>
<thead>
<tr>
<th>Brand</th>
<th>No. open sites V4 2009</th>
<th>No. open sites V4 2010</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASDA</td>
<td>179</td>
<td>186</td>
<td>7</td>
</tr>
<tr>
<td>BP</td>
<td>1,177</td>
<td>1,174</td>
<td>-3</td>
</tr>
<tr>
<td>CO-OPERATIVE</td>
<td>30</td>
<td>29</td>
<td>-1</td>
</tr>
<tr>
<td>ESSO</td>
<td>881</td>
<td>905</td>
<td>24</td>
</tr>
<tr>
<td>FOOD STORE</td>
<td>65</td>
<td>62</td>
<td>-3</td>
</tr>
<tr>
<td>GB OILS</td>
<td>262</td>
<td>227</td>
<td>-35</td>
</tr>
<tr>
<td>CLEANER</td>
<td>71</td>
<td>71</td>
<td>0</td>
</tr>
<tr>
<td>GULF</td>
<td>172</td>
<td>194</td>
<td>22</td>
</tr>
<tr>
<td>HARVEST ENERGY</td>
<td>9</td>
<td>27</td>
<td>18</td>
</tr>
<tr>
<td>JET</td>
<td>355</td>
<td>374</td>
<td>19</td>
</tr>
<tr>
<td>MAXOL</td>
<td>95</td>
<td>99</td>
<td>4</td>
</tr>
<tr>
<td>MINOR BRAND</td>
<td>293</td>
<td>285</td>
<td>-8</td>
</tr>
<tr>
<td>MORRISONS</td>
<td>291</td>
<td>295</td>
<td>4</td>
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<tr>
<td>MURCO</td>
<td>399</td>
<td>400</td>
<td>1</td>
</tr>
<tr>
<td>PACE</td>
<td>132</td>
<td>144</td>
<td>12</td>
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<tr>
<td>RIX</td>
<td>57</td>
<td>44</td>
<td>-13</td>
</tr>
<tr>
<td>SAINSBURYS</td>
<td>254</td>
<td>260</td>
<td>6</td>
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<tr>
<td>SHELL</td>
<td>931</td>
<td>884</td>
<td>-47</td>
</tr>
<tr>
<td>TESCO</td>
<td>451</td>
<td>475</td>
<td>24</td>
</tr>
<tr>
<td>TEXACO</td>
<td>1,038</td>
<td>909</td>
<td>-129</td>
</tr>
<tr>
<td>TOPAZ</td>
<td>14</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>925</td>
<td>915</td>
<td>-20</td>
</tr>
<tr>
<td>UNBRANDED</td>
<td>830</td>
<td>811</td>
<td>-19</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>8,921</strong></td>
<td><strong>8,787</strong></td>
<td></td>
</tr>
</tbody>
</table>

† Co-operative previously named Somerfield
* Harvest Energy were previously included in Minor Brand
Number of Sites with a Shop or Wash by Hand

The table below shows the percentage of sites with a shop and car wash by brand.

<table>
<thead>
<tr>
<th>Brand</th>
<th>Number of Open Sites</th>
<th>% Sites with Shop</th>
<th>% Sites with Car Wash</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASDA</td>
<td>186</td>
<td>12</td>
<td>54</td>
</tr>
<tr>
<td>BP</td>
<td>1,174</td>
<td>99</td>
<td>64</td>
</tr>
<tr>
<td>CO-OPERATIVE†</td>
<td>29</td>
<td>93</td>
<td>83</td>
</tr>
<tr>
<td>ESSO</td>
<td>905</td>
<td>99</td>
<td>43</td>
</tr>
<tr>
<td>FOOD STORE</td>
<td>62</td>
<td>98</td>
<td>50</td>
</tr>
<tr>
<td>GB OILS</td>
<td>227</td>
<td>44</td>
<td>22</td>
</tr>
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<td>GLEANER</td>
<td>71</td>
<td>69</td>
<td>45</td>
</tr>
<tr>
<td>GULF</td>
<td>194</td>
<td>83</td>
<td>38</td>
</tr>
<tr>
<td>HARVEST ENERGY*</td>
<td>27</td>
<td>93</td>
<td>74</td>
</tr>
<tr>
<td>JET</td>
<td>374</td>
<td>98</td>
<td>65</td>
</tr>
<tr>
<td>MAXOL</td>
<td>99</td>
<td>97</td>
<td>71</td>
</tr>
<tr>
<td>MINOR BRAND</td>
<td>285</td>
<td>64</td>
<td>38</td>
</tr>
<tr>
<td>MORRISONS</td>
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<td>99</td>
<td>93</td>
</tr>
<tr>
<td>MURCO</td>
<td>400</td>
<td>90</td>
<td>53</td>
</tr>
<tr>
<td>PACE</td>
<td>144</td>
<td>67</td>
<td>21</td>
</tr>
<tr>
<td>RIX</td>
<td>44</td>
<td>39</td>
<td>16</td>
</tr>
<tr>
<td>SAINSBURYS</td>
<td>260</td>
<td>98</td>
<td>73</td>
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<td>SHELL</td>
<td>884</td>
<td>100</td>
<td>54</td>
</tr>
<tr>
<td>TESCO</td>
<td>475</td>
<td>97</td>
<td>49</td>
</tr>
<tr>
<td>TEXACO</td>
<td>909</td>
<td>95</td>
<td>60</td>
</tr>
<tr>
<td>TOPAZ</td>
<td>17</td>
<td>100</td>
<td>47</td>
</tr>
<tr>
<td>TOTAL</td>
<td>915</td>
<td>94</td>
<td>69</td>
</tr>
<tr>
<td>UNBRANDED</td>
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<td>59</td>
<td>24</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8,787</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† Co-operative previously named Somerfield
* Harvest Energy were previously included in Minor Brand
Market Development by Brand

The table below gives average shop sales per annum and average shop size and looks at the relationship between the two. It also shows average sales per annum per thousand litres of fuel sold, which gives an insight into the strength of the relationship between fuel and shop sales across the various brands.

<table>
<thead>
<tr>
<th>Brand</th>
<th>Average Shop Sales (£,000 p.a)</th>
<th>Average Shop Size (sq m)</th>
<th>Average Shop Sales/Sq Metre Shop Space</th>
<th>Average shop Sales in £/1000 litres fuel sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASDA</td>
<td>421</td>
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<td>11,063</td>
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<tr>
<td>ESSO</td>
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<td>10,341</td>
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<td>FOOD STORE</td>
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<td>86</td>
<td>7,376</td>
<td>255</td>
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<tr>
<td>GB OILS</td>
<td>237</td>
<td>39</td>
<td>6,085</td>
<td>228</td>
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<tr>
<td>GLEANER</td>
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<td>37</td>
<td>4,353</td>
<td>144</td>
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<td>GULF</td>
<td>255</td>
<td>40</td>
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<td>155</td>
</tr>
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<td>6,921</td>
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<td>JET</td>
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<td>46</td>
<td>7,702</td>
<td>128</td>
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<td>MAXOL</td>
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<td>544</td>
</tr>
<tr>
<td>MINOR BRAND</td>
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<td>54</td>
<td>7,043</td>
<td>266</td>
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<td>UNBRANDED</td>
<td>243</td>
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<td>5,256</td>
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</table>

† Co-operative previously named Somerfield

* Harvest Energy were previously included in Minor Brand
### APPENDIX 2

#### Hydrocarbon Distillate Historic Duty Rates

<table>
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<tr>
<th>Period</th>
<th>Light Diesel</th>
<th>Gas Oil</th>
<th>Kerosene</th>
<th>Heavy Fuel Oil</th>
<th>Light Fuel Oil</th>
<th>Motor Spirit</th>
<th>Aviation Spirit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920-25</td>
<td>1.50</td>
<td>1.00</td>
<td>1.00</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
</tr>
<tr>
<td>1926-30</td>
<td>1.50</td>
<td>1.00</td>
<td>1.00</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
</tr>
<tr>
<td>1931-35</td>
<td>1.50</td>
<td>1.00</td>
<td>1.00</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
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<tr>
<td>1936-40</td>
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<td>1.00</td>
<td>1.00</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
</tr>
</tbody>
</table>

1. **Energy and Climate Change Committee: Evidence**

2. **APPENDIX 2**

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1. **Kilogram** and other values in the table are rounded to two decimal places.
2. **Energy and Climate Change Committee: Evidence**
3. **APPENDIX 2**
APPENDIX 3

Letter to Brian Madderson

PRICING

Dear Brian

I am very concerned that we are entering a period of two tier pricing that was so devastating when it occurred in 2000 when Save was driven out of business. Back then most of us had fixed or shared/minimum margins and so could ride it out. Not so this time.

Yesterday for example, Esso, Shell and to a lesser extent Total were selling below cost on a large number of locations in and around Manchester and the North. Both Shell and Esso were selling at 128.9 for unleaded and 135.9 for diesel. This gave Shell a margin of—0.15p/litre on its unleaded and +0.56p/litre on the diesel on the cost prices that I take off the Shell website each day for Platts.

Those cost prices were without the 0.2p/litre it charges for the Shell card promotion and with no premium, say 2p for arguments sake, in at all.

If we assume, depending upon throughput, a margin on fuel required of, say, 2.5p/3.0p/litre to pay site costs, and with little contribution from the shop (Shell not seemingly interested in them), then they were subsidising their company owned sites to the tune of about 2.85p/litre on unleaded and 2.55 p/litre, just to break even.

This is already having a very serious effect on my own groups volumes, but it this were to go for any length of time this reduction in volumes for the independent sector would be so great as to, at best, accelerate site closures; considerably reduce site profitability; greatly reduce site values.

If when you speak to anyone in Government that may listen, I would be grateful if the arguments about could be forcefully put whilst there is still (albeit a rump) of an independent sector left.

Perhaps Shell just want to completely cock it up before they get out altogether from the UK. Ironical that one on the main contributors to a reduction in retail fuel profitability over the last few years should now be thinking of getting out because of a lack of profitability.!!

Kind regards

Peter Brough
Director
Manor Service Stations
APPENDIX 4

CONTENTS
1. Business Goodwill
2. Profitability Of Standalone C-Stores & Petrol Filling Stations
3. VOA Proposed Valuation Framework—Impact On Petrol Filling Station Market
4. Conclusion

APPENDICES

APPENDIX A

TURNOVER ANALYSIS OF PETROL FILLING STATIONS/STANDALONE C-STORES

1. BUSINESS GOODWILL

1.1 A rateable value is supposed to replicate the potential “annual rental value” of a property, therefore the VOA has based rateable values upon actual rental transactions of petrol filling stations (which is the same approach adopted for other property sectors).

1.2 In practice, when a petrol filling station (PFS) is let in the open market, the annual rent not only reflects the value of the property, but also the goodwill in the business. The market does NOT pay a premium on top of the rent for the business—the premium is factored into the rent—and because the VOA is relying on market evidence to set petrol station business rates, they are also reflecting the “value” of the business in all rateable values.

1.3 The VOA consider it to be correct to incorporate this element of goodwill in a PFS rateable value because it is inherent and transferable goodwill as opposed to personal goodwill. Inherent goodwill is defined as “that intangible asset that arises as a result of property specific name and reputation, customer patronage,
1.4 Whilst we acknowledge this point and accept that this is how PFS rental values are assessed, it is critical to highlight that the fuel sector property market is entirely unique to other property sectors and, as a consequence, by adopting this approach to value for rating purposes, it creates huge inconsistencies with other very similar property sectors.

1.5 For example, if you buy a leasehold c-store business (without a forecourt), you would pay an appropriate annual rent (based upon £/ft²) for the property and an additional up-front premium payment for the business. C-store rateable values are therefore based upon rental transactions of the property excluding the value of the business.

1.6 The VOA argue that all inherent qualities of a c-store property are reflected in the rent, therefore if a premium payment is made for an operational c-store business, it is to reflect the personal goodwill of the business. However, some of the major c-store retailers confirm that they will (and do) pay goodwill for an operational business, but strictly on the basis that this payment should reflect the locational qualities of the property and its potential to trade, as opposed to any personal goodwill.

1.7 The VOA *Patrick Bond’s letter dated 17 February 2010+ even remark that it is a little surprising that standalone c-store rents “do not seem to show a strong relationship with turnover or profitability”. This is because the rent that a c-store operator is prepared to pay only needs to marginally out-bid the general market rental value, which is set by a range of different retailers as opposed to just c-store operators. The profitability of the unit, which is largely driven by locational qualities, is therefore reflected in the premium payment.

1.8 An industry ‘rule of thumb’ is that the premium should equate to ten times weekly shop sales (exclusive of VAT, lottery and E-Pay). This multiplier will, however, vary dependent upon the lease terms and rental levels, as well as the future trading potential of the unit.

1.9 The following transaction of a standalone c-store demonstrates the principle of a premium payment on top of the rent:

**Standalone C-Store**

- Standalone c-store achieving weekly sales of circa £30,000 (exclusive of VAT, lottery and E-Pay). The property is let on a 10-year lease from January 2005 at a rent of £25,000 per annum.
- The leasehold business was acquired in August 2005 for £230,000 and we have been advised by the purchaser that this premium reflected the very strong locational qualities. Indeed, the business had, up to the date of purchase, been run poorly therefore no scope to attribute value to personal goodwill.
- If this premium is decapitalised over the term of the lease, the additional property cost would be £32,000 per annum, therefore the total property cost (rent and premium) would be £57,000 per annum. The 2010 Rateable Value for the property has, however, been set at £21,750.

In contrast, a PFS will be let at a rent that incorporates this goodwill element, as the example below demonstrates.

**Petrol Filling Station**

- 2010 Rateable Value: £107,000.
- Barber Wadlow is acting for the owner-operator of the business, who is retiring and wished to let the property. We have recently agreed a new lease at circa 10% below the proposed rateable value. This is an FRI lease for a term of 20 years.
- It should be noted that we have had to accept a discounted rent to reflect a high proportion of account trade, as well as discount for age and type of pumps (circa 10 years old and not stage 2 vapour recovery)—cost of replacement: £60,000.
- No premium is being paid for the business on top of the agreed rent—the rent reflects the value of the property (including all fixtures and fittings (including the office chair)) and the “business” or business potential.

1.10 A standalone c-store is therefore benefitting from a considerable saving in rates (by comparison to a petrol retailer) because the goodwill element, despite being inherent and transferable goodwill, is excluded from the assessment.

1.11 We would expect the above to be challenged by the VOA on the basis that no goodwill is paid when an operator takes a lease on a shop unit that has not previously been operated as a c-store, whereas the rent of a ‘new to industry’ petrol station will still be based off a rent in relation to turnover (therefore inclusive of goodwill). An ingoing tenant to a new PFS will, however, base rent on significantly discounted trading figures in order to reflect the trading uncertainty, thereby discounting the rent. Moreover, the reality is that there are extremely few ‘new to industry’ PFS sites because of these trading risks and the substantial development costs. Experian Catalist report that there were only 54 newly-developed sites in the last three years, but many of these are site redevelopments, therefore not strictly ‘new to industry’.
1.12 Whilst we can appreciate that the VOA want to try and mirror market practices when assessing rents of petrol stations for rating purposes, one must question the logic of adopting the market approach when it creates such inequality with other property types, particularly such similar property types as c-stores. Indeed, in a lot of cases, petrol stations and standalone c-stores are now very similar businesses—the shop is now the key profit driver of a petrol station and its profit margins are more or less identical to that of a standalone c-store. There is also only marginal enhancement in turn-over potential for a petrol station shop, as the section below demonstrates.

2. Profitability of Standalone C-Stores and Petrol Filling Stations

2.1 It would be acceptable to charge higher business rates on a petrol station if it was more profitable or the turnover potential far superior, but this is not the case.

2.2 A product of the proposed VOA valuation framework for petrol filling stations and its assessment of incorporating goodwill (as highlighted in Section 1), is the huge inconsistencies in rateable values attributed to the shop element of a petrol filling station by comparison to a standalone c-store.

2.3 As we have highlighted in previous letters to the VOA, there are examples of rateable values allocated to shop elements equating to £50/ft²–£100/ft² in locations where standalone c-stores are paying rates that are as little as 10%–20% of these levels. This pattern would suggest that a petrol station shop has the scope to be proportionally more profitable than a standalone c-store.

2.4 The VOA in Practice Note 1:2010: Revaluation 2010: Petrol Filling Stations, state that this huge difference is because “turnovers achieved at forecourt shops are understood to substantially out-perform the convenience store industry average, in terms of sales per square metre per sales area. Although an element of this “over-trading” may be due to generally longer opening hours, it is unquestionable that a well-located forecourt convenience store will trade from both forecourt users and destination shoppers and will generally trade at a level above comparable convenience stores in the locality. It will therefore not be unusual for the value of the forecourt shop to show a premium, often substantial, over the local shop tone to reflect:

(a) the level of over-trading; and, as importantly, and
(b) that shop operating costs (heating, lighting, insurance, repairs and, to an extent, staff costs) are relatively less as they are spread across not only the shop income, but also forecourt sales”

2.5 We do not consider this statement to be accurate as the following research in respect of trading performance of both standalone c-stores and petrol filling station shops highlights. This evidence is from a supermarket retailer’s network of c-stores (for confidentiality reasons we cannot identify the retailer), some of which are standalone, whilst others are incorporated within a petrol filling station.

<table>
<thead>
<tr>
<th>Description of Evidence</th>
<th>Average Weekly Shop Turnover (£/ft²—Net Sales Area)</th>
<th>Rateable Value (£/ft²—Gross Area)</th>
<th>Ratio—Turnover to Rateable Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standalone c-store: 140 stores located nationally</td>
<td>£17.75</td>
<td>£9.75</td>
<td>1.8</td>
</tr>
<tr>
<td>C-store ancillary to petrol filling station: 34 sites located nationally</td>
<td>£19.50</td>
<td>£23.75</td>
<td>0.8</td>
</tr>
</tbody>
</table>

2.6 According to these figures, a c-store with PFS will only achieve 10% greater sales than a standalone store, but the rateable value is nearly 150% more. This research is interesting because all shop retail units are directly comparable being more or less identical in terms of size and fitout, whether standalone or part of a forecourt development. Additional evidence is provided at Appendix A, albeit not for directly comparable units, but the pattern and ratios are still evident.

2.7 Given that profit margins for both shop businesses are more or less identical, there is no opportunity to significantly enhance profitability of a petrol station shop and, as a consequence, it creates a hugely anti-competitive situation, which is likely to result in many petrol retailers taking evasive action to avoid the rates increase, including closure of the forecourt so that the shop can be reassessed as a standalone c-store (see Section 3 for more information).

2.8 In addition, the following data provided by IGD indicates that petrol station shop sales do not “substantially outperform the convenience store industry average”.

Ev w126 Energy and Climate Change Committee: Evidence
Energy and Climate Change Committee: Evidence  Ev w127

2.9 The convenience sector has changed considerably over the last 10 years with the arrival of supermarkets. Previously it was the non affiliated independent (ie the corner shop) that dominated the market and by comparison, petrol station shops did (and still do) outperform this outlet type. However, co-operatives and supermarkets have now created a much stronger business model that can outperform the average petrol station shop.

### 3. VOA PROPOSED VALUATION FRAMEWORK – IMPACT ON PETROL FILLING STATION MARKET

3.1 The proposed valuation framework for petrol stations is likely to result in fundamental changes to the network.

3.2 Petrol retailers will look to close forecourts so that the shop can be reassessed as a standalone c-store which, as the above evidence demonstrates, can represent a significant rate saving. For retailers with low volume forecourts, but comparatively strong shops, this will be an easy decision to make. According to Experian Catalist, in 2008 there were 435. PFSs achieving fuel sales below the average dealer volume of 2.25 million litres per annum, but achieving shop sales above the dealer average, which was circa £400,000 per annum. Indeed, the ‘average’ of these sites was achieving fuel sales of 1.4 million litres and shop sales of £775,000 per annum, and with fuel sales at this particularly low level, there is a logic in removing the forecourt to significantly reduce the rateable value.

3.3 The argument for closure is stronger again if the forecourt is old and equipment in need of replacement (which invariably is the case with the low volume sites). The cost of replacing tanks and re-pumping the forecourt can be circa £200,000 and, with fuel margins at only circa 3%, there may be more merit in putting this investment into the shop where margins of 20% plus can be achieved—see calculation below.

#### Petrol Station with Shop

<table>
<thead>
<tr>
<th>Value</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rateable Value:</td>
<td></td>
</tr>
<tr>
<td>Fuel: 1,400,000 litres</td>
<td>@ 2.75ppl</td>
</tr>
<tr>
<td>Shop: £775,000</td>
<td>@ 4.5% @ 76%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>Gross Profit:</td>
<td></td>
</tr>
<tr>
<td>Gross Profit (less rates,</td>
<td></td>
</tr>
<tr>
<td>excluding transitional relief)</td>
<td></td>
</tr>
<tr>
<td>Less annual cost of equipment</td>
<td></td>
</tr>
<tr>
<td>(Financed @ 6% over 10 years)</td>
<td></td>
</tr>
<tr>
<td><strong>Rates—% of Gross Profit:</strong></td>
<td></td>
</tr>
</tbody>
</table>

#### Closed Forecourt with Shop (Assumed shop size @ 1,000ft² + 500ft² ancillary, assumed rent rate @ £7/ft²–10/ft²)

<table>
<thead>
<tr>
<th>Value</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rateable Value:</td>
<td></td>
</tr>
<tr>
<td>1,500ft²</td>
<td>@ £7/ft²–10/ft²</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
</tr>
<tr>
<td>Gross Profit:</td>
<td></td>
</tr>
<tr>
<td>Gross Profit (less rates,</td>
<td></td>
</tr>
<tr>
<td>excluding transitional relief)</td>
<td></td>
</tr>
<tr>
<td>Rates—% of Gross Profit:**</td>
<td></td>
</tr>
</tbody>
</table>

3.4 The suggestion that shop sales will be adversely affected by the closure of the fuel forecourt is only partial. The fuel market has changed, with supermarket operators now dominating with aggressive pricing policies, therefore petrol retailers are already using the shop to pull in customers, as opposed to relying on fuel. Indeed, for sites achieving fuel sales of circa 1,400,000 litres, the forecourt will only be generating a small proportion of shop sales. The shop is therefore outperforming ‘core’ shop sales and what would be typical of a forecourt generating volumes at this level.
3.5 Supported by MUA research, we would expect ‘core’ shop sales to equate to circa 7%–15% of fuel volume, which in this scenario would be £100,000–£200,000. If one assumes that 50% of ‘core’ sales would be lost if the forecourt closed, the gross profit (less rates) would drop to £130,000–£140,000, therefore rateable value would still only equate to 10.5% to 11.5% of profit, and there would only be a circa 10% reduction in profit to the petrol station and shop, without any investment incurred. That said, an operator could (and most probably would) invest in the shop to protect/enhance sales.

3.6 These 435 PFSs (circa 5% of UK network) are therefore highly vulnerable to closure as a result of the proposed rating valuation framework, but it is likely that any site with disproportionately high shop sales by comparison to fuel will be seriously considering closing the forecourt if there is an opportunity to reduce their rates liability, particularly if there is a need to invest in the forecourt. We would therefore expect the number of forecourts ‘at risk’ of closure to be considerably higher, potentially 10% of the network. Given that we have already lost one in three PFS sites since the millennium, a further decline would be particularly damaging to UK infrastructure.

3.7 Transitional relief is not going to assist retailers; it will only delay the decision of closure for a year or two. And with no transitional relief in Wales and Scotland, these retailers are being forced to make the decision now. Moreover, all PFS businesses will be devalued to some extent because of the reduced profit potential going forward—a prospective purchaser will need to factor in the rates increase even if there is some relief in the first couple of years.

3.8 Whilst closure of the forecourt (or even the entire site in certain cases) is a decision that retailers located throughout the country will be faced with, it is likely that a large number of these sites will be in rural locations where the loss of yet another forecourt could be hugely detrimental to local economies. Interestingly, the VOA would appear to be aware of this issue as it has come to our attention that a 2010 rateable value for a rural site has already been more than halved prior to 1 April 2010. We understand that this adjustment was made because at the originally proposed rateable value, there was a serious possibility that the business (or at the very least the forecourt), which is vital to the local rural community, could be lost. The VOA do appreciate that the site in question is a lifeline to the rural community and, without it, many local residents would have been unable to get to another forecourt to fill up their vehicles this winter.

3.9 The VOA is therefore being forced to make adjustments to their framework to protect certain sites that are supporting a local community, which must demonstrate that the proposed valuation framework is not workable.

4. Conclusion

4.1 The 2010 rateable values for PFSs have not been compared with other property sectors, hence the huge distortion in values between standalone c-stores and PFSs. Comparison between property sectors is not standard practice for the VOA which, to some extent, is understandable for property sectors that bear no similarities, but for PFSs and standalone c-stores, with circa 30% of the PFS network now benefiting from a c-store, if this is not undertaken, there is scope for two similar property types to be taxed at entirely different levels.

4.2 The potential impact that this valuation framework is expected to have on the PFS market is substantial (see Section 3); we would therefore strongly recommend that adjustments are made. It has been highlighted that a PFS rent incorporates goodwill, whereas a standalone c-store does not. We would therefore propose to work with the VOA to formulate a method of valuation that ensures that petrol retailers are not being taxed up to 500%–1000% more than standalone retailers.

4.3 In this respect, we consider the biggest area of concern relates to the way shops are treated, with particular reference to the shops that are achieving sales above what one would consider to be typical of a standard PFS. Previously, this was only ever a very small proportion of the network, but the market has changed considerably in the last 10 years and there are now a substantial number of PFSs with c-stores (achieving high shop sales) that are being assessed for rating purposes as if they were a standard PFS.

4.4 Adjustments should therefore be made so that c-stores incorporated within PFSs pay rates that reflect the turnover/profitability of the unit by comparison to a standalone c-store. As shown in Section 2.5, if a PFS c-store turnover is 10% more than that of a standalone c-store, then the rateable value should be 10% greater, as opposed to 150%.

4.5 In addition, an alternative approach would be to analyse the element of shop sales in excess of what is deemed to be ‘standard shop sales relative to the fuel volume’, at a discounted level. A similar approach was adopted by the VOA for the 2005 assessment, and it seems even more relevant in 2010 to include this approach given the growth of c-stores on PFSs in the intervening period.

4.6 Barber Wadlow would like to offer the VOA assistance in formulating a valuation framework that is equitable for petrol retailers and is not going to have any adverse repercussions on the sector as a whole.
APPENDIX A

TURN OVER ANALYSIS OF PETROL FILLING STATIONS/STANDALONE C-STORES

<table>
<thead>
<tr>
<th>Description of Evidence</th>
<th>Average Weekly Shop Turnover (£/ft²—Net Sales Area)</th>
<th>Rateable Value (£/ft²—Gross Area)</th>
<th>Ratio—Turnover to Rateable Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experian Catalist—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>average shop trading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>figures for all UK PFS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sites according to Catalist research</td>
<td>£14.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Barber Wadlow schedule of evidence for circa 50 PFSs</td>
<td>£18.25</td>
<td>£29.75</td>
<td>0.6</td>
</tr>
<tr>
<td>Network of circa 50 standalone c-stores</td>
<td>£9.00</td>
<td>£6.75</td>
<td>1.3</td>
</tr>
</tbody>
</table>

APPENDIX 5

GAPS IN INFORMATION IN DISTRIBUTION, STORAGE, RETAILING AND USE OF BIO-FUELS

Many of the problems incurred through storage and sale of bio-fuels have either been caused or at the least exacerbated by a lack of essential information. Such information could have enabled measures to be taken to avoid or minimise the risk of damage from storing or using bio-fuels. Fuel distributors, retailers, equipment manufacturers and maintenance companies all report the same concerns about the lack of information. More recently, motorists are suffering the damaging effects of bio-fuels and make wrong assumptions of how or who caused the problem. Contaminated fuel is often used as the cause of breakdown, when the repairer is unable to correctly diagnose the vehicle fault.

DISTRIBUTION

It is recognised that unless Suppliers provide information to the fuel distributors, it is impossible for them to provide that information to customers receiving their products. Distributors stocking bio-fuels have themselves suffered damage to their infrastructure, which could have been avoided if sufficient information had been provided to them.

The issue for the Distributor is the lack of confirmation from the Supplier, on the percentage and type of bio-fuel added. Without this information, sensible, accurate information cannot be passed on to the retail site/end user. This information should be required on the delivery documentation from the Supplier.

FUEL RETAILERS

Technical guidance on the storage of bio-fuels was produced by the Service Station Panel of the Energy Institute, which is represented by the stakeholder groups. This guidance advised retailers to carry out preparatory work immediately before receiving bio-fuels. In the event, however, many retailers were not given prior warning, nor did their delivery notes convey the necessary information, neither that the fuel contained a bio element nor the percentage of such bio element. Many retailers only became aware that they were storing bio-fuel when problems began emerging. It then became costly to rectify and also incurred problems for purchasing motorists.

Storage of bio-diesel has caused numerous problems for retailers, through filter blockage, nozzle cut-outs failing, leading to compensation for soiled clothing or damaged footwear, and microbial growths occurring in storage tanks. Left untreated, this can lead to microbial corrosion, tank failure and contamination of soil and groundwater.

In the case of ethanol blends, retailers have suffered high costs as a result of being supplied with fuel that has suffered phase separation prior to delivery, resulting in vehicle breakdowns for which compensation has had to be paid and the costs associated with uplift and disposal of contaminated fuel, all borne by the retailer. Notwithstanding the fact that the site operators had carried out the necessary preparation, suppliers have frequently disclaimed all responsibility by stating ‘its nothing to do with us’. The inability for retailers to check fuel quality before it is offloaded from the road tanker and the total lack of transparency in measurement and fuel quality has left retailers very vulnerable and exposed to high costs to rectify problems frequently caused by others.

Retailers are not given adequate information on the delivery notes about the fuel delivered. In spite of industry guidance advising not to mix an ethanol blend with standard petrol, on more than one occasion suppliers have advised that the ‘next load’ will not contain ethanol. This has left retailers exposed to high risk of phase separation occurring as a result of reducing the percentage of ethanol in their storage tanks.
Motorists

Through numerous breakdowns, Motorists and Motoring Associations have become aware that bio-fuels come with a risk of problems and the potential to cause breakdowns. Not unreasonably, Motorists assume that this was caused by the fuel most recently purchased, which is rarely the case. This has led to high costs for the retailer who has had to call in specialist contractors to give third party verification that no contaminated fuel was found on site. We give a number of case examples below:

**Case 1**

A Motorist contacted a fuel retailer to complain that he had received water in the diesel recently purchased from his site. The Retailer carried out water checks on the tank and found no water. The Motorist was not satisfied with this assertion and so third party verification was paid for by the retailer. The Motorist then threatened court action and the Retailer’s insurer stated that they would pay out as it was cheaper to do that than pay for his defence in a court action. The Retailer worried about his local reputation refused the offer and contacted RMIP who provided a technical report, showing that if water had been dispensed, everything below the suction pipe in the storage tank would still be water. The Retailer won the case and was awarded costs. He did however; have to stand the cost of third party verification of the lack of contamination on site.

**Case 2**

A Motorist topped up the fuel tank of her car before boarding the channel ferry at Dover. Shortly after disembarking in France, the vehicle broke down and was towed to the Volvo dealership. Water mixtures were discovered in the fuel system and the Motorist was advised to contact the garage where she refuelled. As in case 1 above, no water was discovered in the storage tank and no other vehicles refuelled on the same day, suffered the same failure. This Retailer could confirm that as at that moment in time he had not received any ethanol blended fuel. Under threats of litigation and with the advice of his Trade Association, RMIP, he carried out further enquiries, which discovered that the vehicle had been filled up on the previous day at a petrol station in Chester, in the area where many petrol stations had suffered water contamination by receiving ethanol blends which had been separated. Whilst in transit from Chester to Dover and with vehicle movement, the fuel had not separated in the vehicle until it had refuelled in Dover and then remained stationery on the ferry for several hours. Having topped up with pure fossil fuel at Dover, the ethanol percentage in the vehicle tank had also fallen to an unstable level, rendering it more likely to separate.

**Case 3**

A motorist refuelled his new vehicle at a Supermarket petrol station, which subsequently lost power. As the vehicle was still in the warranty period, he took it to the Dealership where he had purchased the car. No faults were discovered by the diagnostic testing system and so it was decided to drain the fuel tank and replenish it with new fuel. The car then ran normally and the motorist was advised to present an invoice for the work carried out, having been told that his warranty did not cover such an incident. He contacted the Supermarket who advised him that no other complaints had been received and asked him to show what the contaminant was, which he could not do. As he had retained the original fuel which looked and smelled normal, he was advised to pay a laboratory to analyse the fuel, in order to determine whether the fuel was contaminated, for which he could pursue a claim from the Supermarket, or whether the replacement of fuel was coincidental to another fault being rectified at the same time and therefore eligible under warranty.

These are just three examples of many such cases which were either caused by or exacerbated by a lack of adequate information.

Motorists need to be provided with essential information that could minimise the risk of mixing fossil fuels with bio blends, prevent them from making costly assumptions about who or what caused the problem if it occurs and advise them of essential housekeeping matters and risk areas.

Forecourt Contractors

Forecourt contractors and equipment repairers frequently report a complete lack of adequate information, regarding the fuel which they are handling in respect of its affect on equipment or its detrimental affect on the engineers exposed to the risk from handling.

Calibration of dispenser meters is crucial to the accuracy of measurement, fairness to the motorist and the ability of retailers to use stock reconciliation to determine the integrity of the storage system and early detection of leaks occurring. The type of fuel metered is an essential factor of the calibration process and varying levels of biomass used, affect the accuracy of measurement, and must be taken into account when calibrating the meter. When meters are calibrated in the factory on new equipment, it is essential to calibrate the meter to the type of fuel for which the dispenser is to be used. Unless that information is readily available errors will occur.

Summary

If the current problems are to be resolved and not escalate, certain changes need to be made. Unless these changes are made, small and particularly rural petrol stations will be under financial pressure to close. Those
that will close will be in locations where the local community is totally dependent on the petrol station for most of its commodities. Problems incurred by motorists will grow, and focus media attention on the problems caused by bio-fuels rather than any perceived benefits. We recommend the following.

1. Delivery documentation provided to fuel distributors must contain sufficient information as to the type and percentage of bio-fuel being received. This should be required for every delivery.

2. Clear concise information needs to be provided to retailers on each delivery note showing whether it contains bio-fuel and not only the maximum, but also the minimum percentage.

3. Practical and possibly, financial support for rural petrol stations, in order that they can accommodate bio-fuels without incurring unsustainable costs or taking the risk of damage to their storage facilities.

4. A simple explanatory leaflet needs to be provided to motorists, which in simple terms, explains the reasons for changing to bio-fuels, the benefits of doing so and some practical advice on how to avoid problems. This will avoid assumptions being made as to the source of problems, if they occur.

Memorandum submitted by Gazprom Marketing & Trading Ltd

Gazprom Marketing & Trading Limited ("GM&T") welcomes the opportunity to comment upon the Energy and Climate Change Committee’s inquiry into the UK’s energy security. GM&T is a UK-based, wholly-owned subsidiary of the wider Gazprom group. GM&T has interests across the energy sector, trading commodities and retailing to 21,000 sites in the UK and Ireland ranging from SME’s to large manufacturing companies. The company also provides services such as automated meter readings and energy management to help its customers to become more energy efficient.

GM&T’s head office is in London, with subsidiary offices in Manchester and around the world in Houston, Paris, Berlin and Singapore. Further information on GM&T can be found at our website, www.gazprom-mt.com.

SUMMARY

GM&T firmly agrees with the UK Government on the imperative of moving to a low-carbon economy. Ensuring that our energy sources are as environmentally efficient is a priority, alongside efforts to reduce our energy usage. Security of supply for energy is important from an economic, as well as political point of view. Central to this concept is a balanced energy mix—ensuring the UK has the capacity to provide sufficient energy in sufficient quantity at the right time.

GM&T is of the view that gas will be crucial in the transition to a low-carbon economy. In the longer-term it will provide the security of supply to ensure our energy needs are consistently met. Gas provides the UK with 39% of its energy supply, coming from a variety of sources and locations around the world. Natural gas is affordable, clean, plentiful and reliable, and we should not be afraid of drawing on it to fill the impending energy gap. Once the switch from coal-fired power stations is made in accordance with EU directives, gas will be the main source of the UK’s energy for electricity. This will have a positive effect on the UK’s carbon emissions. In the longer-term, however, this looks set to change.

The Government’s own predictions show the role of gas in the energy mix declining, with large-scale renewables and new nuclear taking over the bulk of the capacity. Gas will still be needed however, and will also be useful as a means of providing back-up capacity to account for fluctuations in renewables generation, especially wind. Gas-fired power is expected to play an important role in this respect, but there is a significant risk that the Government’s proposals under the EMR fail to incentivise this necessary investment in the gas sector. The consequent risks to the UK’s energy security are considerable, leaving us overexposed to intermittent sources of energy and with little flexibility to respond to peaks in demand.

Our high level comments in response to the Energy and Climate Change Committee’s questions are as follows:

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

Gas storage

2.1 Investment in energy infrastructure is extremely important in order to cope with seasonal fluctuations or interruptions in supply alongside declining gas production from the UK continental shelf (UKCS). Gas storage facilities allow companies to guard against sudden shortfalls or failures in supply, and also to take advantage of reduced prices during the low season.

2.2 The issue of gas storage in the UK has been highlighted as a key issue by politicians and Ofgem as the UK has around 16 days of supply based on average demand, significantly lower than other European countries. In comparison, Germany has enough storage to meet 73 days of gas consumption,
whilst in France the figure is 91 days. This leaves the UK vulnerable to short-term supply disruptions during times of peak demand.

2.3 Developers previously held off making investments in building gas storage facilities due to the difficulties of the planning regime. However, the current Government is rightly taking steps to remove barriers to investment in new capacity. In September 2010 the government approved plans for the conversion of WINGAS Storage’s onshore gas field into a gas storage facility in Saltfleetby, Lincolnshire. This will increase the UK’s gas storage capacity by 15%. WINGAS GmbH is a joint venture between Wintershall (65%) and OAO Gazprom (35%), which is the parent company of GM&T.

2.4 The government and regulators can take further actions to encourage investment in gas storage facilities. This includes ensuring appropriate rules to enable storage facilities to connect to the grid and avoid inappropriate charges on gas which is injected or withdrawn from storage. In the event that the government decides it should have “strategic” gas storage, it must ensure that this is structured in such a way that it does not crowd out normal commercial investment in storage (for example by being used to “manage” gas prices rather than as a true emergency backup facility.)

2.5 As well as having gas storage facilities in the UK, it is important for the UK to access gas storage facilities via interconnections with Europe. For example, Gazprom is investing in a number of underground gas storage facilities in Europe. This is to guarantee the reliability and the continuity of Russian gas deliveries to Europe, and the projects are now at various stages of implementation. Gazprom Export has signed an agreement with the Bergermeer Gas Storage project in the Netherlands which will be Europe’s largest third party gas storage facility with a working gas capacity of 4.1 bcm.

Gas quality

2.6 Closely tied to this is the issue of gas quality. Greater connection with continental European gas markets and storage facilities via pipelines such as the Bacton-Zeebrugge and Bacton-Balgzand interconnectors should enhance UK security of supply as UK indigenous production declines. The UK is part of an interconnected European gas market where gas can freely move between countries where is it is needed most. All countries benefit from a wider diversity of supply and spreading of risk, and if a key part of UKCS was to fail temporarily, replacement supplies could be imported from Europe.

2.7 However, in order for the UK to import gas from the continent, it will be necessary for the country to invest in further gas treatment facilities. One specific important problem is that the specifications for gas that can flow on the UK network are not aligned with those in Europe. Gas that can flow almost anywhere in Europe cannot necessarily enter the UK. As the European market is much larger than the UK, this means that in the long term, gas suppliers will choose to supply European markets until the price differential between the UK and European markets is sufficient to justify investment in facilities to treat the gas so it can meet UK specifications.

2.8 GM&T and other companies have previously raised this issue with both Ofgem and DECC asking them to take action. Unfortunately, there are differences of opinion as to when investment should be made, who should invest, and how the investment should be remunerated. Ofgem has failed to date to put in place a regulatory framework which would enable investment in such treatment facilities. Should this issue not be addressed, UK consumers could find themselves facing price spikes at times of increased demand.

2.9 GM&T believes that regulated investment by National Grid in gas quality treatment is required. Clearly further work is required to develop the detail as to what kind of approach should be taken to facilitate this investment and GM&T is ready and willing to work with all necessary actors to achieve these aims.

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 GM&T supports the reduction of greenhouse gas emissions and believes that in order to do this, gas has an important role to play, as a less polluting fuel in regards to more traditional energy sources such as oil or coal. Once the switch away from coal-fired power stations is made, the increasing use of gas will have a positive effect on carbon emissions. Natural gas is the cleanest-burning fossil fuel and produces 44% less carbon dioxide emissions than coal and 22% less than fuel oil.

5.2 In order to reach its greenhouse gas targets, the UK should pursue a policy of security of energy supply through diversity of sources, including gas. Although renewable sources and nuclear should be part of the mix, there are currently limitations surrounding renewable energy sources and the country should not find itself in a situation where it is exposed to the unpredictability of ever-changing weather patterns or untested experimental technologies.

5.3 In particular, it is unclear whether renewables will be able to meet the UK’s growing energy needs or will be able to respond to peaks in energy demand. It has been well publicised that large-scale renewables such as offshore wind see sharp dips in their production capacity at the times of greatest energy demand. At such times, it is imperative that sufficient generation capacity exists to make up the shortfall as renewables do not equal energy security.
5.4 Moreover, much of the technology involved in large-scale renewables is currently in developmental stages, with more research required before there can be a widespread roll out. Equally important is the question of affordability and competitive price, which is an important pillar of energy security. New nuclear power stations currently being built in France and Finland are both considerably over-budget and behind schedule.

5.5 The principal means of backup generation is expected to be gas-fired power stations. It is therefore essential the Government puts in place a framework which enables investment in both generation capacity, as well as the gas to supply that capacity.

5.6 One concern is that the proposals for Feed in Tariffs under the Electricity Market Reforms and the associated carbon tax proposals could make the UK market “hostage” to nuclear and vulnerable to cost and time overruns for new nuclear plants. Essentially the two proposals will make the investment environment for generation technologies other than nuclear or renewables very unfavourable. Companies will be unwilling to invest in new gas-fired power generation because of doubts as to whether they will be commercially viable. Security of supply will be dependent on nuclear power stations coming on stream on time and on budget. Neither can be taken for granted given recent experience. This would ultimately leave the government with a significant energy generation gap until the new nuclear comes on stream.

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

6.1 GM&T notes that gas has a key role to play in the UK’s energy mix and sustained investment in the sector will ensure reliable supplies into the future, whether this be infrastructure projects, storage or in upstream development.

6.2 GM&T believes that with the right policy framework in place (eg enabling diversity of supply and investment in storage) the UK can still enjoy security of supply.

6.3 Furthermore in the longer term use of Carbon Capture and Storage (CCS) will enable gas to generate electricity with ultra low emissions.

6.4 It is not necessarily the case that reliance on coal fired power with CCS is better for UK energy security of supply than reliance on gas. In 2009 78% of UK steam coal supplies were imported.136

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

7.1 The UK needs to recognise that it is no longer an island when it comes to energy supply. The market approach means that as indigenous production declines we can buy and sell according to the principles of supply and demand. A diversity of suppliers and supplies will reduce the exposure of the UK’s energy security of supply to international events.

7.2 As an importer in an international market, events will clearly have an impact. However, these can be addressed by ensuring that we have access to a variety of sources of supply (eg LNG, different pipelines), that we are integrated into the North West European market via adequate pipeline interconnection, and by enabling investment in storage.

7.3 By being able to access the North West European gas market, we are able to access a potential greater pool of supply. For example, the Nord Stream pipeline constructed by Gazprom in partnership with EU companies will be connecting gas directly to Germany, and will go live in 2011.

7.4 The UK is connected to sources of supply by a variety of pipelines. These include pipelines connecting to North Sea production directly, pipelines connecting to Norwegian supplies and interconnectors with Belgium and the Netherlands (the Interconnector and BBL respectively).

7.5 This means that should problems arise with one source of supply the UK can access other sources of supply via these different pipelines. For example, when there were short-term problems with one of the pipelines from Norway in 2010, the UK was able to import gas via the Interconnector to meet demand.

7.6 The UK is potentially able to source LNG from a wide variety of sources, as it has invested heavily in new LNG terminals at Milford Haven and Isle of Grain.

7.7 In the past the UK has imported LNG from sources such as Qatar, Trinidad, Norway, Egypt and Algeria, but the import capacity means it can ultimately access it from any LNG-supplying country.

7.8 LNG cargoes are flexible, responding to market processes, and can be diverted at short notice according to demand. This has been the case in Japan which sought additional LNG supplies to meet the shortfall in electricity generation cause by the shutdown of nuclear power stations.

7.9 GM&T has been working with its LNG arm (Gazprom Global LNG) since 2005 to extend the reach of Russian gas to international markets. Gazprom is already producing LNG from Sakhalin-II in the Far East and at full capacity will supply about 5% of the world’s LNG. Gazprom has also devoted over $45 billion investments for LNG projects by 2030, when we plan to supply about 90 million metric tons of LNG to the world market—providing for around a quarter of the entire market.

136 Digest of UK Energy Statistics.
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?

8.1 Further investment in gas infrastructure and storage systems will be required if the UK is to meet its increasing energy demands into the future.

8.2 Development of a regulatory framework to enable appropriate investment in gas quality treatment plant. This will enable the UK to access gas storage and gas supplies in continental Europe.

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?

9.1 Yes, market reforms have big implications on the security of the UK's energy supply but they do not receive the attention which they merit. The Government’s proposed Electricity Market Reforms will impact on the security of the UK’s energy supply in the long run and have not gone far enough in addressing the need for investing in the UK’s gas sector. Also the proposals provide windfall profits for nuclear generators long before any new nuclear generation will be on stream, raising costs for consumers unnecessarily.

9.2 Security of supply is not simply a question of volume, but also of price. EU proposals for further regulation of financial and wholesale energy markets could have the effect of making it more expensive for companies to manage their price risk, the costs of which will ultimately be borne by end consumers.

9.3 Proposals by the Commission and EU regulators to change the way the gas market works will undermine the market’s ability to react to changes in gas supply and demand, and make it more difficult to move gas between markets.

March 2011

Memorandum submitted by Scottish Renewables

Scottish Renewables is Scotland’s leading renewables trade body. We represent over 300 organisations involved in renewable energy in Scotland. Further information on our work and membership can be found on our website www.scottishrenewables.com.

Firstly, many thanks for the opportunity to respond on what is an important issue for the renewables industry in Scotland.

This industry is playing a crucial role in the Scottish and UK Governments’ efforts to tackle climate change and increase Scotland’s energy security, and must continue to do so in order to meet our carbon emissions reduction target of 42% by 2020. Scotland has ambitious targets to source 80% of our electricity demand and a fifth of all energy consumption from renewables by 2020.

The main points we make in supplying evidence to the committee are as follows:

— We welcome inquiry to explore the nature and extent of UK energy security.
— We welcome the ambition to increasing the percentage of renewables in the energy demand mix which will make our energy supply more secure.
— Renewables should be the focus of significant capital investment to create energy sources with clean, safe and limitless fuel supplies. Therefore, government must work to create an attractive political and regulatory landscape to encourage investment in renewables.
— We welcome the review of transmission charging and see that a beneficial outcome for renewables projects will be crucial to improvements in security of supply.
— Investment in grid infrastructure is critical to increase the efficiency and output from renewables projects, contributing to security.
— We support the view that a range of technologies will make up the UK’s energy mix but urge the UK Government to recognise that there is no alternative to investing in renewables and associated demand management and storage solutions which will provide increase security of supply coupled with clean, safe power.

I trust that you find Scottish Renewables’ comments helpful in this call for evidence. If you would like clarification on any of the detail in this correspondence please do not hesitate to get in touch.

The Committee invited responses to address each of the following questions. Scottish Renewables’ response is included below each question:

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

Renewable energy technologies are contributing an increasing proportion of electricity and energy to the UK. Scottish Renewables recently called for an increase in the renewable energy target for Scotland to 30% of all energy demand, given the recent increase in the electricity target to 80% and better than expected progress in renewable heat, coupled with the introduction of the Renewable Heat Incentive (RHI).
Figure 1

**PROJECTED PROPORTION OF SCOTLAND’S ENERGY DEMAND MET BY RENEWABLES IN 2020**

<table>
<thead>
<tr>
<th>Energy type</th>
<th>Terawatt hours (TWh) produced</th>
<th>Proportion of energy demand</th>
<th>Proportion of sector demand from renewables</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable electricity</td>
<td>35.5</td>
<td>22%</td>
<td>80% of electricity</td>
<td>GL Garrad Hassan (2010)</td>
</tr>
<tr>
<td>Renewable heat</td>
<td>9.2</td>
<td>6%</td>
<td>16% of heat</td>
<td>Scottish Renewables (2011)</td>
</tr>
<tr>
<td>Renewable transport</td>
<td>3.4</td>
<td>2%</td>
<td>10% of transport fuel</td>
<td>Scottish Government (2009)</td>
</tr>
<tr>
<td>Remainder of energy demand (non-renewables)</td>
<td>111.9</td>
<td>70%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total energy demand</strong></td>
<td><strong>136.0</strong></td>
<td><strong>100%</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Scottish Renewables (2011)

Furthermore, a Garrad Hassan report of 2010 indicates that renewables can play a major role in securing supply. It is seen that even in the most conservative scenario (low renewables growth; demand growth), renewables production could be 81% of gross consumption, thereby greatly exceeding the 2020 target of 50%. In the other scenarios, renewables production is close to or exceeds 100% of gross consumption.

If Scotland meets 30% of all energy consumption from renewables in 2020 (48.1TWh), this would equate to 20% of the UK (15%) renewable energy target (239TWh), and 3% of the whole UK energy consumption in 2020 (1590TWh).138

However, we recognise fossil fuels are still part of the energy mix at this stage and thus that the UK is not immune to changes in the price of fuel. Given the unpredictability of fuel prices in future, securing investment in renewables and associated infrastructure, storage solutions and demand management systems can help to increase the UK’s resilience to such changes and bring with it the benefits of clean and safe power. There is no alternative option that offers this unique set of benefits. Indeed, Ofgem has stated that a growing proportion of renewables in the system is the best option for both energy security and energy costs for consumers in the medium term.

With this in mind, we welcome the recommendation from the UK Committee on Climate Change that, beyond 2020, electricity generation should be largely decarbonised by 2030. This has to be the case if the UK is to meet its commitments under the Climate Change Act 2008 of an 80% reduction in greenhouse gas emissions by 2050.

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

Renewables can offer greater security of supply with more investment in energy infrastructure. In order to smooth out variability of renewable electricity supply to match demand, greater investment is required in the transmission and distribution network, demand management technologies and storage solutions. Grid upgrades in both the transmission and distribution networks can improve the efficiency of renewables technologies by allowing energy generated to be distributed to centres of demand at any point.

However, the location of our renewable resources is often at a greater distance from the centre of electricity demand, and therefore, under the current model of transmission charging, Scottish renewable energy generators are required to pay significantly higher costs for use of the transmission system than those further to the south. In fact, some generators located in Southern England are paid to use the system. This system clearly disadvantages those renewables generators based in Scotland, significantly hampers the exploitation of the UK’s vast renewable energy resources. The announcement in September 2010 that Ofgem were to undertake a review of the transmission charging regime (Project TransmiT) was welcomed across Scotland. Obtaining a positive outcome for renewable generators from this review is a crucial step towards securing safe, clean, sustainable supplies of energy to meet the country’s needs.

Renewables can be made more efficient with the introduction of a European Supergrid and the NorthConnect link to Norway. These connections could export excess renewables generation at periods of low demand in the...
UK to Europe. It would also allow us to import renewable energy whenever required, substituting imports of more volatile and less secure fossil fuels and creating a more consistent demand curve for renewables.

The scale of development required highlights the need for investment to be made in order to realise the sector’s potential in providing enhanced security. For example, as well as renewables developments, a recent Scottish Government report identified the need for significant investment to implement appropriate storage solutions.\(^{139}\) In addition, infrastructure must be improved. National Grid has indicated that they have investment plans of £4.7 billion\(^{140}\) of proposed reinforcements with a programme of extra investment planned for March 2012.

However, criticisms of the capital costs of renewables can be short sighted. They often ignore the huge strategic importance of these natural sources of energy and their ability to provide clean, secure energy for the people and communities across the UK. They also often ignore the alternative reality in the absence of renewable energy. Oil prices are currently hitting multi-year highs, against a backdrop of instability in the regions from which much of the world’s oil supplies are sourced. Furthermore, renewable energy plants do not suffer from the costs of decommissioning and clean-up associated with nuclear power plants.

The ability of renewables to give the UK a secure energy future is therefore dependent on acquiring appropriate finance for the sector, in order to invest in the necessary storage and infrastructure solutions.

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

By increasing electrification of transport and heat, these sectors can be de-carbonised and become more secure by realising the benefits of using renewable fuels and the protection this brings from unstable fossil fuel prices in future.

Renewable heat is likely to see an accelerated uptake with the introduction of the RHI. As outlined earlier, this was one of the reasons for Scottish Renewables calling for an increase in the renewable heat target and thus the overall renewable energy target in Scotland from 20% to 30%. We envisage that the heat sector will utilise renewable electricity solutions to some extent, coupled with a significant increase in projects utilising other renewables technologies which are supported through the RHI such as bioenergy, biogas, anaerobic digestion and solar thermal. As heat accounts for 50% of energy use in Scotland, some electrification of the sector, coupled with other renewable technologies can have a substantial impact on energy security.

Electrifying the transport network can also offer another method of smoothing demand from the grid by charging vehicles in periods where demand is low, such as during the night. They could also operate a battery swapping system, where highly flexible chargers are designed to match grid production and demand. Surplus batteries would act as energy storage during periods of low power generation.

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

Energy demand reduction and efficiency are the cheapest, simplest ways of increasing energy security as well as reducing carbon emissions and the cost of energy. The government should have a strong programme of investment in implementing energy efficiency measures, along with educating the public about the benefits of saving energy.

Energy efficiency can also be improved with the introduction of smart meters. Ofgem recently indicated that Smart meters will play a key role in their energy and environmental policies to ensure secure supply, moving to a low-carbon economy and keeping prices affordable.

Approximately 53 million meters will need to be replaced, involving visits to over 30 million households and businesses. The Government’s impact assessments estimate that the total cost of the rollout programme will be £11.3 billion—further investment required by the sector to realise a more secure and affordable future.

Reducing our energy consumption means we will be less susceptible to fluctuations in prices of fossil fuels. However, with predicted increases in energy consumption from now until 2020, it is essential that investment is also made in renewables technologies and their associated infrastructure alongside energy efficiency measures.

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?**

This is a win-win situation. A mixed portfolio of renewable energy provides low to zero carbon emissions and sustainable and safe supplies of infinite, indigenous energy that are free from the effects of rising and unstable fuel costs and the uncertainty of foreign imports. By displacing imported electricity, gas and fuels, renewable energy maximises the UK’s energy security and shields the public from fluctuations in fuel prices. Provided that there is timely investment in renewables and appropriate storage and demand management


measures, the UK’s energy security should increase as we tackle targets for greenhouse gas emissions and increase deployment of renewable energy technologies.

To secure this timely investment, the government must ensure that foreign investors see the UK as an attractive marketplace. Scottish Renewables wants the Scottish and UK Governments to move quickly to establish a Green Investment Bank in Scotland and also to clarify the plans for Electricity Market Reforms as soon as possible to create certainty in the market.

Scotland is rapidly establishing itself as the UK’s low carbon research and development hub, with the University of Strathclyde and the Energy Technology Partnership leading on academic and company research and development. Major companies such as Mitsubishi, Scottish and Southern Energy, Scottish Power and Gamesa are making significant commitments to Scotland for renewables and Iberdrola has announced Scotland as its world headquarters on CCS. Furthermore, Doosan Power Systems announced a significant initiative earlier this year to enter into the Scottish wind power business and locate its R&D Centre of Excellence for Renewables in Renfrew. This strong base of activity, coupled with Edinburgh being the fourth biggest financial centre in Europe, with particular strengths in asset management, makes it clear that Scotland would make an ideal home for the Green Investment Bank.

To realise this burgeoning potential enhance the UK’s security of supply, the UK Government must move quickly to clarify plans for Electricity Market Reform and Project TransmiT to ensure that renewable energy projects will not be penalised in the market and the appropriate and necessary investment in upgrading infrastructure in Scotland can be made.

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

The UK partly relies on gas fuelled power stations as part of the overall energy mix. Therefore, any second “dash-for-gas” which results in significant price rises would have an effect on the UK’s energy security to some extent, depending on its severity. Scottish Renewables recognises that decreasing reliance on fossil fuels and substituting them for renewables technologies which are protected from fluctuations in fuel price, can offer greatly increased security, provided they are implemented with appropriate storage and demand management measures and upgrades to existing infrastructure.

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

As we currently rely on imported fossil fuels and uranium as part of our energy mix it is clear that the security of supply is, to a certain extent, exposed to international events. Renewable energy is less susceptible to international events as the fuel required is free, limitless and does not need to be imported. Bioenergy is the exception whereby the fuel does have a cost.

Even so, the ability for renewables to offer this security is still affected by international events to a certain degree, for example, the current global economic crisis. Breaking the investment barriers opens the door to clean, safe power that is cheap to operate and protected from future fuel price fluctuations. The UK, and Scotland in particular, has set ambitious targets for renewables and shown political support for the sector.

To ensure that investment is made, government should work to make the economic, regulatory and political landscape of the renewable energy sector as attractive as possible for investors. Scotland has a comparative and competitive advantage across a range of technologies. By being a market leader we will not only experience the benefits of increased energy security and clean power but we also have the opportunity to export our technologies and expertise to the rest of the world.

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?

By continuing to invest in and support clean, low carbon technologies, we will not only provide greater security of supply but will also insulate consumers from the greater price hikes and volatility associated with reliance on fossil fuels. The selling point to secure this investment and subsequent increased security is the economic potential of the industry.

According to a report by the Scottish Government, Scotland’s low carbon environmental goods and services sector (LCEGS) could form more than 10% of the value of the Scottish economy by 2015. This sector includes Renewable Energy; Environmental Management and Low Carbon Technologies. Currently the Scottish GDP is around £100 billion with a LCEGS market of around £8.8 billion, predicted to grow to £12 billion by 2015–16.

An energy security policy which operates in tandem with increasing deployment of renewables can offer long term benefits to our economy which in turn offers further protection and security of supply.

March 2011
Memorandum submitted by the Sussex Energy Group

SUSSSE ENERGY GROUP, SPRU, UNIVERSITY OF SUSSEX

INTRODUCTION

1. The Sussex Energy Group undertakes academically rigorous, policy-relevant inter-disciplinary research that engages with policy-makers and wider interested parties. The aim of our research is to identify ways of achieving the transition to sustainable, low carbon energy systems whilst addressing other important policy objectives such as energy security and fuel poverty. We are a group of 15 social scientists, with diverse disciplinary backgrounds, including engineering and natural science. We are funded from a range of sources, primarily UK Research Councils, Government Departments, and the European Commission. Through the Group, the University of Sussex is a core partner of the Tyndall Centre for Climate Change Research and part of the UK Energy Research Centre.

2. We welcome this opportunity to provide evidence to the Committee’s inquiry into the security of UK energy supplies. In our view this topic requires more attention in policy debates. There is a particular need to assess how the risks to UK energy security are likely to change as a result of the planned transition to a low carbon economy—and what the implications are for policies and strategies to respond to these risks. Our research team conducts a significant amount of research on energy security issues which we have used to inform this response. Notable examples include Steve Sorrell’s review of the evidence for an imminent peak in conventional oil supplies for the UK Energy Research Centre (UKERC 2009a); Andrew Stirling’s research on energy system diversity which has been applied in the UK and Japan (Stirling 2010); and research by Jim Watson on risks to UK gas supplies (Watson 2010) and, with Alister Scott, on the security implications of new investments in nuclear power (Watson and Scott 2009). In addition, Professor Watson is co-leader of a UK research cluster: *Energy Security in a Multipolar World*.142

RESPONSES TO THE COMMITTEE’S QUESTIONS

Q1. How resilient is the UK energy system to future changes in fossil fuel and uranium prices?

3. Price security is an important component of energy security. This means that energy supplies do not necessarily need to be physically disrupted for consumers’ energy security to be affected. Along with most other industrialised countries, the UK remains heavily dependent on fossil fuels (coal, oil and gas) for its energy supplies. Fossil fuels supply well over 80% of the UK’s primary energy needs. We have commented on potential constraints on conventional oil resources that have significant implications for global oil prices in response to question 9 below.

4. The overall resilience of the UK energy system to increases in the price of fossil fuels and uranium partly depends on the energy intensity of the economy. The impact of high or volatile oil prices on major economies has been well documented (Awerbuch and Sauter 2006). These impacts range from a loss of GDP to higher unemployment and inflation. Whilst the UK is less energy intensive than it was in the past, there is a long-term structural shift away from energy-intensive manufacturing and towards service industries, such impacts still matter. In a recent speech, Chris Huhne cited DECC analysis which found that a doubling of oil prices could mean a loss of UK GDP of £45 billion over two years.144

5. Increases in the price of oil and other fossil fuels also have more specific impacts on particular energy consumers. Those households in fuel poverty are particularly prone to energy price insecurity. This is illustrated by the recent rise in the numbers of households in fuel poverty following several years in which numbers fell. Modest gains in household energy efficiency were not enough to outweigh the impact of sharp increases in energy prices. Rapid price increases also have a disproportionate effect on energy intensive industries since energy accounts for a relatively high share of their costs.

6. As noted in our response to question 9, the depletion of oil resources, and the potential for this to drive further price increases and/or volatility, requires particularly urgent attention. There are promising opportunities for mitigation of the impacts of high prices on the demand side, including improving vehicle fuel efficiency, developing electric vehicles and investing in public transport. Such changes are underway in the UK, but may need to proceed faster than is currently envisaged. At the very least, the risks posed by oil depletion deserve more careful scrutiny that has been evidenced to date.

7. The impact of uranium price increases needs to be analysed separately from those of fossil fuels. The price of uranium accounts for a relatively small proportion of nuclear generating costs (typically 3–6%) whilst the cost of fossil fuels can be over 50% of the generating costs of fossil fuel plants. So in principle, the UK energy system is significantly more resilient to rises in uranium prices than it is to similar rises in fossil fuel prices.

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141 This response was prepared by Professor Jim Watson, Professor Andrew Stirling and Steve Sorrell, Sussex Energy Group, SPRU, University of Sussex; http://www.sussex.ac.uk/sussexenergygroup

142 The cluster is led by Professor Catherine Mitchell, Exeter University. See; http://www.exeter.ac.uk/energysecurity/index.shtml

143 Fuel price risks are not the only security-related risks to the economics of energy technologies and systems. Events that impact on energy security such as the nuclear accident at Fukushima have, in the past, led to increasing technology costs as a result of a shift towards tighter regulations.

prices. It is very difficult to forecast prices into the future with any degree of accuracy due to the number of factors involved which are political, technological, geographical and commercial. Whilst an increase in the deployment of nuclear power globally might be expected to increase uranium prices, this may in turn drive investment in new sources of supply—and thereby bring prices back down again.

Q2. How sensitive is the UK’s energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?

8. Like energy prices, levels of investment are an important factor that contributes to energy security (or risks to energy security). Much of the discussion of energy security focuses on investment in new assets to generate electricity. This is understandable—and it is important that such investment takes place quickly, particularly given the need to reduce carbon emissions rapidly in the electricity sector in the period to 2030. Some of the claims made about imminent “gaps” in electricity investment to prevent “the lights going out” are often exaggerated. There is significant investment underway, largely in gas fired capacity (see question 6 below). We would argue that there is not necessarily a problem with investment per se within the electricity generation sector—but there is a problem in securing enough low carbon investment to meet the UK’s climate change targets. For this reason, we support the government’s proposals as part of the Electricity Market Reform process to implement a new system of long-term contracts to incentivise this investment.

9. As the Committee’s question implies, electricity generation is not the only investment challenge. There is also a need for investment to maintain the security of electricity networks. When disruptions to electricity supplies, this is often due to a network fault. Investment is needed to renew existing assets that are reaching the end of their design lives, to extend the grid (for example to integrate the growth in offshore wind power), and to reinforce it (if decentralised generation and/or vehicle charging become significant).

10. A particularly important—and sometimes neglected—investment issue concerns gas storage. The amount of gas storage in the UK has historically been low compared to levels in other comparable European countries (Watson 2010). During the period in which the UK was a net exporter of oil, storage was not thought to be a particular priority. But given the shift towards greater interdependence in gas between the UK and other countries, there is a need to revisit this. The question is whether investors, left to their own devices, will build enough storage capacity. Plans are being developed to significantly increase storage capacity at the moment (National Grid 2010). However, questions remain about whether government needs to provide greater incentives to ensure that enough of this planned capacity is constructed quickly.

Q3. What impact could increased levels of electrification of the transport and heat sectors have on energy security?

11. This is an important question, which emphasises the need to analyse UK energy security in a dynamic way. It is plausible that the decarbonisation of the UK economy will diminish some risks to energy security while introducing new ones (Watson 2009). For example, if fossil fuels become a much smaller contributor to UK primary energy demand, the exposure of the UK to price volatility and/or disruptions will also decrease. However, if the electrification of the UK energy system means a much larger contribution from intermittent low carbon technologies such as wind power, this will lead to new challenges for grid operators charged with maintaining reliability of supplies to consumers. The key issue in analysing these dynamics is to assess the security of the energy (or electricity) system as a whole rather than solely focusing on the security implications of particular generating technologies or networks.

12. The electrification of heat and transport has some potential implications for energy security. One generic issue is that it will mean more reliance across the board on one energy infrastructure—that for electricity generation, transmission and distribution. At present, this infrastructure is just one part of the broader energy system and it exists alongside the gas network (which has a large role in meeting demand for heating in homes), and the oil refining and distribution system (which meets the vast majority of transport demand). If a major disruption occurs to a future electricity system that meets all of these elements of energy demand, the impact could be far more reaching than a similar disruption today. It will therefore be more important to consider the potential risks to security, and to implement strategies to improve electricity system resilience.

13. If it becomes a reality, this all electric future is likely to incorporate a greater contribution from information, communication and control technologies than we have now. Smart meters will be installed in consumers’ homes over the next few years and smart grids are being trialled. Electric vehicles and more decentralised sources of electricity generation could significantly add to complexity and need for such smart technologies. This prospect has already led to questions about the vulnerability of electricity systems to cyber attack due to the greater interdependence of these two infrastructure systems.

14. The risks of electrification clearly depend on the risks that are specific to the particular generating technologies and network configurations deployed. They also depend on what combination of technologies is used to generate and distribute electricity—and with what relative contributions. In energy security debates that focus on the electricity system, diversity is often mentioned as a strategy to minimise risks. Diversity is an important system property, and should not therefore be used to analyse or advocate particular generating options (like nuclear or wind). Electricity system diversity depends not only on balancing reliance across a variety of different technologies, but also on the degree to which these are different from each other. This
factor is not usually taken into account. This crucial property, known as disparity (Stirling 2010), is intrinsically multidimensional and judgemental. Low carbon electricity generating options are often divided into three categories: nuclear, renewables and fossil with carbon capture and storage. But these categories do not adequately capture disparity. In particular, “renewables” as a category seriously understates the large differences between renewable technologies. This means that the diversity benefits of including different combinations of renewables (and to some extent different types of fossil fuel technology) are undervalued in diversity indices that neglect disparity. This is the case for the diversity indicators currently used by DECC.

Q4. To what extent does the UK’s future energy security rely on the success of energy efficiency schemes?

15. Energy efficiency is an important strategy for strengthening energy security. Whilst it is not possible to say definitively that efficiency is good for energy security in all possible circumstances, efficiency schemes have far fewer security downsides than other strategies. This is because successful energy efficiency schemes reduce the amount of energy required for a given level of energy service. Less supply and distribution infrastructure is therefore needed—and the demand for fuels and/or electricity is lower than would otherwise have been the case. A more efficient economy will be more resilient to the economic impacts of fossil fuel price shocks that were noted earlier.

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?

16. The specific impacts on energy security from meeting the UK’s targets for greenhouse gas reductions and renewables are uncertain. As noted above, the nature of the risks to UK energy security will change as investments are made to reduce emissions. Some risks will reduce in magnitude (such as risks due to fossil fuel price volatility) whilst others might increase (such as the security risks stemming from an increase in nuclear power). As noted in our answer to question 3 above, the important issue when assessing the impacts on energy security is to examine them at an “energy system” level. Whilst particular low carbon technologies may have specific security risks associated with them, it is the security of the energy system as a whole that matters.

17. There is comparatively little detailed analysis of the security implications of the UK’s planned low carbon transition that takes such a “system” perspective. One notable exception is the UK Energy Research Centre Energy 2050 project which did this for some potential scenarios for the UK’s low carbon transition (UKERC 2009b).

Q6. What would be the implications for energy security of a second dash-for-gas?

18. It is often argued that a second dash for gas is undesirable from an energy security point of view because this could increase UK gas demand, and would exacerbate the trend towards increasing gas imports. Whilst this may be the case, National Grid’s most recent future scenarios for gas demand foresee demand remaining flat or falling due to the impact of government climate change and energy policies. Whether or not demand rises in future as a result of a renewed dash for gas, it is important to analyse the security implications of a second dash for gas with some care.

19. There are three factors that we think are particularly important to bear in mind. First, as we argue in answer to question 7, dependence on imported energy is not necessarily a recipe for decreasing levels of energy security. In the case of gas, past experience shows that domestic resources and infrastructures can also be vulnerable to disruptions (Watson 2010). Second, the outlook for global and regional gas supplies has changed in the last few years. The advent of shale gas, particularly in North America, has added significantly to global supplies. When coupled with falling demand in many OECD countries due to the recession, this led to some reductions in gas prices—particularly in 2009–10. More recently, the impact of the Fukushima nuclear accident may partly counter this trend. It is plausible that Japan (and perhaps some other countries) will use more gas in future because of nuclear plant closures and/or delays to new nuclear investment.

20. The third factor is the rapid changes to UK gas import infrastructure. The UK has recently developed a diverse portfolio of gas import sources and supply routes. According to National Grid’s most recent 10 year statement, the UK imported 50 billion cubic metres (bcm) of gas in 2009–10 including 24bcm from Norway, 9bcm from the continent via pipelines and 17bcm as liquefied natural gas (LNG)—mainly from Qatar (National Grid 2010). The UK’s own production in 2009 was around 63bcm, some of which was exported. This diversity has already helped to mitigate the impacts on the UK of international risks to gas security such as the disputes between Russia and neighbouring countries in 2009 and 2010—though clearly there have still been price effects from these disputes. As noted above, an increase in the UK’s gas storage capacity is long overdue. It would strengthen the ability of the UK gas supply infrastructure to withstand the impacts of such security threats.

21. Perhaps a more important implication of a renewed dash for gas is for the UK’s climate change policy objectives. As we argued in our evidence to the Committee’s inquiry into Emissions Performance Standards, there is a need to phase out the use of unabated coal- and gas-fired power plants well before 2030 in order to remain within the UK’s medium term emissions reduction targets. A second dash for gas would make this

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145 According to DECC statistics, net imports accounted for 31% of UK gas demand in 2009.
more challenging and would add to the pressure for the successful demonstration and deployment of carbon capture and storage technologies.

Q7. How exposed is the UK’s energy security of supply to international events?

22. As with many of the questions posed by the committee, the extent of UK exposure to international risks to energy security depends on which risks are being considered. An important contextual point is that energy from international sources is not necessarily less secure than energy that originates from within the UK. As the 2002 Energy Review by the Cabinet Office argued: “[I]mports are regarded as inherently more unreliable than domestic sources. However, as in other markets, energy imports allow us to access more diverse, and cheaper, resources, than if energy sources were produced solely at home. Experience with coal in the 1970s and 1980s, and the fuel protests of 2000 suggest that the equation of “domestic” and “secure” does not always apply. (Performance and Innovation Unit 2002: 57).

23. Having said this, the UK does have significant exposure to energy security risks that originate abroad. This is especially the case now that we are a net importer of energy—a position the UK returned to in the mid-2000s. Recent experience illustrates this, particularly how international events can impact on the price of energy paid by UK consumers. Examples include the disputes about gas supplies between Russia and neighbouring countries which, in some cases, led to short term increases in UK gas prices. During the past few months, the political turmoil in the Middle East and North Africa has affected some oil producing states—and has led directly to increases in oil prices which have been felt directly by motorists.

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?

24. UK energy policy has placed progressively greater weight on energy security since the mid-2000s. Key reasons for this have been the aforementioned return of the UK to “net importer” status and a general rise in energy prices. Although the analysis of energy security has improved within government, and some policies have been put in place to deal with energy security risks, gaps still remain.

25. There is a tendency within policy responses to focus on some security risks, but not others. Risks due to lack of investment in electricity generation and geopolitical risks to fossil fuel supplies tend to receive most of the attention for understandable reasons. What is less clear is whether the government has developed an understanding of how resilient the UK energy system is to a range of risks—some of which may not be known and/or quantifiable at the present time. This leads to a need for a policy strategy that focuses on resilience rather than an approach that tries to identify and deal with each risk individually. Of course, some risks can be mitigated directly (e.g. risks of power cuts due to poorly maintained electricity networks). However, the UK government and the energy industry need to take account of risks they cannot control or mitigate directly.

26. In addition to this, there are some more specific areas in which policy may need to be strengthened, many of which we have already mentioned. Examples include the need for more UK gas storage capacity, the need to accelerate the rate at which energy efficiency measures are implemented, and the need to explore alternatives to fossil fuels for road transport.

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?

27. We consider the future supply and demand of oil to be an important issue for UK energy security and one which has received insufficient attention to date. In summer 2010, David Mackay invited a number of groups and individuals (including ourselves) to provide evidence on this topic as part of an internal review by DECC. Since the results of this study have yet to be published, we recommend that the Committee seek to identify what conclusions were drawn.

28. As current events in the Middle East demonstrate, threats to oil supply can derive from a wide range of economic, political and geopolitical factors, even in the absence of any “below-ground” constraints on physical resources. But as is increasingly acknowledged by bodies such as the IEA (IEA 2008a), the depletion of conventional oil resources appears relatively advanced and seems likely to contribute to rising oil prices even if economic and political conditions prove favourable.

29. In our view, the evidence on the near-term risks posed by the physical depletion of conventional oil resources has grown considerably stronger over the last few years. In addition to the comprehensive study we led for UKERC (UKERC 2009a), there have been recent publications by the UK Industry Task Force (ITFP OES 2010), Deutsche Bank (Deutsche Bank 2009), Chatham House (Froggart and Lahn 2010), and Uppsala University (Aleklett, Höök et al. 2009), together with a Wikileaks controversy over Saudi reserves.\(^\text{146}\) The Uppsala study was one of several to criticise the assumptions underlying the IEA World Energy Outlook and to argue that their reference scenario for global oil supply was excessively optimistic (Sorrell, Miller et al. 2010)\(^\text{147}\)—despite repeated downward revisions over the last few years.

\(^{146}\) http://www.guardian.co.uk/business/2011/feb/08/oil-saudiarabia?intcmp=239

\(^{147}\) In particular, the IEA reference scenario implies average global depletion rates for “fallow” and undiscovered resources that are several times greater than the maximum depletion rate previously achieved in any oil-producing region, anywhere in the world.
30. Forecasting oil supply is a hazardous business and the track record of both optimists and pessimists is fairly poor. But two physical features of conventional oil resources make a peak in global production inevitable. First, the rate of production from individual fields tends to rise to a peak or plateau relatively early in a fields’ life and then decline, largely as a result of falling pressure. As a result, some 4% of global production capacity needs to be replaced each year, simply to maintain production at current levels—equivalent to a new Saudi Arabia coming on stream every three years. With demand rising and decline rates increasing, production is becoming progressively more difficult to maintain. Around half of global production capacity will need to be replaced before 2020.

31. Second, most of the world’s conventional oil is located in a small number of large fields. Although there are some 70,000 fields worldwide, around half of global production derives from only 110 fields and as much as one fifth from only 10 fields. Around 500 “giant” fields account for two thirds of all the oil that has ever been discovered. Most of these giants are relatively old, many are well past their peak of production, most of the rest will begin to decline within the next decade or so and few new giants are expected to be found.

32. This combination of features will ultimately lead to a global peak in production. At some point, the additional production from the newer, smaller fields will be insufficient to compensate for the decline in production from the ageing giants. This process has been observed in over a hundred regions worldwide, with the peak typically occurring well before half of the resources have been produced. Economic and political circumstances profoundly influence the timing and at the global level the complex interactions between supply and demand make a “bumpy plateau” much more likely than a sharp peak. But at some point, decline becomes inevitable.

33. The timing of the global peak remains uncertain, but the window is rapidly narrowing. Since 1993, the world has produced half as much oil as was produced in the preceding century and now uses as much oil as the UK has ever produced in only ten months. On current estimates, we have used between 28% and 56% of recoverable conventional oil—with much of what remains being located in smaller fields in less accessible locations, or requiring “enhanced recovery” techniques to extract. These resources will be slow and expensive to produce and are frequently controlled by National Oil Companies who may lack either the incentive or ability to invest. Moreover, it is straightforward to demonstrate that a global peak before 2030 appears likely, even under optimistic assumptions about the size and future development of global oil resources. Under more realistic assumptions, a decline in production seems likely to occur much earlier (Sorrell, Miller et al. 2010).

34. Given the scale of investment required and the associated lead times, there are reasons to doubt whether non-conventional resources can substitute at the scale and speed that could be required. For example, the most bullish forecasters expect the Canadian oil sands to provide six million barrels/day by 2030 which is less than the conventional capacity lost every two years as a result of physical depletion. Developing such resources will also make it more difficult to avoid dangerous climate change.

References


UKERC (2009a), Global Oil Depletion: An Assessment of the Evidence for a Near Term Peak in Global Oil Production. London, UKERC.


March 2011

Memorandum submitted by the Geological Society of London

1. The Geological Society is the national learned and professional body for Earth sciences, with 10,000 Fellows (members) worldwide. The Fellowship encompasses those working in industry, academia and government, with a wide range of perspectives and views on policy-relevant science, and the Society is a leading communicator of this science to government bodies and other non-technical audiences.

2. To address directly many of the specific questions which the committee has set out in its call for evidence is outside the competence of the Geological Society. However, geological considerations inform many of the issues raised. In particular, Earth science expertise and industry are fundamental to understanding the nature and geographic location of most of the natural resources on which we depend for our energy, and to their efficient and least environmentally damaging extraction. Earth science will also be essential to mitigating the impacts of natural hazards on energy security. With this in mind, we offer here some general comments which may be helpful in setting the scene for the committee’s discussions. If the committee is interested in pursuing any of the issues raised below, we would be pleased to offer more detailed evidence, or to discuss other ways in which the Earth science community might help.

3. Implicit in the call for evidence is the observation that energy security is broader than simple energy independence. In considering the current security of UK energy supplies, and their future resilience, it is therefore important to consider not only domestic resources, but also those from other countries and regions, and the possible risks to supply of various resources from these regions. (Such risks are generally much lower within the EU, for instance.) There is a balance to be struck in mitigating these risks, in the context of uncertainty about future market conditions, between developing domestic production (where there is significant but limited potential) and shaping the mix of imported energy. Diversity of supply, both in terms of resource type and its provenance, will tend to reduce the potential impact of interruption to any one resource stream. Security of energy supply can thus be seen as reflecting the interplay between geology (and other physical factors, eg levels of insolation with respect to solar energy), economics and geopolitics. The well established sub-discipline of economic geology has an important role to play in understanding these interactions. A key concept is the distinction between resources (the total amount in the ground) and reserves (the amount of a resource which can economically be extracted with current technology and under current regulatory regimes)—measures of which are dynamic, and depend crucially on prices. In practice, reserves are only viable if they can be exploited in an environmentally and socially acceptable way.

4. Most of the resources on which we rely for energy come from the ground, and their discovery and production depend on Earth science. The majority of our energy needs are currently met by fossil fuels, and despite the recognised need to move to a low carbon economy, we will continue to rely on them for many years. Nuclear energy depends on the supply of uranium. Geothermal energy in its strict sense, as well as energy from ground source heat pumps, also depends on geological phenomena and understanding.

5. Domestic UK resources can make a significant contribution to our energy mix. The main resources available to us are hydrocarbons, particularly coal (surface and underground mining, as well as in situ underground gasification) and gas (including coal bed methane and shale gas—see the Geological Society’s submission on the latter for further details). There is considerable potential for further extraction of North Sea oil and gas, with EOR (Enhanced Oil Recovery) a potentially attractive option especially if deployed in conjunction with CCS (Carbon Capture and Storage) (see below), though development of these resources will depend in part on stability of the tax regime, and may be jeopardised by the £2 billion levy on North Sea producers announced in the budget. Further exploration of deep water areas of the UK continental shelf may yield significant new resources—a field in which BP is a world leader, notwithstanding the Deepwater Horizon explosion and oil spill in 2010. Ground source heat pumps might make a noticeable contribution, as might geothermal energy sensu stricto in a few locations. Whether particular resources can in practice be exploited depends not only on geology, but also on economic factors, and on environmental and societal acceptability (which has historically prevented the extraction of significant uranium resources in Orkney, for instance).

6. The need to move to a low-carbon economy, and to meet other environmental and societal requirements, should not be seen as being in tension with energy security. Rather, they are inseparable aspects of sustainable energy supply and usage. To assess the contribution which a resource stream might make to meeting our energy needs without considering its impact on carbon emissions is meaningless. Given our inevitable continuing reliance on fossil fuels, the rapid deployment of CCS at commercial scale is a critical national need. The UK
is well positioned to be a world leader in the development and deployment of CCS, thanks to the outstanding fusion of our academic and industrial petroleum geoscience, not least through the meetings and publications of the Geological Society. The skills, capacity and infrastructure inherent in the North Sea oil and gas industry are extraordinarily valuable assets in this regard. The Earth science community is confident in its abilities to meet the challenges of the injection and long-term storage of carbon dioxide, and with the right regulatory framework to develop a UK CCS industry on the scale of the North Sea hydrocarbons extraction industry of the past four decades.

7. Globally, coal is far more abundant than gas, and is also more evenly distributed round the planet. Crucially, coal is not concentrated in the Middle East. Together with known domestic resources, this makes coal a particularly attractive energy source for UK energy security, given rapid and widespread CCS deployment. Gas is considerably cleaner than coal, with carbon emissions typically 40–50% lower, but it will still be impossible to meet future carbon emission reduction targets if gas is widely used without CCS in place. As noted above, EOR has the potential to extend the productivity of North Sea oil fields—one means of enhancing recovery is in combination with CCS, essentially displacing the oil with injected CO₂ captured from fossil fuel combustion, which would then be stored in the reservoir.

8. The concept of energy security at a local (sub-national) level may be helpful in addressing public concerns over the environmental and societal acceptability of energy projects. As noted in our supplementary evidence to the committee’s Shale Gas inquiry, following the oral evidence session, there is a tendency for communities to see such projects as delivering “someone else’s energy”. If they are seen instead as supplying local needs, and as contributing to the energy security of an area, they are more likely to gain acceptance.

9. The secure supply of energy, whether from UK or overseas resources, depends on an understanding of the geosphere in a number of other important respects. These include infrastructure planning, particularly in the coastal zone (for instance with regard to the development of nuclear power stations, where predicted sea-level rise associated with climate change must be taken into account in their design for use and subsequent decommissioning), and construction of onshore and offshore facilities including wind turbines.

10. An important aspect of ensuring energy security is to consider and mitigate possible impacts of natural hazards on the supply of energy. The March 2011 earthquake and tsunami in Japan have highlighted this concern. While the UK is not vulnerable to earthquakes of such magnitude, it might be affected by tsunamis triggered by events elsewhere in the world. We can quantify tsunami effects in the recent British geological record. For instance, that which hit Scotland 8,000 years ago, triggered by the Storegga landslide off Norway, was around 25 metres high. More recently, the tsunami following the Lisbon earthquake of 1,755 was several metres high when it reached the southwest of England. Independent of the means of electricity generation, the national grid is vulnerable to geomagnetic storms, which are expected to become more frequent as the sun enters a more active phase of its cycle. The prediction of these storms, and possible means of mitigating their effects, are the subject of active research.

11. We would be pleased to discuss further any of the points raised in this submission, to provide more detailed information, or to suggest oral witnesses and other specialist contacts.

April 2011

Memorandum submitted by the Russia Foundation

RUSSIA AND ENERGY SECURITY—ISSUES FOR THE UK AND THE EU

INTRODUCTION

1. Russia is one of the world’s most important producers and suppliers of energy resources. In 2008 it was the world’s largest producer of natural gas (21.3% of all production) and the second largest producer of oil (11.5% of all production). It holds the largest known reserves of gas (27% of world total) and the eighth largest known reserves of oil (4.5% of world total).

2. Russia is the largest supplier of energy to the European Union, accounting for 31% of gas imports, 27% of oil imports, 24% of coal imports and 30% of uranium imports. Of these, gas is the most sensitive and strategically important. Whereas all the other commodities are mobile and traded globally, gas is still mainly supplied to the European market via fixed pipelines and recipient countries often lack alternative supply options. Dependence on Russian gas is particularly acute for countries in eastern and south-eastern Europe. Ten EU member states depend on Russia for more than 50% of domestic gas consumption, with four of them 100% dependent.

3. The UK meets a relatively small proportion of its energy requirements from Russian imports, accounting for only 2% of gas consumption. But, like the rest of the EU, the UK’s import requirement is rising fast as domestic production declines and long-term demand rises. The European Commission estimates that the proportion of EU gas consumption met from imports is set to rise from 60% to 73–79% by 2020 and 81–89%

145 Data from the US Energy Information Administration.
146 EU-Russia Energy Dialogue, Joint Report, November 2010.
by 2030.\textsuperscript{150} The Department of Energy and Climate Change says the UK’s gas import requirement may rise from 32% to as much as 70% by 2020.\textsuperscript{151}

4. Against a background of rising external dependency for the EU as a whole, unpredictable or disruptive behaviour by a major energy supplier like Russia could have unwelcome consequences for the UK. Excessive market dominance or attempts to use energy resources as a tool of foreign policy could adversely affect prices and security of supply as countries more directly dependent on Russian energy seek alternative sources, including from countries currently supplying the UK market.

**The Politicisation of Russian Energy**

5. Although Russian leaders are careful to avoid describing their country as an “energy superpower”, it is clear that they regard oil and gas as strategic resources of vital importance to Russia’s national strength. A willingness to use energy for political purposes was apparent from the earliest days of the post-Soviet era when the need to compensate for declining military and economic power was most acutely felt. President Yeltsin was willing to use supply cut-offs as a form of coercive diplomacy against the Baltic States in particular. But the politicisation of energy was non-systematic and sat alongside measures to liberalise the Russian energy sector and open it up to foreign investment.

6. A systematic process of politicisation was not attempted until near the end of Vladimir Putin’s first term as President. Putin had set out his personal belief in the strategic function of energy policy in an article published in 1999 when he was still head of the state security service, the FSB. He argued that “the natural resources complex” should become a decisive factor in “the strategy for Russia’s exit from its deep crisis and restoration of its former might on a qualitatively new basis”. Energy policy should be designed to meet more than commercial and civilian objectives alone and should be “aimed at furthering the geopolitical interests and maintaining the national security of Russia”.\textsuperscript{152} This would be achieved by creating strong, vertically integrated energy companies answerable to the state.

7. The same message has been carried in numerous Russian government statements since around 2003.\textsuperscript{153} The “Russia enjoys vast energy and mineral resources which serve as a base to develop its economy; as an instrument to implement domestic and foreign policy. The role of the country on international energy markets determines, in many ways, its geopolitical influence.” “Russia enjoys vast energy and mineral resources which serve as a base to develop its economy; as an instrument to implement domestic and foreign policy. The role of the country on international energy markets determines, in many ways, its geopolitical influence.” “Russia enjoys vast energy and mineral resources which serve as a base to develop its economy; as an instrument to implement domestic and foreign policy. The role of the country on international energy markets determines, in many ways, its geopolitical influence.” “Russia enjoys vast energy and mineral resources which serve as a base to develop its economy; as an instrument to implement domestic and foreign policy. The role of the country on international energy markets determines, in many ways, its geopolitical influence.” “Russia enjoys vast energy and mineral resources which serve as a base to develop its economy; as an instrument to implement domestic and foreign policy. The role of the country on international energy markets determines, in many ways, its geopolitical influence.”

8. Putin’s politicised vision of Russian energy has provided the blueprint for state policy for most of the last decade. The subordination of the energy sector to state control became a major plank of Putin’s strategy for strengthening the “power vertical” starting with the dismantling and expropriation of Yukos Oil, at the time Russia’s largest private energy company. Imprisoning or exiling independent oligarchs and seizing their assets removed rival centres of power and provided the new ruling elite with additional sources of revenue, patronage and political control. Action was also taken to diminish the role of foreign investors with regulatory harassment used to marginalise Shell and BP in the lucrative Sakhalin 2 and Kovykta projects. New restrictions on foreign ownership of strategic energy projects have been included in Russia’s Subsoil Law.

9. The trend towards greater state control has been accompanied by an increase in the use of energy supplies as a tool of foreign policy. A number of countries heavily dependent on Russian energy sources have experienced price rises or supply interruptions widely seen as political in motivation. Two distinct sets of

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\textsuperscript{150} European Commission, Energy Infrastructure Priorities for 2020 and Beyond, November 2010, p21.
\textsuperscript{151} DECC, Annual Energy Statement, July 2010, p8.
objectives have been evident: firstly, to strengthen Russian influence over what President Medvedev has described as its “zone of privileged interests” by punishing neighbouring countries that pursue friendly relations with the west independent of Moscow; and secondly, to enforce the takeover of energy infrastructure beyond Russia’s borders in order to cement its position as a dominant energy supplier. Ukraine, Georgia and Belarus have been the principal victims, but at least one EU member state, Lithuania, has also been targeted.

RUSSIAN ENERGY POLICY PRIORITIES

10. Consistent with its strategic vision of energy policy as a means of strengthening the Russian state and advancing its geopolitical interests, the Russian government pursues a number of priority objectives. The most important of these are as follows.

11. Maintaining supply dominance—The Russian government is anxious to retain its role as a leading international supplier of energy and its dominance over the strategically important European gas market in particular. Its public justification for countering perceived threats to that position is the need to guarantee security of demand for its primary export and source of revenue, but the underlying motivation is political. Its dominant position within the European market allows it to use energy relations as a carrot to encourage friendly attitudes on the part of leading EU countries like Germany and Italy, and as a stick to use against post-Soviet countries that defy it.

12. Controlling the infrastructure of transit countries—A major element of Russian energy diplomacy is focussed on controlling the infrastructure of supply beyond its own borders. Attempts at infrastructure takeover have been a feature of supply interruptions and other forms of energy pressure against transit countries like Belarus and Ukraine. Lithuania became the target of an undeclared oil embargo after it refused to sell its Mazeikiu Nafta oil refinery to a Russian company. Pressure is currently being applied to Ukraine to merge Naftogaz with Gazprom.

13. Controlling new pipeline development—The Russian government seeks to dominate the geopolitics of pipeline supply to entrench its position within the European market. The Nordstream gas pipeline, connecting Russia to Germany through the Baltic Sea, is designed to segment the European market and marginalise existing transit countries in Eastern Europe. Likewise, Russian diplomacy in Central Asia, the Caucasus and the Black Sea region is aimed at preventing European countries from developing the infrastructure and relationships needed to access alternative sources of oil and gas. The South Stream pipeline, as a rival to the EU’s Nabucco project, is another element of this strategy.

14. Increasing strategic export options—Russian officials regularly warn that the adoption of European energy policies that conflict with its interests will force Russia to divert supplies to new markets and to China in particular. Until recently that option has been limited by the absence of the pipeline connections needed for Russia to export oil and gas to China in volume. That is beginning to change. The first Sino-Russian oil pipeline opened at the start of 2011 and is intended to supply fifteen million tons of crude oil per year. Construction of the Altai gas pipeline is currently on hold because of disagreement between the Russian and Chinese governments over price. But the intention is still to complete the project by 2015.

15. Preventing European energy market integration—The EU’s third energy package, by requiring the unbundling of energy production and transmission, represents a particular challenge to the Gazprom model of vertical integration and Russia’s efforts to become a leading player in the downstream European energy market. Considerable efforts have been made to discourage or stop real energy market integration that threatens to undermine strategies of monopoly and market segmentation that have worked to Russia’s advantage in the past.

16. Limiting the growth of unconventional gas supply—Russia has become a leading sceptic on the development of unconventional gas, such as shale gas and coal bed methane. Russia cites environmental and other criticisms as a way of undermining the idea that unconventional gas could become a major source of energy supply for the European market, but it is really concerned to minimise competition to its own conventional supplies. The growth of unconventional gas saw the US out produce Russia in 2009. The consequent increase in gas supply in the Atlantic basin in the form of LNG threatens to change the European market to Russia’s disadvantage.

17. Cartelising gas supply—Although Russia has observer status at OPEC, it has refrained from joining because technical factors give it less flexibility to vary oil production and because it is reluctant to accept the policy constraints of full membership. But it has taken the lead in trying to promote cartel-type arrangements between gas producing countries through the Gas Exporting Countries Forum. The Forum has been institutionalised and its agenda has become more ambitious. Although the nature of gas as a commodity makes it harder for producers to emulate the OPEC model, proposals to cooperate on price formation, market allocation, investment and new technology, like LNG, are clearly aimed at achieving cartel-like results.

18. Minimising rules-based international commitments—The Russian government aims to avoid binding international rules that restrict its behaviour as a producer and provider of energy. Although Russia signed the Energy Charter Treaty in 1994 and was bound by its terms pending ratification, its rules concerning protection of investment and the transit of third country supplies conflicted with the Putin vision of energy as a strategic asset to be controlled by the state. The Russian government refused to ratify the ECT and eventually withdrew
from provisional application in 2009. It is also resisting the inclusion of ECT rules and other binding provisions on energy in the EU-Russia agreement that is currently under negotiation.

19. Attracting foreign investment and technology—Despite its suspicion of foreign involvement in its energy sector, the Russian government needs inward investment to develop new production. Its exiting gas fields in western Siberia are past peak production and new fields in the Arctic north can only be developed with western capital and technology. The capital investment requirement for the Russian energy sector over the next twenty years has been put at $2 trillion.154 The already heavily indebted state energy companies, Gazprom and Rosneft, cannot generate the required funds, nor do they have the technology needed to drill or lay pipeline in the icy waters and permafrost of the Arctic north where the future of Russian energy production lies. This requirement conflicts with other Russian objectives, but the government hopes to attract foreign companies as junior partners in its major energy projects.

POLICY RESPONSES

20. The UK and its EU partners have a range of policy options at their disposal to encourage Russia to behave as a responsible energy supplier. These should be aimed at increasing competition and diversity of supply, strengthening the EU’s collective energy diplomacy, countering monopolistic behaviour and discouraging the use of energy supply as an instrument of foreign policy. Policy options include the following:

21. A stronger EU external energy policy—The EU is formally committed to strengthening the energy dimension of its external policy, but there is still a tendency for individual member states to behave unilaterally in the field of energy diplomacy. This makes it easier for Russia to increase its leverage through a policy of active bilateralism. Investment deals, new pipeline projects and long-term supply contracts are often negotiated without consideration for the common European interest. The energy diplomacy of the EU and its member states should be based on solidarity and a commitment to consult on issues of common concern.

22. A single EU energy market—The removal of technical and regulatory barriers to a competitive European energy market is one of the best ways to prevent suppliers establishing and exploiting a dominant position. The EU’s third energy package has now been passed and requires the separation of production and transmission rights and obligations. Russia is seeking European support as part of Partnership for Modernisation and needs full protection of European commercial law, whereas property rights in Russia remain weak for foreign and domestic investors alike. EU governments should insist that energy cooperation must be based on reciprocal rights and obligations. Russia is seeking European support as part of Partnership for Modernisation and needs access to foreign capital and technology to modernise its energy sector in particular. The EU should be seeking a binding commitment from Russia to strengthen investor protection and the rule of law in return.

23. Closer energy ties in the Eastern Neighbourhood—Closer ties with transit countries in Eastern Europe should be aimed at promoting competition, infrastructure modernisation and greater energy independence. Ukraine, which recently joined the European Energy Community, is particularly important to the security of European gas supply. With EU help, the government of Ukraine should be encouraged to carry out market reforms, modernise and maintain national control of its supply network, diversify its supply options and develop its own oil and gas reserves.

24. Adoption of ECT commitments in a new EU-Russia agreement—Negotiations on a new agreement to replace the EU-Russia Partnership and Cooperation Agreement have stalled over Russia’s refusal to accept binding commitments on energy. The EU’s negotiating mandate is for an agreement that enshrines the principles of the ECT, such as investor protection, third country transit and binding and enforceable international arbitration. Whether these principles are accepted as part of a new EU-Russia Agreement or through Russia’s acceptance of a revised ECT, it is essential that the EU holds firm for a rules-based relationship that is at least as strong as existing ECT provisions.

25. Reciprocity of investment rights—Russian companies investing in the European energy sector enjoy the full protection of European commercial law, whereas property rights in Russia remain weak for foreign and domestic investors alike. EU governments should insist that energy cooperation must be based on reciprocal rights and obligations. Russia is seeking European support as part of Partnership for Modernisation and needs access to foreign capital and technology to modernise its energy sector in particular. The EU should be seeking a binding commitment from Russia to strengthen investor protection and the rule of law in return.

26. The development of unconventional gas—The rise in gas production from unconventional sources has already transformed the European market with LNG imports from the US increasing supply options. The International Energy Agency recently described the exploitation of unconventional sources as a “game changer” that could double global gas reserves.155 European countries with significant deposits of unconventional gas include some, like Poland and Ukraine, which are currently heavily dependent on Russian supplies. The growth of unconventional gas production and supply in Europe and beyond could significantly alter the terms of trade with Russia.

27. Opening up the southern energy corridor—In the absence of Russia accepting third country transit rights, creating direct pipeline access to gas supplies from Central Asia and the Middle East is another means of strengthening Europe’s energy security. The Nabucco gas pipeline project has been delayed by doubts over its commercial viability and the availability of sufficient gas to fill it. But supplier countries are unlikely to commit without a clear sign that Europe intends to build the pipeline. Like Russia, the EU needs to conceive of pipeline projects in strategic rather than purely commercial terms.

CONCLUSION

28. The energy relationship between Russian and the EU ought to be based on a recognition of their interdependence. Russia needs access to the European market just as much as the EU needs Russia to behave as a responsible energy supplier. But the relationship has become unbalanced by the failure of the EU to take a coherent and collective view of its interests. The consequences for the UK are indirect, but real. The EU has the tools needed to create a more balanced partnership with Russia and strengthen the energy security of its member states. UK policy should be aimed at galvanising that sense of common purpose.

March 2011

Memorandum submitted by the Nuclear Industry Association

The Nuclear Industry Association (NIA) welcomes this opportunity to submit evidence to the Select Committee’s inquiry. Modern developed industrial societies require constant, reliable and secure supplies of energy, so this is a very important topic.

NIA is the trade association and information and representative body for the civil nuclear industry in the UK. It represents over 250 companies operating in all aspects of the nuclear fuel cycle, including the current and prospective operators of the nuclear power stations, the international designers and vendors of nuclear power stations, and those engaged in decommissioning, waste management and nuclear liabilities management. Members also include nuclear equipment suppliers, engineering and construction firms, nuclear research organisations, and legal, financial and consultancy companies.

Since the NIA’s main focus is the electricity sector it is not in a position to provide detailed responses to all the Committee’s questions. We have therefore concentrated on those where we believe we have most to contribute.

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

So far as the electricity sector is concerned this will depend on what new capacity is built to replace the power stations that are retiring.

Over the next decade and a half all but one of our existing nuclear stations could close, along with much of our coal fired capacity. Urgent investment in replacement generating capacity and associated infrastructure will therefore be required to ensure the reliability and security of Britain’s future electricity supply. We agree with Government that a start must be made soon on building low carbon technology—new nuclear as well as renewables and coal with CCS. Delays in taking decisions now could result in the UK becoming locked into a high carbon scenario.

New nuclear stations will help to maintain the diversity—and hence the security—of energy supply. Global experience shows that nuclear stations operate reliably, and their operational and refuelling characteristics mean that they can continue to generate electricity at or close to maximum output even if refuelling were delayed beyond the typical 12–18 month schedule. Conversely fossil fuel plant would soon have to shut down if their fuel supplies were interrupted.

With regard to uranium there are sufficient supplies in the UK to fuel the UK’s current fleet of nuclear plant for many years to come. Uranium can also be stockpiled if necessary. Moreover because the price of uranium is not directly correlated to global oil and gas prices, and because the fuel and operating costs are a low proportion of the overall costs, nuclear generation is relatively unaffected by uranium price fluctuations. If global demand significantly affected the price of uranium, it would only have a limited effect on the cost of generation.

Against this background nuclear plant is in a position to act as a stabilising influence on UK wholesale electricity prices. It can also provide large scale reliable and secure generation that would maintain electricity supplies in the event of disruptions to other fuel supplies.

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

Increased levels of electrification of the transport and heat sectors is likely to lead to greater electricity demand, and thus the need for further electricity generation. It is important that this additional requirement should be provided by a diverse range of generating options, including new nuclear and renewable generation.
If this additional generation were to be met from new gas plant the UK would become even more dependant on imported energy sources than it is now.

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 discussed in our response to Question 1 above we believe that new nuclear stations can make a major contribution to achieving both the Government’s carbon reduction and security of supply targets.

6. What will be the implications for energy security of a second dash for gas?

In our view it is in the national interest to avoid a second uncontrolled ‘dash for gas’ for replacement capacity because it increases dependence on a single imported fuel source from potentially unstable parts of the world, increases emissions, and exposes the country to the risks of price volatility.

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

Whilst this is more an issue for energy analysts it is clear that as North Sea oil and gas reserves run out Britain will become increasingly reliant on imported supplies of both oil and gas, and that foreign developments will determine UK gas—and therefore—electricity prices. A more diverse generation mix, by avoiding overdependence on a single fuel source, would help mitigate these risks. Although it might not necessarily lead to the lowest prices at any given time, a diverse mix of generating plant using a variety of fuels would contribute to stability in electricity prices over the longer term by enabling plant whose fuel costs had risen significantly to be displaced by plant which is cheaper to operate.

April 2011

Memorandum submitted by International Power Plc

(I) About International Power Plc

International Power plc (IPR) welcomes the opportunity to contribute to the Energy and Climate Change Committee’s Inquiry Security of Energy Supply.

International Power plc is a leading independent power generation company with active interests in closely linked businesses such as LNG terminals and water desalination. Following the combination with GDF SUEZ Energy Europe and International, International Power plc has strong positions in all of its major regional markets (Latin America, North America, the Middle East, Turkey and Africa, UK-Europe, Asia and Australia). In total, it has 66 GW gross capacity in operation and committed projects for a further 22 GW gross new capacity.

In the UK-Europe region, International Power plc has 13.2 GW capacity in operation and a further 1.3 GW under construction. This includes over 7.3 GW of plant in the UK market made up of a mixed portfolio of conventional plant—coal, gas, CHP, a small diesel plant, and the UK’s foremost pumped-storage facility. Several of these assets are owned and operated in partnership with Mitsui & Co. Ltd; IPR’s assets represent just under 9% of the UK’s installed capacity, making IPR the country’s largest independent power producer.

IPR in the UK-Europe region operates about 1100 MW of wind power. The company is keen to develop its renewable portfolio further and is developing a range of projects in the UK as part of this strategy. The company also has a significant Industrial and Commercial retail supply business, and a gas supply business in the UK.

(II) Summary

— The UK is well placed to maintain secure supplies of fossil and uranium fuels well into the future.
— There is widespread recognition that the UK’s energy infrastructure needs renewal to maintain security of supply but it is not clear the required investment from the private sector will be forthcoming.
— Decarbonisation of the electricity sector will need to go hand-in-hand with electrification of transport and heat to maintain security of energy supply.
— Energy efficiency can help the UK’s future energy security but initiatives that encourage the development of the country’s energy infrastructure are likely to prove more important.
— Greenhouse gas emission reductions and increased penetration of renewables will have implications for energy security, in some ways beneficial, but in other ways much less so.
— Plentiful gas supplies and good infrastructure minimise the risk to energy security of a second dash-for-gas.
— International events do have implications for energy security but it is also true that the markets have invariably delivered the required fossil fuels to the UK, albeit at elevated prices.
— Diversity plays an important role in mitigating security of supply concerns—diversity in fuels, supply options, and technology.
— A more holistic view of security of supply, an assessment of the potential role of gas the UKs energy system, and the implications for competitiveness, are needed in addressing the security of energy supply. Also, it is important the UK keep options open to accommodate future developments.

(III) Detailed Answers to the Inquiry Questions

Question 1: How resilient is the UK energy system to future changes in fossil fuel and uranium prices?
— The UK is well placed to maintain secure supplies of fossil and uranium fuels well into the future.

1. There is a need to distinguish between coal, oil and gas resources because they tend to serve different needs in the economy—coal is used primarily for power generation and steel making while oil services the transport and chemicals sector; gas can be used across economic activity.

2. Gas is arguably the most important of the fossil fuels going forward. Gas use in the UK now outstrips indigenous supply and this gap will grow as the country’s North Sea resources decline. The import infrastructure was able to deliver just under half the annual consumption in 2009, one quarter of which was LNG; according to some experts it is possible that by 2020 up to 40% of gas demand could be sourced via LNG156.

3. The gas transport infrastructure then is good and improving, although storage remains limited in the UK. Nonetheless, the availability of resources into the UK does not at the moment appear to be a limiting factor in the role of gas going forward.

4. Uranium is relatively plentiful in terms of reserves/production ratio but will need to go to increasingly expensive resources if the nuclear renaissance gathers pace. Kazakhstan, Canada and Australia hold 63% of current world production of uranium from mines; three companies, Areva, Cameco, and Rio Tinto control 49% of world production, and this rises to 64% if KazAtomProm is included157. This results in a highly concentrated fuel market, prone to distortions.

5. It is natural that the cost of all these resources will rise in the coming decades as overall global demand rising. However, it is possible there will be an easing of pressure in the developed world due to the efficiency gains and the decarbonisation agenda, releasing fossil resources for higher value products.

Question 2: How sensitive is the UK’s energy security to investment (or lack of investment) in energy infrastructure, including transmission, distribution and storage?
— There is widespread recognition that the UK’s energy infrastructure needs renewal to maintain security of supply but it is not clear the required investment from the private sector will be forthcoming.

6. The UK’s electricity and gas infrastructure has developed over many decades and as such much of it is now old and in need of renewal. Continual investment is needed then to maintain the existing electricity and gas infrastructure and to strengthen established weak spots (eg Scotland-England electricity network); investment will also be needed to extend the network, both in the UK and connection to Ireland and the continent. New CO2 infrastructure will be needed if, as is hoped, carbon capture and storage is developed on a major scale in the coming decades.

7. An analysis by Ernst & Young158 provides an indicative break-down of the £200bln investment needs in energy infrastructure reported by the often quoted Project Discovery159. In broad terms £136bln is needed for new generating plants, £85bln of which will be for renewables and a further £37bln for new nuclear build. An estimated £38bn is needed to maintain, improve, and extend the electricity and gas networks making the support infrastructure fit for purpose. A further £15 bln will be needed for energy efficiency measures in the domestic sector which will help reduce the pressure on the energy infrastructure and thus improve security of supply. This investment will need to come almost entirely from the private sector and the Government will need initiatives and incentives that encourage the sector to deliver on an unprecedented scale.

8. Gas storage is particularly weak in the UK when compared with some EU countries. For example, the UK with 4.3 bcm storage capacity compares poorly with Germany where storage is a factor of five higher at 21bcm and where there are plans to raise this to 37 bcm in the future160. There is little doubt that more gas storage will be needed, not only to ensure sufficient supplies but also to accommodate a more volatile gas demand from the electricity sector.

9. The UK will have to rely on global gas markets once the North Sea resources have been exploited—past experience suggests they can deliver the security of gas supplied needed. This will be helped by the rapid growth

158 Source: Securing the UK's energy future—seizing the investment opportunity, Ernst & Young, July 2009
159 Source: Project Discover, February 2010, Ofgem
in LNG terminal capacity over the last decade or so, although price will be a key determinant as to where LNG ship loads will land.

10. Pumped-storage of electricity can make a valuable contribution to system integrity, particularly when a large unit, such as a nuclear plant, comes off the system unexpectedly; in this case pumped storage helps maintain the 50Hz frequency needed for all modern electrical systems. In total the UK has just under 3000MW of pumped storage, much less than, for example, Germany, France, and Japan.\(^{161}\) The UK could benefit from more pumped storage but such capital intensive investments will require incentives, much like those being offered to nuclear and renewables.

11. As indicated earlier, the level of investment needed is unprecedented and Government knows that it needs to provide incentives for the private sector not only to deliver on the required scale, but also to channel such investment on specific technologies such as renewables and nuclear, and the supporting electricity infrastructure. This will mean greater costs to the consumer at a time when there is already considerable financial pressure on households. It is not clear at this time if the initiatives in the Electricity Market Reform process will indeed stimulate the sustained investment needed.

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

— Decarbonisation of the electricity sector will need to go hand-in-hand with electrification of transport and heat to maintain security of supply.

12. Electricity demand will rise—the Committee on Climate Change in its Fourth Budget Report that electricity demand will rise from about 320TWh today to about 450TWh in 2030 as electrification of transport and heat proceeds.\(^{162}\) This implies an average growth rate of 1.7% per annum compared to just 0.8% per annum over the last 20 years.\(^{161}\) This will place considerable strain on the electricity sector and there is a real question as to whether it will be possible to satisfy all Government’s objectives.

13. Energy security will be determined not only by the level of demand but also in the nature of the mix that evolves. For example, in addition to an increase in electricity demand the Committee on Climate Change has indicated the carbon emissions of the sector need to decline from over 500gm/kWh today to about 50 gm/kWh in 2030.\(^{162}\) This means much greater low carbon generation in the mix going forward and this will result in greater security of supply. In this future, transport and heat would become less exposed to internationally driven fuel supply shocks.

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

— Energy efficiency can help the UK’s future energy security but initiatives that encourage the development of the country’s energy infrastructure are likely to prove more important.

14. Energy efficiency does not eliminate the exposure to energy supply shocks in itself. It can help mitigate the monetary impact on the economy, but the magnitude of this effect is related to the efficacy of energy efficiency schemes. Energy security should not rely on energy efficiency, but it can benefit from its deployment.

15. Such schemes can play an important role going forward but evidence suggests this is a very difficult area to affect, not least because it is addressing an area which, for example, the domestic ‘stock’ is relatively slow changing and relies on large scale changes in consumer behaviour.

16. There is little doubt that the various energy efficiency schemes introduced by Government, such as the Climate Change Agreements for industry and CERT for the domestic sector, have delivered some substantial gains in this area. These have worked because there have been clear incentives to deliver energy efficiency gains; it is not clear that the new Green Deal will be successful because it is a largely voluntary activity, and because consumers are expected to commit to repaying a ‘loan’ for the goods and services at a time when family finances are tight.

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?

— Greenhouse gas emission reductions and increased penetration of renewables will have implications for energy security, in some ways beneficial, but in other ways much less so.

17. The Government is committed to decarbonising the energy mix, with the electricity sector a clear focus of attention over the next two decades. This is because the sector needs renewal and it involves a relatively small number of point sources of carbon emission making it easier to address. Also, with electrification of transport and heat very much on the agenda, carbon reduction in the power sector will naturally feed into decarbonisation in the transport and domestic sectors.


\(^{162}\) Source: The Fourth Carbon Budget, Committee on Climate Change, December 2010

\(^{163}\) Source: Electricity information 2010, IEA Statistics

\(^{164}\) Source: See Reference 7
18. It is proposed that decarbonisation of the electricity sector will be affected mainly through nuclear new build and renewables deployment—indeed, the main focus of the Government’s Electricity Market Reform initiatives is aimed at promoting these technologies. If successful deployed, security of supply, at least for electricity production, should improve with a considerable reduction in fossil fuel imports into the UK. It is worth noting however, that increased penetration of renewables will expose the country to weather unpredictability with adverse implications for security of supply.

19. There will be a need for some thermal generation to fill the gaps left by a system mix dominated by large inflexible nuclear plant and intermittent renewables; fossil generation can service this need without which the electricity system could not deliver the ‘quality’ demanded by a modern economy. Some fossil fuels will continue to be imported well into the future.

20. There is a question then as to how much can be accommodated by the carbon intensity of 50gm/kWh in 2030 suggested by the Committee on Climate Change. This means the amount of fossil generation possible will be heavily curtailed. As indicated earlier, the Committee on Climate Change projections also suggest demand for electricity in the UK could rise to 450 TWh over the next two decades or so, a significant increase on the 320 TWh today. A 50gmCO₂/kWh for the mix means the sector emissions will be just 16 MtCO₂ emissions compared with about 150 MtCO₂ today.

21. A fundamental question is how much fossil generation can the electricity sector accommodate to meet the 50gmCO₂/kWh target in 2030. In terms of unabated coal, this carbon intensity would allow just 18TWh to fill in the gaps; if unabated gas were used the system would have 46 TWh available to provide the flexibility we need to maintain system integrity. To put these numbers into context, coal generation in 2009 amounted to 105 TWh and gas 165 TWh.

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

— Plentiful gas supplies and good infrastructure minimise the risk to energy security of a second dash-for-gas.

22. There are plentiful supplies of gas around the world. There are resources available in every region of the world and considerable diversity in the types of resources with shale gas the most recent ‘new’ resource made available to us. However, a small number of countries are prominent—Russia has 24% of the proven reserves, Iran and Qatar, 16% and 14% respectively; and crucially, the Middle East combined amounts to 40% of the total reserves at this time.

23. There is a global Reserve-to-Production ratio of over 60 years for gas, unchanged for 25 years during which time gas use has expanded significantly and LNG, and an extensive pipeline infrastructure, has increased connectivity—gas has changed from a regional to a global actor.

24. Gas use in the UK now outstrips indigenous supply and this gap will grow as the country’s North Sea resources decline. The import infrastructure was able to deliver just under half the annual consumption in 2009, one quarter of which was LNG; as indicated earlier, it is possible that by 2020 up to 40% of gas demand could be sourced via LNG.

25. The gas transport infrastructure then is good and improving, although storage remains limited in the UK. Nonetheless, the availability of resources into the UK does not at the moment appear to be a limiting factor in the role of gas going forward.

**Question 7: How exposed is the UK’s energy security of supply to international events?**

— International events do have implications for energy security but it is also true that the markets have invariably delivered the required fossil fuels to the UK, albeit at elevated prices.

26. Looking ahead, there remain significant fossil resources in general and gas in particular; also diversity in supplies is good and an extensive global transport infrastructure has improved connectivity between regions.

27. It is worth noting that there is a mutual reliance between producers and consumers and because of this it is in all stakeholders’ interests that international energy markets continue to function. Nonetheless, some countries, notably Germany, have mitigated the risk of disruption by entering into long term gas contracts and expanding its gas storage capacity significantly. The UK, for historical reasons and because of its North Sea resources has been less active in these areas.

28. The UK’s declared intention to radically reduce its power sector carbon intensity by 2030 to meet its climate change objectives has the additional benefit of reducing the country’s reliance on fossil fuels and thus improves its security of supply.

29. The potential further development of nuclear power in the UK is fundamental to the decarbonisation agenda and also helps with security of supply. The crisis that has enveloped the Fukushima Dai-ichi plant following the earthquake and tsunami off the coast of Japan has re-opened the debate on the future of nuclear power in many countries and it is possible that some countries may now not proceed with their plans.

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165 Source: BP Statistical Review of World Energy, June 2010
166 Source: See Reference 10
30. The UK has indicated it will continue with its new build programme. This has two important implications for the UK: there will be greater pressure on fossil resources elsewhere and less pressure on uranium resources. The former could lead to higher fossil prices while the latter will make uranium more readily available.

31. Clearly the potential demise in the fortunes of one technology will enhance the prospects of others. It will take many months, perhaps years before the full implications of recent events are felt on nuclear power sector, and on fossil generation.

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?

— Diversity plays an important role in mitigating security of supply concerns—diversity in fuels, supply options, and technology.

32. The UK’s electricity mix is probably at the best it has been in terms of diversity and the resilience it brings. History also suggests this tendency to greater plurism is true of the energy system as a whole. It is a concern then that government policy is ‘facilitating’ a move in the opposite direction with fewer energy carriers in the system; also greater regulatory intervention and a move away from markets will lead to much higher costs to the consumer.

33. Additional investment/support for gas storage infrastructure would help reduce energy supply shocks exposure. Further, other types of storage should be encouraged to help mitigate security of supply concerns.

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?

— A more holistic view of security of supply, an assessment of the potential role of gas the UKs energy system, and the implications for competitiveness are needed in addressing the security of energy supply. Also, it is important the UK keep options open to accommodate future developments.

On a more holistic view of security of supply

34. In recent years Security of Supply has mostly focused on the availability or otherwise of gas as our indigenous resources have declined. Also, a reserve margin in excess of 20% was considered necessary in the past for the power sector to ensure security of electricity supply. But this is with a mix in which most of the generation has been from fossil plant which could largely be relied on to come on when needed to cover trips, maintenance, and other outages.

35. Looking ahead, the proposed mix will be dominated by a combination of larger, inflexible nuclear plant and intermittent renewables, resulting in a more dynamic and volatile generation sector. The traditional view of security of supply is perhaps less relevant today and we must extend our view to include a number of outcomes—not only is it necessary to address gas availability, it is also important to have sufficient flexible plant that can respond quickly on some occasions, have greater dynamic range on other occasions, and can respond to greater volatility. Gas, alongside pump-storage, can play an important role in what will be a crucial part of the sector.

On the future role for gas

36. The future role of gas needs to be more carefully assessed. The Committee on Climate Change has indicated there is little role for gas going forwards if the UK is to meet its 2050 greenhouse gas target. The question remains however at the pace of decarbonisation to 2030 and whether allowing a greater retention of gas in the UK economy in the medium term would be a more cost effective approach in affecting a transition to a low carbon economy, albeit at a slightly higher risk to security of supply.

37. It is worth reiterating the many important attributes of gas. As indicated above there are plentiful supplies of gas around the world with a reserve-to-production ratio in excess of 60 years—this value that has remained unchanged for 25 years during which time the growth in consumption has risen significantly and gas has emerged from a regional to a truly global actor.

38. Gas technology is mature. We are able to build stations at various scales to suit our needs from small peaking plants to large baseload units; we can build them quickly and the capital cost is relatively low when compared to the other technologies.

Source: See Reference 10
Ev w154  Energy and Climate Change Committee: Evidence

40. Gas generation can help reduce carbon emissions. We have already touched on the need to decarbonise the electricity mix. The fact that gas has a carbon intensity less than half that of coal is a key attribute in this context—indeed there are many people who suggest the simplest and most cost-effective way to deliver carbon emission reductions is to replace coal with gas generation.

41. Gas can provide flexible generation. As shown earlier, there will be generation gaps in a sector increasingly reliant on inflexible nuclear and intermittent renewables—system integrity with such a mix could be compromised unless there are technologies that fill these gaps.

42. And finally, gas is highly versatile. It is currently used in the domestic sector for heating purposes, and compressed natural gas is already being used in transport; also, excellent technologies to convert gas to liquid transport fuels already exist. It can also be used as a feedstock for value added products across the economy. Overall, gas can continue to make a genuine contribution to the UK’s economy going forward in a low carbon economy, if Government policy allows.

On competitiveness

43. Competitiveness of our economy remains a key issue and in this context it is important the UK is not too far out of line with the rest of Europe. Using carbon intensity as a proxy for our electricity mix, an analysis of European countries in which we operate suggests that 200gmCO$_2$/kWh in 2030 is already at the lower end of projected values—the cost of going to the significantly lower level of 50gmCO$_2$/kWh in the UK could have implications for our industrial competitiveness. The security of supply benefits associated with a much lower carbon intensity then need balancing against the potential erosion of industrial competitiveness.

On keeping options open

44. There is little doubt that decarbonising the electricity mix is fundamental to meeting our climate change targets. But it is worth remembering that we have a further iteration with our mix in the period 2030 to 2050, and there is a danger that we believe we have all the answers right now. There are always surprising developments and we must ensure whatever we do we are able to exploit new ideas and opportunities that may yet arise in the coming years and decades.

March 2011

Memorandum submitted by the Association for the Conservation of Energy

SUMMARY

The new Coalition Government should focus primarily on energy efficiency as the cheapest, safest and most reliable way to achieve energy security. The Government’s own figures, from the recently updated 2050 Pathways Analysis,$^{168}$ show that well over half of the necessary emissions cuts needed to meet the UK’s 2050 carbon targets can be achieved through efficiency measures alone. A systematic implementation of the most ambitious level of energy efficiency measures in the domestic, business and transport sectors would reduce the energy demand of the UK by more than half by 2050, with only a minimal increase in electricity use. This would bring about a 56% reduction in CO$_2$ emissions without affecting quality of life and without having to make any steps towards decarbonising the current energy supply. With total energy demand slashed to half, achieving energy security and independence for the UK will be significantly cheaper and considerably easier.

Some may argue that aiming for the most ambitious level of effort on energy efficiency is unrealistic, but even at lower levels, the contribution that energy efficiency can make to carbon reduction is sizeable. Using the same 2050 Pathways Calculator tool, and setting all the demand-side and energy efficiency measures below the maximum, can still achieve CO$_2$ cuts of 42% without having to make any changes to our primary energy supply—or in other words, without having to invest in expensive new energy generation infrastructure. This would have the added benefits of reducing fuel bills and thus ‘bringing the public along’ with measures to reduce climate change.

Thus energy efficiency must be the starting point to achieving both energy security and cutting greenhouse gasses. The current Energy Secretary of State and his Minister of State have both described energy efficiency as the most cost effective way of meeting energy policy objectives. Yet still a full analysis of the cost and benefits of saving energy as against those of generating it has not been carried out. The Chief Scientist himself has said this is a ‘crucial comparison to make.’$^{169}$ It should be done immediately.

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$^{169}$ In a letter to ACE Director 11th February 2011
RECOMMENDATIONS TO INDIVIDUAL QUESTIONS

We have confined ourselves to responding to questions of relevance to the Association.

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

   In 2007 the UK’s primary energy demand was met through gas (39%), oil (33%), coal (18%), nuclear power (6%) and a mixture of renewables (4%). With 96% reliance on fossil fuels and nuclear power the UK is at great risk of changes in fuel price. As the UK moves towards an energy future with an increasing proportion of renewables in the mixture then this risk is reduced. However fossil fuels will continue to be a part of the UK’s primary energy supply up to 2050 and beyond, whether in micro-CHP boilers at the small-scale level or as CCS power plants at the large-scale level, and so this risk is unlikely to be removed entirely. However if thorough energy efficiency measures are implemented then the UK’s need for nuclear power is entirely removed, and in turn the UK’s vulnerability to fuel price changes is also minimised.

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

   Energy infrastructure can cost millions to build and take years before being fully functional. While the severity of the impacts of climate change justifies large expenditure by Government, we believe that, pound for pound, investment in energy efficiency can contribute far more to the UK’s energy security. Energy security can refer to two things—the ability of the energy networks (gas pipelines and electricity grids) to be able to match demand with sufficient supply, and the reliability of fuel supply chains internally and from abroad. Not only is energy efficiency is unaffected by the latter (unlike energy generation) but it will contribute positively to energy security in the UK by reducing the pressures on the distribution networks. Energy security will always be sensitive to investment (or lack of) in energy infrastructure, but with proper investment in cost-effective energy efficiency this sensitivity can be lessened.

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

   The future energy security of the UK will be dependent on successful energy efficiency schemes, regardless of the extent to which energy supply is decarbonised. The 2050 Pathways Calculator tool shows us that even if the UK chooses maximise growth in all renewable and low-carbon sectors of energy generation, we would still not be able to achieve our 80% CO₂ reduction target by 2050 without some demand-side effort. Decarbonisation must go hand in hand with energy efficiency in order to effective tackle the UK’s contribution to climate change. Since the carbon abatement of efficiency measures can deliver profits of between £80 and £300 per ton of CO₂, while renewable technology incur costs of up to £500/tCO₂ then it is clear that investment in energy efficiency should take priority in achieving energy security.

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170 Ibid