Response to the Department of Energy and Climate Change Gas Generation Strategy – Call for Evidence

Submission by International Power Plc

(I) About International Power Plc

International Power Plc (IPR) welcomes the opportunity to contribute to the Department of Energy and Climate Change Call for Evidence on the proposed Gas Generation Strategy.

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 76 GW gross capacity in operation and committed projects for a further 13 GW gross new capacity.

IPR has significant experience in operating gas-fired power generation, both in the UK and in overseas markets. Of IPR's installed capacity, approximately 60% is gas-fired Combined Cycle Gas Turbine (CCGT) technology. IPR operates gas plant across each of the regional markets in which it operates, and across a wide range of market structures – from merchant to contracted markets.

In the UK, some 4.1 GW of the 9.2 GW gross total portfolio is gas-fired, predominantly CCGT plant. IPR's UK fleet has always included gas-fired generation, and the company aims to optimize the running of this technology as part of the overall portfolio mix. At times, it may be necessary to mothball plant when the electricity market outlook suggests it is uneconomic to run, as was the case at Teesside where 1830MW has been mothballed since April 2011.

(II) Summary key points

General Comments

- **Increased intermittency on the GB power grid, driven by increased wind capacity, will require gas generation to run more flexibly in the future, with the ability to meet rapid changes in power demand.**

- **Gas-fired generation is needed to provide a 'firm' source of electricity to assist in meeting both security of supply and system integrity of the GB power network.**

- **A significant portion of the current generation fleet is beginning to age. By 2016, 40% of gas capacity will be greater than 20 years old. Incentivising existing plant via the capacity mechanism will assist in reducing the risk of a capacity gap emerging in the UK power market.**

- A number of factors influence the economics of investing in new gas-fired generation, from capital to environmental costs. A commercial barrier to entry is the current level of spark spreads in the UK market, which remain below new-entrant levels. It is envisaged that the introduction of a capacity mechanism will support and act as a catalyst to new-build development in the UK.

- Gas generation has historically set marginal power prices and will continue to do so in the future. However, there may be periods in the longer-term when low carbon technologies set prices. For example, overnight when demand is low and the amount of commissioned low carbon technology is sufficient to meet this demand.

- Future tension could exist between carbon intensity in the Electricity Supply Industry and Government environmental targets. This is particularly the case in 2030, when IPR analysis suggests the amount of gas generation required to meet demand is likely to produce a higher carbon intensity than the 50g/kWh target.

- **If Carbon Capture and Storage (CCS) is commercially available by this date, environmental concerns associated with gas generation are significantly reduced, and meeting Government's targets is likely to be easier.**

- It is important that the grandfathering principle is adhered to by Government, particularly regarding changing levels of the Emissions Performance Standard (EPS). Without grandfathering, gas generation developers are likely to see greater risk in their investment and could restrict the amount of new-build gas in the UK in future.

- Unconventional sources of gas, including shale, have the potential to significantly impact the global gas market and hence future generation costs in the UK.

(III) Answers to DECC Questions

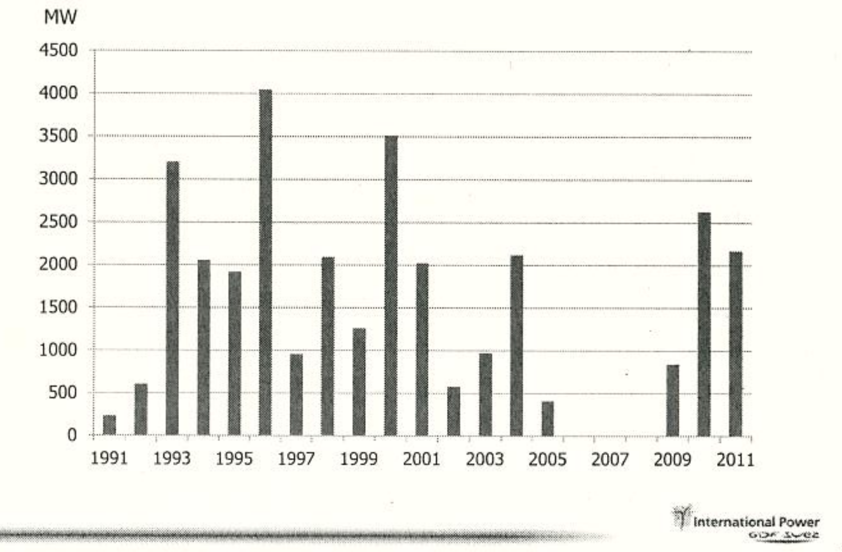
Question 1 – What are the main strengths and weaknesses of gas generation in helping deliver a secure, affordable route to decarbonisation through to 2020 and then by 2050?

On Strengths

1. Gas generation is a proven technology that has seen large-scale deployment in the Great Britain (GB) electricity market over the last 20 years, as shown in Figure 1. The GB market has seen 31.6 GW of gas-fired CCGT has commissioned and 0.6GW decommissioned since 1992; a further 0.75 GW will begin construction in 2012. Crucially, 40% of capacity will be 20+ years of age in 2016 when 12GW of old coal and oil plant would also have retired under the Large Combustion Plant Directive; this could be offset to some of the 8GW of gas plant that is currently consented.

2. In 2011, gas generation supplied 162 TWh to the GB market, representing 43% of total supply[1]; this was the largest contributor to supply. In addition, gas-fired technologies can be deployed relatively quickly when compared to other types of large scale generating technology, such as nuclear. For example, the construction time for a Combined Cycle Gas Turbine (CCGT) plant can be as low as 4 to 5 years, including lead and development time.

Figure 1 - Gas generation commissioned over the last twenty years



3. Most generation from gas-fired plant in the UK has typically been provided from CCGTs and Open-Cycle Gas Turbines (OCGTs). Historically, CCGTs have tended to operate more in the baseload rather than peaking segment of the electricity market, although as gas prices have risen in recent years more CCGT plant is being forced to operate flexibly including IPR's Deeside station. It is clear that a 'flexible' role in the market, where plant ramps up and down to meet demand, will become increasingly important. Some manufacturers are now designing turbines specifically with this in mind, for example GE's FlexEfficiency 50 CCGT[2]. When commercially proven and available, such designs will allow gas generation to respond to more volatile demand and intermittent supply in power markets.

4. Gas generation technologies have typically been associated with a lower capital cost compared to other sources of power generation.[3] This has enabled gas generation to compete with nuclear and other types of fossil generation from a capital cost perspective.

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[1] Digest of UK Energy Statistics (DUKES) 2011, Table 5.1, Commodity Balances, Chapter 5.

[2] http://www.ge-flexibility.com/products/flexefficiency_50_combined_cycle_power_plant/index.jsp

[3] UK Electricity Generation costs Update June 2010, Mott McDonald.

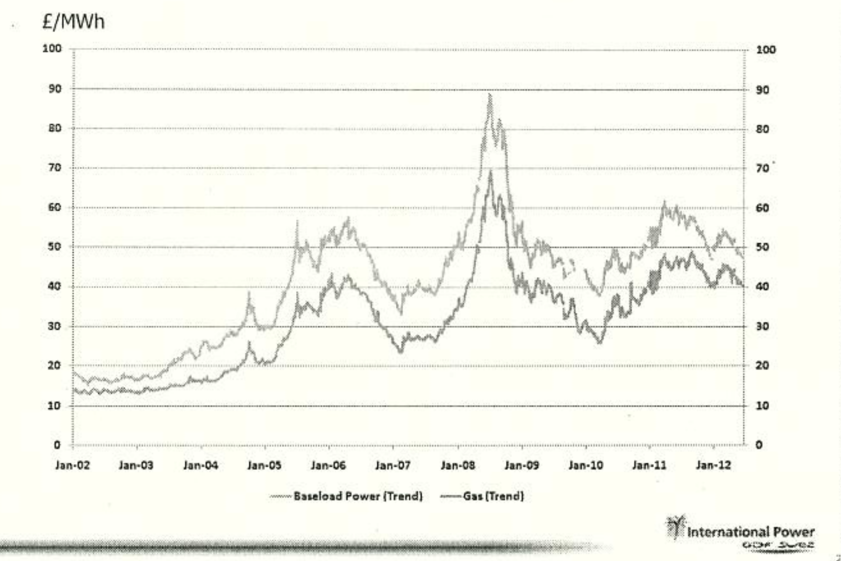
<u>*On Weaknesses*</u>

5. In recent years concerns have been raised regarding the UK's gas security of supply. Concerns have included increased reliance on imports, the developing role of Liquified Natural Gas (LNG) and high and volatile wholesale gas prices.

6. With regard to increased reliance on imported gas supplies, the UK's own domestic gas production is steadily declining, as recognized in DECC's Gas Security of Supply policy statement from April 2010[4]. By 2020, 75% of gas consumed in the UK could be supplied from imported sources[5]. Issues concerning security of supply therefore arise as greater reliance is placed on imported sources, both from Continental Europe and in the form of LNG predominantly from the Middle East (although the UK's LNG import capacity is currently under-utilised. This may be exacerbated up to and beyond 2020 should an increasing reliance be placed on generation from gas. Maintaining a diverse supply of gas is key to the UK's security of supply position.

7. Regarding high and volatile prices, the wholesale price of gas in the UK is driven largely by demand and supply, and the price of imported gas both from LNG and the Continent. Forward UK gas prices over the last five years have ranged from over 100p/therm in 2008 to 40p/therm in 2010, and have been the primary influence on UK power prices as illustrated in Figure 2[6].

Figure 2 – United Kingdom Power and Gas Forward Curve Trends



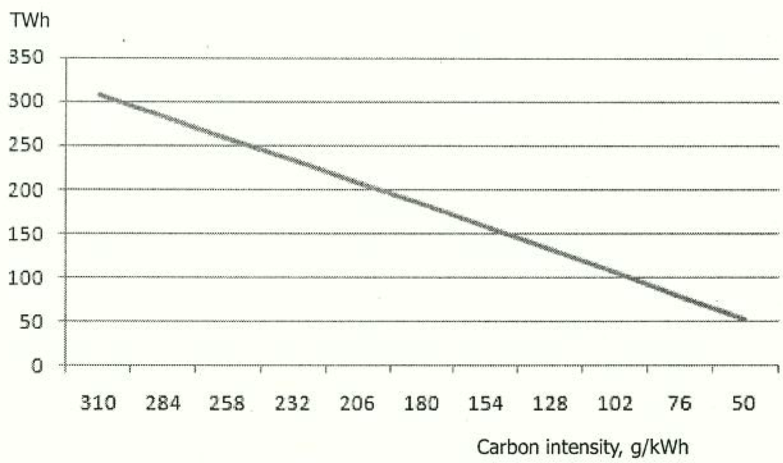
[4] Section E.5, page 3, DECC Gas Security of Supply, April 2010.
[5] National Grid Transco Ten Year Statement, 2010, Gone Green Scenario.
[6] Gas prices sourced from Argus.

The range between gas price maximum and minimum over this period illustrates the potential for swing in prices from one year to the next, and the resulting impact on wholesale power prices, particularly when gas plant set prices in the electricity market. Consequently, there is the potential for wholesale energy costs such as electricity to vary with gas prices, which could lead to varying end-user electricity prices. This may become exacerbated should gas generation as a proportion of total supply increase in future.

8. In order to meet Government emissions reduction targets between 2030 and 2050 it is likely that any existing or new-build gas generation will require Carbon Capture and Storage (CCS). The Committee for Climate Change has recommended a reduction of 60% in UK CO_2 emissions on 1990 levels by 2030, whilst Government aspirations for 2050 are a reduction of 80%. To meet these targets, Government is seeking an average CO_2 emissions rate from the ESI of 50g/kWh by 2030, and 10g/kWh by 2050. The average CO_2 emissions rate for a modern gas-fired CCGT is about 350 g/kWh, so whilst this represents a reduction on the ESI average emissions rate for 2010 of 458g/kWh[7] it shows that any reliance on gas in future will not lead to Government targets being met unless, for example, CCS becomes commercially viable.

   This is demonstrated in Figure 3, which shows the level of generation that can be accommodated from gas generation assuming an emissions rate of 350g/kWh, no CCS, and a target of 50g/kWh carbon emissions intensity by 2030. It also assumes electricity demand growth of 0.8% p.a. for the period up to 2020 and 0.5% p.a. between 2020 and 2030.

Figure 3 – Gas generation that can be accommodated for different levels of carbon intensity



[7] UK Digest of Energy Statistics (DUKES) 2011, Chapter 5, Table 5A.

The diagram illustrates that at 50g/kWh carbon intensity, approximately 50TWh could be sourced from gas generation without CCS, assuming that all other sources of generation are zero carbon emitters. Compare this to the analysis shown in Figure 4, from IPR's own modeling studies which show at least 160TWh is required from gas generation in 2028 to maintain system integrity.

9. If Carbon Capture and Storage (CCS) is commercially available by this date, environmental concerns associated with gas generation are significantly reduced, and meeting Government's targets is likely to be easier.

10. Care should also be taken with any expansion of gas generation concerning fugitive emissions. This includes any potential leaks or emissions of methane from supply or exploration, particularly as this gas is about 25[8] times more potent than carbon dioxide as a greenhouse gas when assessed over a one hundred year period. Consequently, rigorous safeguards should be established if increased gas generation requires greater gas exploration or supply in future.

Question 2 – What role can gas fired generation play in the future and what level of gas generation capacity is desirable?

11. When considering the role a generation technology can provide it is useful to assess its attributes against the three key criteria being sought for the UK market, namely (a) security of supply, (b) low carbon, and (c) affordability.

12. Regarding electricity security of supply, over the next 10 to 20 years it is expected that intermittency on the UK power network will grow, particularly as wind capacity and generation increases. Volatile changes in short-term supply of power will become more common place which will necessitate rapid response from either existing or new generation.

13. IPR's modeling studies show the implications of growing levels of intermittency and volatility on thermal generation, and the associated gas supply, in the electricity system in Figures 4 and 5. Figure 4 illustrates the GB market load duration curve for 2010 and 2028, plotted against the forecast supply from different generation technologies for a system in which the level of wind capacity rises from 6.6 GW in 2010 to 38.6 GW in 2028. The charts show that as the level of wind capacity and output rises, so does the intermittency on the power network (as wind generation rises and falls with wind speed). Consequently, both existing and new CCGT will be required to run flexibly in order meet volatile swings in supply from wind generation.

14. Figure 5 shows that the gas supply system that services the gas generation will also demonstrate much greater volatility than before and the infrastructure for this sector will also have to develop to accommodate this change.

[8] http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

Figure 4 - Generation from thermal plant from highest to lowest demand hours

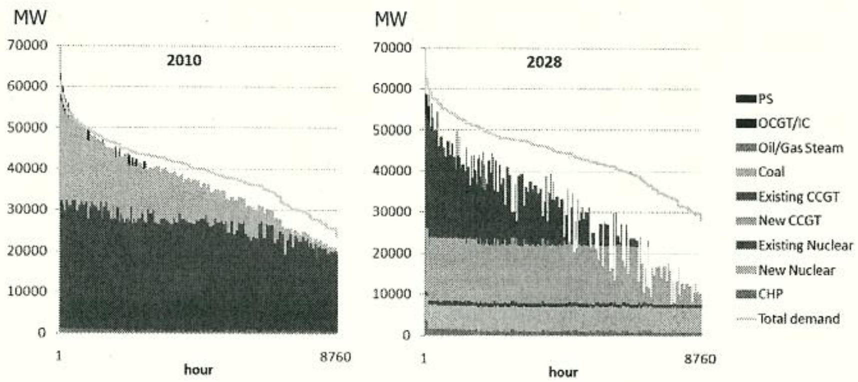


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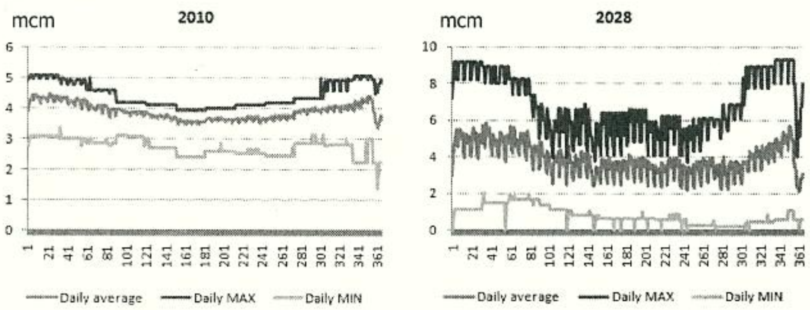
Figure 5 - Daily gas consumption in power generation



Note – mcm, million cubic metres

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15. Gas generation is not the only technology capable of helping to resolve intermittency but it will have a particularly crucial role to play in delivering significant replacement energy on the days in which the wind generation is close to zero. Other forms of technology will be required to provide additional flexibility, particularly in fast response timescales to the grid network.

16. Gas generation will also have a key role to play in overall system security and integrity. IPR forecasts the need for new-build capacity by 2016/17 following the closure of several existing coal and oil-fired plant under LCPD conditions and the carbon price floor pushing up the costs of coal relative to gas generation.

17. To retain a secure level of supply, it is difficult to see a technology other than gas large enough in scale to replace retired plants to provide firm power supply in the short-medium term. New nuclear generation, although large scale, is unlikely to become available until around 2020, and new-build coal plant is highly unlikely in the UK in future. Up to 26GW of both offshore and onshore wind is expected to be installed before 2020, but this technology will provide intermittent and not firm power and as such cannot ensure system security and integrity.

18. This situation may become further exacerbated by 2025 when existing coal plant running under the Transitional National Plan finally close, and the first wave of CCGTs built in the early 1990s could begin to retire. In addition, existing nuclear plant, with the exception of Sizewell and possibly Torness and Heysham 2, are expected to close by this date. Whilst up to 5GW of new-build nuclear and 8 GW of new-build CCGT is expected to commission before 2025, together with new wind capacity it is unlikely that in this scenario the capacity gap will be filled. This underlines the importance of new-build gas as an option for maintaining system security of supply up to 2025.

19. IPR considers gas generation has an important role to play in meeting Government's aim for a transition to a low carbon economy. CO_2 emissions from gas plant (in particular CCGTs) tend to average approximately 350g/kWh, lower than other forms of conventional fossil fuel generation such as coal and oil (approximately 900g/kWh and 650g/kWh respectively). As ageing fossil fuel plants retire between now and 2025, and new nuclear plant are gradually commissioned, there is likely a need for both firm and flexible generation to fill capacity gaps, as discussed above.

Question 3 – What are the key factors driving the economics of investing in new gas-fired power generation and how are these factors likely to change?

20. A number of factors drive the total cost and economics of building a new gas-fired power plant. The key factors typically include:

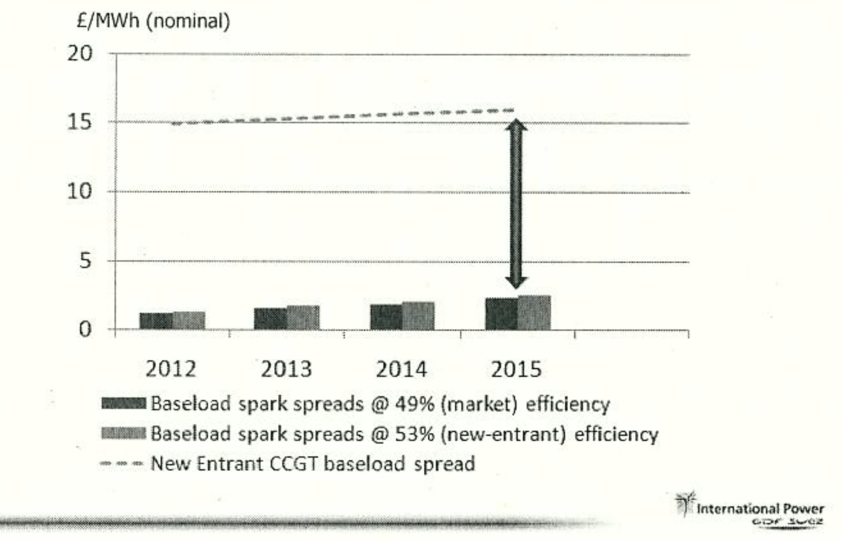
    a) Capital Cost of the plant;
    b) Operational costs, such as variable and fixed running costs;
    c) Technical/performance factors, such as efficiency and availability;
    d) Expected load factor/running regime of the plant;
    e) Fuel costs;
    f) Environmental costs, such as the cost of EU ETS allowances, or carbon tax, or both;
    g) Corporation/business taxation;
    h) Impact of regulatory/local issues e.g. local planning issues;
    i) Forecast electricity supply and demand fundamentals and achievable spark spreads.

21. Under the current market structure (pre-EMR), gas generation developers have looked towards market signals and spark spreads before making a decision on investment. However, with new-build likely to be required from 2016/17, the liquidity of forward electricity spark spreads in these years tends not to be strong, and consequently developers have little visibility of the forward market in 4 to 5 years time.

22. Using the information that is currently available, IPR analysis shows that a baseload clean spark spread[9] of £16-£17/MWh would need to be reached by 2017 to justify new-build, as shown in Figure 6. As the diagram below shows, forward spreads over the next 2 to 3 years show little sign of movement towards this level.

23. In the longer term it is recognized that the economics become even more challenging as load factors are expected to fall and become more uncertain as a result of greater wind penetration. The decision for developers to progress new-build projects will be therefore be influenced by the capacity mechanism. IPR supports a market-wide capacity mechanism, especially as this approach provides a security of income for existing plant which may allow them to continue operating longer, and also encourage new-build generation as it becomes necessary. This has the potential to be the cheapest overall option for consumers.

Figure 6 – Current market spark spreads compared to new entrant spark spreads



24. Addressing how each of the above factors is likely to change is complex. However, IPR's insights on the key factors are as follows:

    a) Capital Cost – there have been periods when volatility has occurred in the supply chain (e.g. metal prices during 2008); it is possible that this could occur again in the future impacting capital costs.

9 Calculated as power price less fuel cost less cost of CO_2.

b) Return requirement - greater uncertainty brings with it greater risks, demanding higher project returns.
c) Regulatory environment - regulatory uncertainty and/or regulatory change could make investments more difficult going forward.
d) Levels of incentives in the market/level playing field - the greater the market is distorted with incentivised generation or more favoured terms for certain asset types the more risky the investment climate.
e) Volatile fuel prices – should future gas prices become increasingly volatile (e.g. through swings in demand and supply or underlying oil price) then developers may be deterred from gas generation investment, particularly where gas is sourced in merchant markets (i.e. without a long-term fuel supply agreement).

Question 4 – What barriers do investors face in building new gas generation plants in the UK? What are the key regulatory uncertainties that may prevent debt and equity investors making a final investment decision in gas generation and supply infrastructure?

25. Potential barriers to new gas generation plant include:

a) Lack of clarity on Electricity Market Reform (EMR) detail;
b) Offtake and fuel availability;
c) Access to finance;
d) Planning issues;
e) EPC/Construction availability.

26. In addition to the above points, the Emissions Performance Standard (EPS) may also provide a barrier for new gas generation. Government may be minded to reduce the EPS rate of 450g/kWh in future and this could create uncertainty amongst gas developers, particularly those seeking to deploy and operate technology above this rate. Government has applied the grandfathering principle in the past projects and indications are they are minded to continue to do so (for example, a gas CCGT built in 2017 with EPS rates at 450g/kWh should operate under this level for the remainder of its plant lifetime); this is helpful to investors. Government should also seek to provide clarity on plans to reduce the EPS rate in future years, so that new-entrants to the market will have visibility of changing levels ahead of committing to investment.

27. The UK's gas transmission infrastructure should also be considered as new gas plants are built. In particular, the ability of the gas transmission network to respond to sudden changes in gas demand, and increased demand volatility, will need to be considered should gas-fired generation provide a role in this respect. Likewise, the overall capacity of the gas transmission network would also need to be considered in the event that the proportion of power generation met by gas increases beyond current levels. This may be tempered should heat load demand move from the gas to the power market (i.e. through electrification of heating). However, this is unlikely to change the need for flexibility to support this demand particularly as gas-fired CCGT is likely to remain a key provider in the power market.

28. Nevertheless, the ability of the gas transmission network to respond should be considered, particularly as in-day flexibility will be critical in future. Imported gas supplies are inherently less flexible than local supplies, although existing LNG storage at the import terminals mitigates this issue to some extent. It is not clear that the market will deliver sufficient flexibility to cover pinch points such as periods of intermittency in winter months.

29. It should be noted that a number of current players in the UK power market are international companies and will be seeking to invest finite capital across a number of potential markets. Consequently, such players will be seeking attractive returns on capital employed and may therefore invest in other markets if they feel that regulatory uncertainty is too great, or returns too low, in the UK.

Question 5 – Are there any other policy issues that need to be addressed beyond the Government's proposals for the capacity mechanism and the EPS?

30. Developers make long-term investment decisions when constructing a new power plant. Lifetimes of gas-fired generation typically range from 25 to 30 years for a CCGT, in some cases longer. To this end, developers will need to take a view on a range of long-term assumptions and unknown factors, from future prices of fuel and power to potential changes in the regulatory framework.

31. Further clarity on plans for potential development of shale gas would be welcome. The future availability of gas supplies is a key factor in considering new gas-fired generation, both from an infrastructure and commercial point of view. Potential shale gas resources in the UK have received much media and industry comment in recent years, with views varying on the possibility of future deployment. Government's assessment of, and aspirations for the use of shale gas in the future would be welcome as part of a future gas generation strategy for the UK.

32. Industry would also welcome further clarity on the role of the Carbon Price Support (CPS) mechanism beyond 2020, particularly the 'glide-path' of the CPS from £30/tonne in 2020 to £70/tonne in 2030[10]. There is genuine concern that the CPS could place the UK in an uncompetitive position compared to the rest of the EU, which is subject to solely the EU ETS trading scheme and no other mechanism in addition to it.

33. It would also be useful to see clarity provided on future support for Combined Heat and Power (CHP) plants in the UK, and how this particular technology fits within Government's future gas strategy.

[10] In 2009 prices.

Question 6 – Given a continuing role for gas and the potential for increased volatility in gas demand, to what extent is gas supply and related infrastructure a barrier to investment in gas fired generation? What impact will unconventional gas have on the case for investing in gas generation and the supporting infrastructure?

34. Please see item 17 above regarding gas supply and infrastructure becoming a barrier to investment.

35. Unconventional gas in the USA has already been shown to have a major impact on the energy sector and industries and consumers that rely on it; it has been demonstrated to be a truly 'disruptive' technology, with implications for the USA energy self-sufficiency and wider afield as gas resources that would have gone to the USA are now being diverted to other markets.

36. Longer-term, it is likely that other sources of unconventional gas may be found and developed that could have an impact on global reserves and hence global gas competition. For example, the use of domestic reserves in China could lessen its reliance on imports, hence impacting the global gas market. Furthermore, development of shale gas in Poland may impact the European gas market, where incremental sources of conventional gas are currently viewed as from Russia.

(IV) <u>For further information please contact:</u>

Or