Green Alliance briefing
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Avoiding gas lock-in

Why a second dash for gas is not in the UK's interest

The first dash for gas, following liberalisation of the UK electricity market in 1990, was clearly in the UK's national interest, because it significantly reduced carbon emissions and electricity prices. Our research shows that a second dash for gas would not be in the UK's long-term interest as it will raise the cost of meeting the nation's carbon budgets.

Gas will continue to have an important role as a flexible fuel in the transition to a low carbon economy. However, because the UK has already cut its emissions by switching from coal to gas, a second dash for gas could prevent us from meeting our carbon budgets or significantly increase the cost of meeting them. Relying on unabated gas which is cheap to build now doesn't lead to lower cost decarbonisation; it will simply load the cost of decarbonisation into the 2020s. It could also deter investment in technologies such as offshore wind and Carbon Capture and Storage (CCS), technologies in which the UK has a competitive advantage.

Our conclusion is that the government cannot both govern for the long-term and allow a second dash for gas. It needs to begin to manage the gas generation market, both through its consenting decisions, support for CCS demonstration, and reform of the electricity market.

Our findings:

- It is very unlikely that the government can meet its fourth carbon budget[1] if there is a second dash for gas, as the resulting carbon emissions from electricity generation could be six times greater than the Committee on Climate Change's (CCC's) recommendation for 2030.
- Current and planned gas capacity will either lock the UK into higher carbon levels, or result in gas power station investments of up to £10 billion being retired early or needing costly CCS retrofit if these power stations are run as baseload.
- If both renewables and nuclear new-build meet the CCC's expectations, 16 GW of gas would need to shut prematurely, and a further 7 GW of gas would need to be retrofitted with CCS, assuming that it is in the right location for captured CO_2 to be stored in redundant gas and oil reservoirs.

To avoid this, the government needs to:

- Ensure gas is used efficiently across the whole energy supply chain. The government should strengthen policy, for example ensuring that Combined Heat and Power (CHP) is the default option for industry.
- Deliver an electricity market reform package that provides incentives for the right type of gas plant: gas CCS and efficient gas peaking plant. Relying on carrots alone, in the form of low carbon contracts, is risky and simply may not deliver decarbonisation if a large amount of new gas plant is built. The government needs to carefully design its capacity mechanism to ensure the right type of gas plant is built and introduce an emissions performance standard (EPS) that progressively incentivises the deployment of CCS during the 2020s, and ensures any remaining unabated gas capacity is limited to a peaking role.
- Include a gas project in the CCS demonstration programme.
- Strengthen planning requirements so that new plant is located in such a way as to have a realistic prospect of being retrofitted for CCS.
- Develop a proactive CCS roadmap that can drive the development of CCS clusters and CO_2 networks to ensure the UK deploys CCS in a strategic and cost effective way, capturing the co-benefits of CCS for energy intensive industry.

The problem with gas

The UK has a legally binding target to reduce greenhouse gas (GHG) emissions by 80 per cent by 2050 compared to 1990 levels. The independent body that advises government on its interim carbon budgets, the Committee on Climate Change (CCC), has stressed the need for early electricity sector decarbonisation as the most cost effective way to meet that target. Currently carbon emissions from the electricity sector hover at around 500gCO_2/kWh and will need to fall dramatically to a tenth of this level in less than two decades, as shown in the graph right. Power stations have long lifetimes, so what is built from this point forward determines whether or not the UK has any chance of reaching 50gCO_2/kWh by 2030 and meeting its carbon budgets.

The main form of investment in new power generation over the past two decades has been in combined cycle gas turbines (CCGTs). With emissions from

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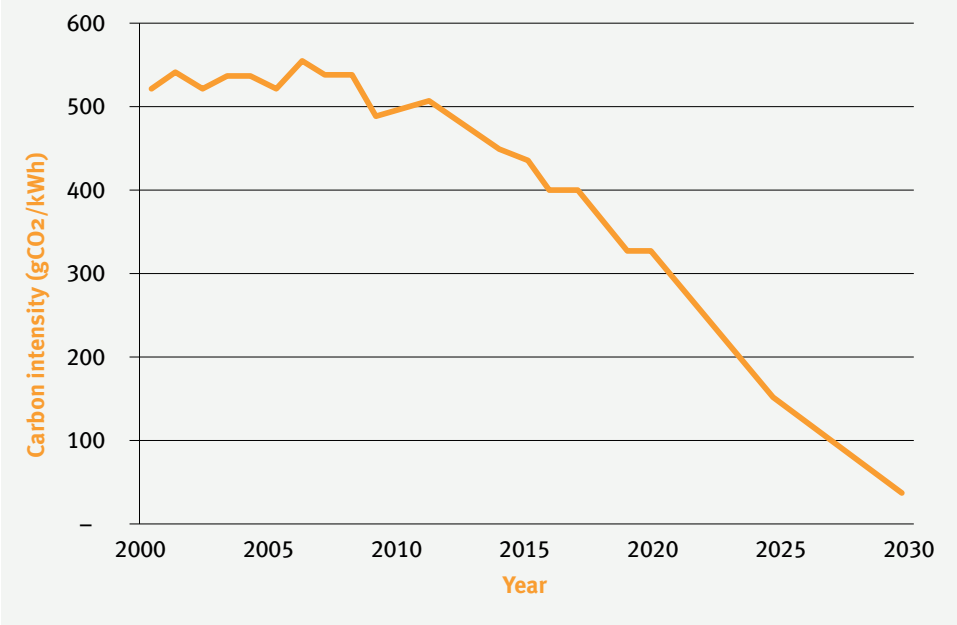
CCGTs at around 440gCO_2/kWh, these gas power stations are significantly lower carbon than coal-fired power stations which emit roughly double the amount of carbon. Gas is a flexible fuel and has a role to play in peaking plant and as a transition fuel. However, by 2030, when electricity needs to be produced at 50gCO_2/kWh, the unabated, low flexibility CCGTs currently planned look like a distinct liability.

In addition, there are growing concerns about the upstream emissions associated with new forms of gas. The UK is increasingly dependent on liquefied natural gas which has a higher carbon footprint than North Sea gas as it needs to be compressed, imported and then re-gasified. Early studies of shale gas have indicated that this source of gas may have a lifecycle carbon footprint similar to coal[2]. Environmental concerns associated with unconventional gas production may also limit the availability of low cost gas in the medium term.

Finally, although concerns about security of supply due to dependency on imported gas have fallen off the political agenda over the past year, there are still significant concerns about imports. As North Sea reserves decline, the UK is becoming increasingly exposed to the international gas price which risks continuing to rise with increasing volatility. This raises concerns about the impact of wholesale gas price spikes on households and energy intensive users if the UK continues to rely on gas as the largest source of electricity generating capacity. The issue of price spikes is especially challenging for gas as around two-thirds of gas in the UK is used to produce heat. We should question an over reliance on gas for power generation when we are so dependent on gas to heat our homes and to provide high temperature heat for industrial processes for which there are limited alternatives.

Power sector emissions intensity
Source: *The renewable energy review*, Committee on Climate Change, 2011



An electricity market for gas or for new low carbon technology?

The current electricity market favours investment in low capital cost, low risk plant such as gas power stations. It does not favour investments in high capital cost, potentially riskier technologies, such as renewables, nuclear and fossil power stations that use CCS. Government is currently seeking to reform the electricity market and the policies shaping it to

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address this issue. Through its electricity market reform (EMR) package it aims to get higher volumes of low carbon generation at a lower cost, by reducing some of the risks faced by investors and, therefore, the cost of capital required to finance new low carbon generation.

Reducing the cost of capital is particularly important for low carbon options because the majority of their costs are capital costs. Therefore, reducing the cost of capital is key to reducing the cost of low carbon power.

The main feature of the EMR package is a move from the Renewables Obligation to long-term contracts for all forms of low carbon electricity in the form of Contracts for Difference (CfDs) with the wholesale electricity price. The government would hand out contracts to operators of renewable, nuclear and CCS power stations which would guarantee that if the operator sells the electricity from their plant, the government would agree to top up the amount of money the generators receive up to an agreed 'strike' price.

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"One way of ensuring the UK achieves electricity sector decarbonisation is to ensure generous enough contracts are handed out."

One way of ensuring the UK achieves electricity sector decarbonisation is to ensure that generous enough contracts are handed out to ensure sufficient low carbon generation comes forward. This would crowd out the unabated fossil plants as low carbon generators with contracts should be able to bid into the market at lower prices. Unabated carbon plant would then run at lower and lower load factors, acting as back-up for times of low output from renewables. There are a number of problems with using CfDs alone to deliver decarbonisation, many of which are linked to the amount of gas plant built:

Political risk: The amount of money available for the contracts for low carbon generation may be limited on short-term cost grounds if there is ample capacity in unabated gas. Faced with other financial pressures, the Treasury may limit the number of contracts given out or reduce the strike price[3]. Therefore, if too much baseload gas plant is built, the case for paying for low carbon generation may be significantly reduced.

Offtake risk: Low carbon contracts will only pay if low carbon generators sell their electricity in the market. If lots of gas plants are built, this may blight the investment environment for the lifetime of the plants as investors may fear that low carbon generators will be unable to sell their electricity as the market is over-supplied[4]. This would increase the cost of capital to build these low carbon plants, and would reduce the number of low carbon generators actually built.

Delivery risk: There are delivery risks associated with all forms of low carbon generation. The UK may fail to keep up with the ambitious nuclear new-build rate envisaged by the CCC due to supply chain bottlenecks or problems insuring new plant. In this case, the default generator may continue to be unabated gas, which would put the achievement of carbon targets at risk. Our analysis shows that there is already sufficient gas plant in place (constructed, in construction, or with planning permission) not to require significant new investment in unabated gas before 2030.

Long-term costs: The more unabated gas plants are built between now and 2020, the greater the likelihood that electricity consumers will have to pay either a) to increase subsidy for existing gas plants by increasing the number of contracts to retrofit CCS, or b) to absorb the cost, through higher bills, of prematurely retiring unabated gas plants built in the 2010s. In view of the entirely avoidable nature of these costs, it seems unfair that the public should have to pick up the tab for short-term investment decisions made by the private sector.

The carbon floor price should also, in theory, drive baseload gas plants off the system so that they only run as back-up plant by increasing the cost of generation. However, there is a risk that generators may

choose to run as baseload and absorb the carbon floor price for longer than economic modelling based on levelised costs[5] would suggest if they have already recovered their capital costs. In addition, government may come under external pressure to deviate from the carbon price trajectory it has set (which reaches £70/tonne of CO_2 in 2030) if it is faced by pressure from industry to reduce the level of taxation it imposes on fossil fuel plant operators.

Given these risks, we considered a number of scenarios, outlined in table 1 below.

The role of gas in future generation scenarios

Our scenarios explore how using baseload, unabated gas to meet demand might put the achievement of the CCC's carbon budgets at risk. They also consider how much gas would need to fit CCS if new nuclear fails to materialise.

In 2010, there was around 27 GW of gas power capacity on the system[6]. 4 GW of new plant is under construction. A further 8 GW has been given planning permission. In the last year alone, the coalition government has approved 5.7 GW of new gas plant. In total National Grid currently predicts there will be around 45 GW of gas plant on the system in 2018[7].

The scenarios below explore the role of gas plant in a decarbonised electricity system in 2030 by showing how much baseload gas plant would be required to meet forecasted demand[8] under different scenarios, what this means for the need for new-build, and the resulting impact of unabated gas on carbon intensity.

Our scenarios are based on assumptions about the delivery rates of renewables and new nuclear set out in the CCC's *The renewable energy review*[9]. We assume that all existing unabated coal will be shut by environmental regulations by 2030.

We support CCS demonstration and are hopeful that coal CCS will be competitive before 2030, but we have not modelled its impact on these scenarios as any coal CCS would only exacerbate excess gas capacity and carbon intensity issues.

Even if only 40 GW of the 45 GW of gas currently expected to be on the system by 2018 is actually built, in our central forecast scenario, up to 16 GW or £10 billion of gas plant, may not be required. Taken together, the scenarios show that CCS will be required on a large proportion of gas plant in all scenarios for 2030, and that, with the exception of a major failure to deliver renewables and nuclear, there is no need to build new gas-fired generators in addition to those already planned. This calls into question whether investment in any further new-build unabated baseload plant is justified on either an economic or carbon basis.

Table 1: Electricity scenarios in 2030 and resulting carbon intensity

Scenario	Total baseload gas capacity required (GW)	Impact on new gas capacity to 2030 (GW)[10]	Capital cost of stranded assets[11]	Carbon intensity without CCS (gCO2/kWh)	Proportion of gas plant that would need CCS to meet target
Gas lock-in: no new nuclear, renewables at 2020 levels, gas fills remaining demand	55	23.5 GW of new baseload gas needed	–	302	95%
Central forecast: renewables and nuclear on track[12], gas fills remaining demand	16	16 GW of excess baseload capacity	£10bn	85	50%
Nuclear go-slow: renewables and half nuclear ambition, gas fills remaining demand	31	0.5 GW of excess baseload capacity	£300m	170	80%

Policy tools to avoid gas lock-in

Getting the right types of gas plants

Limitations to the rate at which we can scale up renewable electricity production will mean that a certain amount of baseload gas capacity may be required over the coming two decades. As the UK moves closer to 50gCO_2/kWh average emissions intensity, this gas capacity will need to consider whether it will retrofit CCS technology or only operate as peaking plant. In the period before 2020 the demonstration of CCS on both coal and gas power stations will be vital as a means of diversifying the UK electricity mix and enabling consideration of CCS retrofit.

However, much of the gas plant that has been given planning approval (12 GW, of which 4 GW is already under construction[13]), and a large proportion of the gas plant in planning (5 GW, most of which could be built by 2020[14]), is not likely to be able to retrofit CCS, despite being 'carbon capture ready'. This is because many of these proposed gas plants are geographically dispersed in the wrong locations, miles from likely storage sites in the North Sea.

> "While CCS still remains to be demonstrated at commercial scale, the UK is ideally placed to be a world leader in CCS."

Flexible gas power stations such as Open Cycle Gas Turbines (OCGTs) will be needed to provide back-up when the output of low carbon generators is low. OCGTs may be more flexible than CCGTs but are far less efficient and, therefore, more carbon intensive. New types of CCGTs coming onto the market may offer greater flexibility but are not currently the default option. Government needs to be careful to ensure the right type of gas plant is built in the right location, and that EMR does not create perverse incentives to run OCGT as baseload.

The EMR package also includes the introduction of a new capacity mechanism. The consultation document suggested that a targeted capacity mechanism that only rewards flexible power stations, such as OCGT, or demand-side measures would be the best option to ensure the grid can manage the introduction of high levels of intermittent wind generation. The government is currently looking at other options that would potentially reward all types of capacity, including baseload CCGTs, to address concerns about overall levels of spare generation in the system.

Depending on the level of the capacity payments compared to the wholesale electricity price, the capacity mechanism could have a strong influence on the level of reward given to different types of gas plant and may heavily influence which plants remain open or the type of new plants that look attractive to investors. It will be vital for the government to consider both the type and amount of gas plant it wants before it undertakes the detailed design of the capacity mechanism.

Need for gas demo, a CCS roadmap, and a smart EPS

Our analysis shows that even if the government's EMR proposals deliver the Committee on Climate Change's central scenario for nuclear and renewables, around half of all existing or permitted gas capacity would need to fit CCS to decarbonise the power sector at a pace compatible with meeting the UK's existing carbon budgets.

While CCS still remains to be demonstrated at commercial scale, the UK is ideally placed to be a world leader in CCS, and currently has seven projects bidding for finance from the EU NER300 funding mechanism. A strategy for decarbonising the UK power sector should proactively consider how both coal and gas CCS projects can be incentivised to come forward in the post-demo phase from 2020 onwards, helping to meet expected need for generating capacity while avoiding over investment in unabated gas plant.

In view of this, it is clear that the government's CCS strategy must include a CCS demonstration project for a gas-fired generator. Such a project is required if gas is to continue to contribute to a low carbon power sector, and to ensure that CCS technology is available for deployment and retrofit.

Simply demonstrating the feasibility of CCS in time to deliver CCS retrofits is not, however, sufficient. To maximise the deliverability of CCS, and to reduce costs, the government must develop a clear strategy for the widespread deployment of CCS. It must ensure that its CCS roadmap, to be published later this year, factors in gas. The roadmap needs to identify suitable areas for the co-location of power plants with industrial sources, as it is unlikely that future power station owners will invest in costly CCS infrastructure on their own.

Finally, a smart EPS designed to guide power sector decarbonisation in line with CCC advice by 2030 would send a strong, long-term signal to investors and power companies not to over invest in unabated gas. Such a regulatory driver would help to prevent the carbon risks posed by gas lock-in; reduce the cost of capital for CCS project developers provided with a clearer market opportunity; support investment in the green technologies and supply chains needed for decarbonisation; and limit the long-term costs of investing in the wrong sort of gas plant now.

Endnotes

[1] Setting out recommended levels of greenhouse gas emissions for the period 2023-2027

[2] Robert W. Howarth, Renee Santoro, Anthony Ingraffea. *Methane and the greenhouse-gas footprint of natural gas from shale formations.* Climatic Change, 2011; DOI: 10.1007/s10584-011-0061-5.

[3] This might occur for two reasons: if the costs of renewables or nuclear prove to be higher than expected in the run up to 2020, there could be a temptation to make over-optimistic assumptions about the cost of retrofitting CCS to existing gas plant, as these costs will only have to be paid in the future. It may be similarly tempting to make optimistic assumptions about the ability of other sectors to deliver low-cost decarbonisation some time in the future if electricity demand could be met through unabated gas generation.

[4] In a perfectly liquid wholesale market, most low carbon plant, such as wind, should always be able to sell its electricity as it has very low marginal costs. However, the large amount of vertical integration and low levels of market liquidity currently in the market make it far from certain that low carbon generators will be able to sell electricity, particularly in the face of high levels of investment in unabated new gas capacity. CCS operators will need to be more confident about how they can compete against unabated gas plant (factoring in both gas and carbon prices) in relation to the lifetime of the plant. Non-price measures may be needed to make CCS plant more attractive than unabated gas, for example, giving CCS priority in the merit order.

[5] in which capital cost is spread over the full lifetime of the plant

[6] DECC, *Digest of UK energy statistics* (DUKES), Power stations in the UK – operational at the end of May 2010.

[7] National Grid, National Electricity Transmission System (NETS) *Seven Year Statement*, 2011, p. 4.

[8] Based on a CCC forecast of electricity demand in 2030 of 456 TWh. This includes a reduction in demand for existing services but increased demand in other sectors due to high levels of electrification of heat and transport.

[9] Figures for electricity demand and delivery of new nuclear and renewables sourced from: Committee on Climate Change, *The Renewable energy review*, May 2011.

[10] Based on a 35 year lifespan for existing gas plant, and including only gas plant which was under construction or had received planning consent in 2010.

[11] Based on capital cost of new CCGT of 1050$/kW, Source: Mott MacDonald, *UK electricity generation update*, June 2010.

[12] Renewables and nuclear in line with the CCC's 40% scenario., *The Renewable energy review*, May 2011.

[13] 2011 National Electricity Transmission System (NETS) *Seven year statement*, table 3.4, retrieved from http://www.nationalgrid.com/NR/rdonlyres/5FC39DC5-A26A-4B70-8C0F-26730F36A720/46994/Charts_TablesChapter3.xls

[14] Ibid, table 3.4 and figure 3.10.

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