

Call for Evidence by DECC

“New gas generation strategy”

Summary

1. Gas is currently the largest primary energy source in the UK, providing significant heating and power generation. Although the UK was self-sufficient in gas production until 2003, in 2010 over half the net usage was supplied through imports..
2. The future cost and availability of gas will depend to some extent on the global discovery and development of unconventional gas sources. Although this is an established industry in the USA, it is only just starting in the UK and other countries, (especially China). The current inability of the US to export its significant production surplus as LNG, combined with low production costs, has produced a “gas bubble” locally in the US that may distort long-term expectations for global gas prices.
3. Use of Combined Cycle Gas Turbine (CCGT) provides the lowest capital cost fuel efficient generation proposition and is a highly proven technology to supply electricity. Open Cycle Gas Turbines (OCGT) are cheaper but are much less efficient and are generally used for peak generation only. The project lead time for construction of a new turbine installation is usually short. CCGT generation is therefore the clear ‘low risk’ candidate to fill any potential (near-medium term) gap in required power generation capacity caused by the closure of existing nuclear and coal generators together with uncertainties around new-build programmes for onshore and offshore renewables, nuclear and CCS. The uncertainties on these latter developments are linked to both economics (particularly the scale of capital required and the perceived risks on return compared to alternatives) and lead-time constraints (originating from a range of issues including planning, infrastructure, financing, technical and market risk).
4. Recognising the long-term need to mitigate CO₂ emissions from new-build CCGT plants the ETI see two potential technical solutions – retrofit of CCS capability or conversion to burn hydrogen rather than fossil gas. Consequently, locating new gas generation where CO₂ transport piping infrastructure would be problematic and choosing equipment without a defined upgrade path to burn hydrogen would block both of these routes to low carbon electricity production using CCGTs initially constructed without CCS. The grandfathering provision proposed under Energy Market Reform (EMR) requires such plant to be “capture ready”.
5. Based on total UK energy system cost, ETI analysis has gas and nuclear as the likely significant primary energy sources in the UK by 2050. Under this modelling gas represents a smaller proportion of overall supply than at present and a very much smaller proportion of power generation, with bio-energy, waste and renewables having a much larger share than at present. In the designs of most lowest-cost scenarios nuclear has a larger share than at present.

6. The ETI is developing a project to demonstrate an advanced CCGT post-combustion retrofit technology with significant capital and operating cost advantages compared to existing technologies. In addition the ETI has ongoing project work on a design basis for hydrogen safety in gas-engines and gas-turbines and is developing analyses of the likely future role of gas turbines in the UK generation mix to help identify the best approach to future-proofing new investments.
7. Although it makes economic sense to build gas power stations as an important and low capital element of generation capacity out to 2025, this should not be as a substitute for driving down the cost of offshore wind, building new nuclear plants and demonstrating fully commercial CCS operations. Our modelling work indicates gas turbines without CCS are not a viable long term economic option.
8. There should be a clear strategy to decarbonise these new gas plants by 2030 or very shortly thereafter. This strategy again should ensure that “capture ready” is a viable future technical and business proposition for each new asset, in order to provide investor confidence - including the infrastructure to transport and store captured CO₂ or alternatively (for plants designed for conversion to hydrogen fuel) to supply hydrogen.

Specific Issues

9. We believe anticipated UK onshore unconventional gas reserves are not likely to provide more than a modest fraction of future UK requirements. Unconventional offshore reserves have not yet been assessed. Therefore we anticipate UK production costs to be significantly higher than in the US and the technologies for accessing both onshore and offshore reserves will need to be developed and proven. The extent of the economically competitive reserves is therefore very uncertain.
10. The relative global prices of coal, gas, uranium, diesel, petroleum and other oil products will depend on a complex set of interactions. The extent to which countries adopt gas as a cheap and low-carbon fuel supply will be significant in the global supply-demand balance. The attractions of gas as a fuel for heavy land and marine vehicles provides an incentive for technology development and a potentially large new global demand pool.
11. The ETI is exploring natural gas as a low cost and low carbon fuel for heavier land and marine vessels. Although it may well be cost competitive, the costs of removing unburned methane from the exhaust gases may mean that the greenhouse gas benefits are limited. We are undertaking further work in this area to understand the consequences.
12. It is easy to envision a scenario where globally traded gas is a relatively cheap and secure fuel out to 2030 and sometime thereafter becomes rapidly more expensive. This would arise where the growth in demand overtakes the global capacity to develop new reserves cost effectively.
13. The relative levels of up-front capital currently required for different types of generation per unit of power generated (ie not nominal capacity) is approximately CCGT 100% (benchmark), Ultra Super Critical Coal with CCS 500%, Nuclear 600%, Onshore Wind 800%, Offshore Wind 1200%.

14. The total cost of electricity to consumers includes other factors, such as fuel costs, transmission costs to grid connection, operations and maintenance costs etc., (including mechanisms designed to reflect “carbon prices”). Capital charges will also reflect different required rates of return, depending on the perceived technical, policy and commercial risks of the technologies and also asset lifetimes (for example nuclear plants have much longer lives than CCGT plants). At a system level, variable renewables attract additional system costs for back-up capacity (beyond a modest level of penetration) and less flexible generators also incur system costs.
15. Only a small part of the future CCGT fleet is likely to be in constant base load operation by 2030 and the additional capital burden of the capture, transport and storage injection assets will more than double the capital charges per unit of capacity. At full utilisation we currently expect a CO₂ price of at least £70/Te will be required to retrofit CCS. Operation at lower utilisations and the impact of CCS on operating flexibility will require significantly higher CO₂ prices to drive retrofit in time to meet broader policy objectives.
16. Market uncertainties over the future generating mix, price setting mechanisms and changes in the pattern of demand caused by activities such as heating or transport electrification are especially problematic for investors in gas generation capacity. This is because whilst they are low capital cost units they have the highest marginal costs of generation (driven by high operating costs including fuel) and are therefore most exposed to capacity utilisation risk, for example being shutdown during periods of high wind production.

Responses

17. Gas generation is an attractive option in the short term for electricity supply security and cost, due to its low capital costs, short lead time for construction and the likely cost and security of gas supplies to the UK over the next twenty years. Modern CCGT plants produce less than half the greenhouse gas emissions of a modern USCPC coal plant. Nevertheless CCGT plants are still significant producers of greenhouse gases, with similar costs of carbon capture per unit of power to those for a coal plant (albeit with lower transport and storage costs). The development of the global gas market out to 2050 has a very wide range of possible outcomes and we should not succumb to over-optimism based on short-term low prices in the USA and the discovery of some unconventional reserves in the UK. At any realistic long term carbon price, ETI’s current modelling shows nuclear power as a more attractive strategic economic prospect for the UK than gas with CCS.
18. Although the capital costs for generating capacity are attractive for gas generation, the level of economic stimulus provided by nuclear plant construction is correspondingly greater. The ETI has not made a study of the differential GDP stimulus impact of nuclear and gas construction, but, as part of a linked national energy strategy and industrial strategy, this may represent an additional medium term advantage for nuclear plants.

19. Out to 2030 CCGT plants without CCS will provide a core of cost-effective electricity generation with medium greenhouse gas emissions. Beyond 2030 some of these assets can be expected to be retrofitted with CCS or converted to burn hydrogen (produced from coal, biomass or natural gas). The remaining CCGT and OCGT assets can be expected to be used for low utilisation reserve capacity or be decommissioned.
20. The barriers and costs to being “capture ready” for a gas generator spread well beyond the immediate facility. Hypothetically, if the government were to provide a comprehensive package of site specific policy, planning, regulatory etc. support to assist investors to be genuinely ready to retrofit CCS, this would reduce the risk loading on the capital investment.
21. The contribution of gas generation in the UK energy mix out to 2030 is to provide low capital cost generating capacity to fill the gap between uncertain demand (which current policy aims to reduce) and other generating technologies (which will increasingly benefit from mechanisms which reflect their lower greenhouse gas emissions). The expected operation of capacity support mechanisms will therefore determine investor appetite, since the capacity utilisation of any new asset is hard to predict and gas generation will be the lowest merit order plant. In this uncertain environment, even with the short lead time for investment, the chance of closely matching available capacity to actual demand is therefore low.