A framework for the development of clean coal

Response from:

- The Royal Academy of Engineering
- The Energy Institute
- The Institution of Chemical Engineers
- The Institution of Civil Engineers
- The Institution of Engineering and Technology
- The Institution of Mechanical Engineers

To the Department of Energy and Climate Change

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The Royal Academy of Engineering, The Energy Institute, the Institution of Chemical Engineers, the Institution of Civil Engineers, the Institution of Mechanical Engineers and the Institution of Engineering and Technology are pleased to submit a joint response to the Department of Energy and Climate Change's consultation on 'A framework for the development of clean coal'.

The response was formulated by consulting with experts in the field from all the organisations listed above as well as views expressed during a workshop arranged specifically to discuss this consultation. It deals mainly with the general engineering aspects of the consultation from a multidisciplinary perspective. Some of the organisations named above have also submitted complementary responses independently that cover issues specific to their own areas of expertise.

Introduction

1. In general, the engineering community sees a future for coal in both UK and global energy systems, with carbon capture and storage (CCS) an essential component of that future. The fact that agencies such as the International Energy Agency predict that coal will still hold a major share of the energy market over the coming decades highlights the need to find a way to limit emissions from coal fired power plants. CCS offers this possibility and, if successfully applied to coal fired plants, could also provide a way to reduce emissions from electricity generating plants fuelled by gas or oil or other large industrial installations.

2. The UK is currently in a strong position in the development of CCS technology along with countries such as the US, China, Germany and Australia. Indeed, the proximity to subsea storage sites in the North Sea gives the UK a unique advantage in certain aspects of the development of CCS. However, the UK does not have a good record of turning early technological advances into profitable businesses and, given the amount of investment being afforded to CCS in other countries, the UK runs the risk of falling behind if the Government does not push forward with its proposed framework as quickly as possible. The fact that the original Government competition for a CCS demonstration plant has still not announced a winner after more than 18 months highlights this concern.

3. In terms of potential employment opportunities, the majority of jobs are expected to come in the capture phase (around two thirds). These will be mainly in construction and will be essentially global and transferable within energy companies. The jobs created in the transport and storage phases will be more local but fewer in numbers, although they will be highly skilled with storage sites requiring detailed and long term monitoring. The UK must move quickly if it is to benefit economically from CCS and central to the economic development will be to build and sustain a supply chain for the emerging industry as well as the training of suitable personnel to work in the industry.

4. CCS has a major role to play both in terms of tackling climate change and in economic development and we support the Governments efforts to promote this crucial technology. With this in mind, the framework must be brought into effect with some urgency and it must show sufficient ambition to put the UK at the forefront of developing CCS – the technology, the skills, the infrastructure and the public acceptability. One way Government could show such ambition would be to commit to at least four full demonstration plants rather than ‘up to four’ partial demonstration plants.

Question 3.3 What are your views on the proposed objectives of the UK CCS demonstration programme, including the scale of individual demonstration projects? Please provide evidence to support your views.

5. We broadly support the objectives as laid out in the consultation document. All four objectives are important and make it clear that CCS cannot be considered independently of the wider economic and energy context. The main criticism of the objectives is that they are not sufficiently well defined or measurable. This could cause problems in the future when the success and impact of the framework is assessed. For example, it might be possible to rewrite the first objective ‘Advancing the global development of CCS

technology' to something much more specific such as 'X tonnes of CO_2 to be successfully captured and stored by Y'.

6. In terms of the different capture technologies, there is little doubt within the engineering community that the three which are closest to commercial deployment - pre-combustion, post-combustion and oxy-fuel - are all technically feasible on similar scales and timeframes. However, the specific engineering constraints mean that the optimum development path might be slightly different for each. For post-combustion, units of 400MWe would be the best route leading ultimately to a full 1600MWe plant. Pre-combustion IGCC projects would most likely wish to proceed at the 800MWe scale while for oxy-fuel, a smaller initial test plant followed by a full size plant would be favoured[1]. Each of these options could be built in around four to five years if planning consent and regulations are not taken into account. However, with EU funding being contingent on demonstration plants being operational by 2015, this would not leave much time for the UK framework to be put in place.

7. The original UK Government competition, in electing to focus on post-combustion capture technology, restricted the options of the companies considering applying. Now that the framework has increased the number of potential projects there is more flexibility in the choice of technology. It is important that industry is allowed freedom to choose the technology it would develop even though it will be difficult to design a funding mechanism that will suit each of the technologies equally well, although, the fewer restrictions imposed the more likely this would be.

8. Some clarification is sought as to whether the Government intends to specifically choose a range of technologies for the proposed demonstration projects. With up to four projects to be funded, it would be a simple matter to pick at least one from each of the main capture technologies. While this might appear to be an attractive option, it is important that the broader picture from Europe and the rest of the world be taken into consideration. It is not the UK Government's job to conduct the whole CCS experiment but to contribute meaningfully to a global drive to develop CCS.

9. Therefore, when bidding for funding, each company should make as strong a case as possible for whichever technology they prefer and the Government should make a decision based solely on that case. In the UK's case, cost, speed and export potential are perhaps more important criteria than an even split amongst the different technologies.

Question 4.1 Do you agree, in principle, that new coal power stations should be required to demonstrate CCS? Please provide evidence to support your views.

10. Whilst there is agreement in principle with the requirement that new coal power stations should be required to demonstrate CCS, in purely engineering

[1] It should be noted that the Government must be careful when using energy or power units as to whether they are talking about primary energy input or electrical output as there is a significant difference between the two. Due to thermodynamic and other losses a power station rated at, for example, 600MWe requires a boiler with a significantly higher thermal rating. It is the rating of the boiler that the CCS part of the plant must be rated against rather than the electrical output as it is during the combustion that the CO_2 is released.

terms there is no particular reason that all new coal plants should be required to do so in terms of the overall objectives of the framework. Indeed, with the looming energy gap and the need to diversify energy supplies, consideration must be given to the whole energy system moving forward. What is most important is that the maximum potential is gained from each site in terms of cost and development of CCS and that the energy system is developed in a secure and cost efficient manner while continuing to reduce the overall carbon intensity of the grid.

11. Requiring retrofits of CCS to all plants within a limited time from when the technology is proven is a concern. It will likely place a step load on what will be relatively undeveloped supply chains, resulting in substantial price pressure and the possibility some plants may have to shut down whilst awaiting fitment. We would recommend that this is softened to allow agreement of the timing of retrofit based on best procurement value.

Question 4.6 Do you agree, in principle, that there should be requirement to retrofit? Please provide evidence to support your views.

12. The issue of retrofitting brings up a number of difficult engineering considerations. Not all plants lend themselves to being retrofitted as easily as others. This will also be dependent on which of the technologies is first to be proven. For example, if post-combustion technology is shown to work ahead of the other capture technologies, will a gasification plant be expected to be retrofitted with this technology and, if so, how will this affect its operation? Similarly, it would be difficult to fit a gasification unit to a plant originally designed to run on pulverised coal.

13. Gas should not be ignored and requiring all new gas powered plants (consented after a certain date) to be capable of future conversion to hydrogen or syngas as well as being built ‘capture ready’ would increase the options available for retrofitting and carbon reduction.

Question 4.7 What are your views on the criteria that should form the basis of an assessment of when CCS is technically and economically proven? Please provide evidence to support your views.

Question 4.8 Do you agree that the Environment Agency should be tasked with assessing when CCS is technically proven? Please provide evidence to support your views.

Question 4.9 Who do you think should be tasked with judging when CCS is economically proven? Please provide evidence to support your views.

14. The capture technology will be able to be technically proven ahead of the storage phase as the viability of the geological storage sites will require longer time periods to verify their effectiveness. For the capture technologies, what will be required will be for the equipment to be operational for a specified running period at a pre-defined performance standard. This performance standard should be set by the operating company when making their application for funding and should meet a minimum level set by Government. Existing agencies such as the Environment Agency should be capable of carrying out the monitoring; there is no need for a new independent body to be established to carry this out. However, whichever body is tasked with this must be properly resourced and technically competent.

15. One of the main criteria for CCS to be technically proven must be that the full chain of CCS has been shown to work. This is one of the major unknowns on which the demonstration plants need to provide information as all the individual parts of the chain have already been show to be feasible, although there are also scaling up issues which need to be dealt with. However, with capture technologies potentially taking around a year to be considered technically proven but storage taking longer (eg it will be some years or decades before injection finishes and site closure experience is gained) the criteria will need to be designed so as not to slow down the development of any of the parts of the chain.

16. The first phase of demonstration plants may not require strict performance standards from the outset. A more flexible grey scale may be preferable that tightens the emissions restrictions over time as what is required most from the first raft of demonstration plants is answers about how to scale up the technology for later phases.

17. The terms economically proven, economically attractive and commercially viable are all related and difficult to pin down. In essence, CCS could be said to be economically proven if the plant along with the funding mechanism is commercially viable in the local energy market. The EU ETS will clearly have a large role to play in this but it is feared that the ETS will not provide a sufficiently high carbon price fast enough or with enough certainty in order make CCS an attractive investment option. When considering the economics of CCS it is important to compare the costs and support mechanisms for other low carbon technologies. For example, the cost of ROCs associated with offshore wind is considerably higher than the proposed levy scheme for CCS both in scale and in terms of cost per tonne of CO_2 sequestered.

Question 4.13 Do you agree, in principle, that there is a need for a contingency measure? Please provide evidence to support your views.

Question 4.14 Do you agree that decisions about the introduction and design of any contingency measure should be subject to an independent review that would report in 2020? Please provide evidence to support your views.

Question 4.15 Which aspects of any contingency should be defined through a review, and which should be defined now? Please provide evidence to support your views.

18. While the need to continue to reduce carbon emissions from electricity generation is well understood, the case for additional contingencies for coal powered plants is less clear. The majority of people from the CCS engineering community fully expect that CCS will be shown to be viable in the near future and few generating companies expect to be able to build and operate an unabated coal fired power plant.

19. Imposing stringent contingency measures, while providing the Government with an extra safety net, may increase the perceived risk for companies and stop them investing in CCS despite the Government funding, instead favouring new gas powered plants that do not carry the same restrictions. Thus, there is a delicate balance to set between the framework's incentives and contingency measures.

20. An additional point concerning contingencies is their relationship with the EU ETS. There is danger that, if stringent contingency measures are imposed on coal fired power plants requiring them to emit less carbon than would be allowed under the ETS, the difference would result in ETS credits that could then be sold in Europe to any participating industrial sector. Thus, the additional carbon savings would simply be emitted somewhere else and no advantage would be gained in terms of tackling climate change.

Question 5.1 What are your views of the proposed mechanism for providing financial support to CCS demonstration projects? Does it strike the right balance between attaining value for money from public funding while addressing the needs of potential investors? Do you agree with our initial view that a CfD is the most appropriate model for a disbursement mechanism? Please provide evidence to support your views.

21. Overall, there is general support for the Government's preferred CfD levy scheme but the desire that the mechanism be kept as flexible as possible in order not to give preference to any of the technologies

Question 6.2 What are your views on how can we best ensure that CCS business clusters are encouraged, maximising the future opportunities for UK business? Please provide evidence to support your views.

22. With only up to four demonstrations planned in the UK, the scope for developing clusters of CCS development is seen as being limited. However, the Government needs to be looking forward to where the UK should be in 2030. The UK is well placed to exploit storage sites in the North Sea that could be used by CCS projects throughout Europe, although with assets in the North Sea already coming to end of their life span there may be a narrow window of opportunity to utilise these natural resources.

23. Serious consideration should therefore be given to developing trunk pipelines to transport the CO_2 to these sites. This work may not be utilised until the second phase of CCS development but work could start now that could set the CCS industry on the right path for the future.

24. Consideration should also be given to how CCS clusters could be developed to the advantage of the wider energy system. CCS clusters could provide ready supplies of syngas and waste heat which could, if managed correctly, be utilised locally by other industries and services as well as the electricity generation sector.