# 2020 Vision – will the 2010 Energy Bill be enough to get CCS where it needs to be by the end of the next decade, and beyond to 2030?

A memorandum to the Energy Bill Committee

Jon Gibbins and Stuart Haszeldine,

Scottish Centre for Carbon Storage, University of Edinburgh, 9 December 2009

**Summary**

The financial support for carbon capture and storage (CCS) proposed in the 2010 Energy Bill is very welcome, but should be extended to power plants fuelled by natural gas and biomass alone, as well as to the currently specified plants fuelled by coal and biomass co-fired with coal. The full decarbonisation of the electric power sector by 2030 recommended by the Committee on Climate Change is likely to require progressively greater numbers of individual fossil power plants to be fitted with CCS between 2020 and 2030. Many of these units will be gas fired, so reference CCS plants for gas must be in place before this transition can properly be planned. The principle of CCS on biomass, which effectively removes $CO_2$ from the air, should also be encouraged.

1. The proposed 2010 Energy Bill (EB 2010), for the first time, offers support for multiple Carbon Capture and Storage (CCS) projects as a way of accelerating commercial scale deployment in the UK. This is a very welcome correction of an inherent market failure in the EU Emission Trading Scheme when it comes to introducing new low-carbon technologies. But is it sufficient to get CCS to where it needs to be in 2020 - and beyond?

2. The key clause in EB 2010 is the following:

> ***4 Electricity supply levy***
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> *(1) The Secretary of State may by regulations provide for an electricity supply levy to be charged in connection with provision of financial assistance—*
>
> *(a) in respect of CCS demonstration projects, and*
>
> *(b) in respect of additional CCS use at demonstration stations.*

This clause can make top-up funding available to compensate for a low and uncertain carbon price and an inevitably-higher cost for ground-breaking early CCS projects. If it was left to the market alone these leading projects would probably not be started until well after they were needed for initial 'learning by doing' technology development within the UK. Instead learning would be imported, to the extent that this is feasible, at a much later date from North America and possibly from elsewhere in the EU and the Middle East. The UK would become a follower, not a leader, potentially making it both harder and more expensive for UK society to deploy CCS effectively as part of the UK's $CO_2$ emission strategy in support of global efforts to minimise the risk of dangerous climate change. It is absolutely critical that primary legislation to enable such funding is in place as soon as possible – and certainly before the turmoil of an election and its aftermath – so that ongoing long-lead commercial-scale projects that are an essential stage in the technology development/innovation path can make timely progress. Time lost now will be un-recoverable.

3. But, welcome as the Bill is, while the main clause talks of CCS in general the later clauses state that support for CCS is limited to coal projects.

> *(4) For the purposes of this section—*
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> *"carbon dioxide" includes any substance consisting primarily of carbon dioxide;*
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> *"commercial coal-fired electricity generation" means generation of electricity, on a commercial scale, by generating plant that is powered—*
>
> *(a) by coal, or*
>
> *(b) by coal and biomass.*

4. This is despite the Explanatory Notes for the Bill correctly identifying that *CCS could reduce the carbon dioxide emissions from a range of industrial processes, including coal-fired and gas-fired electricity generation, by around 90%.* It is obvious why a bill dealing with an electricity levy would not cover CCS on non-electricity fossil fuel industrial processes, but it is less clear

why it omits the option to cover CCS on natural gas power plants (and, in principle, also on biomass-only plants to achieve negative emissions, i.e. capture and burial of carbon dioxide arising from combustion of biomass, producing a net reduction of atmospheric carbon dioxide). Consequently, it is recommended that the body of Section 4 in EB 2010 adds additional fuels as follows:

(c) by natural gas or by other natural or manufactured[1] gaseous fuels, or

(d) by biomass, or

(e) by any other liquid or solid fuel[2].

This would enable CCS demonstration projects to be incentivised on the full range of plant types generating electricity without further primary legislation. It might also be useful to say '*generation primarily of electricity'* so that power plants supplying district heating, for example, would feel confident in being eligible for funding.

5. Provided that most or all other low-carbon generation capacity additions, and electricity end-use demand reductions, are delivered by then as planned, CCS on gas power plants is unlikely to be needed to achieve Committee on Climate Change targets for 2020. Gas fired plant, however, currently contributes over thirty percent of UK electricity supply, and around 10 GW of new gas plant is currently under construction or planned. Most of these units will still be commercially operational after 2020, while the building of new coal generating capacity before and after 2020 is still uncertain, so it is probable that gas fired plant will be the source for a major part of UK power-sector emissions of fossil carbon dioxide in the 2020s and beyond.

6. The Committee on Climate Change suggests that, for the entire UK electricity fleet (i.e. an average of all generation sources, fossil and non-fossil) an overall electricity emission intensity of 70 $gCO_2$/kWh or less will be required by 2030 (compared to an average value of around 500 $gCO_2$/kWh now). This implies that fossil fuel plants should on average be emitting around 100 $gCO_2$/kWh, with the lower UK fleet average resulting from the inclusion of renewables and nuclear as very low carbon options. Individual gas power plants will emit of the order of 350 $gCO_2$/kWh at full load, but significantly more if they are running at part-load or varying load to compliment and support wind-generated electricity. Even gas-fired CHP plants can only approach an electricity emission intensity of 200 $gCO_2$/kWh, and then only for ideal operating conditions and location with full heat/electricity matching and with an acceptance of an accompanying $CO_2$ emission from heat production. It is clear, therefore, that any gas power plants running for extended periods in 2030 (as well as coal plants) will need CCS in order to achieve emissions of 100 $gCO_2$/kWh or less[3].

7. The questions are: 'how to get from unabated natural gas in 2020 to CCS as the norm on all fossil power generation in 2030?'; and also 'how to deal with existing coal and gas plants?'. For all capture-ready plants, i.e. including all gas, coal and biomass plants over 300MW output permitted since 2009, it seems the best approach would be to retrofit a progressively larger number with capture equipment treating all of the flue gases (or all of the potential carbon emissions using pre-combustion or oxyfuel methods) and achieving around 90% capture or higher. Also new fossil fuel plants built after 2020 would logically be designed for this level of capture from the outset.

8. This progressive adoption of full capture is suggested because it is neither technically feasible nor economically efficient progressively to decrease the emissions limit on an individual power plant in small steps from a value that can accommodate the range of natural gas plant operation without CCS (so in the region of 500 $gCO_2$/kWh) until 2030 (or other

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[1] The reference to any other gaseous fuel is needed to cover the possibility of synthetic gas being produced from coal, pet coke or biomass, and that should not be argued to be omitted between the definitions.

[2] This reference to liquid fuel is needed because many coal and biomass plants are likely to burn oil during a start-up period and possibly also for safety reasons during periods of low output. Also some natural gas plants may burn liquid fuels instead of natural gas as a backup fuel if gas supplies are interrupted. Additional fuels, such as petcoke, tar, refinery wastes, or processed municipal refuse or sewage, may also be used in future power plants. Differentiating between $CO_2$ originating from different fuels would increase the complexity of delivering support for CCS and is not likely to be desirable from an environmental standpoint.

[3] It is premature to make more detailed emissions specifications at the level of individual CCS plant, because of the lack of commercial experience in operating coal or gas or biomass plant with CCS and at varying load.

target date) when low emissions from an individual plant, of perhaps 100 $gCO_2$/kWh, are the norm. So in the period 2020 to 2030 an overall $gCO_2$/kWh Emission Performance Standard (EPS) could also apply to the whole UK fleet of fossil fuel power plants, acting as a driver for a technology transformation on an increasingly-large number of plants[4].

9. An essential adjunct to such a driver would also be a way of sharing the burden of CCS costs across all the fossil generation in the fleet, with retrofit directed to the lowest cost available opportunities where possible to reduce the overall burden. Therefore at some future stage, attention needs to be directed towards more specific planning and enabling of inter-plant trading during this decade of transition.

10. As already noted, for existing non-capture-ready plants, it is clear that special measures will be required if they do not wish to retrofit CCS but some capacity from these plants is to be retained in the system for a specified period of time to ensure security of supply during periods of peak demand until replacement capacity is built. Assessing what these measures might be requires a detailed examination of the make-up of the fleet and how it may evolve in the next decade or so. In general, though, other market (and regulatory) forces may tend to encourage much of the now-existing UK coal plants to close anyway over this period and many existing, older and less efficient, natural gas plants will be encouraged to move to peaking or emergency duties. (Although not a CCS matter, it is possible that additional ways to support these 'emergency backup' plants will be required as well as the prospect of them receiving perhaps extremely high, but uncertain, electricity prices during periods of high demand and/or constrained electricity supply.)

11. These are only tentative outlines, however, for the 2020 to 2030 transition. The nature of regulation to drive the transition, and possible interim corrections, will depend on a number of factors, including:

- Other low carbon electricity capacity construction such as nuclear, onshore and offshore wind, other renewables and related grid connections;
- Progress in implementing electricity demand side management (DSM) and also electricity and heat storage capacity;
- Developments in the UK and EU electricity markets and the number and capacity of further interconnectors that may be built; and
- International and EU climate change policy and regulations.

But in this uncertainty fossil fuel, and particularly gas, is in effect being used as a *de facto* insurance policy to keep the lights on if other options fail to deliver – and ensuring that CCS is developed in time for widespread roll-out from around 2020 is, therefore, the insurance policy to make sure that the UK $CO_2$ emission targets set by the Committee on Climate Change are met.

12. So coming back to EB 2010, in this context it is very important that clarity exists on how CCS can be implemented on natural gas plants well in advance of 2020 so that the 2020 to 2030 transition process can be planned. It might be argued that this will be covered by adapting technology applied in coal capture demonstration, or that natural gas capture technology will be developed elsewhere, but these are not reliable options. Actual reference plants to validate the specific application are an essential precursor to routine deployment in the electricity industry, so there will be a delay in transferring and demonstrating technologies that only have coal reference plants.

13. With respect to technology demonstration elsewhere, conditions are most relevant in Norway, but low demand there for fossil power may hinder rapid development of gas-CCS at scale. Conditions elsewhere in the world where gas with CCS is being discussed, notably the Middle East, are rather different with respect to ambient conditions and gas and $CO_2$ prices, so optimum technology approaches may also be different there.

[4] Plants which are required only for short-term duties, with a maximum number of hours per year, might become subject to less stringent emission standards; this principle is already established practice and is currently planned to be continued for SOx and NOx in the forthcoming EU Industrial Emissions Directive (COM 844, Dec 2007), which could also be extended to include $CO_2$ emissions.

14. Our conclusion, which is also consistent with the recommendations of the DECC Advisory Committee on Carbon Abatement Technologies[5] (ACCAT) is, therefore, that it would be prudent not to rule out the possible inclusion of natural gas CCS demonstration projects from the outset in the wording of EB 2010. Such an option might be seen as worth exercising if, after due consideration of the complex issues involved by stakeholders such as DECC and the Committee on Climate Change over the next year or so, it was determined that CCS on natural gas had to be demonstrated before 2020 in order to provide a sound basis for a 2020 to 2030 transition to a decarbonised electricity system.

[5] For more information on ACCAT, including copies of their reports, see: http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/emerging_tech/carbon_abate/carbon_abate.aspx