The race is on to capture the carbon castle

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January 07 2010
*By **Jon Gibbins and Hannah Chalmers***

It is not surprising that a Bill to support Carbon Capture and Storage (CCS) is only now making its way through Parliament; unlike renewables, CCS did not receive serious political attention until the UK's G8 Gleneagles initiative in 2005. If left to the market alone, it will take many more years to become a viable tool for tackling climate change. But the Energy Bill provides for four large-scale first-of-a-kind CCS demonstration projects, each 300-400MW, around the same amount of low-carbon electrical energy over a year as the London Array wind farm.

Importantly, it will also support additional capture later at the same sites to allow CCS on the whole power plant, giving reference projects for future deployment. Large offshore wind farms would not happen without subsidies and, even though they may turn out to be a little cheaper, neither will early CCS projects. The Energy Bill, if passed, together with its associated secondary legislation, clears a significant hurdle in the race to open up options to reduce CO_2 emissions from electricity generated from fossil fuels.

The critical point to reach by 2020 is having some early reference projects for CCS roll-out in the UK and globally — full-scale power plants reliably treating all of their flue gas with technology that is sound enough to replicate in large numbers, combined with demonstration of both large-scale CO_2 transport and storage.

The Energy Bill would achieve this by allowing a first stage of learning-by-doing on the initial 300-400 MW demonstration projects, followed by a second stage, when the now-improved capture technology is extended to the whole power plant, to give full-scale CCS reference projects. To save a number of years in this progression it is important that CO_2 transport pipes are sized for the whole power plant, and possibly additional CO_2 from other nearby sources, from the outset. The programme will also have to be supported by a legal and regulatory framework and backed with a strong political commitment

Early action by the UK is important because very few countries have yet moved fast enough on CCS to get the necessary funding and enabling legislation in place. The USA has now allocated some stimulus money for CCS, but still has no climate bill to establish a way of paying for CCS. The EU has a modest amount (about €1bn) of stimulus money for CCS and some additional measures under development for funding perhaps 10-12 commercial-scale demonstration projects but, because it is much more crowded than the USA, has had 'not under my backyard'-ism causing difficulties in deploying what could have been leading CCS projects in Germany and the Netherlands.

So the UK, with its mature coal and gas generation sector and its long North Sea coast and old oil and gas fields — and our much larger offshore regions of saline rock formations which don't hold extractable hydrocarbons but which may be just as valuable for their pore space in the future — is placed in a position where it can act on commercial-scale CCS more quickly than any other EU member.

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Several studies have shown that the UK deep offshore holds a vast storage potential, perhaps enough to store 100 years of emissions from all power plants in NW Europe (Figure 1). Selling UK storage capacity which is proven and licensed as an EU asset may be worth €5bn a year for 50 years if developed efficiently. An essential first step is to evaluate UK storage in more detail using actual CO_2 injections at a number of different sites, but this cannot be done without a demonstration programme to supply the CO_2.

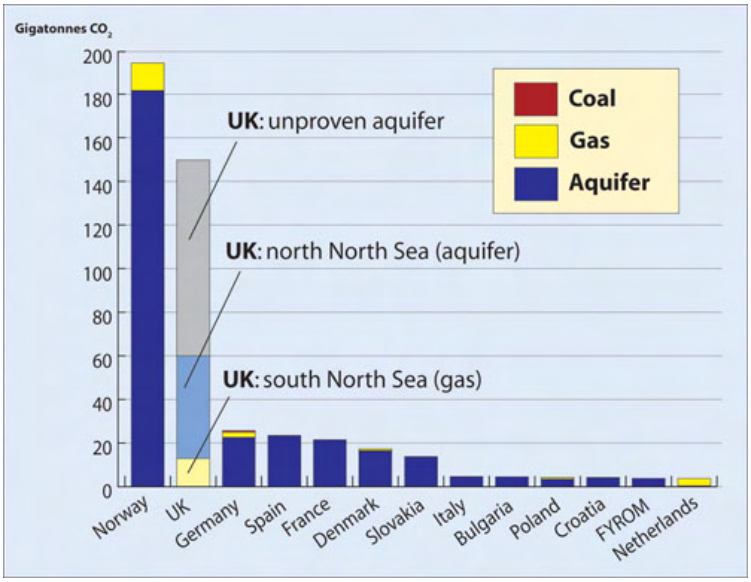

*Figure 1: **CO_2 storage capacity in top 13 states in and around EU.** Mid-ranged capacities used from EU GeoCapacity FP6; compiled by S. Haszeldine, Scottish Centre for Carbon Storage.*

The type of UK CCS project that may immediately come to mind is one to 'clean up' coal — as proposed for conventional coal-burning power plants at Kingsnorth in Kent or Longannet in Scotland, or coal gasification plants as at Hatfield Colliery in Yorkshire. But CCS is a lot more than a way of keeping coal in the UK energy mix — or of keeping Greenpeace out of coal-fired power stations.

The UK is likely to be heavily reliant on gas in 2020 under most, if not all, plausible scenarios for the development of the electricity mix in the next decade, so to decarbonise electricity CCS will be required on gas as well. The Bill should be extended to cover CCS on power plants fuelled by natural gas to prepare for this. A tonne of carbon dioxide from a gas plant increases the risk of dangerous climate change just as much as a tonne of CO_2 from a coal plant — even if it does comes with twice as much electricity.

This need to tackle emissions from natural gas is also related to our suggestion not to include an Emission Performance Standard (EPS) in the current Bill. Amendments have been suggested specifying that 'new coal fired power stations will produce no carbon emissions from 2020' (Lib Dem) or allowing the Secretary of State to place 'a restriction on the amount of carbon dioxide that [all] electricity generation plants are permitted to emit' (Con).

But with respect to new coal plants, the Secretary of State would appear already to have powers to specify future levels of emissions, appropriately taking into account any site and technology-specific factors, as part of the contractual conditions for supporting CCS demonstration/reference projects.

With respect to an EPS that would cover all new fossil fuel (i.e. gas and coal) power plants and also the existing fleet the situation is, however, more complex

and legislation is probably premature. Natural gas power plants currently achieve around 350 gCO_2/kWh at full load, but will emit more when running at varying load to back up wind. Even gas-fired plants in a CHP scheme under the most ideal conditions can only achieve 200 gCO_2/kWh.

The question for a generally-applicable EPS is how to make a transition from unabated natural gas being the norm in 2020, and hence a limit of about 500 gCO_2/kWh, to CCS on all fossil power generation being the norm in 2030, with plant-level emissions of about 100 gCO_2/kWh.

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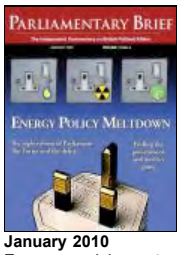

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It is not practicable progressively to decrease the emissions from an individual power plant in small steps between these two levels; once the technology is reasonably well-developed, a plant should either have full CCS or none. So between 2020 and 2030 the best approach appears to be to apply a decreasing EPS to the whole UK fossil fleet rather than to individual plants.

The fleet-average emissions would then be reduced as progressively more individual plants achieve 100 gCO_2/kWh or less by fitting full CCS. This in turn would require a mechanism to share the costs of CCS fairly across the whole fleet (and also presumably to encourage early adopters to some extent). Special transition arrangements might also be necessary, to deal with natural gas and coal plants built before regulations came into force in 2009 that require all new CO_2-emitting power plants above 300MW electrical output to be 'capture ready'.

Future European legislation, the Industrial Emissions Directive, on emissions to atmosphere from power plants will probably also be extended to CCS by the 2020s. If the UK has demonstrated CCS then this will have a powerful influence on shaping any new EU regulations, as well as ensuring UK industry is well-prepared for the change.

So, because of the number of factors that need to be considered in CCS legislation and regulations to cover the 2020 to 2030 transition, we suggest that the Energy Bill remains focussed on delivering a fast-track programme to full scale CCS reference projects by 2020. Specifically, legislating for EPS at this stage, when the detailed values and effects on individual plants and on the electricity industry as a whole are so poorly understood, brings in additional contention and risk that does not appear to be justified by an overwhelmingly urgent need.

Providing timely support for UK CCS demonstration and reference projects with the Energy Bill is, however, a crucial step in achieving a fully decarbonised energy economy in the UK, and also globally. If the EU, led by the UK with its extensive offshore sub-sea storage, and the USA and other OECD countries with less-populated, out-of-town onshore storage locations, don't lead on CCS, then who will? China has the technical ability to, but it almost certainly won't. However, once putting fossil CO_2 securely back underground instead of releasing it into the atmosphere starts to become the norm for advanced economies — then China will almost certainly join in.

Recent events in Copenhagen have emphasised how early UK reference CCS projects could help to encourage the world as a whole to start on a path that is ambitious enough to avoid dangerous climate change.

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Feedback

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