



Carbon capture and storage: additional background

Standard Note: SN/SC/6136

Last updated: 23 March 2011

Author: Louise Smith

Section Science and Environment Section

Carbon capture and storage (CCS) is a new, developing, technology that would capture the carbon dioxide (CO₂) from fossil fuels either before, during or after combustion in energy generation. The CO₂ would then be transported and stored long-term in underground geological formations, such as saline aquifers and depleted oil and gas reservoirs.

Despite legally binding targets to reduce greenhouse gas emissions, in 2008, [91.5% of UK energy supply](#) was met by use of carbon-intensive fossil fuels. About [a third](#) of UK electricity is generated from coal, but it emits [more CO₂ per unit of electricity](#) than all other forms of generation: [roughly twice](#) that of an equivalent gas-powered station. Tackling emissions from coal is therefore seen as a priority for the UK, and also in India and China where coal consumption is increasing rapidly.

Approximately 90% of the CO₂ produced by a coal fired plant could be captured with CCS. CCS could help to make up to [20% of the global cuts](#) in emissions needed by 2050.

There are however, some concerns about CCS: it is not yet proven on a commercial scale; transportation of the CO₂ will require a whole new infrastructure; capturing the CO₂ reduces the efficiency of power plants by approximately [20-25%](#). The cost of CCS and its associated infrastructure are uncertain. Industry requires significant financial support or some other form of carbon reduction incentive to make the technology commercially viable. Support for CCS could also deter investment in other low carbon energy technologies.

In Budget 2007 a [competition](#) was announced for government funding for one post-combustion CCS demonstration plant, originally due to be operational around 2014. There is now only one entrant left in the competition: the Scottish Power consortium at Longannet in Fife. Completion is expected in 4-6 years time. A process to select for a further three demonstration projects is due to be announced later in 2011. In November 2010 it was announced that one of these latter demonstrations could be a gas CCS project.

This note sets how CCS might work, along with some of the concerns. It also outlines Coalition Government proposals for an emissions performance standard on coal-fired power.

This information is provided to Members of Parliament in support of their parliamentary duties and is not intended to address the specific circumstances of any particular individual. It should not be relied upon as being up to date; the law or policies may have changed since it was last updated; and it should not be relied upon as legal or professional advice or as a substitute for it. A suitably qualified professional should be consulted if specific advice or information is required.

This information is provided subject to [our general terms and conditions](#) which are available online or may be provided on request in hard copy. Authors are available to discuss the content of this briefing with Members and their staff, but not with the general public.

Contents

1	Why CCS?	3
1.1	Coal trends and the present fuel mix for generation	3
2	The technology	5
3	Concerns about the technology	5
3.1	Capture	5
3.2	Transport	6
3.3	Storage	6
3.4	Cost of capture	7
3.5	Reliance on coal	8
4	Clusters	8
5	European law	9
6	Encouraging development of CCS technology	9
6.1	The first demonstration project	9
6.2	Further action and future competitions to develop CCS	10
6.3	Source of finance for CCS demonstration	12
6.4	Planning permission for coal-fired plant	13
6.5	CCS on gas-fired plant	14
7	An Emissions Performance Standard	14
7.1	Political party debate about an EPS	14
7.2	Coalition Government proposals for an EPS	16
	The two proposed levels	16
	Coverage of the EPS	17

1 Why CCS?

Against the background of a legally binding target for greenhouse gas reductions of at least 80% by 2050, the UK needs urgently to find ways to reduce the carbon emissions from fossil fuels. In 2008, 91.5% of our energy supply was met by fossil fuels (coal, oil and gas)¹. It has been estimated that CCS could contribute up to 20% of the cuts needed in greenhouse gases by 2050.² This would require storage of over 10Gt (gigatonnes) CO₂ per year.³

Quick coal info

- In 2009 the UK produced 17.9 million tonnes of coal; we imported 38.2 million tonnes, principally from Russia, South Africa and Columbia.
- In 2008, the UK consumed approximately 35.4 million tonnes oil equivalent (toe) of coal; India 231.4 million toe and China 1406.3 million toe.
- The IEA predicts that by 2030 China's coal demand will nearly double, with India's demand to more than double.

Coal provides about a third of the UK's electricity, but emits more CO₂ per unit of electricity produced than all other forms of generation: roughly twice the CO₂ of an equivalent gas-powered station.⁴ Coal is still a popular choice of fuel and many countries, particularly developing countries such as India and China, still hold reserves of it in abundance. Coal provided 41% of the world's electricity in 2006 and provides about a third of the UK's electricity.⁵ Estimates suggest that world demand for coal-fired generation will increase by 70% over the period to 2030.⁶ Tackling emissions from coal power stations is therefore seen as a priority.

It is anticipated that at least 90% of the CO₂ produced by a coal fired power plant could be captured and stored using CCS.⁷ CCS may therefore allow continued use of fossil fuels, in spite of any requirements to lower greenhouse gas emissions from electricity.

CCS could also contribute to ensuring a diverse energy mix and could create economic development opportunities for the first country or region to demonstrate the technology. The first mover advantage gained from the demonstration programme, could win the UK business worth about £3–6.5bn a year by 2030 in the supply of fossil power generation equipment with CCS.⁸ The CCS industry is also estimated to sustain up to 60,000 jobs in Britain by 2030.⁹

1.1 Coal trends and the present fuel mix for generation

Internationally, coal provides some 40% of the fuel for electricity generation, and that proportion is likely to rise, as fast-growing economies such as India and China depend heavily on coal.

¹ HC Deb 16 March 2010 c 797W

² [HHC Deb 7 January 2010 c261](#)

³ Department for Energy and Climate Change, [HClean coal: an industrial strategy for the development of carbon capture and storage across the UKH](#), March 2010, p5

⁴ HC Deb 28 January 2010 c 339WH and Parliamentary Office of Science and Technology, Carbon Footprint of Electricity Generation, Number 268, October 2006, p

⁵ Department for Energy and Climate Change, [HGovernment Response to the House of Commons Environmental Audit Committee Report: Carbon Capture and Storage \(CCS\)H](#), August 2009, p6

⁶ HC Deb 28 January 2010 c339WH

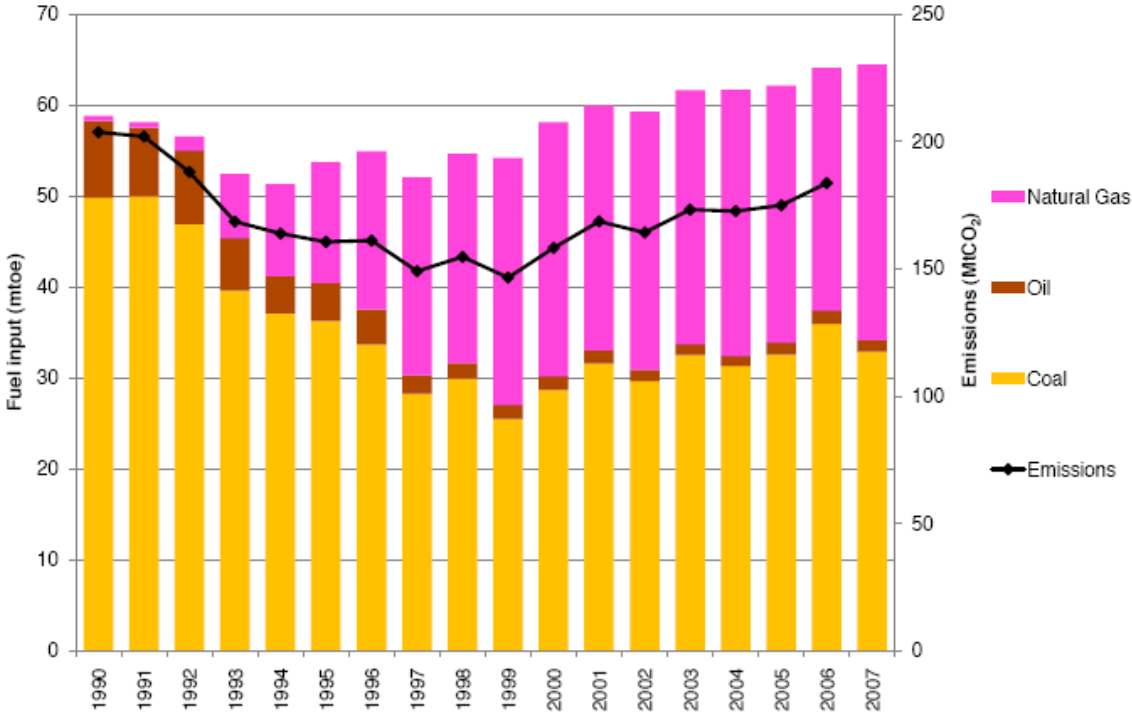
⁷ IEA Clean Coal Centre, [Flexible Operation of Coal-Fired Power Plant with CO₂ Capture](#), January 2010, p5

⁸ Department for Energy and Climate Change, [HClean coal: an industrial strategy for the development of carbon capture and storage across the UKH](#), March 2010, p16

⁹ HC Deb 28 January 2010 c 343WH

The most striking development in the generating capacity in recent years has been the ‘dash for gas’. During the 1990s, gas grew from a very low base to be the biggest source of electricity in the UK. By 2007 natural gas was generating 43% of the electricity supplied in the UK, a development largely driven by cost. During the 1990s, gas, along with oil, was generally cheap and the UK had abundant reserves. Added to the low price of the fuel was the speed and low cost of constructing gas-fired power stations. However, with the rise in oil prices after 2000 and subsequent volatility, the price advantage of gas was no longer clear; UK demand for coal rose somewhat over the last couple of years as gas prices spiked along with oil prices. Coal use has fallen back since then as gas prices have moderated. The unpredictability of fossil fuel prices is a big problem for electricity generation.

Fuel input for electricity generation and CO₂ emissions since 1990



Source: DUKES *Long Term Trends*, NAEI (2008), quoted in *Building a low-carbon economy – the UK’s contribution to tackling climate change*, Committee on Climate Change

The availability of subsidies can also have an impact on costs for the sector. Until the end of 2002, coal mining operations could apply for state aid under the UK Coal Operating Aid Scheme (UKCOAS). At that point the state aid scheme was closed to new entrants. In 2003, an alternative state aid scheme, Coal Investment Aid, was opened. £60 million was provided for investment at coal mines. That scheme, too, is now closed.¹⁰

A major challenge to the coal electricity generating industry is the Large Combustion Plant Directive.¹¹ This EU measure is intended to reduce the amount of sulphur dioxide, nitrous oxide and dust released into the atmosphere, and will lead to the closure of about a third of the existing coal fired plant in Britain. Any new coal-fired plant will be fitted with ‘scrubbers’ to remove most of these emissions from its exhaust gases.

¹⁰ For more information about the UK coal industry and state aid see Department of Energy and Climate Change website, *The UK coal industry* [on 20 April 2010]

¹¹ See the Defra website, *Air quality - European Directives: Large Combustion Plant Directive* for more information on the implementation of the directive [on 20 April 2010]

The biggest long term problem for coal is its level of carbon dioxide (CO₂) emissions. The estimated CO₂ emissions from coal in 2008 in the UK were 880 tonnes of CO₂ per gigawatt hour (GWh) of electricity supplied, easily the worst figure among the fossil fuels. The equivalent figure for gas, on the other hand, was 357 tonnes of CO₂ per GWh supplied.¹² Given the predicted growth in world coal demand and stringent emission reduction targets, the potential solution offered by carbon capture and storage (CCS) has become attractive to policymakers.¹³

2 The technology

The technology to reduce the emission of CO₂ from the burning of carbon-based fuels exists. CCS involves a 3-step process: capturing the CO₂ from power plants and other industrial sources; transporting the CO₂ (usually via pipelines) to storage points; and storing the CO₂ in geological sites such as depleted oil and gas fields.

There are three different types of carbon dioxide capture systems:

- Post-combustion – where CO₂ is separated from flue gas. The most common method is to scrub the flue gas with chemical solvents, which is an established industrial process
- Pre-combustion - (for use in Integrated Gasification Combined Cycle power stations). It involves reacting the fuel with oxygen or air, to produce a gas consisting mainly of carbon monoxide and hydrogen. The carbon monoxide is reacted with steam to produce hydrogen and CO₂, which is separated. The hydrogen is then burnt as the fuel
- Oxyfuel – here, high purity oxygen is used in combustion which results in high carbon dioxide concentrations in the gas stream. The carbon dioxide can then be more easily separated.¹⁴

The technology can be used on any combustion plant: gas power stations and other industrial plant that emit CO₂ could be fitted with CCS. It is even possible to use the technology simply to remove CO₂ from the air, although this would be one of the more expensive ways to reduce CO₂ levels.

3 Concerns about the technology

3.1 Capture

The technology is not yet proven on a large scale. There are currently no commercial scale integrated CCS projects involving carbon dioxide capture at power plants yet. Not all scientists are convinced by the feasibility of the technology. The investment in infrastructure will be huge and the timescale long. Vaclav Smil, a Professor at Manitoba University, has

Department of Energy and Climate Change, *HDigest of United Kingdom energy statistics 2009H*, Annex E Energy and the Environment, E.23

¹³ Detailed information on the present mix of generation fuels, and future trends for demand and supply are available in chapter 5 on decarbonising electricity production in the Committee on Climate Change's report, *HBuilding a low-carbon economy – the UK's contribution to tackling climate changeH*, 2008

¹⁴ For further explanation of the capture processes involved see POSTnote, *HCO₂ Capture, Transport and Storage, number 335H*, June 2009

calculated that if 10% of global carbon dioxide emissions are to be stored underground it will have to be pumped faster than all the crude oil that is currently pumped out of the ground.¹⁵

3.2 Transport

Transport of the carbon dioxide would be either by pipeline or by ship or both. Onshore carbon dioxide pipeline transport proven, but there is limited experience of transporting carbon dioxide offshore. Significant investment would be needed to construct and operate the pipeline infrastructure.¹⁶ According to the Royal Academy of Engineering if CCS is to prove viable, it may need a network of pipes to transport the CO₂ at a scale equivalent to the North Sea oil and gas industry.¹⁷

3.3 Storage

Depleted oil and gas fields are the first sites to be considered for storage capacity because they are known and are already equipped with infrastructure such as platforms and pipelines. The potential for much more storage space in saline aquifers exists on the UK continental shelf.

According to the EU Commission, there are four main processes by which carbon dioxide can be trapped and stored in geological formations:

The first is structural trapping, which is the presence of an impermeable cap-rock which prevents CO₂ to escape from the outset. The second is called residual CO₂ trapping where CO₂ is trapped by capillary forces in the interstices of the rock formation, which develops about 10 years after injection. The third is solubility trapping where the CO₂ dissolves in the water found in the geological formation and sinks because CO₂ dissolved in water is heavier than normal water. This becomes important between 10 and 100 years after injection. Finally, mineral trapping happens when dissolved CO₂ chemically reacts with the formation rock to produce minerals.¹⁸

Labour government figures estimated that **7 to 10Gt** of CO₂ could be stored on the UK Continental Shelf in depleted oil and gas fields. The UKCS could offer enough storage for approximately 100 years worth of UK emissions.¹⁹ Estimates of the size of the UK's saline aquifer storage capacity are varied, ranging from **20 to over 200Gt**.²⁰ Quantifying the exact amount of UK storage available for CCS is difficult. Each potential site will need to be surveyed in detail for its suitability for permanent storage and the monitored afterwards for any leakage. A March 2010 DECC report, *CO₂ Storage in the UK - Industry Potential*, sets out some of the difficulties:

A key issue for CCS and for government is that developing storage sites may be an uncertain, time-consuming, costly and risky business opportunity. This may be a barrier to suitable industry participants with the necessary capabilities and financial strength that need to be involved. Securing industry participation may require further

¹⁵ 'A 'Bold' Step to Capture an Elusive Gas Falterers', *New York Times*, 3 February 2008

¹⁶ International Energy Association, Greenhouse Gas Issues, *The Economics of Transportation of CO₂ in Common Carrier Network Pipeline Systems*, Issue 97, March 2010, p16

¹⁷ Royal Academy of Engineering, *HGenerating the Future: UK energy systems fit for 2050H*, 18 March 2010, p14

¹⁸ European Commission, *HQuestions and Answers on the proposal for a directive on the geological storage of carbon dioxideH*, MEMO/08/36 , 23 January 2008

¹⁹ HM Government, *HClean Coal: an industrial strategy for the development of carbon capture and storage across the UKH*, March 2010, Para 1.15-6

²⁰ Ibid

consideration of risk sharing, regulatory development and the role of government in the storage exploration, appraisal and possibly even development.

Initial assessments of storage potential and capacity are publically available for most of the UK. These have defined the storage opportunities in different regions and potential storage capacity. However they are screening level research projects based on desktop studies of existing data. There is significant uncertainty attached to current storage capacity estimates, and further work is required to determine practical and matched capacity level estimates both for policy assessment purposes and for site characterisation and project investment. Ongoing studies should advance the current understanding.²¹

3.4 Cost of capture

Capturing the CO₂ reduces the efficiency of power plants by approximately 20-25%, and transporting the CO₂ to storage sites through new pipeline infrastructure will be expensive.²²

The extra cost of building a power station with CCS is large. In a report for the Policy Exchange, a think tank, it is estimated that the cost of building a 400MW plant together with transport and storage facilities to be close to £1 billion.²³ Add to that the expense of running the CCS plant and transporting and storing the CO₂, and it is clear that electricity produced in this way will be more expensive.

The Policy Exchange report estimates that if all large gas and coal-fired power stations in the UK were fitted with CCS, it would add about £60 to electricity bills per household per year, making CCS-abated electricity about the same price as wind-generated electricity, at present the cheapest renewable source of power. Overall, CCS is expected to add about 25% to the wholesale cost of electricity.²⁴ The report also estimates that full-scale CCS plant could deliver CO₂ abatement for £30 per tonne.

The Committee on Climate Change found in its report that the increase in costs might be quite 'modest':

[R]easonable estimates suggest a modest cost penalty. The IEA presents estimates that CCS could add 2-4¢/kWh to new gas and coal-fired generation costs. Estimates for the UK suggest costs of around 2-3p/kWh. These costs primarily arise from reduced thermal efficiency and the engineering cost of CO₂ capture; in addition transportation, storage and monitoring costs and the costs to cover residual emissions are relatively small. There are also costs entailed in purchasing emissions credits to cover residual emissions; in the long run, in which we might expect a carbon price considerably higher than today's, co-firing of biomass in coal CCS plants could potentially be used to eliminate these residual emissions.²⁵

When a full-scale demonstration project has been run for some time the cost will become clearer, but the policy depends to a considerable extent on the expectation that costs of running the technology will decline over the early decades of full commercial use, and on the impact of the carbon price.

²¹ Department of Energy and Climate Change, *HCO₂ Storage in the UK - Industry Potential*H, March 2010, piii

²² The Carbon Trust website, *HCarbon Capture and Storage*H [on 18 March 2010]

²³ Stuart Hazseldine and Gil Yaron, *HSix Thousand Feet Under: Burying the Carbon Problem*H, Policy Exchange, 2008

²⁴ Stuart Hazseldine and Gil Yaron, *HSix Thousand Feet Under: Burying the Carbon Problem*H, Policy Exchange, 2008

²⁵ The Committee on Climate Change, *HBuilding a low-carbon economy – the UK's contribution to tackling climate change*H, December 2008

Estimates of how long it will take to move to full CCS also vary widely, and this will be crucial. ScottishPower has said that full scale CCS at Longannet could be operational by 2014.²⁶ Other estimates are much less optimistic, with the mid-20s or even 2030 being suggested.

3.5 Reliance on coal

Dr James Hansen, a climate scientist, has said that coal needs to be left in the ground if we are to avoid the worse effects of climate change. There are concerns that CCS and other clean coal technologies are being used as a fig-leaf to enable the construction of coal-fired power plants. Some argue that there are no guarantees that CCS can be made effective in the medium term or that it will be possible to retrofit the technology to power plants.²⁷

The Committee on Climate Change concluded that CCS could not be the only solution to reduce carbon emissions from energy generation, saying it:

...cannot be a sufficient solution in itself. It has not yet been demonstrated on large production scale and cost estimates are therefore uncertain. If it requires the construction of pipelines, it may be subject to local opposition and planning delays similar to those that hold up nuclear and wind deployment. And if many countries simultaneously attempted to deploy CCS on a large scale, it would be highly likely to be subject to the similar supply bottlenecks and cost increases to those that have recently been observed in nuclear, wind and solar PV.²⁸

4 Clusters

Until recently, the funding debate has focussed largely on power stations and how to get demonstration plant built. CCS proposals put forward by the climate change secretary in April 2009 are for groups of power stations to share transport and storage infrastructure. In March 2010 DECC published [A study to explore the potential for CCS business clusters in the UK](#). The study states that CCS demonstration projects are likely to be located in regions where coal fired power stations are already located, such as Humberside, Teesside, Thames estuary, the Firth of Forth or Merseyside

Thames cluster

The proposed Thames Cluster would collect carbon dioxide from major emitters in the Thames and Medway estuaries, where there is some 10,000MW of generating capacity. It is proposed that a pipeline should be built running under the sea from the Thames Estuary to the Hewett field, where there is capacity for some 360Mt of CO₂, enough for several decades of CO₂ output from the power stations in the cluster. If the Leman and Indefatigable fields were added, E-On calculates that there would be enough capacity to collect all the captured emissions from the power stations in the Thames Cluster for 64 years.²⁹

²⁶ 'Carbon capture technology tested', *BBC News online*, 29 May 2009

²⁷ 'Coal fired power stations are death factories. Close them', *Guardian*, 15 February 2009

'Greenwash: dirty claims on clean coal', *Guardian*, 5 February 2009

²⁸ The Committee on Climate Change, Building a low-carbon economy – the UK's contribution to tackling climate change, December 2008

²⁹ [Capturing carbon, tackling climate change: A vision for a CCS cluster in the South East](#), E-on. The storage capacity figures given are taken from: Holloway et al., [Industrial Carbon Dioxide Emissions and Carbon Dioxide Storage potential in the UK](#), British Geological Survey, 2006

Other clusters

The other proposed clusters are around the Humber, the Mersey, the Tees and in Scotland. There is even more generating capacity around the Humber than the Thames Estuary and the distances to the proposed North Sea sites are even shorter, but the demand for power in the region is not as high.

In March 2010 the Labour government announced that the first Low Carbon Economic Area (LCEA) for CCS, will be led by Yorkshire Forward in the Yorkshire and Humber region. LCEAs are aimed at accelerating low carbon economic activity in areas where existing geographic and industrial assets give clear strengths to a particular location. The Labour government also announced £6.3 million in funding for a small-scale 5MW capture plant at Scottish and Southern Energy's station in Ferrybridge.³⁰

It has also been reported that the coal-mining and generation group Powerfuel has been awarded €180m of EU economic recovery funding for a proposed CCS plant at Hatfield Colliery, South Yorkshire. An article in the ENDS Report explains that construction is expected to begin in 2010 and that the plant will be built in two phases: a combined cycle gas turbine to run on natural gas by 2013, converting to hydrogen-rich syngas from the gasification of local coal by 2014, capturing and storing 5MtCO₂e per year.³¹

Generators with plant in Scotland have also expressed interest in CCS, and sites are available. The power stations in Scotland are more widely spaced, however, making the transport infrastructure more expensive, and demand is not so high.

5 European law

In January 2008, the European Commission adopted a proposed directive on CCS,³² which became, [Directive 2009/31/EC on the geological storage of carbon dioxide](#) of 23 April 2009. The Directive enables CCS by providing a framework to manage environmental risks and remove barriers in existing legislation. It defines the type of site at which storage is allowed, provides a framework for issuing exploration and storage permits, sets certain obligations for the operation, closures and post-closure of storage sites and specifies that third parties must be given access to transport and storage sites. In September 2010 the Department for Environment, Food and Rural Affairs published a consultation, [Consultation on further amendments to the Environmental Permitting \(England and Wales\) Regulations 2010](#), on proposals to transpose the Directive into the *Environmental Permitting (England and Wales) Regulations 2010* (SI 2010/675).

6 Encouraging development of CCS technology

6.1 The first demonstration project

In Budget 2007 a [competition](#) was announced for government funding for one post-combustion CCS demonstration plant, originally due to be operational around 2014. Until 20 October 2010 there were two projects bidding: Kingsnorth in Kent by the E.ON consortium, and at Longannet in Fife, by the Scottish Power consortium.³³ In March 2010 both of these projects were awarded government funding to support Front End Engineering and Design

³⁰ [HLetter from Edward Miliband to Paddy Tipping MP dated 17 March 2010](#)

³¹ "EU, pre-Budget funding to boost clean coal", *ENDS Report*, Issue 419, December 2009

³² [HProposal for a Directive on the Geological Storage of Carbon Dioxide](#), COM(2008)18

³³ HC Deb 8 March 2010 c7-8WA

studies, which enable the bidders to further their project designs. These studies involve detailed engineering and design work and will be completed within twelve months, after which the final competition winner will be selected.³⁴

On 20 October 2010 E.ON announced that it would not to proceed to next stage of Government's carbon capture and storage competition as Kingsnorth could not meet the competition timescales.³⁵ The company said that it was still interested in CCS, but that its efforts on this would now be concentrated in the Netherlands:

Dr Paul Golby, Chief Executive of E.ON UK, said: "Having postponed Kingsnorth last year, it has become clear that the economic conditions are still not right for us to progress the project and so, simply put, we have no power station on which to build a CCS demonstration.

"We therefore took the decision to withdraw from the Government's competition because we cannot proceed within the competition timescales.

"As a Group we still believe that carbon capture and storage is a vital technology in the fight against climate change and will now be concentrating our efforts on our Maasvlakte project in the Netherlands as we believe the lessons from that project can be brought back to the UK for future generation CCS projects.³⁶

An article in Business Green following E.ON's announcement said that it was evidence that "uncertainty about the government's planned CCS programme was undermining investor confidence and allowing other countries to build a leadership position in the new technology."³⁷

The Scottish Power consortium project at Longannet in Fife is now the only entrant left in the competition.

A written answer in the House of Lords from 22 October 2010 said the Government would aim to agree commercial terms with the remaining bidder for the CCS demonstration competition, Scottish Power, "in the second half of 2011."³⁸

6.2 Further action and future competitions to develop CCS

It was [announced](#) by the Labour Government that a process for selecting a further three CCS demonstration projects would begin later in 2010, with the process to complete in 2011.³⁹

³⁴ Department of Energy and Climate Change, [HFunding for design studies in clean coal competitionH](#), 12 March 2010

³⁵ E.ON UK press release, [HE.ON not to proceed to next stage of Government's carbon capture and storage competition as Kingsnorth cannot meet competition timescalesH](#), 20 October 2010

³⁶ E.ON UK press release, [HE.ON not to proceed to next stage of Government's carbon capture and storage competition as Kingsnorth cannot meet competition timescalesH](#), 20 October 2010

³⁷ Business Green, [HE.ON pulls out of UK CCS competitionH](#), 20 October 2010

³⁸ HL Deb 22 October 2010 WA206

³⁹ HL Deb 8 Mar 2010 HcWA8

In March 2010 the [Office for Carbon Capture and Storage](#) (OCCS) within DECC was established within DECC, which was tasked with facilitating the delivery of CCS in the UK.

Between April 2005 and March 2010 the Government contributed £46 million to developing carbon abatement technologies, including CCS.⁴⁰

The full text of the coalition agreement reached by the Conservatives and the Liberal Democrats on 12 May 2010 shows that both parties have agreed to the continuation of the Labour Government's proposals for public sector investment in CCS technology for four coal-fired power stations.

The agreement shows that the coalition government has proposed to introduce an emissions performance standard (EPS) for coal-fired power stations (for more information about an EPS, see section below). It committed to:

The establishment of an emissions performance standard that will prevent coal-fired power stations being built unless they are equipped with sufficient CCS to meet the emissions performance standard.⁴¹

Recent Government CCS policy documents

- BERR, [Towards Carbon Capture and Storage](#), 30 June 2008
- DECC, [Towards Carbon Capture and Storage: Government Response to Consultation](#), April 2009
- DECC, [Guidance on Carbon Capture Readiness and Applications under Section 36 of the Electricity Act 1989: A Consultation](#), April 2009
- DECC, [Building a low carbon economy: a framework for the development of clean coal](#), Policy statement, April 2009
- DECC, [A framework for the development of clean coal: consultation document](#), June 2009
- DECC, [UK Low Carbon Transition Plan: National Strategy for Climate and Energy](#), July 2009
- DECC, [A framework for the development of clean coal: Consultation response](#), November 2009
- DECC, [Clean Coal: an industrial strategy for the development of carbon capture and storage across the UK](#), March 2010
- DECC, [Market sounding for CCS Demonstration Programme Projects 2-4](#), 8 July 2010
- DECC, [Planning for new energy infrastructure Consultation on revised draft National Policy Statements for Energy Infrastructure](#), 18 October 2010
- DECC, [Developing Carbon Capture and Storage \(CCS\) Infrastructure: Consultation on Implementing the Third Party Access Provisions of the CCS Directive and Call for Evidence on Long Term Development of CCS Infrastructure](#), 10 December 2010
- DECC, [Electricity Market Reform: Consultation Document](#), CM 7983, 16 December 2010

DECC Minister, Gregory Barker, stated that the Government was committed to 5 GW of CCS by 2020 in a debate on 30 June 2010:

... the coalition Government are committed to carbon capture and storage, which will be a major plank in our efforts to decarbonise our energy supply by 2030; we are committed to the generation of 5 GW of CCS by 2020. We see the potential of CCS, not just for our domestic use and as part of our plan to decarbonise the economy, but as a huge potential export industry for the UK in which we can not only capture new markets for British jobs, but help the world in striving to decarbonise the global economy.⁴²

On 10 December 2010 the Government issued a consultation on [Implementing the Third Party Access Provisions of the CCS Directive and Call for Evidence on Long Term Development of CCS Infrastructure](#). The consultation asks for views on two issues likely to affect future development of CCS infrastructure (for example, carbon dioxide pipelines and storage sites): third party access; and how best to organise long-term investment. The consultation makes clear that proposals in the Government's consultation on [Electricity Market Reform](#), such as creating a carbon support and an emissions performance standard will have a bearing on future investment in CCS:

⁴⁰ HL Deb 22 October 2010 WA206

⁴¹ BBC News Website, [Full Text: Conservative-Lib Dem deal](#), 12 May 2010

1.11. Beyond the demonstration phase the deployment of CCS is expected to be driven largely by economic and regulatory considerations, within the context of reforms being considered as part of a wider review of the electricity market. In the Annual Energy Statement to Parliament on 27 July 2010 it was announced that Government will publish a consultation on electricity market reform, with a White Paper in 2011. With significant challenges ahead for the energy sector and a need for substantial new investment, this will review the way that market design choices affect investment decision in generating capacity.⁴³

Government documents (both from the current and former Governments) relating to CCS are available from the [Carbon Capture and Storage publications library](#) on DECC website.

6.3 Source of finance for CCS demonstration

The *Energy Act 2010* provided a basis for a financial assistance scheme to support the demonstration projects, but further regulations would be needed to enact it. It would have allowed the finance to be raised from a levy on electricity supplies and suppliers and was expected to raise £9.5 billion over the next two decades.⁴⁴ It was anticipated that this would have added 2-3% on household electricity bills by 2020.⁴⁵

The October 2010 Spending Review made clear that the Government was committed to providing funding for four CCS demonstration plants. £1 billion would be allocated to one demonstration project, but it was not clear whether funding for the remaining demonstration projects would come from the CCS levy, (as set up by the Labour Government in the *Energy Act 2010* but not yet in operation), or from general public spending:

The Government remains committed to the Coalition Agreement policy of providing public funding for four CCS demonstration plants. Up to £1 billion will be invested in one of the world's first commercial scale CCS demonstration projects at a power station. This funding is provided from general public spending and so does not require the introduction of a levy on electricity supplies for CCS. The Government will decide whether to introduce such a levy or to fund future demonstrations from general public spending once work has been completed in Spring 2011 on the reform of the climate change levy to provide support to the carbon price.⁴⁶

The Budget on 23 March 2011 confirmed that future funding for demonstration projects would not come from the CCS levy:

2.149 Funding for Carbon Capture and Storage (CCS) demonstration programme –

The Government remains committed to providing public funding for CCS demonstration plants. However, consistent with its objectives for tax simplification, it will not proceed with the CCS levy. It will instead fund its commitments to CCS demonstration from general taxation.⁴⁷

An article in the *Guardian* on 22 March 2011, pre-empting the Budget announcement, highlighted concern from the CCS industry about whether energy firms would want to invest

⁴² HHC Deb, 30 June 2010 c873

⁴³ DECC, *HDeveloping Carbon Capture and Storage (CCS) Infrastructure: Consultation on Implementing the Third Party Access Provisions of the CCS Directive and Call for Evidence on Long Term Development of CCS InfrastructureH*, 10 December 2010

⁴⁴ HC Deb 7 December 2009 c44

⁴⁵ HC Deb 24 February 2010 c 337

⁴⁶ HM Treasury, *HSpending Review 2010H*, Cm 7942, 20 October 2010, para 2.101

⁴⁷ HM Treasury, *HBudget 2011H*, 23 March 2011

in untested carbon capture technology without some form of direct financial support from government.⁴⁸

6.4 Planning permission for coal-fired plant

It was the Labour government's policy that no planning permission would be granted for a new coal power station that was not 'CCS-ready'.⁴⁹ It was also announced that all combustion-powered generating plants over 300 MW will need to demonstrate carbon capture readiness (CCR) and that no new coal plant will be permitted unless at least 300 MW of the proposed capacity has CCS installed.⁵⁰

The energy industry has expressed concern however, that it is not possible to conduct a meaningful CCS readiness assessment on proposed new plants given the early stage of the technology. It seeks further guidance on how planning bodies will determine such applications.⁵¹

In November 2009 the Labour government set out its vision for a "long-term transition to clean coal":

Our ambition is to see CCS ready for wider deployment from 2020 and for any new coal plant constructed from then to be fully CCS from day one. We expect demonstration plant will retrofit CCS to their full capacity by 2025, with the CCS incentive able to provide financial support. A rolling review process, which is planned to report by 2018, will consider the appropriate regulatory and financial framework to further drive the move to clean coal. In the event that CCS is not on track to become technically or economically viable, an appropriate regulatory approach for managing emissions from coal power stations will be needed.⁵²

On 18 October 2010 the Coalition Government published a consultation on the revised draft National Policy Statements (NPS) for energy infrastructure. The consultation sets out that the NPS had been changed to clarify that CCS must be demonstrated on at least 300MW new of the proposed generating capacity of any new coal-fired power station:

Carbon Capture and Storage (CCS)

This section has been revised. It requires CCS to be demonstrated on at least 300MW new of the proposed generating capacity. The purpose of the CCS requirement in the NPS is to specify a minimum requirement for the purposes of consent and to ensure that no consent is given to proposals to build coal-fired power stations which do not include commercial-scale demonstration of CCS. The Government has said it will establish an emissions performance standard (EPS) that will prevent coal-fired power stations being built unless they are equipped with sufficient CCS to meet the EPS. An autumn consultation will consider further the introduction of an EPS alongside wider reform of the electricity market.⁵³

⁴⁸ "Budget 2011: Osborne poised to ditch CCS levy" *HThe GuardianH*, 22 March 2011

⁴⁹ DECC, *HA framework for the development of clean coal: Consultation responseH*, November 2009, p3

⁵⁰ House of Commons Energy and Climate Change Committee, *HThe Proposals for National Policy Statements on EnergyH*, Third Report session 2009-10 HC 231-I, 23 March 2010, p12

⁵¹ Energy and Climate Change Committee, *HThe proposals for national policy statements on energy, Third Report of Session 2009-10H*, HC 231, 23 March 2010, para 46

⁵² DECC, *HA framework for the development of clean coal: Consultation responseH*, November 2009, p3

⁵³ Department of Energy and Climate Change, *HPlanning for new energy infrastructure Consultation on revised draft National Policy Statements for Energy InfrastructureH*, 18 October 2010, p9-10

6.5 CCS on gas-fired plant

Lord Adair Turner, Chair of Committee on Climate Change wrote to the Secretary of State for Energy and Climate Change in June 2010 to recommend that a CCS gas demonstration project should be funded:

Given new evidence on the potential competitiveness of gas CCS with other forms of low carbon generation, and the very limited international effort to develop this technology, serious consideration should be given to funding at least one gas CCS demonstration project as part of the four CCS demonstration projects committed to in the Coalition Agreement.⁵⁴

On 8 November 2010 the Government announced that demonstration programme for the final three projects would be open to projects on gas-fired power plants as well as coal-fired power plants. A press release explained that the decision was taken following advice from the Committee on Climate Change:

The Government took the decision to include projects on gas-fired power stations in the demonstration programme after analysing the net benefits of this approach; including an assessment of the evidence and recommendations from the Climate Change Committee's second progress report (released in June) and information collected through the market sounding exercise conducted by the Office of Carbon Capture and Storage over the summer.⁵⁵

7 An Emissions Performance Standard

An EPS would set maximum levels of carbon dioxide that may be emitted from power generating stations, as a way to encourage investment in cleaner energy generation.

7.1 Political party debate about an EPS

During the Committee and Report Stage proceedings of the now *Energy Act 2010*, there was debate about whether an emissions performance standard (EPS) should be introduced.

At report stage, new Clauses 6 and 15 (both tabled by Alan Simpson) and **25** (tabled by Simon Hughes) all sought to give powers to the Secretary of State to introduce an EPS to various sorts of power station:

- in New Clause 6, in *all individual generating stations*, with emission limits to be specified later;
- in New Clause 15, in *all new electricity generation plant*, with the emission limits to be specified later; and
- in New Clause 25, in *any coal-fired electricity generating station*, setting a maximum level of carbon dioxide as no more than 25% of the emissions that would be produced by an equivalent size coal-fired power station operating without carbon capture and storage equipment.

⁵⁴ Letter from Lord Adair Turner, Chair of Committee on Climate Change, to the Secretary of State for Energy and Climate Change, [HCCC advice on the approach to investment in fossil fuel power generation](#), 17 June 2010

⁵⁵ Department of Energy and Climate Change, [Government opens up carbon capture and storage demonstration to gas](#), 8 November 2010

The Labour government did not support these new clauses. The then Minister, Joan Ruddock, argued that introducing an EPS was premature. It would lead to too much uncertainty for industry, which in turn, would deter investment in clean coal technology:

What we are saying clearly is that an EPS, whether it is set at a specific level or whether it is entirely open, will undermine the coal programme that we set out, all the provisions in the Bill, and the investment that companies will be prepared to make if—there is support for CCS. They will not be prepared to make that investment in circumstances in which there is uncertainty about layering over some other standards. (...)

The hon. Gentleman will have to answer questions about the level at which the standard would be set, when it would be introduced and what he understands would be the effect on investment in new coal. I suggest to him that the effect would be no new coal. If that is the Conservative party policy and intention, he will have the opportunity to tell the House this afternoon when he makes his own speech.

I shall try to make progress. The energy industry, the CBI and the TUC have all told us, in no uncertain terms, that an emissions performance standard introduced now will significantly undermine investment plans. If there are no new coal power stations, that puts at risk the whole demonstration of CCS in the UK. Does that matter? We think it does. It matters because CCS has the potential to play a critical role globally in tackling climate change. It matters because fossil fuels play a vital role in our energy mix, and CCS is the only technology that will allow them to continue in a low carbon future.⁵⁶

She went on to clarify that if an EPS is required at a later date to help deliver investment in low-carbon generation, a framework for introducing one already existed under the provisions of the *Pollution Prevention and Control Act 1999*.⁵⁷

Charles Hendry for the Conservatives maintained his support for New Clause 15, arguing that it would bring clarity about the level and timetable for an EPS for investors.⁵⁸ He worried that at present there was “tacit acceptance that an EPS is hanging over the industry like the sword of Damocles”, and that more clarity was needed:

In the boardrooms of Essen, Madrid and elsewhere around the world, people are having to look at the realistic prospect of an EPS being introduced in Britain. At this stage, however, because of the way that the Government have gone about it, those industries do not know whether it will be imposed retrospectively or on new plant, at what level it will be introduced, if it will be imposed on peaking capacity, or if it will be imposed on plant in its start-up phases. An incredible amount of doubt exists, which the Minister's approach has itself created, and that is why we need to go further in providing clarity.⁵⁹

Martin Horwood for the Liberal Democrats, said that it was important to promote greater seriousness about introducing renewables and CCS because current market arrangements, such as the EU Emissions Trading Scheme were “insufficient”.⁶⁰ He said that there needed to be clearer market signals and he favoured New Clause 25, calling it the most “robust and specific of the three new clauses on offer”, but also said that he would support New Clauses 15 and 6:

⁵⁶ HC Deb 24 February 2010 c 337

⁵⁷ HC Deb 24 February 2010 c 340

⁵⁸ HC Deb 24 February 2010 c 346

⁵⁹ HC Deb 24 February 2010 c 344

⁶⁰ HC Deb 24 February 2010 c 351

Rather less robust is new clause 6, tabled by the hon. Member for Nottingham, South, which we on the Liberal Democrat Benches are perfectly happy to support. Equally, it would mandate an emissions performance standard, but rather less specifically. Then we have the most flexible proposal, or the weakest, depending on one's point of view: new clause 15, which has the virtue of being supported by those on the Conservative Front Bench. Compromising on compromise, we are equally happy to support that, too, if it is the best that we can get today.⁶¹

None of the proposed new clauses were added to the Bill. New Clause 6 was not called. New Clause 25 was not moved. New Clause 15 was defeated on division by 252 votes to 244.⁶²

7.2 Coalition Government proposals for an EPS

On 16 December 2010 the Government published a consultation on Electricity Market Reform.⁶³ The Consultation closed on 10 March 2011. The Consultation explained that the Government envisaged an EPS playing a role in a package of reforms to prevent the construction and operation of new unabated coal-fired power stations. It made clear that the objective of an EPS was to not to rule-out new coal-fired power completely, but to ensure that coal could continue to contribute towards security of energy supply, in a manner consistent with low-carbon objectives.⁶⁴

The two proposed levels

The document consulted on two proposed levels for an EPS for new, individual coal-fired plant. The first proposed level would place an annual limit on the amount of CO₂ plant could emit, equivalent to 600gCO₂/KWh for plant operating at baseload. The Government explained that this limit would be consistent with the levels envisaged in the current CCS demonstration competition:

This level is consistent with demonstrating CCS on a new, supercritical coal-fired power station, which are typically sized at around 1600MW (gross). It would allow stations to demonstrate CCS on around a quarter of their capacity (300MW net or 400MW gross), consistent with the draft National Policy Statements. The Government also considers that this would be consistent with the CCS Demonstration Programme, which is predicated on the Government funding four commercial-scale demonstrations across a range of technologies.⁶⁵

The second proposal is for a tougher EPS. This would be an annual limit on the amount of CO₂ a plant can emit equivalent to 450gCO₂/kWh for plant operating at baseload. The Government explained that this level of EPS would send a stronger signal to the market about the desire for low carbon energy generation, but that the CCS demonstration projects would need a special exemption so as not to prevent the technology from developing to commercial viability:

This option would provide a stronger signal on the need for decarbonisation, requiring new plant to meet the tighter standard. For example, it would require a new,

⁶¹ HC Deb 24 February 2010 c 355

⁶² HC Deb 24 February 2010 c 395

⁶³ Department of Energy and Climate Change, *Electricity Market Reform: Consultation Document*, CM 7983, 16 December 2010

⁶⁴ Department of Energy and Climate Change, *Electricity Market Reform: Consultation Document*, CM 7983, 16 December 2010, p69

⁶⁵ Department of Energy and Climate Change, *Electricity Market Reform: Consultation Document*, CM 7983, 16 December 2010, p71

supercritical coal plant, sized at around 1600MW (gross) to use CCS on around 700MW (gross) of its capacity, around 40%. However, in order not to constrain demonstration of the full range of approaches to CCS, exemptions are proposed for plant forming part of the UK's CCS Demonstration Programme or benefiting from European funding for commercial-scale CCS projects.⁶⁶

Coverage of the EPS

The consultation made clear that the Government does not propose to apply an EPS retrospectively to existing plant. It explained that this is because: it did not want to impose significant economic burdens on existing operators; it was concerned that this would cause security of supply risks if a number of coal-fired power stations suddenly had to close; and that it may reduce the attractiveness of the UK as a place for electricity investment, because of perceptions about regulatory risk. The Government proposed to “grandfather” the EPS, so that the level of an EPS when a plant is first consented is the level that it remains at for that plant over the course of the plant's lifespan:

Another way of helping to ensure continued investor confidence in the UK energy sector would be to apply the principle of grandfathering, which is widely used in regulatory regimes, including the Renewables Obligation. In its simplest form, the principle of grandfathering, when applied to an EPS would mean that the level of the EPS in place at the point that a power station is consented remains the level which is relevant for the economic life of that power station, i.e. if Government decided to lower the level in the future, say to reflect advances in CCS technology, the EPS would only be at the lower level for plant consented after the date of that decision. Without such protection in place, the regulatory risk around investing in any new fossil-fuel power stations might prevent any new flexible plant being built, creating a risk to security of supply. The Government's initial view is, therefore, that the EPS be grandfathered, for a period linked to the period of time investors would expect to see a return on their capital investment.⁶⁷

The Government stated that it was keen however, not to create incentives to extend the life of existing plant over the building of new, cleaner plant. It therefore proposed that an EPS should be applied to existing plant whenever they underwent a significant life extension or upgrade.⁶⁸

The consultation proposed that the EPS should be technology neutral; that is not to specify what type of energy generation it applied to. However, at the levels proposed at the moment it would only apply to coal-fired power as gas plant is much cleaner. The Government suggested that it may review the level of the chosen EPS once it has a better understanding of the commercial viability of CCS technology.⁶⁹

⁶⁶ Department of Energy and Climate Change, [HElectricity Market Reform: Consultation DocumentH](#), CM 7983, 16 December 2010, p71

⁶⁷ Department of Energy and Climate Change, [HElectricity Market Reform: Consultation DocumentH](#), CM 7983, 16 December 2010, p73

⁶⁸ Department of Energy and Climate Change, [HElectricity Market Reform: Consultation DocumentH](#), CM 7983, 16 December 2010, p73

⁶⁹ Department of Energy and Climate Change, [HElectricity Market Reform: Consultation DocumentH](#), CM 7983, 16 December 2010, p73-74