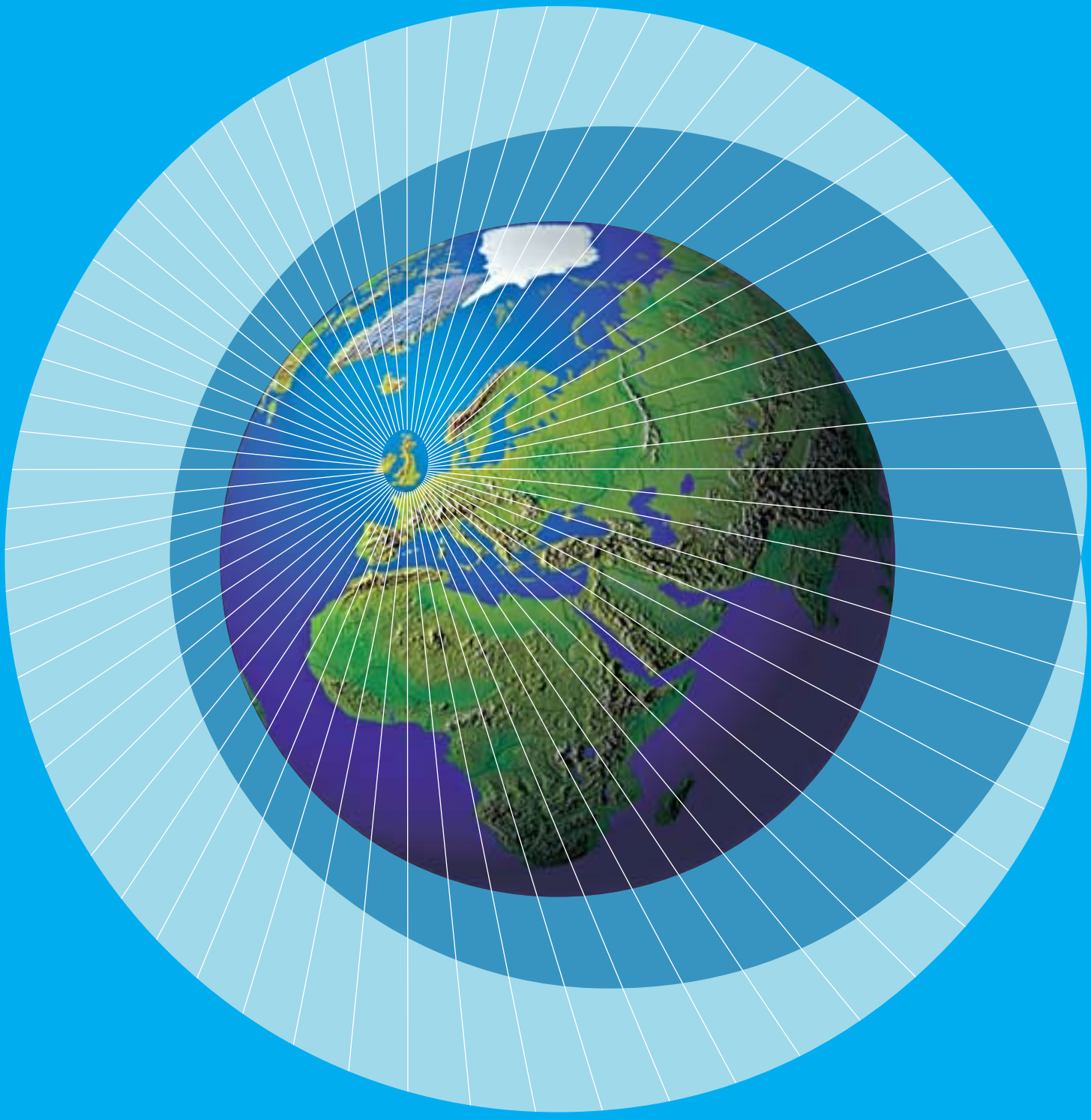
DEPARTMENT OF ENERGY & CLIMATE CHANGE

A framework for the development of clean coal: consultation document



June 2009

A framework for the development of clean coal: consultation document

The purpose of this consultation

This consultation seeks views on:

- the design of a financial incentive to support the delivery of up to four Carbon Capture and Storage (CCS) demonstration projects in the UK.
- a regulatory framework for coal power stations that would drive the development and deployment of CCS technologies and reinforce our expectation that emissions from coal power stations will be substantially reduced in the 2020s.

Issued 17 June 2009

Respond by 9 September 2009

Enquiries to Faye Williams.

Department of Energy & Climate Change, 4th floor Area C, 3-8 Whitehall Place, London, SW1A 2HH.

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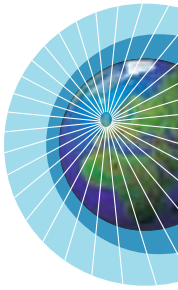


Foreword from the Secretary of State

In April, the Budget announced financing for up to four CCS demonstration projects in the UK and, the following day, I outlined proposals for a new regulatory regime for new coal-fired power stations. Following the statutory Strategic Environmental Assessment, this consultation document sets out the proposals in more detail.

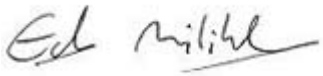
Coal is currently the most polluting fuel on the planet, but with technology that already exists we know this needn't be the case. The aims of our proposals are simple: to drive the decarbonisation of our energy supply, to safeguard our energy security and to get the best deal for consumers and businesses.

We believe the conditions on new coal proposed in this document are the most environmentally ambitious of any country in the world, requiring the demonstration of CCS on a substantial proportion of any new power station and the 100% retrofit of CCS when it is proven. At the same time, by providing funding for demonstrations, we can maintain coal as part of our energy mix, supporting diversity and therefore security of supply.

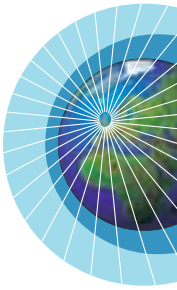
By acting early, jobs will also be created as Britain develops the expertise in what could be a major new industry, with CCS projects offering the potential to form the hubs for clusters of low carbon industries.

By driving the development of CCS in this country, we are also, as a country, playing an essential role in the battle against climate change. Coal is already widely used in developed and developing countries and its use is expected to grow further: scientists tell us that 70-80 per cent of the predicted growth in emissions in the coming decades will come from developing countries unless we find a route to low-carbon growth.

These new coal conditions are a major development in our energy policy, and we want to be sure we get the regulatory, financial and industrial elements of it right. We have set out our framework but we want to hear from you in order to make it work best in the interests of preventing climate change, promoting energy security and helping British industry. I look forward to continuing to work with you through this consultation.



Executive Summary



We urgently need to find ways to reduce the carbon emissions from fossil fuels if we are to avert dangerous climate change while enabling countries to maintain their energy security and industrial activity. Tackling emissions from coal power stations is a priority: there are abundant global reserves of coal; global coal consumption is growing faster than for any other fuel; and the carbon emissions from coal combustion are higher than from other fuels. Enabling continued use of coal power stations in a future global low carbon economy would support energy security and affordability.

Carbon Capture and Storage (CCS) is the only suite of technologies that currently has the potential to substantially reduce emissions from power stations. But, while the various technological stages of the CCS chain have been shown to work, CCS has not yet been demonstrated end-to-end at large scale on a power station.

The UK is a global leader in promoting the development of CCS and in 2007 we launched a competition to build one of the world's first commercial-scale CCS demonstration projects. We are now raising our ambitions: the proposals in this document would see the UK hosting up to four CCS demonstrations on coal power stations, a substantial contribution to global demonstration efforts. We hope this will invigorate global action on CCS as well as bring direct benefits to the UK by placing us firmly at the forefront of a technology area that could develop into a multi-billion global market. The Government believes that new coal power stations in the UK will be important to maintain the diversity and security of our energy supplies; this document therefore also sets out the proposed conditions under which such power stations would be required to demonstrate CCS. We also propose a clear pathway from CCS demonstration to wider UK deployment and consider how we could prepare for the possibility that CCS technologies will not be developed as quickly as we expect.

Chapter 1 sets out our vision for clean coal at home and abroad, and describes four objectives for our proposed framework should be judged: advancing the global development of CCS technology; improving the affordability of CCS investment; delivering a diverse and secure energy supply in the UK; and helping create jobs and economic opportunities for UK-based businesses in a new industrial sector.

Chapter 2 sets out the rationale for strategic government intervention to drive the development and deployment of CCS considering: the need to decarbonise electricity supplies; the contribution of coal to secure and affordable energy supplies within the UK and globally; and the potential role of CCS in reconciling these two objectives.

Chapter 3 sets out an overview of our proposed financial and regulatory framework for clean coal, discusses the objectives of the UK's CCS demonstration programme, and considers how emissions performance standards (EPS) could contribute to our framework.

Chapter 4 considers each of the regulatory aspects of the proposed framework in turn. Firstly, the proposal that any new coal power station should be required to demonstrate CCS on a defined proportion of its capacity; secondly, the proposal that those demonstration power stations should be required to retrofit CCS to their full capacity within some five years of the technology having been proven, and that any further new coal station should then be fully CCS from day one; and thirdly possible approaches to a contingency measure should CCS not be proven as early as we expect.

Chapter 5 considers the financial aspects of the proposed framework, focusing on the design of the new mechanism that will provide funds to support CCS demonstrations; the possible approaches to payment of the incentive to CCS projects; and how the UK approach should mesh with the funding available from the EU.

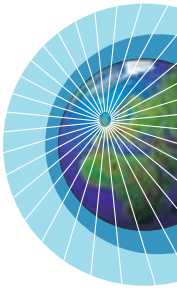
Chapter 6 explores how we can ensure that we maximise the benefits to the UK economy through our interventions, including how we could best lay the foundations of a future CCS infrastructure.

Our proposals are focused on coal power stations. As far as gas power stations are concerned, they too face a carbon price under the EU Emissions Trading System and must be constructed carbon capture ready and we expect operators will, in time, look to fit CCS. We are focusing further action on coal because: the emissions from coal generation are substantially higher than from gas; the projected increases in coal use globally creates a greater urgency to tackling emissions from coal; tackling coal first makes the most economic sense as the carbon intensity of emissions from coal are much greater than from gas; and new coal power stations would contribute to the diversity and security of UK energy supplies.

Some of the proposals under consideration would affect how future planning applications will be judged and may be regarded as a 'plan or programme' that sets a framework for future development consents, as defined in the SEA Directive. So, we are carrying out a Strategic Environmental Assessment as an aid to our decision-making process. An Environmental Report is published alongside this document, on which we would welcome comments.

We have also published an initial Impact Assessment, which will be developed further throughout the consultation process. We would welcome comments on the nature of the impacts it identifies and on our assessment of costs and benefits.

Territorial extent



The territorial extent of our proposals vary: the financial mechanisms discussed in chapter 5 would be intended to apply across Great Britain, while the regulatory options discussed in chapter 4 would apply in England and Wales only.

The Scottish Executive has devolved powers for the consenting of power stations over 50MW under section 36 of the Electricity Act 1989; and for environmental regulation, which is delivered by Scottish Environment Protection Agency (SEPA). Any applications for new thermal power stations in Scotland over 50MW will therefore be decided by the Scottish Executive and would require an environmental permit from SEPA.

The Scottish Executive has already consulted on revised section 36 guidance for the development of thermal power stations in Scotland, including the EU directive's provisions on carbon capture readiness and other measures that might be necessary to address future emissions from such power stations[1]. Scottish Ministers are currently considering the consultation responses and their decisions will be further informed by responses to this consultation and UK government policy.

Respondents with a particular interest in Scottish Executive policy are invited to copy their responses to this consultation to Scottish Ministers.

Next steps

The responses to this consultation will inform the development of primary legislation to enable the creation of a new financial mechanism to support CCS demonstration and decisions on whether, and how, to amend the regulatory framework within which coal power stations are constructed and operated. We intend to set out our proposed way forward as soon as possible after the end of the consultation. However, as the consultation covers different aspects of policy, we may respond to these different aspects separately.

Decisions on any applications to construct a new coal power station will be taken once this consultation process has been completed.

We are, in parallel with the development of a new framework for clean coal, taking forward a wider programme of work to support CCS development and deployment. We plan to publish a CCS strategy later in 2009 that will consider: international development of CCS, including in the EU; UK business opportunities and jobs; infrastructure development; skills; capacity building and other supply chain constraints; and technology development.

1 The consenting process for thermal power stations in Scotland. 2008. Scottish Government. www.scotland.gov.uk. Consultation closed 31 January 2009.

How to respond

We are inviting responses to this consultation by **9 September 2009** at the latest.

When responding, please state whether you are responding as an individual or representing the views of an organisation. If responding on behalf of an organisation, please make it clear who the organisation represents and, where applicable, how the views of members were assembled.

A response can be submitted by email or letter to:

Faye Williams

Department of Energy & Climate Change, 4th floor Area C,
3-8 Whitehall Place, London, SW1A 2HH.

Email: coalandccsconsultation@decc.gsi.gov.uk

A list of those organisations and individuals consulted is in Annex 2. We would welcome suggestions of others who may wish to be involved in this consultation process.

Additional copies

An electronic version of this document can be found at www.decc.gov.uk. You may make copies of this document without seeking permission. Further copies are available from

Faye Williams

Department of Energy & Climate Change, 4th floor Area C,
3-8 Whitehall Place, London, SW1A 2HH.

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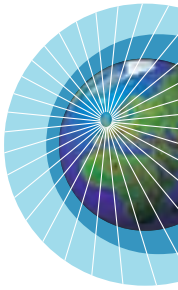
Other versions of the document in Braille, other languages or audio-cassette are available on request.

Confidentiality & Data Protection

Information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the access to information regimes (these are primarily the Freedom of Information Act 2000 (FOIA), the Data Protection Act 1998 (DPA) and the Environmental Information Regulations 2004). If you want other information that you provide to be treated as confidential, please be aware that, under the FOIA, there is a

statutory Code of Practice with which public authorities must comply and which deals, amongst other things, with obligations of confidence.



In view of this it would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded as binding on the Department.

The Department will process your personal data in accordance with the DPA and in the majority of circumstances this will mean that your personal data will not be disclosed to third parties.

Help with queries

Questions about the policy issues raised in the document can be addressed to:

Faye Williams

Department of Energy & Climate Change, 4th floor Area C,
3-8 Whitehall Place, London, SW1A 2HH.

Tel: 0300 068 5483.

Email: coalandccsconsultation@decc.gsi.gov.uk

The Consultation Code of Practice criteria are published at Annex 1. If you have any comments or complaints about the way in which this consultation has been conducted, these should be sent to:

Marjorie Addo

Consultation coordinator, Department of Energy & Climate Change,
Area 7C, 7th floor, Nobel House, 17 Smith Square, London, SW1P 3JR

Tel: 020 7238 5947

Email: consultation.coordinator@decc.gsi.gov.uk

Consultation questions

Question 3.1 What are your views on how effective the proposed framework of financial and regulatory measures will be in supporting delivery of our vision for clean coal at home and abroad? Please provide evidence to support your views.

Question 3.2 How do you think the proposals might impact on decisions to invest in new coal power stations and CCS demonstration in the UK? How can this framework best be developed to encourage investment in coal and CCS in the UK? Please provide evidence to support your views.

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.

Question 3.4 What are your views on whether and how an emissions performance standard (EPS) could support our policy objectives? Please provide evidence to support your views.

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.

Question 4.2 What additional planning conditions do you think an operator should have to meet to show that they would be able to meet a requirement to demonstrate CCS? Please provide evidence to support your views.

Question 4.3 What are your views on the best approach to monitoring the operation of CCS demonstrations? Please provide evidence to support your views.

Question 4.4 Under which circumstances would you consider it acceptable and/or necessary for power station operators to switch off the CCS chain? Please provide evidence to support your views.

Question 4.5 Do you agree that new coal power stations should be required to cease operation if the operator cannot demonstrate that they are making reasonable efforts to operate the CCS chain? Please provide evidence to support your views.

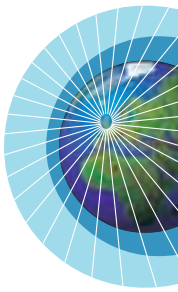
Question 4.6 Do you agree, in principle, that there should be requirement to retrofit? Please provide evidence to support your views.

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.

Question 4.10 Should the decision of when CCS is proven be one for an independent body to take, or for Government on the basis of independent advice? Please provide evidence to support your views.



Question 4.11 Do you agree that the Environment Agency should implement any requirement to retrofit CCS through the Environmental Permitting regime? Please provide evidence to support your views.

Question 4.12 What are your views on how the requirement to retrofit should apply to existing coal power stations? Please provide evidence to support your views.

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.

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.

Question 5.2 What are your views on the proposed arrangements for selecting and managing CCS demonstration projects? Are there any additional or alternative arrangements we should consider? Please provide evidence to support your views.

Question 6.1 What are your views on how the CCS demonstration projects could make the most cost-effective contribution to future carbon dioxide infrastructure? Please provide evidence to support your views.

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.

Question 6.3 Are there any other actions that the Government should consider taking at this stage to prepare for the full commercial deployment of CCS? Please provide evidence to support your views.

Chapter 1: Our vision for clean coal at home and abroad

1.1 Avoiding dangerous climate change is an increasingly urgent challenge. We need co-ordinated global action to ensure that a global economic recovery is built on sustainable low-carbon foundations. It is essential that we agree a post-2012 international framework if we are to have any chance of avoiding the worst social, economic and environmental costs of climate change. That is why we are working intensively with other countries to resolve the issues and remove barriers to reaching an effective international agreement at the UN Copenhagen conference later this year. We are determined to ensure that the UK's domestic emissions reduction effort contributes to achieving this global deal.

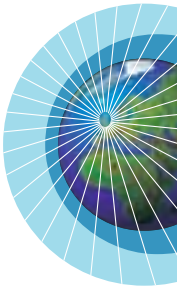
1.2 The Climate Change Act 2008 creates a new approach to managing and responding to climate change in the UK. At the heart of the Act is a legally binding target to reduce the UK's greenhouse gas emissions to at least 80 per cent below 1990 levels by 2050, to be achieved through action at home and abroad. The key ingredients will be a progressively declining cap on emissions in the power and industrial sectors through the EU Emissions Trading System (EU ETS), incentivising a shift to low carbon sources of electricity including, in particular, renewables, nuclear and cleaner fossil fuels through carbon capture and storage (CCS); dramatic improvements in energy efficiency; and switching energy demand in the heat and transport sectors to renewable and cleaner fuels.

1.3 The shift to low carbon electricity generation is an essential part of our move to a low carbon economy and the challenge is to achieve this transition while maintaining the security of our electricity supplies. This means ensuring that we have sufficient electricity generation capacity available, that we maintain a diverse energy mix so that we are not overly reliant on any one fuel or technology, and that electricity is affordable.

1.4 Today, coal power stations play a vital role in providing the UK with reliable electricity supplies: they can be operated flexibly in response to variations in demand from consumers and supply from other generators, which will become increasingly important as we see growth in wind generation; and they add diversity to our energy mix, in particular providing an alternative to gas.

1.5 So the development and demonstration of CCS technology is a vital issue for the UK, but it is also critical globally. Coal provided 41% of the world's electricity in 2006 and the International Energy Agency

(IEA) predicts that, under current policies, by 2030 this could increase to around 44%[2]. Given predicted increases in electricity demand, the IEA predict that the amount of electricity generated from coal could increase by around 23% in the US, around 172% in China and around 258% in India between 2006 and 2030.



1.6 This is not sustainable: coal power stations have higher carbon emissions per unit of electricity produced than any other, including gas stations. Any credible strategy for tackling climate change must actively set out to address the challenge of reconciling nations' energy security needs with the urgent need to tackle global carbon emissions.

1.7 CCS technologies, which have the potential to reduce emissions from fossil fuel power stations by around 90 per cent, offer the opportunity for coal to continue to be an important element of a secure and diverse low carbon energy mix and to reduce the costs of tackling climate change: the IEA estimate that the global costs of tackling climate change would increase by 70% without CCS available as a proven technology for reducing emissions[3].

1.8 The UK is leading international efforts to develop CCS. We were, for example, one of the first countries to launch a commercial-scale CCS demonstration project in 2007, and were instrumental in securing EU funding to support a programme of up to 12 EU demonstrations and a G8 commitment to launch 20 demonstration projects by 2010. However, progress is still not happening quickly enough if CCS is to achieve its potential in tackling carbon emissions within the timeframes necessary to prevent dangerous climate change. We expect to see CCS starting to make a substantial contribution to UK and global efforts to tackle climate change in the early 2020s, which will require a concerted, shared effort to drive the technology forward over the next decade.

1.9 We must, therefore, step up efforts for the development and deployment of CCS. This consultation sets out, and seeks views, on proposals for a new regulatory and financial framework to drive the development of clean coal by:

- Providing financial support for up to four commercial-scale CCS demonstrations in Britain covering a range of CCS technologies.
- Requiring any new coal power station in England and Wales to demonstrate CCS on a defined part of its capacity.

2 World Energy Outlook 2008. International Energy Agency.
3 Carbon dioxide capture and storage: a key carbon abatement option. IEA 2008.

- Requiring new coal power stations to retrofit CCS to their full capacity within five years of CCS being independently judged technically and economically proven. We will plan on the basis that CCS will be proven by 2020.

- Preparing for the possibility that CCS will not become proven as early as we expect.

1.10 This consultation also explores how an emissions performance standard could support the measures outlined above and whether we should consider applying any aspects of the framework to existing coal power stations.

1.11 These proposals offer the opportunity to stimulate the development of future business CCS clusters in the locality of the demonstration projects by encouraging CCS organisations into the locality, will encourage innovation and thereby enhance our competitive advantage. The Humber, Teesside, Thames Gateway, the Firth of Forth and Merseyside are all potential locations for CCS projects and cluster development, which would create new jobs as part of the low carbon economy and provide a contribution to our Low Carbon Industrial Strategy.

Objectives for an effective framework for the development of clean coal

1.12 Our proposals for a framework for the development of clean coal should be tested against four key objectives.

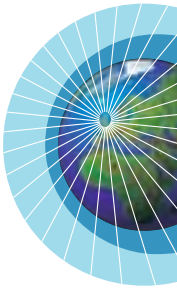
Advancing the global development of CCS technology

1.13 CCS has the potential to make a substantial contribution to UK and global climate change mitigation. Our proposals aim both to accelerate development of this technology and show a clear route to wider application that will stimulate further action across the world.

Improving the affordability of CCS investment

1.14 The costs and risks of commercial-scale CCS demonstration mean that projects will only proceed with Government intervention. We will minimise the financial support costs of CCS demonstration by seeking to maximise the contribution of EU funding and to combine private and public investment. Our approach aims to put in place a strong framework to ensure competitive and cost effective delivery of a CCS demonstration programme. Any public support must be affordable, sustainable and crucially must lay the foundations for more affordable CCS deployment. CCS demonstrations are expected to reduce significantly the costs for

later CCS deployment. So, investment now has the potential to reduce substantially the costs of tackling climate change in the longer term.



Delivering a diverse and secure low carbon energy supply in the UK

1.15 The challenge is to deliver the transition to a low carbon economy while maintaining the security of our electricity supplies. This means ensuring that we have sufficient electricity generation capacity available and that we maintain a diverse energy mix so that we are not overly reliant on any one fuel, fuel source or technology. Our proposals could see up to four new coal power stations operating in the UK before 2020, contributing to the diversity of our energy mix in the medium term. Perhaps more significantly, our efforts to drive the development of CCS should enable coal to continue to play a long term role in our energy security as we move into a low carbon economy.

Helping create jobs and economic opportunities for UK-based businesses in a new industrial sector

1.16 Building on the momentum already developed through our commitment to our first commercial-scale CCS demonstration project, which was launched in 2007, our interventions aim to sow the seeds of a new CCS infrastructure and industry in the UK, developing capacity, expertise and more robust supply chains. This strategic intervention is a key part of our Low Carbon Industrial Strategy and will renew the value of the North Sea and Irish Sea as fossil fuel production declines and bring major employment and industrial benefits to regions such as Yorkshire and Humberside, the Firth of Forth, the Thames Estuary, Tyne Tees and Merseyside[4].

Other strategic measures to promote CCS

1.17 We are, in parallel with the development of a new framework for clean coal, taking forward a wider programme of work to support CCS development and deployment within the UK and globally. We plan to publish a CCS strategy later in 2009 that will consider: international development of CCS, including in the EU; UK business opportunities and jobs; infrastructure development; skills; capacity building and other supply chain constraints; and technology development.

4 Investing in a low carbon Britain. HM Government. 2009.

Chapter 2: The rationale for a framework for the development of clean coal

Summary

2.1 Coal power stations play a vital role in the UK and globally by providing reliable and affordable electricity supplies. The Government believes that new coal power stations in the UK will be important to maintain the diversity and security of our energy supplies. Yet decarbonisation of the power sector will be key to delivering our 2050 climate change targets. So, any credible strategy for tackling climate change must actively set out to address emissions from coal power stations. The challenge is to deliver the transition to a global low carbon economy while maintaining the security of electricity supplies.

2.2 CCS technologies offer the potential to substantially reduce emissions from coal power stations and would enable coal to continue contributing to energy security in a low carbon future. However, CCS technologies are not yet proven for commercial deployment.

Decarbonising electricity generation

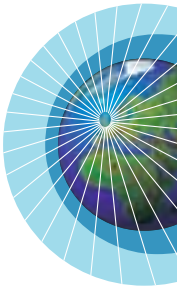
2.3 Decarbonisation of the power sector will be key to delivering our 2050 climate change targets, not only because electricity generation is currently responsible for a significant proportion of our emissions, but also because a shift towards electric heating and transport could be the most effective way to reduce emissions from those sectors. This means that, by 2050, demand for electricity could be substantially higher than today.

2.4 Today, coal and gas power stations provide most of the UK's electricity. By 2050, we will need to have moved to low carbon generation sources. We are driving this transition through the three central elements to any approach to carbon reduction that were set out in the Stern Review: support for new low carbon technologies, removing barriers to energy efficiency and carbon pricing.

Carbon pricing

2.5 Underpinning the transition to low-carbon electricity generation is the EU Emissions Trading System (EU ETS), which has set a cap on the level of emissions that the heavy industrial sectors – including power – can emit since 2005. Support for the EU ETS and carbon trading is central

to our domestic and international strategies for tackling climate change because: it provides a framework for multilateral action – no single country can tackle climate change alone; it offers certainty on the level of emissions reductions that will be delivered; and it enables those emissions reductions to be delivered where they cost least.



2.6 We will continue to work for a robust EU ETS with a cap on carbon dioxide emissions that tightens in line with our climate change objectives. The cap is already set to tighten by 1.74% per year from 2013, delivering emissions reductions from power stations and industrial installations of 21% by 2020 compared to 2005 levels. This represents a significant contribution to the EU's current target to reduce emissions by 20% by 2020 compared to 1990 levels. Moreover, the target could be increased to up to 30% in the context of a global agreement on climate change, which would see a further tightening of the EU ETS cap.

2.7 As the EU-wide cap on carbon emissions under the EU ETS tightens, the carbon price should rise and options for reducing emissions will become progressively more economically attractive. There are a number of options already available to coal power station operators for reducing their emissions.

2.8 Firstly, the efficiency can be improved by building new power stations or refurbishing existing power stations with advanced technologies (e.g. high efficiency boilers and steam turbines) that allow the same amount of electricity to be generated from less coal, thereby lowering carbon dioxide emissions per unit of electricity produced, or by making use of waste heat through CHP.

2.9 Secondly, net carbon dioxide emissions can be reduced from coal power stations by replacing a proportion of the coal that would have been burnt with biomass, so-called co-firing. The proportion of co-firing that is technically possible is generally limited to about 10 to 15%, offering equivalent reductions in emissions, although higher levels may be possible as technologies develop. The Renewables Obligation provides a financial incentive for operators to co-fire with biomass and, in 2007, co-firing with fossil fuels accounted for 10% of UK electricity generated from renewable sources.

2.10 There are, however, some issues around the use of biomass. Biomass supply chains are currently in their infancy and, while they are expected to develop, the availability of sustainable biomass supplies may constrain its use. Further, the greatest contribution to our carbon emissions goals are achieved where biomass is used in areas that are not covered by the EU ETS – such as for heating at domestic and commercial scale.

2.11 Thirdly, coal power stations can reduce their running hours. The carbon price will be one factor affecting decisions about running hours;

another is the changing shape of our electricity generation mix. As the proportion of intermittent wind generation increases, all other things being equal, fossil fuel power stations would be expected to operate for fewer hours each year.

2.12 However, we will reach a point when it is no longer economic to run coal power stations without reducing carbon dioxide emissions to a substantially greater extent than any of these existing options can offer: CCS technologies have the potential to enable coal power stations to continue operating in a high carbon price world.

2.13 Assuming that a series of successful demonstration projects reduce the costs and risks of CCS, we might expect the carbon price under the EU ETS to start to drive CCS deployment on coal power stations in the 2020s. However, the independent Committee on Climate Change has argued that uncertainty over future carbon prices means that investment in new coal power stations might go ahead without a clear acceptance of the need for future CCS installation[5]. They suggest there is a need to establish a clearer expectation that CCS would need to be retrofitted in the early 2020s and their advice has informed the development of the proposals in this document.

Support for low carbon technologies

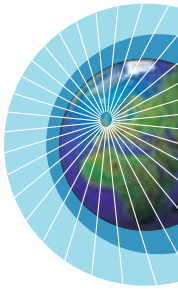
2.14 We are working to overcome barriers to the deployment of the three key technologies expected to contribute to decarbonisation of UK electricity generation – nuclear power, renewable electricity, and CCS. Our strategy to promote each of these technologies is tailored to their development status. For example, nuclear is already well established as a commercial technology, while CCS has yet to be demonstrated at a commercial scale on a power station.

2.15 The introduction of the Renewables Obligation, a financial incentive, has already seen renewable generation increase from less than 2 per cent in 2001 to 4.9 per cent in 2007. We sought views in summer 2008 on how to further drive up the use of renewable energy in the UK, as part of the overall strategy for tackling climate change and to meet the EU target to source 15 per cent of the UK's energy from renewable sources by 2020. Building on this consultation, we will publish the UK Renewable Energy Strategy in the summer.

2.16 Nuclear power has been part of the UK's energy mix for the past five decades and currently provides around 15 per cent of the electricity generated in the UK. In January 2008, the Government decided that new nuclear should be allowed to play a role in the UK's future energy mix alongside other low carbon technologies[6]. The Government is

5 Building a low carbon economy. CCC. December 2008.
6 Meeting the energy challenge: a White Paper on Nuclear Power. HM Government. January 2008.

committed to enabling nuclear new build as soon as possible, with the first new nuclear power stations expected to start generating electricity from around 2018. New nuclear power has now reached the stage where nominations for eleven potential sites for new build have been received.



2.17 CCS involves capturing carbon dioxide and transporting it for permanent storage in underground geological formations, for example in depleted gas and oil fields, or in saline aquifers. It has the potential to reduce emissions from power stations and other industrial installations by around 90%, but is not yet ready for general deployment. The UK is already considered to be a global leader in CCS: the proposals in this document seek to strengthen this position and further drive the development and deployment of this technology.

Removing barriers to energy efficiency

2.18 In the UK, the starting point for reducing emissions from electricity generation is to make more efficient use of electricity. We do this in part through measures such as the Climate Change Levy and agreements with business and the supplier obligations that reduce household emissions.

2.19 We can also support steps to improve the efficiency of electricity generation by utilising the heat that is produced, in a process known as combined heat and power (CHP). CHP can improve efficiency by over 30% compared to generating heat and electricity separately and is already delivering significant carbon emissions reductions within the UK. CHP is supported by a number of policies, such as the EU ETS, exemption from the Climate Change Levy and, for renewable CHP, additional support under the Renewables Obligation. In Budget 2009, the Government announced that it will extend the Climate Change Levy exemption for indirect sales of CHP electricity to 2023. These measures will bring forward future investment in CHP of around £2.5 billion. All applicants for development consent for power stations over 50MW are required to explore options for CHP.

Ensuring diverse and secure low carbon energy supplies

2.20 Reliable and affordable supplies of electricity are fundamental to our quality of life and health, and to the success of our economy. Energy security depends on having sufficient electricity generation capacity available and a diverse energy mix so that we are not overly reliant on any one fuel, fuel source or technology.

2.21 The challenge is to maintain our energy diversity and security while we make the transition to a low carbon energy mix. As part of this transition, we will need to see investment in new fossil fuel power

stations, both to provide sufficient generating capacity through the next decade and to provide flexible back-up for intermittent renewable generation. We must ensure that we facilitate this investment in a way that is consistent with our path to low carbon economy.

Investment in new capacity

2.22 The UK's electricity mix will change significantly over the next decade. By 2018, 18-20GW of generation capacity, from a total of 78GW, is expected to close. Seven nuclear power stations are expected to close as they reach the end of their licensed lifetimes, while six coal and three oil power stations will close by 2016 as a result of EU environmental legislation to reduce emissions of sulphur dioxide and nitrogen oxides (the Large Combustion Plants Directive). The proposed Industrial Emissions Directive, which is currently under negotiation and sets out to further tighten emissions standards, could drive the closure of many of the remaining 13 coal stations.

2.23 So, the UK needs substantial investment in new electricity generation capacity if supply is to reliably continue to meet demand. Current evidence on planned investment shows we are making good progress towards delivering sufficient electricity generation capacity to deliver secure supplies through the next decade. 10GW of new generation capacity is already under construction, a further 10.5GW has both planning consent and agreement to connect to the grid (see box 2.1), while a further 7.5GW has applied for planning consent in England and Wales. Assuming that most of this new capacity comes forward, there is a sound basis for taking us through the next decade with sufficient generation capacity.

2.24 We expect further proposals for new generation capacity to come forward across all generation types: our Renewable Energy Strategy will drive a step change in renewables deployment; we are taking steps to facilitate investment in nuclear; and expect further applications for gas and coal power stations to come forward.

2.25 One issue is how the global recession will impact on our electricity needs. The recession has depressed UK electricity demand from almost all sectors, with an 8.1% drop in the industrial sector between the last quarter of 2007 and the last quarter of 2008. However, it is difficult to predict how demand patterns might develop as the economy recovers and, at the same time as seeing changes in demand, we might also see changes in investment plans. We will ensure continued strategic monitoring and planning to ensure that the UK remains on track.

Box 2.1: New electricity generation capacity

The table below shows the quantity of electricity generation capacity with agreement for connection to the National Grid transmission system and a) under construction or b) with planning consent in England and Wales (but not yet under construction).

Fuel type	a) under construction, GW	b) with planning consent (all have TEC), GW		
		As at 1 Jan '09	*Plus Feb '09*	*Total*
Coal	0	0		0
Gas/Gasified Coal (Hatfield)	0	0	0.9	0.9
Gas	7.0	3.7	3.0	6.7
Nuclear	0	0		0
Wind	1.0	2.5		2.5
Other renews	0.1	0.4		0.4
CHP	0.6	0		0
Interconnector	1.2	0		0
Totals	**9.9**	6.6	3.8	**10.5**

Source: National Grid, SYS, January 2009 update for TEC connected plant. Excludes embedded capacity (e.g. renewables) not requiring connection to the national grid.

Gas power generation

2.26 In 2008, gas power stations provided 46% of the UK's electricity, and gas power stations make up the majority of the new generation capacity: 7GW of the capacity under construction and 6.7GW of that with planning consent and grid connection agreement. This investment is important in ensuring that we have sufficient generating capacity and because gas power stations can be operated flexibly, in response to variations in demand from consumers and supply from other generators, which will become increasingly important as we see growth in wind generation.

2.27 Even so, total UK demand for gas is expected to remain broadly constant through the next decade. Electricity generation accounts for only a third of the UK's total gas consumption and growth in renewable generation means that fossil fuel power stations are expected to be operating for fewer hours each year. In the domestic and industrial sectors, which account for the remainder of the UK's gas consumption, energy efficiency improvements and the growth of renewable sources of heating are expected to reduce gas demand.

2.28 Nevertheless, the decline of indigenous UK gas production is a major structural shift in our energy system, requiring additional gas import and storage capacity to provide us with sufficient and diverse sources of gas.

2.29 Commercial initiatives have already brought forward several new large gas import facilities, with more to come, contributing to future diversity of gas supplies. Around 20 gas storage projects are at various stages of development or planning. Steps to improve the strategic framework for gas storage investment include changes to the consents regime introduced through the 2008 Planning and Energy Acts that will provide a faster and fairer system for decisions for these and other nationally significant infrastructure projects both onshore and offshore. The recent announcement that cushion gas is eligible for tax relief through the capital allowances regime should act as a further incentive to investment in additional gas storage capacity.

Coal power generation

2.30 Within the UK's energy mix, coal power stations play a vital role in providing reliable electricity supplies: like gas power stations they can be operated flexibly; and they add diversity to our energy mix, in particular providing an alternative to gas.

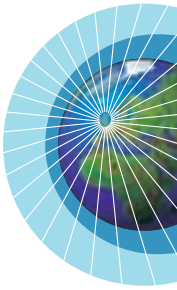
2.31 In 2008, coal power stations provided 31% of the UK's electricity with the coal burned coming from a range of sources. Around a third comes from UK mines while, of the UK's coal imports, in 2007 46% came from Russia, a five-fold increase in volume since 2001, with South Africa, Australia, Colombia and the US seeing a fall in their share to account for 43% of imports.

2.32 We will lose around a third of the UK's current coal generation capacity by 2016, reducing our coal generation capacity from 29GW to 21GW. Most of the remaining existing coal generation capacity is likely to close by 2025.

Maintaining diversity

2.33 We therefore expect to be somewhat more reliant on gas for electricity generation by the middle of the next decade than we are today. The steps that we are taking to deliver secure gas supplies mitigate the risks associated with this small reduction in the diversity of our energy mix.

2.34 However, the issue of diversity becomes more critical later in the next decade and beyond as we start to see further closures of ageing coal power stations as industrial emissions legislation tightens further and on economic grounds. CCS technologies offer the opportunity for coal to remain a long term part of a diverse low carbon UK generation mix, contributing both to energy security and affordability.



2.35 Coal is also widely used as a fuel for electricity generation globally: there are abundant reserves available in many countries, which can be easily extracted, transported and stored (albeit at some cost to the local environment); while coal power stations offer reliable and controllable output. As a result, coal provided 41% of the world's electricity in 2006 and the International Energy Agency (IEA) predicts that, based on existing policies, by 2030 this could increase to around 44%[7]. Given predicted increases in electricity demand, the IEA predict that the amount of electricity generated from coal could increase by around 23% in the US, around 172% in China and around 258% in India between 2006 and 2030[8].

2.36 CCS therefore has a crucial role to play in the UK and globally in reconciling energy security and climate change goals.

Carbon capture and storage

2.37 CCS involves capturing carbon dioxide and transporting it for permanent storage in underground geological formations, for example in old gas and oil fields, or in saline aquifers. CCS has the potential to reduce emissions from power stations and other large industrial installations by around 90 per cent. Further, the IEA estimate that the global costs of tackling climate change would increase by 70 per cent without CCS available as a proven technology for reducing emissions.

2.38 The UK is leading international efforts to develop CCS. In 2007, we were one of the first countries to launch a commercial-scale CCS demonstration project. We were instrumental in reaching agreement in December 2008 to allow use of free allowances from the New Entrant Reserve of the EU ETS to support the EU's ambition to have up to 12 demonstration projects operational by 2015. Further EU support was agreed in April 2009 through the European Energy Programme for Recovery (EEPR) which included €1.05bn for CCS projects in seven EU Member States.

2.39 In July 2008, the G8 Leaders announced that "we strongly support the launching of 20 large-scale CCS demonstration projects globally by 2010, taking into account various national circumstances, with a view to beginning broad deployment of CCS by 2020"[9]. We will be seeking concrete progress this year on this commitment. The Australian Government has recently launched a Global Carbon Capture Storage Institute aimed at facilitating the development of these projects and sharing the knowledge and experienced gained and we are one of the first Foundation Members of the Institute.

7 World Energy Outlook 2008. International Energy Agency.
8 Carbon dioxide capture and storage: a key carbon abatement option. IEA 2008.
9 Joint statement by G8 Energy Ministers. Amon, Japan on 8 June 2008

2.40 We have also played a key role in the development of the EU-China Near Zero Emissions Coal (NZEC) initiative to demonstrate commercial-scale CCS in China. On 13 October the UK will co-host with Norway the Carbon Sequestration Leadership Forum (CSLF) Ministerial conference in London, where its 22 member countries will agree recommendations on the commercialisation of CCS ahead of the UNFCCC conference in Copenhagen.

2.41 The IEA's Technology Roadmap for CCS envisages 30 commercial-scale demonstration projects globally by 2020 in order to deliver a 50% carbon dioxide reduction by 2050 scenario. These demonstrations are intended to cover gas fired generation as well as coal and potentially other large point sources of carbon dioxide such as cement and steel, in addition to the alternative methods for carbon dioxide capture and storage.

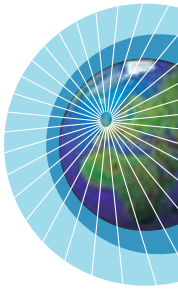
2.42 The UK, Norway, USA, Canada and Australia have announced their intent to support commercial-scale, full chain, CCS projects. Other projects are in prospect, and the welcome recent agreement of support from the EU should encourage these within Europe.

Technological status of CCS

2.43 Each of the different stages of CCS – capture, transport and storage – has already been used successfully in other applications. However, while pilot CCS projects for power generation (up to about 30MW) have been taken forward and will provide valuable lessons, CCS has never been applied at commercial scale as an end-to-end process on a power station – and this transition to commercial-scale is the critical next step.

2.44 Of the different stages in the CCS chain, it is the capture of carbon dioxide from the combustion of fossil fuels that presents the greatest technical challenge (see box 2.2). A power station fitted with carbon capture will itself be more complex to operate, and will have to run in sequence with down stream transport and storage. This may reduce the overall flexibility of power generation compared to equivalent power stations without CCS, and therefore affect its position in the wholesale electricity market.

Box 2.2: Status of carbon dioxide Capture Methods



Post-combustion capture uses solvents to scrub carbon dioxide out of flue gases. The carbon dioxide is then released as a concentrated gas stream by a regeneration process. Post-combustion capture is applicable to pulverised coal power stations and is already deployed commercially on other processes albeit at a smaller scale than that required for power stations. The UK has already launched a competition to support a CCS demonstration project which would be one of the first large-scale applications of post-combustion capture to a coal power station.

Pre-combustion capture involves reacting fuel with oxygen or air, and in some cases steam, to produce a gas consisting mainly of carbon monoxide and hydrogen. The carbon monoxide is then reacted with more steam in a catalytic shift converter to produce more hydrogen and carbon dioxide. The CO2 is then separated and the hydrogen is used as fuel in a gas turbine combined cycle (GTCC) generation plant. The shift conversion and CO2 separation processes are well established but not at the scale needed for power generation. With coal this method is based on integrated gasification combined cycle (IGCC) technology, which has been demonstrated at full scale in power generation.

Oxy-fuel combustion involves burning fuel in an oxygen/CO2 mixture rather than air to produce a flue gas that is predominantly carbon dioxide. With coal the technology would be deployed with a suitably modified pulverised coal combustion system, whilst with gas it could be used with a combined cycle system. The technology is now being demonstrated in pilot plant at the ~30MW scale.

As well as being applicable to new power stations, all three of the capture methods could potentially be retrofitted to power stations that are suited for that particular capture technology. Post-combustion capture is considered to be the optimal technology for retrofit to pulverised coal power stations: most existing and new-build coal power stations across the world use pulverised coal. Pre-combustion capture is considered the optimal technology for application to coal integrated gasification combined cycle (IGCC) power stations. The ability to retrofit CCS offers the potential for any coal power station constructed today, which could have an operating life of 40-50 years, to substantially reduce its emissions within its lifetime.

All three capture methods will also be capable of minimising emissions of other power station pollutants: sulphur dioxide, nitrogen oxides and dust.

2.45 There is considerable experience of the transport of carbon dioxide at pressures and quantities comparable to those needed for CCS either by pipeline or by ship. For example 3000km of pipelines are currently used to transport about 20Mt of carbon dioxide per year for use in Enhanced

Oil Recovery in the US and Canada, though largely through relatively sparsely populated areas.

2.46 Issues for transport are therefore associated with the development of the infrastructure and the regulatory aspects relating to the environment and health and safety, particularly how these should apply in more populated regions than those currently hosting large volume carbon dioxide transport.

2.47 Geological storage combines a number of engineering processes to compress and inject carbon dioxide into suitable formations. It also demands a good scientific understanding of the geochemical and geophysical processes affecting carbon dioxide to give assurance that the underground system will retain its integrity long term.

2.48 The storage of gases in geological formations is a tried and tested technology. Natural gas has been safely and routinely stored in sub-surface stores for many decades. Additionally, in Norway, Statoil has been re-injecting carbon dioxide co-produced with natural gas into a deep aquifer overlying its offshore Sleipner field, solely for storage since 1996. The Weyburn-Midale project in Canada started storing carbon dioxide in 2000, as part of an Enhanced Oil Recovery Operation, and stores around 2.8Mt of carbon dioxide per year. There are also significant storage projects in In-Salah, Algeria and Snohvit, Norway, and the US is sponsoring 12 projects which will each start storing up to 1Mt per year over the next 12 months. This has built up a significant body of experience that gives confidence that the risk of leakage from properly selected and managed sites, which have been fully characterised, is likely to be very small indeed.

2.49 Overall there is a general consensus, reflected by the declared aims of the G8, the IEA and the European Technology Platform for Zero Emission Fossil Fuel Power Plants (ZEP), that the next step towards commercialisation of CCS is commercial scale demonstration. In particular, while there may be reasons to be confident about the performance of separate components (e.g. pipeline transport, one form of capture, EOR) it is the demonstration of the integrated CCS chain that is needed. To quote the ZEP the purpose of such demonstrations is "to de-risk CCS for all players within the value chain"[10]. To give some key examples:

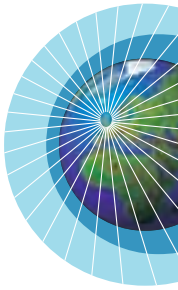
- Project developers and investors need to be satisfied that the full CCS chain is safe, effective, environmentally benign and reliable, and to have experience of where CCS will fit in a low carbon electricity supply system.

10 EU Demonstration Programme for CO2 Capture and Storage, ZEP's Proposals, November 2008: www.zero-emissionsplatform.eu

- Plant operators need to be familiar with the technology chain in order to be informed buyers.

- Equipment suppliers need to advance their understanding and experience of CCS technologies so that in the future they are prepared to offer performance guarantees.

- Regulators, NGOs and the public need to have direct experience with CCS to be assured that a future expansion in deployment is implemented in an acceptable manner.



2.50 These uncertainties and risks are likely to cause investors to impose high risk premia on early CCS projects. Therefore the purpose of commercial scale demonstration projects is not just to prove CCS technically, but also to reduce other uncertainties affecting investment risk.

2.51 In summary the steps that we believe are needed to take CCS towards commercialisation are:

- Initial demonstration of the technology at commercial scale, to prove technically the full integrated CCS chain and get a better understanding of both capital and operating costs. This is where activity currently lies including the current UK demonstration project and demonstrations elsewhere.

- Transition to commercial viability, where there is some experience with the technology from a first wave of large scale projects, but where further demonstration is needed to prove CCS, driving down technical and investment costs and risks. This is where we see the contribution of the UK's additional commitment to CCS demonstrations.

- Full commercial deployment, where technical and economic viability is proven and investors can choose CCS as one of a suite of low carbon options. Ultimately, as with other technologies, our goal should be that the carbon price is sufficient to incentivise such choices. However, again as with other technologies, whether, and for how long, any support framework in addition to the carbon price will be required cannot be determined at this stage.

Rationale for financial and regulatory support for the development of CCS

2.52 If CCS is to fulfil its potential to make a significant contribution to combating climate change, fossil fuel power stations with CCS will need to be able to compete with other low-carbon technologies. However, CCS is currently at an early stage of development and very costly,

and market forces alone are unlikely to deliver sufficient investment in innovation to take CCS from where it is today to commercial deployment.

2.53 There are a number of market failures which affect investment in innovative energy technologies such as CCS. Some of these are general to all innovation, and some are specific to energy technologies and the markets they operate in. These include:

- Companies underinvesting in innovation activity (e.g. R&D), as they are not able to appropriate the full benefits of these investments. Market failures resulting from such externalities and spillovers are most likely to occure in innovation resulting from R&D investments.

- Energy generation usually involves large, capital-intensive investments. Energy innovation therefore needs costly full-scale trials. The type of engineering and learning-by-doing associated with the energy innovation process is particularly vulnerable to free riding, as all firms benefit from lessons learned from major investments in innovation. Some innovative technologies face a high cost to establish new enabling infrastructure while in competition with established technologies whose development is publicly supported.

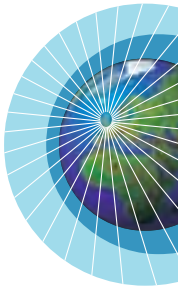
- The economics of CCS depends on the investor receiving a commercial return for the carbon emissions saved by capturing the CO_2. Carbon emissions create a negative environmental externality, which the EU Emissions Trading System corrects or by creating a price for carbon. But energy technologies have a long payback time and so perceived uncertainty over the policy framework which puts a cost on emitting carbon could make firms reluctant to invest in innovative or higher-risk low carbon technologies.

- The homogeneous nature of electricity – electricity is a commodity, which means there are few niche markets where developers of generation technologies can secure early returns. Energy companies have little appetite for using unproven and more costly technologies to deliver their basic commodity.

2.54 Reflecting these issues, current private investor activity in CCS in the UK and elsewhere is focused on R&D and pilot plants at around one tenth scale, which clearly will help to advance CCS, but not at the pace needed to prove the technology for commercial deployment in the 2020s.

2.55 The UK has an opportunity to support CCS demonstration, or could choose to wait for others to make the investment. While waiting would enable the UK to learn from others' experiences, little progress would be made if all countries were to take this approach. Further, there are potential direct benefits to the UK in taking actions that would see us

at the forefront of a technology that could develop into a multi-billion global market through its deployment as part of a global effort on climate change mitigation. Estimates by consultants AEA Technology suggest that low carbon coal technologies could be worth £2-4 bn/yr to the UK by 2030, sustaining between 30,000 and 60,000 jobs, with a cumulative value of £25-45bn between 2010 and 2030[11]. We have the opportunity to sow the seeds of future CCS business clusters in areas of high carbon dioxide emissions, around which a new infrastructure and industry in the UK can develop, and this is an important part of our Low Carbon Industrial Strategy.



2.56 Government, by fulfilling an active strategic role, can support innovation through the right regulatory design, through appropriate use of public procurement, and through specific policies for research, development and demonstration of new technologies[12]. This consultation document explores how regulatory intervention and financial support could help to overcome the barriers to investment in CCS and, together, deliver demonstration and deployment of CCS technologies. These proposals sit alongside a wide range of other government activities to promote development of CCS technologies.

11 "Future Value of Coal Carbon Abatement Technologies to UK Industry", report to DECC by AEA Technology, June 2009

12 Innovation Nation – science and innovation White Paper. DIUS. March 2008

Chapter 3: The proposed framework for the development of clean coal

An overview of the proposed framework

3.1 The UK's aim is to establish a stable regulatory and financial framework that will enable a transition to a low carbon economy alongside investment in clean coal power stations. Our proposals are set out in summary here; Chapter 4 provides more detail on the regulatory aspect of our proposals, and Chapter 5 on financial aspects.

Finance: funding CCS demonstrations

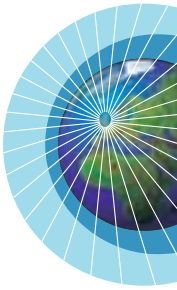
3.2 The costs and risks of CCS demonstration mean that projects will only proceed with Government intervention. Our proposals would see the UK supporting up to four commercial-scale CCS demonstrations, which would represent a substantial contribution to global efforts to develop CCS technologies, and would be supported by the introduction of a new financial incentive funded by a levy on electricity suppliers.

3.3 It remains the Government's intention to proceed with the CCS demonstration competition that we launched in 2007, to contract award, subject to receiving suitable bids and being able to reach appropriate terms. As with any long-term procurement, final funding approval for this will depend on decisions taken at the next Spending Review. This demonstration could potentially be supported by a combination of funding sources: the new financial incentive mechanism, EU funding, and also by public expenditure. We plan up to three further CCS demonstration projects which would be supported by the new financial incentive mechanism.

3.4 In Chapter 5, we explore the design of the new mechanism that will provide funds to support CCS demonstrations; the possible approaches to payment of the incentive to CCS projects, including a contract for differences for carbon dioxide abated or additional payments for the CCS electricity generated; and how the UK approach should mesh with the funding available from the EU. The new financial incentive would require primary legislation, which the government would seek to introduce at the earliest opportunity.

Regulation: requiring CCS demonstration

3.5 While the financial support should on its own support CCS demonstration, to further incentivise timely and effective development



of this new technology at commercial scale and to push forward de-carbonisation of the electricity supply, we are proposing a new regulatory requirement for any new coal power station seeking development consent in England or Wales: it should be required to demonstrate CCS on at least 300MW net (around 400MW gross) of its capacity. In practice, for technical reasons the size of a demonstration project may need to be larger depending on the technology to be demonstrated. This option is discussed further in section 1 of Chapter 4.

3.6 The combination of this regulatory requirement and the financial incentive is intended to enable up to four new coal power stations to be built by 2020, supporting both the diversity of our energy mix and the transition to a low carbon economy.

Regulation: requiring CCS retrofit

3.7 To minimise technical barriers to the retrofit of CCS to any new combustion power station, from April 2009 we are already requiring power stations to be constructed carbon capture ready i.e. they must demonstrate that they have been designed with operational CCS in mind and that there are no known barriers to installation once the technology has been proven.

3.8 To reinforce the expectation indicated by the EU ETS that CCS will need to be retrofitted in the 2020s, we propose that new coal power stations should be required to retrofit CCS to their full capacity within some five years of CCS having been independently judged economically and technically proven. We will plan on the basis that CCS will be judged proven by 2020 and propose that there should be an independent review to assess the status of CCS technologies that would report in 2020. Further new coal power stations would then be required to install CCS technology on the full generating capacity from the outset. We also explore whether, and how, this requirement should apply to existing coal power stations. This option is discussed further in section 2 of Chapter 4.

Regulation: Contingency

3.9 While we will plan on the basis that CCS will be proven by 2020, there remains the possibility that CCS will take significantly longer to prove, or that it will not be proven at all. In order to signal our clear expectation that, with or without CCS, there will need to be substantial reductions in emissions from coal power stations in the future, we need to consider whether other measures might be needed.

3.10 In section 3 of Chapter 4, we consider how emissions from coal power stations could be managed in the event that CCS is not proven as quickly as we expect. We propose that the detailed implementation of a contingency measure should be determined following an independent

review that would report in 2020, but would consider it important that we set out our clear expectations at a higher level now.

Question 3.1

What are your views on how effective the proposed framework of financial and regulatory measures will be in supporting delivery of our vision for clean coal at home and abroad? Please provide evidence to support your views.

Question 3.2

How do you think the proposals might impact on decisions to invest in new coal power stations and CCS demonstration in the UK? How can this framework best be developed to encourage investment in coal and CCS in the UK? Please provide evidence to support your views.

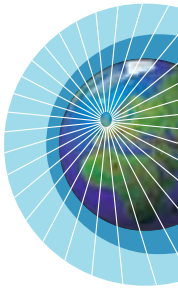
The UK CCS demonstration programme

3.11 The number of demonstrations required to prove CCS commercially is difficult to estimate because CCS is not one single technology but a range of technical options for carbon dioxide capture and storage, and there may also be circumstances in which transport by ship may be favoured over pipeline transport.

3.12 There are currently three basic approaches to capture involving post-combustion, pre-combustion and oxy-firing methods (see box 2.2) and three types of geological formations considered suitable for storage involving depleted gas and oil reservoirs and saline aquifers. However, the position is further complicated by the on-going development and identification of alternative solutions within each of these general approaches. For example post-combustion capture can be undertaken with different amine compounds and an alternative chilled ammonia solvent is also being developed. Similarly there are alternative gasifier and separation technologies applicable to pre-combustion capture, and pipeline transport may be undertaken with gaseous or dense phase carbon dioxide depending on location specific safety requirements. It is for this reason that the EU is aiming to have 12 demonstrations while the G8 wants to see 20 projects launched by 2010.

3.13 In deciding what should be the UK's share of this global demonstration activity we have considered what should be done to deliver maximum benefits both globally and for the UK, taking account of climate change, security of supply and low carbon economy goals. We believe the key objectives of a UK programme of CCS demonstrations should be:

- To gain experience of a range of CCS technologies.



- To develop a broad and sustained UK capability in the design, construction and operation of alternative CCS technologies that will be capable of capturing a significant share of the expected global market.
- To maintain momentum in the UK development of CCS that will be sustained until the technology is expected to become commercially viable.
- To establish CCS as "best available techniques" (BAT) for the deployment of clean coal power generation in the UK, which will require the establishment of a strong knowledge base on the cost and performance of CCS technologies[13].
- To help establish competitive supply chains for CCS design, equipment and operation.
- To accelerate diffusion of knowledge on CCS both within the UK and globally.
- To deliver projects that are affordable and represent value for money.

3.14 We believe that the attainment of these objectives will require up to four commercial scale demonstration projects in the UK, coordinated with other projects to form an integrated international portfolio of demonstrations.

3.15 Commercial-scale demonstration needs to be of a size that ensures learning is directly relevant to deployment of the technology on the full capacity of a power station. While larger projects may deliver lower unit costs, we need to balance this against the need to attain value for money and affordable projects.

3.16 The size needed for an effective commercial-scale demonstration will vary between types of capture technology. For technical reasons, pre-combustion and oxyfuel capture technologies demonstrations will need, as a minimum, to capture carbon dioxide from a single unit of a coal plant. For pre-combustion this could mean that a demonstration would need to be applied to a single coal gasification and turbine unit of around 450-500MW and for oxyfuel a single boiler of around 800MW. The first demonstration of post-combustion is likely to be around 300MW net but a second project could be larger if this is justified. Our concern is that the demonstration projects are sized to achieve the objective of proving the technology at commercial scale. While larger demonstrations could capture more carbon dioxide, this must be judged

13 As BAT, CCS would also be capable of meeting all other relevant environmental requirements, particularly those emanating from the integrated pollution prevention and control ((IPPC) Directive (2008/1/EC)

against the extra overall cost and whether there is value in terms of additional learning[14].

3.17 In considering the appropriate size for individual demonstration projects, and for the programme as a whole, we will take into account the needs of technology demonstration, the goal of enabling new coal power stations to be built for energy security, the total cost of the programme and its cost effectiveness in meeting our objectives.

3.18 From a carbon dioxide storage perspective, we believe that any demonstration project would need to store a minimum of 20 million tonnes over a 10 to 15 year period in order to test the geological aspects of the storage site. On a 1600MW power station, about 20-25 percent of the carbon dioxide would be captured.

3.19 Overall, in our view, a commercial-scale demonstration should:

- Capture and transport the carbon dioxide emissions from the generation of at least 300MW net, (around 400MW gross generation from a CCS power station once the electricity consumption of the capture facility and the transport and storage processes is taken into account).
- Store at least 20 million tonnes of carbon dioxide over a period of 10 to 15 years.

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.

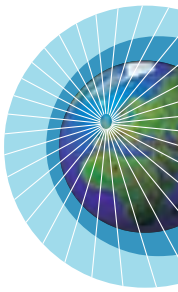
Emissions Performance Standards

Background

3.20 We want to explore whether a limit on carbon dioxide emissions from individual coal power stations (i.e. an emissions performance standard, EPS) could support our goals. This section sets out some general background on an EPS, while we discuss how an EPS could support each of our regulatory proposals – a requirement to demonstrate CCS, a requirement to retrofit, and a contingency measure – in Chapter 4.

14 The Impact Assessment that is published alongside this consultation document is based on a scenario where a first demonstration of 300MW starts operation in 2014, a second of 450MW in 2015 and two further demonstrations of 450MW in 2018.

3.21 The EU ETS will remain a significant factor in investment and operational decisions, and will be central to the future commercial viability of CCS. It is therefore important that we consider how the approach to any EPS would be designed to complement the EU ETS.



Emissions levels from coal power stations

3.22 Levels of emissions from power stations can be compared by considering the amount of carbon dioxide that is released for each unit of electricity generated. This is determined primarily by the carbon intensity of the fuel (where coal is the most carbon intensive), the efficiency of the power station, and whether the carbon dioxide is released to the atmosphere or captured and stored.

3.23 The rate of carbon emissions varies between power stations of the same type, depending for example on whether investment has been made in efficiency upgrades. Further, the emissions from a single power station will vary over time. For example, a power station that is running part load would be likely to be less efficient than one running at full load. The operation of partly loaded power stations is an important contributor to security of supply as it enables rapid response to sudden reductions in supply of electricity from other sources, (which will become more important as the proportion of wind generation increases), or increases in demand. New gas power stations emit around 350kg/MWh.

3.24 For the UK's existing coal power stations, emissions in 2007 averaged 940 kg/MWh, with variation between power stations[15]. These power stations use pulverised coal as fuel and are based on subcritical technology. New pulverised coal power stations would use supercritical technology, which enables more efficient use of fuel, reducing emissions to some 750 kg/MWh. Further technology developments would be likely to enable this to be brought down further. Alternatively, new coal power stations may, instead, use gasified coal as a fuel (IGCC), where efficiency levels would again be higher than for our existing power stations. For comparison, emissions from the UK's gas power stations averaged 400 kg/MWh in 2007 and emissions from oil power stations averaged 660 kg/MWh

3.25 The net emissions from coal power stations can be reduced by replacing a proportion of the fuel burned with biomass. The proportion of co-firing that is technically possible is generally limited to about 10 to 15%, offering equivalent reductions in emissions, although higher levels may be possible as technologies develop.

3.26 CCS has the potential to reduce emissions by around 90%.

15 Digest of UK Energy Statistics 2008. BERR.

Approaches to emissions performance standards

3.27 Emissions performance standards (EPS) have long been used to regulate emissions of pollutants that have an impact on the local environment. For example, the first European-wide limits on air pollutants from motor vehicles were introduced in 1970, while the Large Combustion Plants Directive, which first entered into force in 1988, set limits for emissions of sulphur and nitrogen dioxides and dust from combustion power stations. Setting emissions limits is an essential feature of the system of integrated pollution prevention and control that applies to industrial activities of all kinds[16].

3.28 More recently, attention has turned to the potential for an EPS to form part of the package of interventions aimed at tackling carbon dioxide emissions from power stations. These standards set thresholds for the acceptable level of carbon dioxide emissions per unit of electricity generated for individual power stations. An EPS can be absolute, so that a power station would be expected to operate within the standard minute by minute, or averaged over a period of time, whether a year or a lifetime, so that average emissions over the period are within the standard.

3.29 California was the first US State to introduce an EPS, in 2007, for baseload electricity supply (see box 3.1). This was initially established as an interim policy until the introduction of a cap and trade system like the EU ETS, but the option of maintaining the EPS as a complement to any cap and trade system is being considered. Some other US states have subsequently introduced EPSs shaped to their own situations, and proposals have been put forward at the Federal level for an American Clean Energy and Security Act which includes proposals for an EPS on coal power stations.

3.30 Having set an EPS, there is then scope for the level to be ratcheted downwards either automatically or by a process of reviews. For example, the draft American Clean Energy and Security Act proposes five yearly reviews of the standards.

3.31 From a UK perspective, we can learn from the approaches implemented elsewhere but should not assume that an approach that is appropriate in one particular context is necessarily appropriate to our own energy market and policy objectives.

16 Directive 2008/1/EC – transposed in England Wales through the Environmental Permitting (England and Wales) Regulations 2007 and similar secondary legislation in Scotland and Northern Ireland.

Box 3.1: US approaches to Emissions Performance Standards for carbon dioxide

Several US States have introduced an EPS for power generation, with flexibilities available that aim to protect energy security and consumers.

California

California introduced an EPS of 500kg/MWh in 2007. The EPS applies to new investments in, or new contracts for, baseload generation (load factors of more than 60%) within California and imported from other states. The level of the EPS was set so that it could be met by most existing gas power stations. Those existing gas stations that have higher emissions are deemed to meet the standard. Approval for investment is given on the basis of technical information provided in advance of the investment; compliance is not monitored. Any coal/CCS project must show that net emissions projected over its lifetime meet the standard. Exemption from the EPS can be given if the investment is necessary to ensure reliable service or to avoid a threat of significant financial harm.

Oregon

Oregon introduced legislation in 2007 requiring the introduction of an EPS for new power stations, although the level for coal power stations has yet to be set. The standard may be met by offsets or by paying a fee per tonne of carbon dioxide emitted.

Washington

Washington introduced an EPS in 2008 for new baseload generation, based on the level of emissions of a gas power station, with allowance for exemptions on grounds of system reliability and costs to consumers. For CCS projects: carbon dioxide storage should start within 5 years of operation; there is provision for operators to purchase emissions reductions if CCS does not operate as envisaged.

Proposed American Clean Energy and Security Act 2009

In March 2009, the Chairs of two House of Representative Committees, Henry Waxman and Edward Markey, set out draft proposals for new US legislation. The initial proposal was for an emissions standard of 500kg/MWh for new power stations with implementation linked to the development of CCS. The bill has since been amended, and may change again as the bill progresses. The current proposal is that power stations permitted between 2009 and 2020 should be required to reduce their emissions by 50% four years after 4GW of CCS is operational within the US (provided two CCS plants are over 250MW and that 12MtCO2/yr is being stored in aggregate), or 2025 at the latest.

Options for implementation of an EPS in the UK

3.32 We see two broad alternative approaches to the possible use of an EPS as part of the regulatory framework.

3.33 The first approach would reflect the development of CCS technologies, so that the timing and level of any EPS implementation would be linked to progress with CCS. As discussed in Chapter 4, this could mean initially setting an EPS at a level that supported CCS demonstration then, once CCS had been proven, tightening the EPS to a level that supported CCS retrofit or, if CCS was not proven as quickly as we expect, using an EPS as part of a suite of measures that could form a contingency to ensure that emissions reductions are delivered. It may be that there is a better case for using an EPS to support some of these stages than others.

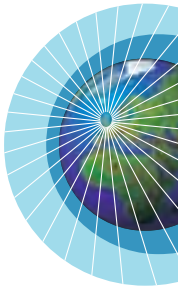
3.34 The second approach would set out the levels and timing of an EPS in advance of any knowledge about how CCS will operate, and could describe a downwards trajectory for emissions from coal power stations in line with climate change objectives. This approach could provide greater regulatory certainty and have the effect of driving investment in CCS. On the other hand, if investors are concerned about their ability to meet a future EPS while maintaining economic operation of a coal power station, they may simply chose not to invest, to invest instead in a gas power station, or to invest in coal fired generation under an alternative regulatory regime in another country. This is not the approach taken by the framework proposed in this document.

3.35 To maintain regulatory clarity, to date under EU law the EU ETS has been the only mechanism for controlling emissions of carbon dioxide from large installations such as power stations. For example, to avoid double regulation, control of carbon dioxide emissions through the setting of an emissions limit has been excluded from the Integrated Pollution Prevention and Control (IPPC) Directive, which controls emissions of other pollutants. It would be essential that any approach to an EPS within the UK is designed to complement the EU ETS, which will remain a significant factor in investment and operational decisions and will be central to the future commercial viability of CCS. A UK EPS would have no net effect on EU emissions, which would continue to be determined by the EU ETS cap. We would also need to confirm that implementation of a UK EPS was consistent with EU law.

Question 3.4

What are your views on whether and how an EPS could support our policy objectives? Please provide evidence to support your views.

Chapter 4:
The proposed regulatory framework



4.1 This chapter considers the three regulatory aspects of the proposed framework for the development for clean coal:

- Section 1: Requiring any new coal power station in England and Wales to demonstrate CCS on a defined part of its capacity.
- Section 2: Requiring new coal power stations to retrofit CCS to their full capacity within five years of CCS being independently judged technically and economically proven. We will plan on the basis that CCS will be proven by 2020. Any further new coal power stations would then be required to fit CCS from day one.
- Section 3: Preparing for the possibility that CCS will not become proven as early as we expect.

Section 1: Requiring demonstration

Summary

4.2 While the financial mechanism set out in Chapter 5 would, on its own, support CCS development, to further ensure timely and effective development of this new technology at commercial scale, we are proposing a new regulatory requirement for any new coal power station to demonstrate CCS from day one. As discussed in Chapter 3, we consider a commercial scale demonstration should have a minimum electrical output of 300MW net (around 400MW gross) and be able to store at least 20 million tonnes of carbon dioxide over a period of 10 to 15 years.

4.3 In this section, we consider:

- how we could use the planning system in England and Wales to ensure that new coal power stations would be designed and constructed so that they are able to operate with a CCS demonstration from day one
- How to monitor the subsequent operation of the CCS demonstration
- How we could enforce operation of the CCS demonstration.

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.

Implementing a requirement to demonstrate through the planning system

Background

4.4 Under section 36 of the Electricity Act 1989, developers must gain consent from the Secretary of State for Energy and Climate Change to construct any onshore power station over 50MW in England or Wales. Schedule 8 to the Act and relevant Regulations[17] set out comprehensive procedures in which the views of the local planning authority, local population, statutory bodies such as the Environment Agency, Natural England/Countryside Council for Wales, and other interested parties can be considered as part of the decision making process. Applications under the Electricity Act in Scotland are handled by the Scottish Executive[18].

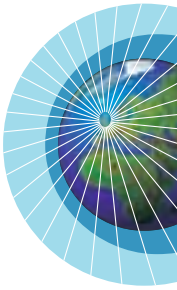
4.5 As part of this process, since April 2009 applicants for all new combustion power stations in England and Wales with an electrical output at or over 300MW have had to demonstrate that their power station will be, and will be maintained as, carbon capture ready (CCR. See box 4.1). All existing and proposed coal power stations are well above the 300MW threshold.

4.6 The Planning Act 2008 introduced a new system for nationally significant infrastructure planning that will replace the current processes under s36 of the Electricity Act for England and Wales for such projects. An Infrastructure Planning Commission (IPC) will be established as the new authority granting development consent for nationally significant infrastructure projects, including power stations over 50MW. The IPC is expected to start operating in 2010. National Policy Statements will be produced by Government to provide the framework for the IPC's decisions and will reflect government policy, setting it within a planning context.

4.7 Any policy decisions taken following this consultation that have the effect of changing the framework within which development consent for coal power stations is given will need to be reflected in s36 guidance, for any applications that are received before the IPC starts operation, and to be reflected in the National Policy Statements that apply to energy infrastructure under the IPC regime.

17 See the Electricity (Applications for Consent) Regulations 1990 and the Electricity Works (Environmental Impact Assessment)(England and Wales) Regulations 2000 as amended.
18 See the Scotland Act 1998 (Transfer of Functions to the Scottish Ministers etc.) (No. 2) Order 2006

4.8 Given their long operating lives, it will be important for new coal power stations to put in place effective adaptation measures at the start of their development to minimise risk from climate change. New coal power stations will therefore need to consider the impacts of climate change in their location, design, build and operation to ensure they can remain operational in the face of a changing climate.



Box 4.1: Carbon capture readiness

All new combustion power stations (e.g. gas, coal, biomass) in England and Wales with an electrical output at or over 300MW are required to be carbon capture ready (CCR). CCR aims to ensure that there are no barriers to the deployment of CCS on the full capacity of the power station, once the technology has been proven. The Government set out its policy on CCR on 23 April 2009[19] and published draft guidance on CCR for applicants for s36 Electricity Act 1989 consent for consultation[20].

In summary, to demonstrate CCR, as part of their application for s36 Electricity Act consent developers will be required to:

- demonstrate that they have sufficient space on or near the site to accommodate carbon capture equipment in the future;
- undertake an assessment into the technical and economic feasibility of retrofitting carbon capture technology;
- propose a suitable area of deep geological storage offshore for the storage of captured carbon dioxide;
- undertake an assessment into the technical and economic feasibility of transporting the captured carbon dioxide to their proposed storage area; and
- if necessary, apply for and obtain Hazardous Substance Consent (HSC) when applying for section 36 Electricity Act consent.

If granted consent, developers will be required to:

- retain the additional space on or near the site for the carbon capture equipment;
- if their application included plans for some space needed for the capture and compression of carbon dioxide to be off site, retain their ability to build on that site in the future; and

19 http://www.decc.gov.uk/en/content/cms/consultations/closed/closed.aspx
20 http://www.decc.gov.uk/en/content/cms/consultations/open/open.aspx

- submit reports to the Secretary of State for DECC on the effective maintenance of the plant's CCR status. These reports will be required within 3 months of the date on which a consented station first begins to supply electricity to the grid (so avoiding any burden on the operator with an unimplemented consent) and every two years thereafter until the plant moves to retrofit CCS.

Further detail on CCR requirements, taken from the draft guidance for s36 applicants, is given in annex 3.

Principles

4.9 In considering how the process of awarding development consent could support any requirement to demonstrate CCS, some principles have underpinned our thinking:

- The process for making any decision on a planning application for a new coal power station should be made independently of any decision on allocation of funding for CCS demonstration. This is a fundamental principle and means that planning decisions would continue to be based purely on planning and environmental issues relevant to the development itself. It does mean that planning consent could be given to more coal power stations than will be able to secure financial support for CCS demonstration. Given the costs of CCS demonstration, we would expect only those power stations able to secure financial support to move to construction.

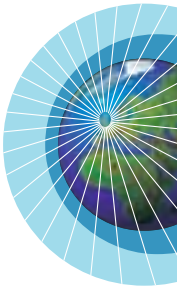
- The development consent process is best used to implement firm and fixed conditions that will not change over time.

- We should avoid duplication between the development consent process under s36 of the Electricity Act (or, subsequently, the Planning Act 2008) and the functions of the Environment Agency to permit the ongoing operation of power stations.

- We would ideally establish a process that enabled developers to submit applications for consent quickly. This would support timely delivery of the UK's CCS demonstration programme and support the diversity of our energy mix.

- The policy should apply to any new power station that uses coal as a primary fuel, whether directly in a pulverised coal power station or indirectly in an IGCC plant. For an IGCC plant, the policy should apply regardless of where the syngas is generated, whether that is at an on-site or off-site gasification unit, including underground coal gasification.

Proposals



4.10 We suggest that the planning process should be used to ensure that the CCS chain is constructed as part of any new coal power station: a new coal power station could only gain development consent if it could show that it was designed and intended to capture, transport and store at least 20 million tonnes of the carbon dioxide emitted from at least 300MW net (around 400MW gross) of its capacity. This would sit alongside usual requirements to demonstrate that the proposal is acceptable in planning and environmental terms, and to show that the full plant is carbon capture ready.

4.11 DECC is not aware of any proposed coal power stations below this size. However, we would not want our policy to have the unintended consequence of driving investment in smaller coal power stations in order to avoid this new condition, and so propose that for any smaller power stations the requirement should be to capture carbon dioxide from the full capacity of the power station. The quantity of carbon dioxide to be stored would then need to be determined on a case by case basis.

4.12 In order to secure consent, in addition to demonstrating that the power station met CCR requirements, operators would have to show:

- how the design and construction of their power station incorporated a minimum 300MW net carbon dioxide capture unit, that the CCS unit was designed to ensure that there was a reasonable expectation that it would operate as intended, and that the necessary consents were in place (for example, Hazardous Substances Consent, where necessary)

- how the carbon dioxide would be transported and evidence that the necessary consents were in place, for example authorisation for the construction of a pipeline

- that they had access to an offshore facility for the storage of at least 20 million tonnes of carbon dioxide and that the operator of the storage facility has the necessary lease and licence.

4.13 Under any new regulatory framework, applications for development consent would be dealt with under usual section 36 procedures (and subsequently by the IPC under the Planning Act 2008). Any consents would be subject to the conditions above and no construction would be allowed to begin until the Secretary of State (of IPC) was satisfied that the conditions had been fully met.

Question 4.2

What additional planning conditions do you think an operator should have to meet to show that they would be able to meet a requirement to demonstrate CCS? Please provide evidence to support your views.

Monitoring and enforcing a requirement to demonstrate

Background

4.14 CCS demonstrations that receive financial support through the UK demonstration programme will be monitored and payment will be linked to the operation of the CCS chain.

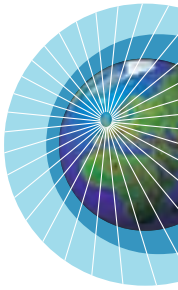
4.15 Funding for CCS demonstration may also become available from other sources, and these could have different monitoring and payment arrangements.

4.16 Power stations are also monitored by the Environment Agency. All power stations in England and Wales must hold an Environmental Permit from the Environment Agency in order to operate, which is issued under the Environmental Permitting Regulations 2007[21]. The process of applying for this permit is independent of, and can precede, the s36 development consent process but without both in place operation cannot commence. In applying for the Environmental Permit, operators must demonstrate that they have the processes in place to meet all the relevant requirements. If it decides to issue a permit, the Environment Agency then has an ongoing role in monitoring compliance with the permit and has powers of enforcement where breaches occur or are considered likely. Enforcement action depends on the level of the environmental threat, but can range from informal warnings, to a temporary prohibition on operation until an issue is resolved, through to full revocation of the permit. Criminal prosecution may also result where breaches are significant or prolonged.

Principles

4.17 In considering how the requirement to demonstrate could be monitored and enforced, some principles have underpinned our thinking:

21 The Environmental Permitting (England and Wales) Regulations 2007. Available from: http://www.opsi.gov.uk/si/si2007/uksi_20073538_en_1



- CCS is a demonstration stage technology. If we are to maximise learning from the demonstrations, operators need the flexibility to try out different approaches and refine the operation of the unit. We also need to recognise that the CCS demonstrations may not operate as intended, at least initially, and to give operators reasonable opportunity to overcome technical issues.

- To minimise regulatory burdens, we should look to use existing regulatory systems to monitor any requirement to demonstrate: the operation of power stations is currently regulated by the Environment Agency in England and Wales under Environmental Permitting Regulations 2007.

- As the aim of CCS deployment is to capture and store carbon dioxide, any monitoring regime should focus on these outcomes, while also recognising that the primary purpose of CCS demonstration is to generate learning that will accelerate wide-scale deployment.

- As the EU ETS underpins approaches to emissions reductions across Europe, it is important that any policy measures are designed to complement the EU ETS.

Proposals for monitoring the operation of CCS demonstrations

4.18 We should, as a minimum, monitor the operation of CCS demonstrations and place that information in the public domain. We consider three possible approaches below. These would sit alongside both the monitoring of compliance with environmental and Health and Safety requirements that would apply to any installation and the monitoring that will be required as part of the conditions for receiving CCS demonstration funding.

Option 1: regular reporting to the consenting body

4.19 As part of the CCR requirements, operators must submit a report to the consenting body every two years on the effective maintenance of the power station's CCR status[22]. We could require, for new coal power stations, that a similar reporting arrangement is put in place to gather information about the operation of the CCS demonstration. This would provide publicly available information on the operation of the CCS demonstration and support the knowledge-sharing that will accelerate CCS development. The report could, for example, highlight key issues and lessons learned about the operation of the CCS chain, state the total amount of carbon dioxide produced by the power station and the

22 Guidance on CCR and applications under section 36 of the Electricity Act 1989: a consultation. DECC. April 2009.

amount stored, and set out high level plans for the future operation of the CCS chain.

Option 2: monitoring carbon dioxide storage

4.20 We expect a commercial scale demonstration to store at least 20 million tonnes of carbon dioxide over a period of 10 to 15 years, as set out in chapter 3. The Environment Agency collects data to verify EU ETS emissions, which provides one source of information for monitoring. Under the UK's regulatory regime for storing carbon dioxide, those holding the permits for offshore carbon dioxide storage will be required to provide regular reports to DECC, with the exception of storage within Scottish territorial waters for which the Scottish Executive is responsible. DECC's monitoring will include ensuring that there is consistency between the reporting of carbon dioxide capture through the EU ETS regime and the reporting of the quantity of carbon dioxide stored. All of this information could be collated and published for the demonstration projects.

Option 3: an emissions performance standard

4.21 An indicative EPS could be set at a level that reflected the expected reduction in emissions as a result of operating the CCS demonstration. For example, a new coal power station might be expected to emit 750g/kWh which, for a 1.6GW coal power station, could be reduced to around 600g/kWh with a 300MW net CCS demonstration unit. The Environment Agency would be collecting information that would enable monitoring of a power stations emissions levels.

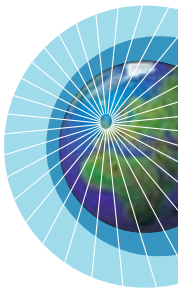
4.22 Monitoring of emissions levels has the advantage that it could provide a link through to the implementation of a requirement to retrofit CCS (discussed in section 2). It is also technology neutral and so would recognise other approaches to emissions reductions such as co-firing with biomass and efficiency improvements.

4.23 However there are some disadvantages: maintaining operation within an EPS could limit the flexibility needed for a demonstration; the EPS would need to be set at a different level for power stations and CCS demonstrations of different sizes, which risks some loss of clarity and transparency in our expectations; and a technology neutral approach may reduce our clear focus on driving CCS technology development as quickly as possible.

Question 4.3

What are your views on the best approach to monitoring the operation of CCS demonstrations? Please provide evidence to support your views.

Proposals for enforcing the operation of CCS demonstrations



4.24 We expect operators to make all reasonable efforts to maximise the operation of the full chain of a CCS demonstration. This does not necessarily mean that the CCS chain will be operational at all times. For example, operators will need to refine the operation of the CCS components, particularly as this is a demonstration stage technology, which could mean that the power station is running without CCS for a period. Further, depending on how the CCS chain impacts on the operation of a power station, there may be times when operators choose to cease operating the CCS chain in order to optimise electricity production. We consider this flexibility necessary and acceptable.

4.25 We also have to recognise that there may be circumstances outside the control of the operator that mean that the operation of the CCS chain is not possible.

4.26 Nevertheless, if operation of commercial-scale CCS proves to be particularly difficult or costly, there is a risk that operators will choose not to make reasonable efforts to operate any CCS demonstration chain that had been put in place. We would not consider this to be acceptable.

4.27 We would expect such action to be revealed both through the monitoring carried out under the terms of the funding arrangements, and through any additional monitoring arrangements put in place, as outlined above. While there is clearly a need for some flexibility, if it became obvious that the operator was not making reasonable efforts to operate the CCS chain we need to consider our response. We have considered several options and our initial preference is for option 1: the power station should not be allowed to continue operation. We will be exploring whether this would be best enforced through the planning regime or the Environment Agency's Environmental Permitting regime, and would welcome views.

Option 1: cease operation

4.28 The power station would not be allowed to operate with coal as a primary fuel until the CCS demonstration chain is restarted and there is confidence that the operators will continue to make reasonable efforts to capture and store carbon dioxide. For a pre-combustion demonstration, the operator could choose to switch to gas as a fuel. For a post-combustion demonstration, there would seem to be no option but to shut down.

Option 2: emissions limit

4.29 The operation of the coal power station could be limited so that emissions are no higher than would have been expected through use of the CCS chain. This could be achieved by limiting running hours,

introducing a power station level cap on carbon dioxide emissions, or through an emissions performance standard – all options that are considered for the contingency measure in section 3.

Option 3: continue operation

4.30 The coal power station could continue operation without the CCS demonstration, within the constraints of the EU ETS. Any further limits on emissions would be introduced through either the requirement to retrofit CCS, discussed in section 2, or through the contingency measure, discussed in section 3.

Question 4.4

Under which circumstances would you consider it acceptable and/or necessary for power station operators to switch off the CCS chain? Please provide evidence to support your views.

Question 4.5

Do you agree that a new coal power station should be required to cease operation if the operator cannot demonstrate that they are making reasonable efforts to operate the CCS chain? Please provide evidence to support your views.

Section 2: Requiring Retrofit

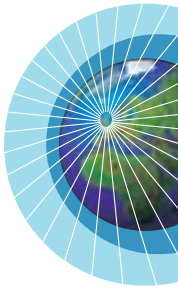
Summary

4.31 To reinforce the expectation indicated by the EU ETS that CCS will need to be retrofitted in the 2020s, we propose that new coal power stations should be required to retrofit CCS to their full capacity within some five years of CCS having been independently judged economically and technically proven. We will plan on the basis that CCS will be judged proven by 2020 and propose that there should be an independent review to assess the status of CCS technologies that would report in 2020. Further new coal power stations could then be required to install CCS technology on the full generating capacity from the outset.

4.32 In this section we consider:

- how to reach a judgement of when CCS is proven and who could take on this role

- how to implement a requirement to retrofit policy in England and Wales.



4.33 Our primary focus is on new coal power stations (i.e. any that gain development consent after policy decisions have been made following this consultation) because of their long lifespans – up to 50 years – and the risk that we could be locked in to decades of high emissions if operators are not, today, factoring the EU ETS into their plans. However, we also explore whether our proposals should apply to existing coal power stations.

Question 4.6

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

How to determine when CCS is proven

Background

4.34 The concept that is currently used to identify the most effective technologies for reducing emissions and the impact on the local environment of power stations and other installations is known as Best Available Techniques (BAT), defined under the EU Integrated Pollution Prevention and Control (IPPC) Directive (2008/1/EC) as follows:

- 'techniques' includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

- 'available' techniques, means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the member state in question, as long as they are reasonably accessible to the operator.

- 'best' means most effective in achieving a high level of protection of the environment as a whole.

4.35 It is for the Environment Agency to determine what are BAT for each installation in England and Wales, taking account of the technical characteristics of the installation concerned, its geographical location and the local environmental conditions. The process is described in box 4.2.

Box 4.2: The process for defining 'best available techniques'

The Environment Agency's assessment of BAT must be evidence based. One key source of evidence is the information exchanges facilitated by the European IPPC bureau. These exchanges, typically lasting between 2-4 years, bring together relevant technical experts from across industry, with the aim of reviewing technological progress from installations and research from around the world. The outputs from these exchanges are "BAT reference documents" (BREFs). The BREFs are the principal reference documents the Environment Agency and operators use in identifying the appropriate techniques to be used at each site.

The BREF relating to large combustion plants was published in July 2006 and is currently expected to be reviewed in a process starting in 2010. This may culminate with the publication of a revised BREF in 2012/2013, with the expectation thereafter of a further review commencing in 2016/17 and a further revised BREF in 2018/19.

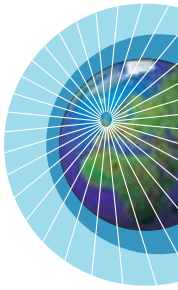
The BREFs provide an important source of evidence but do not constrain the Environment Agency, which can draw on other evidence to make it own assessments of BAT at any time.

Principles

4.36 In considering how the judgement of when CCS is proven should be taken, the following principles have underpinned our thinking.

- Electricity supplies will need to be more-or-less decarbonised by 2050 if we are to meet climate change goals.

- All interested parties should understand and have confidence in the process for making the judgement of when CCS is proven taking into account both technical and economic viability. This means that the judgement should be: made by, or based on advice from, an independent body; evidence-based, with evidence drawn not only from the UK demonstration programme but from the EU and globally; and informed both by those with expert knowledge and a wider interest in the decision.



- To mitigate the risk that investors might judge investment in coal power stations too risky because of the uncertainty over when CCS retrofit might be required, how much this might cost, and their ability to recover these costs, the judgement should encompass economic and commercial factors. This assessment would need to establish that a CCS equipped power station would be economic to operate and will need to consider the capital and operating costs of the CCS chain, the projected carbon and electricity prices, how CCS affects the operation of the power station, and the nature of any policy interventions in place at the time. Some of these variables, such as the price of EU ETS allowances and the wholesale electricity price will be generic. Others will vary according to the type of CCS technology used and the location of the plant and its chosen storage site.

- An assessment of whether CCS was technically proven would need to look across the CCS chain at the capture, transport and storage of carbon dioxide and would need to incorporate factors such as any impact on the reliability of the electricity generation, the safety of the carbon dioxide transport and storage, and the long term security of carbon dioxide storage sites.

- An assessment of whether CCS was proven would need to consider environmental and safety factors, such as those relating to the consumption of raw materials and the use of particular chemicals. We expect that evidence gathered from responses to our Environmental Report as part of the Strategic Environmental Assessment of our proposals (published alongside this consultation) will contribute to the development of environmental criteria.

- The process should have the flexibility to allow for different CCS technologies and processes to be proven on different timescales. Judgements may therefore be needed on a site by site basis, taking the specific situations of each into account.

- To minimise regulatory burdens and costs, we should look to use existing regulatory concepts such as BAT and integrated pollution prevention and control (IPPC) more generally, and ensure that any approach is designed to complement the EU ETS.

Proposals

4.37 We need to consider both who should be tasked with judging whether CCS is proven, including whether a single body would be likely to be competent to judge both the technical and economic aspects, and the timetable for that assessment to be made.

4.38 We are planning on the basis that CCS will be proven by 2020, which is an ambitious timetable. We propose that an independent review should report in 2020 having considered evidence on the status of CCS technologies. In the light of that evidence, the review could conclude:

- that some or all CCS technologies were proven and that retrofit should be required.
- that CCS technologies were likely to be proven soon and to propose next steps. Next steps could conceivably cover issues from technical developments, to the regulation of the CCS chain, to the policy framework within which CCS deployment might be further supported. In this case, a further review should be scheduled in case developments were not delivered as quickly as expected.
- that CCS technologies were unlikely to be proven within the 2020s. In this last case, the review should then go on to consider the contingency options discussed in Section 3.

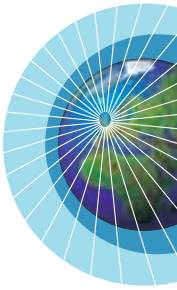
4.39 We think it important that this review is conducted by an independent body. However, given the likely importance of the policy framework in determining when CCS is economically proven, it may be appropriate for Government to make any decisions about when retrofit should be required, based on independent advice.

4.40 We have considered several options for the source of that independent assessment, which are discussed below, although we are open to suggestions for other approaches. Our current preference would be for the Environment Agency to be responsible for considering the technical aspects of the assessment. They could also take on the economic assessment, although it may be preferable for another body such as the Committee on Climate Change to take this on.

Option 1: the Environment Agency

4.41 The Environment Agency is a non-departmental public body with a remit across England and Wales to protect and enhance the environment and in doing so to make a contribution towards the objective of achieving sustainable development. The Agency has a range of broad functions, including acting as an environmental regulator, where determining what are BAT for each installation plays an important role. In determining which techniques are BAT, the Environment Agency is required to consider the technical and economic implications of a particular technique, as well as a range of wider considerations including environmental impacts[23].

23 Set out in Annex 4 of the IPPC Directive



4.42 BAT has the benefit of being well-established and understood by interested parties. It is supported by an existing EU-wide framework that provides for an independently gathered evidence base that is updated in a transparent way on a reasonably frequent basis, providing increasing certainty to all stakeholders about when CCS technologies would become BAT.

4.43 There is, however, currently a better understanding of how BAT might apply to a technical assessment of CCS than economic. There could be several solutions to this issue, including setting out clearly in advance how any economic assessment under BAT should be approached, or inviting another body to consider economic viability in parallel with BAT.

4.44 Some observers have expressed concern that the BAT process is too passive and would not therefore be appropriate for driving progress towards CCS deployment. We do recognise that, if CCS is to become BAT on the timescales that we envisage, then the role of the Government in providing a clear sense of direction and commitment is likely to be important. Our intention is that the comprehensive financial and regulatory framework for the demonstration and deployment of CCS that is proposed in this consultation document, alongside our wider actions to promote CCS, will provide this momentum.

4.45 While engagement in the BAT process is a normal part of the Environment Agency's functions, to signal the importance we attach to CCS and our expectation that the Environment Agency would play an active role in assembling and assessing the evidence base for CCS technologies, we would consider issuing a formal Direction to that effect to the Agency.

Option 2: Committee on Climate Change

4.46 The Committee on Climate Change (CCC) is an independent body established under the Climate Change Act 2008 to advise the UK Government and Devolved Administrations on the emissions reduction pathway to the 2050 target (80% from 1990 levels) and specifically on the appropriate levels for setting carbon budgets. The CCC also reports annually to Parliament on the progress made in reducing greenhouse gas emissions. It would be possible to extend their remit to include responsibility for advising Government of when CCS is proven, and to set out the factors that the Committee should consider in making their judgement.

4.47 This approach would have the advantage that it would bring together thinking on CCS and the delivery of climate change targets. The CCC carries out a range of economic modelling to inform their advice on the pathway towards a low carbon economy, which could support advice on CCS.

4.48 The CCC has quickly established itself as a credible independent voice within its current remit, and would have to establish new processes and gain access to new expertise if it was to be able to take on the role of assessing the development of CCS in the depth that would be required. This expertise could come from industry and academia as well as from organisations such as the Environment Agency, the Health and Safety Executive and Ofgem.

Option 3: creation of a new body

4.49 Creating a new body tasked with making judgements on when CCS is proven has the advantage that the remit and membership could be tailored to fit the task. This could enable the body to establish strong credibility with stakeholders. However, a new body may find it difficult to establish momentum early before any CCS demonstrations are operational and this could affect their ability to contribute to momentum around CCS.

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

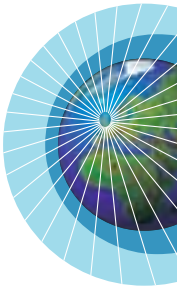
Who do you think should be tasked with judging when CCS is economically proven? Please provide evidence to support your views.

Question 4.10

Should the decision of when CCS is proven be one for an independent body to take, or for Government on the basis of independent advice? Please provide evidence to support your views.

Implementing a requirement to retrofit

Background



4.50 All power stations in England and Wales must hold an Environmental Permit from the Environment Agency in order to operate, which is issued under the Environmental Permitting Regulations 2007[24]. The permit conditions are periodically reconsidered and, where necessary, updated. One of the drivers for permit review is where substantial changes in BAT make it possible to reduce emissions significantly without imposing excessive costs. The Environment Agency can reconsider permit conditions whenever deemed necessary.

4.51 In addition to the review of environmental permits under the Environmental Permitting Regulations, other legislation can drive the deployment of technologies. For example, the Large Combustion Plants Directive (LCPD) was revised in 2001 and set maximum sulphur dioxide emission limits that generally could only be met by existing coal power stations if they fitted flue gas desulphurisation technology. For those coal power stations that opted to continue operating under this new environmental regime, the Environment Agency undertook a site by site assessment taking account of how BAT applied in each situation.

4.52 The Environment Agency then amended Environmental Permits to specify acceptable maximum levels of sulphur dioxide emissions at each site, which in some cases are the same as set out in the LCPD and in others go further. Power stations were expected to meet these new levels when the LCPD came into force on 1 January 2008.

4.53 In this case, the Environmental Permits were amended to specify an emissions level that had to be met; it was then for each operator to determine what steps to take to meet that level. An alternative approach also available to the Environmental Agency is to specify a technical measure that the operator must implement.

4.54 The carbon price under the EU ETS will provide an incentive for operators to retrofit CCS. To maintain regulatory clarity, to date under EU law the EU ETS has been the only mechanism for controlling emissions of carbon dioxide from large installations such as power stations. For example, to avoid double regulation, control of carbon dioxide emissions through the setting of an emissions limit has been excluded from the Integrated Pollution Prevention and Control (IPPC) Directive, which sits above the environmental permitting regime[25]. It would be essential that any approach to controlling carbon dioxide emissions within the UK is designed to complement the EU ETS, which will remain a significant

24 The Environmental Permitting (England and Wales) Regulations 2007. Available from: http://www.opsi.gov.uk/si/si2007/uksi_20073538_en_1

25 Article 9(3) of the IPPC Directive, 2008/1/EC

factor in investment and operational decisions and will be central to the future commercial viability of CCS. A requirement to retrofit would have no net effect on EU emissions, which would continue to be determined by the EU ETS cap. We would also need to confirm that implementation of policy measures to regulate emissions from individual coal power stations was consistent with EU law.

Principles

4.55 In considering how we should implement the requirement to retrofit for new coal power stations, we have considered both the principles set out above that underpinned thinking on an approach to judging when CCS is proven, and considered how we can ensure that the judgement on when CCS is proven can be directly linked to a requirement to retrofit.

Proposals

4.56 Following a judgement of whether CCS is proven for a particular site, we suggest that the Environment Agency should implement the requirement to retrofit through its Environmental Permitting regime. Operators would need to be given a reasonable period of time to comply with the new requirements: they will need to commit significant capital investment, and to have time to install the technology at a time when supply chains and the skills base may still be relatively undeveloped. We suggest that a period of five years from the judgement that CCS is proven should be a suitable period of time.

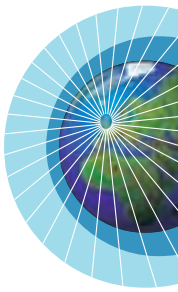
4.57 The Environment Agency could implement the requirement through either a technical measure or introduction of an emissions performance standard (EPS), or a combination of the two. The decision on which of these approaches might be more appropriate may be best taken at the time but our initial view is that option 2, an emissions performance standard, should form part of any approach, and could be complemented by technical measures.

Option 1: Technical measure

4.58 The Environment Agency would specify in the environmental permit that coal power stations had to retrofit CCS technology to their full capacity through the environmental permit.

4.59 This approach has the advantage that it maintains the focus on CCS as a key technology for tackling climate change. Once installed, operators would have flexibility in the use of the CCS chain to support the economic operation of the power plant, with the carbon price being the primary driver for carbon dioxide capture and storage. On the other hand, such a technical measure would not encourage operators to actively consider other options for reducing emissions.

Option 2: Emissions Performance Standard



4.60 The Environment Agency would apply an EPS for carbon dioxide to coal power stations through the environmental permit. Operators would have the flexibility to determine how to meet the standard, which could include co-firing with biomass and improved operational flexibility, as well as operation of a CCS chain or any other new technologies.

4.61 The key issues would be at what level to set the EPS and who should make that decision.

4.62 As discussed in chapter 3, the emissions from power stations vary over time depending, for example, on whether a power station is ramping up or running at a constant level. So, we are not proposing that any emissions performance standard should have to be met minute by minute but rather that average emissions over a period of, say, a year, should fall within the standard. Further, given the variation in emissions levels between coal power stations, it may be most appropriate to set a maximum emissions level that could be tightened for individual sites if they are judged technically and economically able to meet that standard.

4.63 In setting the maximum level, there are various possible approaches including:

- The standard could be linked to the emissions of a gas power station. This would create a level playing field for coal and gas power stations in terms of emissions. Older gas power stations emit around 400-450kg/MWh, while new gas power stations emit around 350kg/MWh. Very high levels of cofiring (50%) with biomass could take coal power stations some way towards meeting a 350kg/MWh level but, in practice, given technical constraints on co-firing and limited sustainable supplies of biomass, they would need to fit CCS.

- The standard could be based on the minimum achievable emissions at that site while continuing to allow economic operation of the plant, based on assessment of best available techniques. Until we know more about the operation of CCS at commercial scale and the future carbon price, it is not possible to make an informed judgement about what this level might be, but a level of 150kg/MWh has been considered in other fora[26].

26 Scenarios on the introduction of CO2 emissions performance standards for the EU power sector. Ecofys. 2009.

- The standard could be linked to modelling projections of the contribution that reductions in emissions from coal power stations could make to deliver climate change goals. As with any modelling exercise, assumptions would need to be made about factors such as the carbon price and the availability and costs of options for reducing emissions across all sectors.

4.64 Any site by site assessment of achievable emissions levels would seem best carried out by the Environment Agency. However, if we were to go down this route once CCS has been proven, it may also seem appropriate for Government to set out expectations as to the maximum level that it would expect the Environment Agency to set.

Question 4.11

Do you agree that the Environment Agency should implement any requirement to retrofit CCS through the Environmental Permitting regime? Please provide evidence to support your views.

Construction of new coal power stations once CCS is proven

4.65 We propose that any new coal power station applying for development consent and an Environmental Permit once CCS has been judged proven for new build would have to comply from day one with the same conditions as those having to retrofit. It is quite possible that CCS will be judged BAT for additional new coal power stations earlier than for the demonstration power stations.

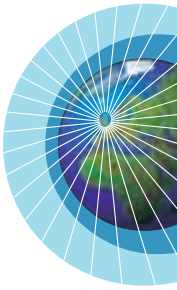
4.66 Implementation would require, first, amendment of the requirements for development consent, which is an action to be completed nearer the time. And, second, for the Environment Agency to apply the same criteria in assessing applications for new Environmental Permits as in reviewing existing permits.

Existing coal power stations

4.67 Our existing coal power stations are ageing: the youngest started operating in 1974, and many will close over the coming decade. Six coal power stations already have their operating hours limited and will close by the end of 2015 under the Large Combustion Plants Directive (LCPD). The Industrial Emissions Directive, which is currently under negotiation, is likely to further tighten environmental standards[27]. As with the LCPD, operators will need to make a decision for each of the remaining 13 coal power stations as to whether to invest in new technology needed

27 Proposed by the European Commission on 21 December 2007: see information at http://www.defra.gov.uk/environment/ppc/regs/index.htm

to meet the standards or close down: we expect most to close down. The economics of operating older, inefficient coal power stations will also become more difficult as the carbon price rises, and as older coal stations have to compete with newer and more efficient coal power stations.



4.68 Nevertheless, it is possible that operators will decide to make substantial investments in existing coal power stations that would enable them to continue operating beyond the 2020s within the constraints of the EU ETS and environmental legislation. We should therefore consider whether our proposals should apply to existing coal power stations in such situations.

4.69 Existing coal power stations were not designed to be carbon capture ready and are much less efficient than new coal power stations. So, in most cases, any requirement to fit CCS technology would be likely to force the closure of the power station.

4.70 We have considered several options, and would welcome views:

- The requirement to retrofit CCS could be applied to existing coal power stations in line with the timetable for new coal power stations. In this case, we could expect them to close.
- Existing coal power stations could be excluded from the requirement to retrofit, on the basis that air quality legislation and the increasingly difficult economics of operating existing coal stations will limit operation to an extent that is in line with our climate change objectives. Further, we may not want to force closure of existing power stations as they could continue to make an important, albeit limited, contribution to security of supply at times of peak demand or low supply from other generation sources.
- Existing coal power stations could be excluded from the requirement to retrofit but, at the time that a retrofit requirement is applied to new coal power stations, the contingency measures considered in Section 3 could be applied. This could allow continued, limited, operation.
- If operators were to invest in upgrading to supercritical technology, they would see a substantial increase in their efficiency and in their potential lifespan. In that case, those units of the power station that have been upgraded to supercritical could become subject to a requirement to retrofit.

Question 4.12

What are your views on how the requirement to retrofit should apply to existing coal power stations? Please provide evidence to support your views.

Section 3: Contingency

Summary

4.71 While we will plan on the basis that CCS will be proven by 2020, there remains the possibility that it will take significantly longer to prove, or that it will not be proven at all. In order to signal our clear expectation that, with or without CCS, there will need to be substantial reductions in emissions from coal power stations in the future, we need to consider whether other measures might be needed.

4.72 In this section, we consider how emissions from coal power stations could be managed in the event that CCS is not proven as quickly as we expect. We propose that the detailed implementation of a contingency measure should be determined following an independent review that would report in 2020, but would consider it important that we set out our clear expectations at a higher level now.

Question 4.13

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

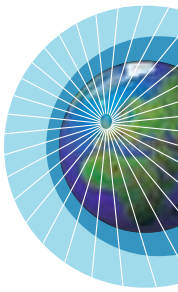
Background

4.73 Without CCS, the options available for reducing emissions from coal power stations would be to increase operational efficiency so that the same amount of electricity can be generated from less coal, replace a proportion of the coal with biomass, or reduce running hours.

4.74 However, as the carbon price rises, even with these measures, we will reach a point when it is no longer economically attractive to run coal plant without options that enable a more radical reduction in carbon dioxide emissions. If CCS is not proven, and if no other equivalent technology to reduce carbon dioxide emissions is discovered, coal power stations will be forced to close.

4.75 Nevertheless, there could be a period within and beyond the 2020s when CCS is not yet proven and nor is the carbon price sufficient to make operation of coal power stations uneconomic. While this would have no net effect on EU emissions, as the power stations would still be required to operate within the EU ETS cap, we still need to consider whether there is a need for a measure to reinforce our expectation that, with or without CCS, coal power stations will need to substantially reduce their emissions if they are to continue operating in the 2020s.

4.76 The Large Combustion Plants Directive (LCPD) provides a useful case study to inform thinking on the approach to any contingency (see box 4.3). It offered power station operators three options to comply with new air quality standards: compliance with an EPS; closure following a period of limited running hours; or participation in trading of emissions allowances.



Box 4.3: The Large Combustion Plants Directive (LCPD)

The Large Combustion Plants Directive (LCPD) is a piece of European environmental legislation that aims to control emissions of nitrogen oxides, sulphur dioxide and dust from combustion plants in power stations, petroleum refineries, steelworks and other industrial processes.

'Existing' operators (those installations licensed before 1 July 1987) were given three options to meet the requirements of the Directive:

- Accepting concentration-based Emissions Limit Values (ELVs) for the three pollutants stated within the Directive (equivalent to an EPS);
- Taking part in the a National Emissions Reduction Plan (NERP), which in the UK incorporates a trading scheme based on the trading, or transfer, of mass emission based allowances;
- Opting out of these requirements, providing they do not operate for more than 20,000 hours between 1 January 2008 and 31 December 2015, at which point they must close if they have not already used up their 20,000 hour allocation.

New operators (installations first permitted between 1 July 1987 and 27 November 2002 and all installations first permitted after 27 November 2002) are required to meet the ELVs set out in the Directive.

The timeline for the implementation of the LCPD provisions was as follows:

- 2002 Member States to bring in laws, regulations and administrative procedures to comply with LCPD
- 2003 Members States to communicate National Plan to EU Commission
- 2004 operators of opted-out plant must submit a written declaration to Environment Agency that they will not run for more than 20,000 hours between 2008 and 2015;
- 2008, opted in plants in Member States must comply with LCPD.

The table below shows how the LCPD opt-out power stations have been using their hours. If the coal power stations continue to use up their running hours at these rates, they would all have to close before the end of 2015.

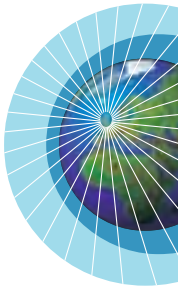
Site Name	Fuel Type	Operating Hours Allowance	Cumulative Operating Hours to:	Remaining Hours	% Running Hours used
			31-Mar-09		
Grain	Oil	20,000	1,161	18,839	6
Ironbridge	Coal	20,000	3,407	16,593	17
Kingsnorth	Coal	20,000	6,793	13,207	34
Didcot A	Coal	20,000	6,287	13,713	31
Fawley	Oil	20,000	651	19,349	3
Littlebrook	Oil	20,000	1,046	18,954	5
Tilbury LCP 1 Boilers 7&8	Coal	20,000	5,813	14,187	29
Tilbury LCP 2 Boilers 9&10	Coal	20,000	7,137	12,863	36
Ferrybridge C Unit 1 & 2	Coal	20,000	3,491	16,509	17

Note: only plants monitored by Environment Agency included in table. For this reason Cockenzie is not included because its use of LCPD running hours is monitored by Scottish Environment Agency.

Principles

4.77 In considering the need, and possible approach, to any contingency measure, the following principles have underpinned our thinking:

- Electricity supplies will need to be more-or-less decarbonised by 2050 if we are to meet climate change goals.



- There is a risk that investors might judge investment in coal power stations today too risky because of uncertainty or concern over how the contingency measure might affect the profitability of their investment. Mitigation will involve a trade-off between providing early regulatory certainty and the time it will take to develop a robust evidence base on which to base decisions.

- Regulatory certainty would be maximised by giving early clarity on the approach to any contingency measure. If investors still considered new coal power stations a profitable proposition, this could facilitate investment. It could also have the effect of driving industry efforts to prove CCS to avoid the implementation of the contingency measure.

- Given the significant changes expected in our energy mix over the next decade, and the uncertainty over future carbon prices, there is little robust evidence available now on which to define the details of any contingency measure. Early definition therefore creates risks that we would design an inappropriate approach.

- Any contingency measure should be designed to enable coal power stations to continue in operation and contribute to the UK's energy security, particularly as the proportion of intermittent generation increases, providing that operation is limited.

- The potential for gaming should be minimised, for example through clear and transparent policy design and implementation so as to make non-compliance obvious early.

- As the EU ETS underpins approaches to emissions reductions across Europe, it is important that any policy measures are designed to complement the EU ETS.

Proposals

4.78 We need to consider, first, the timeframe for making decisions about the need for, introduction of and approach to any contingency measure.

4.79 The framework set out in this document aims primarily to drive the demonstration and the wide-scale deployment of CCS. If CCS does not prove to be a viable approach either technically or economically, we need to be clear about the purpose of a contingency measure as a complement to the EU ETS. Our preliminary view is that, by signalling intentions now, we reinforce the message that coal power stations will need to substantially reduce their emissions if their operation is to be consistent with our climate change goals. This message is important both within the UK and globally and should drive investment in low carbon technologies.

4.80 We are planning on the basis that CCS will be proven by 2020, but recognise that there is uncertainty over the rate at which CCS technologies and supply chains will develop, and over the future carbon price.

4.81 As discussed in Section 2, we therefore propose that an independent review should be undertaken and report in 2020, considering evidence on the status of CCS technologies and the likely timescales for when CCS technologies would be likely to be judged proven. In the light of that evidence, if the review concluded that CCS technology was unlikely to be developed within the 2020s, it should advise on how a contingency measure should be designed and taken forward. Contributions to the independent review could come from bodies such as the Committee on Climate Change and the Environment Agency, but decisions on the design and implementation of a contingency measure would be for Government.

4.82 As also discussed in Section 2, we would welcome views on whether our existing coal power stations should be brought within the scope of the contingency measure.

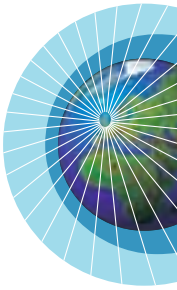
4.83 We suggest that it should be for the review to determine the details of any contingency measures, but believe that it is important that we set out now our expectations. We describe three possible approaches to limiting emissions from coal power stations below although the most effective approach may be, like the LCPD, to offer operators a choice of various defined options in order to comply with requirements.

Option 1: Cap on carbon dioxide emissions from individual coal power stations

4.84 A cap on carbon dioxide emissions from individual coal power stations would allow power stations to emit up to a specified amount of carbon dioxide each year, or over a number of years.

4.85 This approach would have the merit of a transparent focus on emissions, which is our major concern if CCS is not proven as quickly as anticipated. It would allow the operators of coal power stations to use any available measure to stay within the cap, whether reduced running hours, biomass co-firing, operational efficiency, or a combination of these measures. This would support continuing economic operation of coal power stations within the constraints set. For example, operators could choose when to operate their power station in order to achieve maximum profitability while staying within their cap: power stations could run at high load factors when fossil fuel prices were low or electricity prices high, and at lower load factors at other times.

4.86 While a carbon dioxide cap could serve to make the power station less profitable and may therefore affect decisions to invest, this risk is mitigated compared to other options by the flexibility available in meeting the cap.



Option 2: Running Hours Limit

4.87 A running hour's limit would allow coal power stations a maximum number of running hours, either as a yearly limit or over a longer period in an approach similar to one of the options under the LCPD.

4.88 While there is not a direct correlation between running hours and emissions, as it depends on the level at which the power station is being operated, a reduction in running hours could be a straightforward and effective approach to reducing emissions. The operators of coal power stations would choose when to run the station in order to achieve maximum profitability. We expect this to happen to a certain extent anyway as the proportion of intermittent generation increases, with fossil fuel power stations increasingly operating as flexible back-up.

4.89 However, a running hour's limit offers power station operators no incentive to explore other options for reducing emissions.

Option 3: Emissions Performance Standard

4.90 An EPS would limit the amount of carbon dioxide that could be emitted per unit of electricity generated.

4.91 Without CCS, an EPS would have to be set at a level achievable through biomass co-firing and operational efficiency. This may offer a lot less scope for driving substantial emissions reductions than the options which force a reduction in running hours. However, from an investor's perspective, an EPS may be preferable to an approach that required a reduction in running hours and hence revenue.

Benchmarking

4.92 Regardless of the approach, a key issue will be how to determine the level at which any limit on operation should be set. Possible benchmarks that could inform any standards include the emissions from a gas power station and projections of our pathway towards 2050.

4.93 If the emissions from a gas power station were to be used as a benchmark, for the first two options this would depend on the running hours of gas power stations. These are likely to change significantly over the coming years as the energy mix changes, and in particular as the proportion of intermittent generation increases. For an EPS, it would

need to be established whether coal power stations would be technically able to meet a standard benchmarked against a gas power station, given developments in carbon abatement technologies other than CCS.

4.94 Alternatively, modelling exercises can be used to generate scenarios for the pathway towards decarbonisation of the power sector by 2050. This could inform the setting of standards for coal power stations.

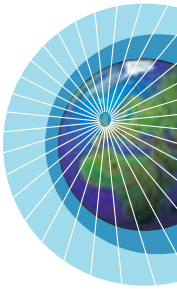
Question 4.14

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.

Chapter 5: Funding a UK CCS demonstration programme



Summary

5.1 CCS is at an early stage of development, and consequently the costs and risks of commercial-scale CCS demonstration mean that projects will only proceed with Government intervention. Our proposals would see the UK providing funding for up to four commercial-scale CCS demonstrations, including the project launched in 2007. This would represent a substantial contribution to global efforts to develop CCS technologies, and would be supported by the introduction of a new financial incentive funded through a levy on electricity suppliers.

5.2 This chapter focuses on the demonstration project(s) announced at this year's budget and in particular on the options for providing financial support and arrangements for selecting and supervising demonstrations. The proposals for financial support are subject to State Aid approval by the European Commission. The position of the existing technology demonstration competition that was launched in 2007 is discussed at the end of the chapter.

Provision of financial support

Options for funding CCS demonstrations

5.3 Two approaches have been considered for providing financial support to CCS demonstration projects: an obligation to supply CCS electricity; and a levy on electricity suppliers.

An obligation to supply CCS electricity

5.4 An obligation to supply would be similar to the Renewables Obligation (RO), and would involve placing an obligation on electricity suppliers to purchase certificates (equivalent to ROCs) issued to the generators of "CCS electricity". In other words electricity generated from the CCS demonstration element of a coal fired power station. The sale price of certificates would effectively be a premium that CCS projects would be able to charge suppliers for the electricity they generated, making them a viable commercial investment, and the size of the obligation would increase as additional CCS demonstrations are commissioned.

5.5 Such an obligation would have the benefit of determining both the source of funding for CCS, and the mechanism for disbursing financial support to the demonstration projects. However, there are also several drawbacks with this approach that are linked to the demonstration status of CCS:

- A supplier obligation such as the RO typically has a buyout price which allows the suppliers an alternative mechanism for complying if there are not enough certificates available for them to fulfil their obligation. Under the RO the buy-out fund is recycled to suppliers who hold certificates, so allowing the market to set the price for the certificate and so signal the price of generating electricity. It would be difficult to establish at what level to set the buyout price for CCS, given the lack of experience with commercial-scale projects. Further, the risk premium allocated to certificate prices would probably be high for CCS because its unproven status makes it difficult to estimate what costs and eventual generation will be. This risk premium will tend to decrease the value for money of such a scheme.

- Later CCS demonstrations should learn from earlier projects and therefore should require less financial support. Different CCS technologies will also have different costs, as will different locations and different storage methods. Accommodating this would require some form of "banding" that would add further complexity to the obligation structure.

- Because the CCS projects are demonstrations, it is uncertain how much electricity they will generate, particularly in the early years when teething problems may arise, and therefore it will be uncertain at what level to set the obligation to take account of this.

- An obligation covering all suppliers could result in them all having to set up trading operations with a high compliance cost for the limited amount of CCS electricity involved.

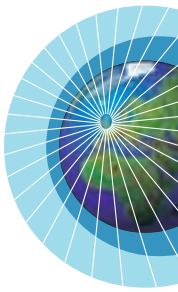
- It would be difficult to take account of attributes other than cost in the selection of projects which may mean we cannot focus on elements of the technology that we are keen to see demonstrated.

- The limited market competition with a small number of further CCS demonstration projects may not be enough to ensure sufficient price competition between potential projects to prevent excessive profit taking.

A levy on electricity suppliers

5.6 A levy on electricity suppliers would involve placing an order on suppliers to pay a specified amount, per unit of electricity supplied, to support CCS demonstration projects. The projects would be identified through

a separate process. The arrangement for managing this financial mechanism including selecting and disbursing financial support to CCS demonstration projects, is examined later in this chapter.



5.7 A levy mechanism avoids some of the problems associated with an obligation. It avoids the need to set a buyout price, and by separating the selection process enables attributes other than cost to be taken into account when choosing demonstration projects. Also it is easier to accommodate the sort of variations in CCS output (i.e. electricity and carbon abatement) to be expected from untried demonstration projects as the levy can be adjusted regularly.

Mechanism for disbursing support to CCS demonstration projects

5.8 A number of background factors provide an important context for the development of an effective CCS funding mechanism. Because of the "unproven" status of commercial scale CCS, demonstration projects will involve more risk than normal investments in the power sector. This has implications for the readiness of organisations to invest and the premium required to reward this greater level of risk. The Government also needs to achieve value for money in their delivery.

5.9 A further consideration is that each CCS demonstration project could entail about 2-4TWh a year of electricity generation, and therefore substantial step changes in overall CCS output are likely to result as the UK portfolio of demonstrations builds up. This variation in output of CCS has important implications for the choice of mechanism, because it could lead to quite substantial year on year variations in the funding needed. For example a significant increase will occur when an additional project begins to operate.

5.10 From these background considerations we have derived some basic starting principles to guide our choice of disbursement mechanism. These may be expanded and developed over time as thinking develops and will be informed by the consultation process. These principles are that the mechanism should be:

Effective by:

- Delivering sufficient and cost effective funding to CCS demonstration projects in the UK, taking into account public affordability considerations.
- Making a material contribution to bringing forward the date at which CCS is commercially viable.

Efficient by:

- Encouraging the efficient operation of CCS projects with regard to both electrical output and carbon dioxide abatement.
- Enabling operators to make optimal decisions about plant operation patterns.
- Having a clearly defined duration sufficient to enable the technical performance of CCS to be proven.

Value for Money by:

- Keeping costs down by facilitating price competition or an alternative mechanism for lowering the impact on consumer bills.
- Being flexible over time so as not to over pay for CCS demonstrations (eg. takes into account the changing market price of carbon and any contribution from EU CCS support mechanisms).

5.11 CCS involves additional capital and operating costs compared to conventional fossil fuel power stations, both of which will need to be taken into account by the payment mechanism. Our proposal is to do this through a single payment linked to outputs from the CCS projects (i.e. electricity supplied or carbon abated).

5.12 Three basic payment mechanisms based on project output have been considered, namely:

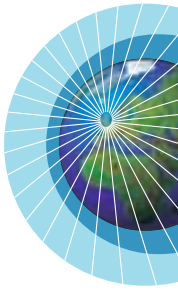
- A fixed payment per unit of CCS electricity supplied, similar to the "feed-in tariff" used in some countries to support the deployment of renewable electricity generation sources (FIT).
- An additional payment per unit of CCS electricity supplied, paid over and above the wholesale price of electricity (AP).
- A payment based on a 'contract for differences' for carbon abated by CCS linked to the price of allowances in the EU Emission Trading System (CfD).

5.13 Each of these mechanisms is outlined below together with their main attributes and drawbacks.

Feed in Tariff

5.14 With a feed-in tariff (FIT), prospective CCS projects would bid to be paid a guaranteed fixed amount or tariff for the electricity they export into the grid. This mechanism would be similar to the kinds of FIT which have been used to support the deployment of renewable electricity

generation sources in some EU countries, and a FIT will shortly be introduced to incentivise small-scale renewable generation in the UK.



5.15 A FIT removes some of the uncertainty associated with an obligation (see above). However it is less suited to CCS because, unlike renewable energy, the cost of electricity from CCS projects is affected by the price of fossil fuels and the cost of carbon emissions set by the ETS[28]. Consequently a fixed tariff mechanism would introduce fuel price, and to a lesser extent, carbon price risks, which could inflate the FIT levels required by investors to cover these risks. This would lead to excessive profits should coal and/or carbon prices follow a relatively low trajectory.

Additional Payment for CCS electricity

5.16 Under this mechanism CCS demonstration projects will be paid a fixed amount, per unit of electricity supplied, in addition to the revenue gained from selling their electricity in the wholesale market. This additional payment will be to cover the cost of building and operating the carbon dioxide capture, transport and storage facilities.

5.17 By providing support through an additional payment over and above the wholesale price of electricity, this approach avoids most of the fuel price uncertainty associated with a fixed tariff approach. By taking the market price for the electricity produced, generators will effectively be left to manage fuel price risks just as they would for any new fossil fuelled power station. However, it is recognised that a remnant of fuel price risk remains, which is linked directly to the CCS demonstration, because a CCS plant uses more fuel than a conventional fossil fuelled power station to operate the CCS unit. For example if the price of coal increases by say £10/t (~£1.4/MWh) this would increase the generation cost from a new coal fired power station by about £3.1/MWhe, but the corresponding increase for a coal-CCS plant would be about £4/MWhe.

5.18 Assuming carbon prices are carried through into the market price for electricity CCS plant should benefit from an increase in carbon price by getting a higher price for their electricity while not having to buy so many ETS permits as unabated coal power stations. However, this represents a further uncertainty for investors because this benefit will be sensitive to the carbon price. To cover this risk investors will tend to assume low carbon prices when bidding for a CCS demonstration, which could result in excessive profits should carbon prices follow a higher trajectory.

28 CCS plant still emit about 10% of the CO2 produced.

Contract for difference with the ETS carbon price

5.19 With a contract for difference with the ETS carbon price for abatement delivered by CCS projects prospective CCS demonstration projects will receive a fixed/strike price for the carbon they abate, measured relative to an agreed counterfactual, based on the emissions from an unabated fossil generation plant (eg the emission from the same plant without CCS or a new gas fired plant). This strike price would be paid minus the EU ETS carbon price.

5.20 By providing support through a contract for differences on the carbon price this approach avoids the carbon price uncertainty associated with the Additional Payment mechanism. The CfD effectively leaves the power generator to manage fossil fuel price uncertainty, and to sell the CCS electricity, as for any other power station. As with the Additional Payment method set out above there is a small remaining coal price risk linked directly to the CCS demonstration, which arises because the CCS plant uses more fuel than a conventional fossil fuelled power station.

5.21 The CfD could be two sided to address the potential for higher carbon prices in the future.

Conclusions

5.22 We have concluded that a levy on electricity suppliers should be used to provide funds to support a programme of CCS demonstrations.

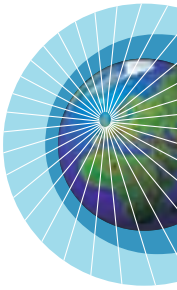
5.23 Because the levy is applied to electricity suppliers it seems reasonable that the funds collected should only be disbursed to projects supplying electricity to the public supply and the subsidy should not be available to demonstrate CCS on large industrial installations. We believe this to be acceptable because electricity generation is probably the most favourable sector for early deployment of CCS, because it has the largest point sources with substantial annual operating periods needed to maximise economies of scale.

5.24 In addition to the investment risks and uncertainties associated directly with CCS demonstration, it is recognised that the overall regulatory and financial package proposed here introduces other market uncertainties that may influence investment decisions. However, the choice of disbursement mechanism is not likely to affect investor perspectives in this respect.

5.25 We have concluded that a CfD on carbon abated is our initially preferred option for disbursing an output related payment to CCS demonstration projects, but views are welcome on the merits of the alternative Additional Payment (AP) option set out above.

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.



Selecting and supervising demonstration projects

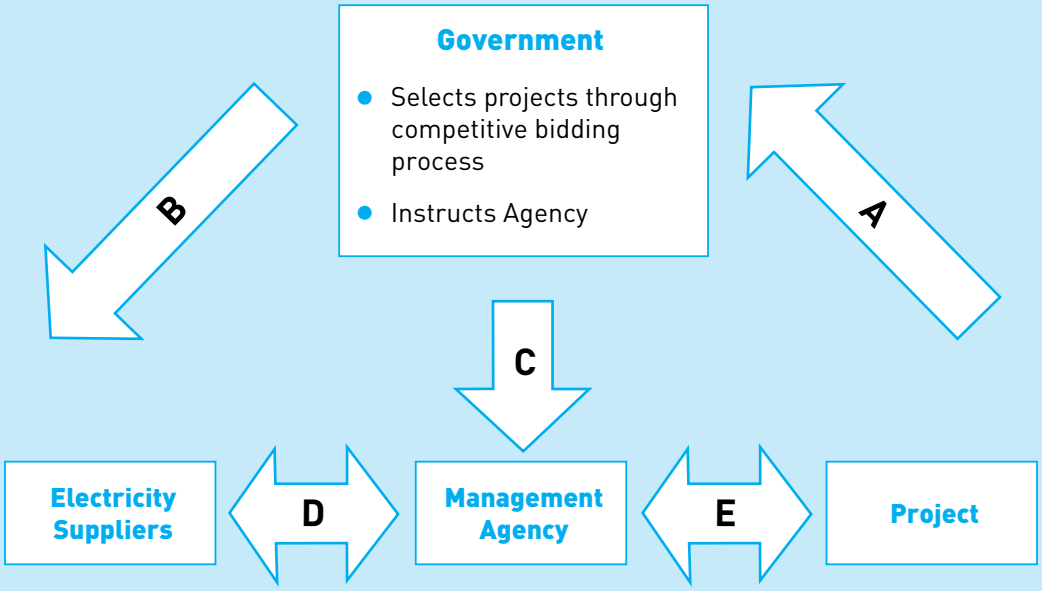
5.26 It is envisaged that irrespective of the disbursement mechanism (ie. payment based on a CfD per unit of carbon abated or an AP per unit of CCS electricity), the funds needed to operate the incentive will be collected through a levy on electricity suppliers on the basis of a charge per unit of electricity supplied.

5.27 When up and running it is intended that the mechanism will be able to support up to four full-scale demonstrations of CCS. It is proposed that the mechanism will be available to support operation of each demonstration project for up to 15 years and storing a minimum of 20Mt CO2, which is judged to be sufficient to achieve all the technical and operational objectives involved in proving CCS at commercial scale.

5.28 The levy will need to be revised annually to take account of changes in the output (ie electricity or carbon abated) of CCS power plant as projects develop and additional projects come on stream, and, in the case of the CfD to adjust to changes in the ETS allowance price. An example arrangement for collecting and dispensing funds through such a mechanism is illustrated in the Box 5.1. There are three key steps:

- Selection of demonstration projects
- Establishment and role of a management agency
- Interaction with the EU funding for CCS demonstration.

Box 5.1 – An illustrative example of how an incentive mechanism funded through a levy on suppliers may work



A: Prospective CCS demonstration projects submit bids and a project(s) is selected by the Government.

B: A levy requirement is set on electricity suppliers.

C: The government instructs the management agency to proceed with the project(s).

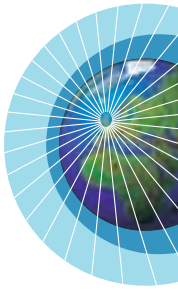
D: The size of the levy is determined annually with the project(s), and the agency instructs the electricity suppliers on the amount of the levy for the coming year.

E: The management agency makes payments to the project(s) at suitable payment intervals. The management agency takes necessary actions to balance levy collected with actual payments.

Selection of the UK's CCS demonstration projects

5.29 The Government intends to select CCS demonstration projects through a process that will ensure that appropriate projects delivering value for money go forward. We will then instruct the management agency to proceed with the projects and provide the agreed financial support. It was decided that the current demonstration competition should cover post combustion carbon dioxide capture, because of its capability to be retrofitted to the type of coal fired power stations currently being operated and built extensively world wide. The Government does not have any such technology preference for further demonstrations, but

would want to select projects that meet a published set of criteria. These might include:



- Provides the UK with experience of a range of alternative CCS technologies.
- Are coordinated with other projects to capture learning and to form an integrated international portfolio of demonstrations.
- Ensures the projects are affordable and represent value for money.
- Ensures the projects meet DECC's requirements for knowledge sharing and participation in international CCS demonstration networks.
- Ensures the projects are big enough to deliver full-scale demonstration of CCS.
- Minimises the risk of "project blocking" by ensuring projects are robust and will have a high probability of being delivered (i.e. constructed and operated).

5.30 It is important that the projects are relevant to new and future coal generation plant, make a useful contribution to carbon dioxide abatement and have the prospect of operating for at least the 10 – 15 year demonstration period and preferably longer. Our current view is that demonstration projects based on existing coal fired plant that have not been refurbished to bring their generation efficiency up to best attainable standards should not be considered for financial support within the extended demonstration programme.

5.31 It is presently envisaged that invitations will be published by DECC requesting bids for any new demonstration projects (the Government has committed to support up to four demonstrations), thus allowing these to be sequenced and integrated with other demonstrations, particularly within the EU. The invitation may specify the type of capture technology required for the demonstration and/or possibly the type of geological storage medium to be used. Projects will be short listed from competing bids on the basis of how well they meet the specified requirements.

5.32 With regard to value for money the Government has a responsibility to ensure CCS demonstration projects are delivered with minimum additional cost to electricity consumers. We believe the best approach to achieve this is to maintain price competition by running a bidding process amongst short listed projects for each of the specified demonstration projects. The winning bid would then be the lowest cost bid meeting the quality criteria specified. Lowest cost would be determined by the projects making bids for the CfD or AP they require

and the total quantity of carbon dioxide they plan to abate or the total quantity of CCS electricity they plan to generate over the duration of the project. Both these factors would be needed to assess bids since clearly the cost will be the product of the unit payment multiplied by the total output (e.g. CfD times millions of tonnes of carbon dioxide to be abated). Views are sought on what other forms of competition process could be considered which would best encourage projects to come forward and for costs to be minimised.

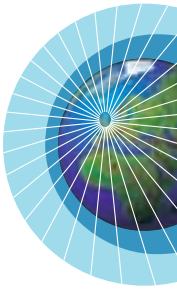
5.33 The cost of demonstration projects will also be affected by the size. Commercial-scale demonstration needs to be of a size that enables learning relevant to the application of CCS to the full capacity of a power station. At the same time, we need to take into account the need to balance value for money against diminishing returns for learning once the demonstrations pass the necessary size for commercial scale demonstration.

5.34 The size needed for an effective commercial-scale demonstration will vary between types of capture technology. For technical reasons, pre-combustion and oxyfuel capture technologies will need, as a minimum, to capture carbon dioxide from a single unit of a coal plant. For pre-combustion this could mean that a demonstration would need to be applied to a single coal gasification and turbine unit of around 450-500MW and for oxyfuel a single boiler of around 800MW. The first demonstration of post combustion will be 300MW net but a second project could be larger if this is justified both technically and in terms of value for money and affordability. It is important that demonstration projects are sized to achieve the objective of proving the technology at commercial scale; the additional cost of supporting projects larger than this may not be justified in terms of additional learning.

5.35 We are aware that bidding into such a competition entails significant costs, in particular the Front End Engineering and Design (FEED) needed to make firm price bids. Over time these costs will be recoverable for the successful projects through the support mechanism, but investors will wish to weigh the cost of bidding against the probability of winning as well as the benefits of owning a CCS demonstration. Therefore we would welcome suggestions on how to facilitate and minimise cost of the bidding process while enabling the Government to fulfil its responsibility to gain value for money and remain cognisant of public affordability constraints.

5.36 It has been suggested that demonstration projects should be selected and located to act as nuclei for future carbon dioxide transport and storage infrastructures in areas with a high density of large carbon dioxide sources suited for later retrofit with CCS. Further, it has been proposed that the pipelines to CCS demonstration projects should be over-sized to provide capacity for later additional CCS in the region. There are pros and cons associated with these issues, which are considered in Chapter 6.

Establishment and role of the management agency



5.37 A key feature of the support mechanism for CCS demonstrations is the need for a managing agency for the CCS demonstration programme with the functions of:

- Supervising the operation of the demonstration projects to measure if they deliver against the funding agreement (i.e. carbon dioxide abated or units of CCS electricity supplied);
- Agreeing the payment to be made to CCS projects for each operational year;
- Dispensing funding in accordance with the agreed payment schedule;
- Advising the Government on what level to set the levy each year;
- Undertaking balancing and settlement actions to take account of any differences between the planned and actual output of the projects.

5.38 The Government's preference is for this function to be undertaken by Ofgem. As an existing agency Ofgem avoids the cost and delay of establishing a new body, and has the appropriate experience and expertise to collect and disburse the financial support and monitor the projects.

How much will the UK demonstration programme cost?

5.39 We expect that a levy on suppliers to fund a CCS support mechanism would need to be operational from about 2011 to contribute to the first demonstration project. Estimates of the cost of supporting four CCS demonstration projects have been made in the accompanying Impact Assessment: in 2020 the average annual impact of supporting four demonstration projects on domestic and industrial electricity bills would be an increase of around 2%. These impacts would be reduced if the EU support mechanism contributes to some of the UK demonstration projects, but this benefit cannot be quantified until the operation of the EU mechanism has been determined. Similarly, this impact would be lower if the Government were to support fewer demonstrations.

5.40 By supporting up to four demonstration projects, we will put Britain at the forefront of CCS technology development. We believe this is a better strategy, for UK consumers and businesses, than leaving it to others to develop the technology. Investment today will reduce the long term costs of the transition to a UK low carbon energy mix, support security of supply by enabling coal to be part of a diverse low carbon energy mix, and offer industrial benefits through first mover advantage.

Conclusions

5.41 We have concluded that the CCS demonstration projects should be selected by the government. Projects will be short-listed on the basis of a set of criteria designed to deliver good quality projects that are affordable, represent value for money, and will be delivered in a timely manner.

5.42 Monitoring and operation of the financial support to the projects will be undertaken by an agency, probably Ofgem.

Question 5.2

What are your views on the proposed arrangements for selecting and managing CCS demonstration projects? Are there any additional or alternative arrangements we should consider? Please provide evidence to support your views.

How the EU funding streams may contribute to the UK's CCS demonstration projects

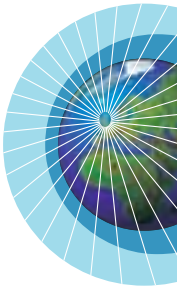
5.43 The EU has announced two funding packages designed to contribute to CCS demonstration. It is hoped that at least one, and possibly two UK CCS demonstration projects will qualify for some EU support from one of these:

- Part of the European Energy Programme for Recovery (EEPR) amounting to €1.05B for CCS to be distributed between France, Germany, Italy, Netherlands, Poland, Spain and the UK, with €180m assigned for the UK. The European Commission launched its call for the EEPR projects[29] on 18 May 2009.

- 300M EU ETS allowances from the New Entrant Reserve to be used to support up to 12 CCS demonstrations and demonstration of innovative renewable energy technologies. The European Commission is working on criteria for selecting projects with EU Member States through the comitology (technical, Commission-led) process. It will be important for the UK to work to ensure the details of this scheme are compatible with the mechanism for supporting CCS demonstration in this country.

29 http://ec.europa.eu/energy/grants/2009_07_15_en.htm

Position of current demonstration project



5.44 The Government launched a competition for a CCS demonstration project in November 2007. It will be one of the first in the world to demonstrate the full chain of capture, transport and storage at commercial scale on a coal-fired power station. A key element in the Government's policy to encourage the swiftest possible global roll out of CCS, the objective of the project is to demonstrate post-combustion capture on 300MW of supercritical pulverised coal generation plant in the UK with storage of carbon dioxide offshore.

5.45 The project is designed so that the learning and experience gained will be directly relevant to the great majority of coal fired power stations currently operating or in the process of construction or planning throughout the world. The project is therefore central to the Government's wider aims of encouraging the deployment of CCS on a global scale. Budget 2009 confirmed the Government's intention to proceed with the competition, subject to receiving suitable bids and final funding approval in subsequent spending reviews. The funding mechanism discussed in this chapter could contribute to the financial support for this first UK demonstration project.

5.46 As the first step, the Budget also announced the Government's intention to fund detailed design and development work (FEED studies). Once complete these studies will reduce project risks and provide greater clarity on costs. They will also ensure that preparation for construction can start at the earliest possible date.

5.47 Selection of the preferred bidder will follow after the FEED studies are complete and the assessment of the remaining bidders will be based on a range of factors incorporating value for money, the technical merits of the proposal and the wider benefits in securing the Government's energy and climate change objectives.

Chapter 6:
Maximising the benefits to the low carbon economy: a strategic role for Government

Summary

6.1 If we are to see wide scale deployment of CCS on all installations with high carbon emissions in the UK – fossil fuel power stations and industrial units – massive investment will be needed in new infrastructure and technology innovation. We need to start preparations now for wider deployment.

6.2 As part of this work, we need to consider how our programme of up to four CCS demonstrations can be designed to facilitate subsequent deployment of CCS in the UK and abroad. Low carbon coal technologies represent a major future market for UK business estimated to be worth of the order of £2-4bn to the UK by 2030, sustaining 30,000 – 60,000 jobs[30]. In short, we need to consider how Government can play a strategic role so as to ensure that UK businesses are fully prepared to take advantage of the first user advantages that our investment in CCS demonstration will provide. This effort will form an integral part of our developing Low Carbon Industrial Strategy.

6.3 The strategic actions fall under three broad headings:

- Facilitating the timely development of supporting infrastructure for further CCS deployment.
- Using the CCS demonstration projects to foster business clusters.
- Retaining momentum in CCS innovation.

Business Clusters

6.4 Business Clusters stimulate and enhance competitive advantage, and we have the opportunity to generate these advantages for CCS businesses. Clustering can bring a number of benefits and be driven by a range of interventions, until they attain a critical size and become self sustaining. Geographical advantage, a core grouping of innovation centres (e.g. universities, research agencies) or an existing group of organisations with relevant know-how or skills can all act as a nucleus towards which others gravitate (see box 6.1).

30 AEA (2009) Future Value of Coal Carbon Abatement Technologies to UK Industry. www.decc.gov.uk.

Box 6.1: Business Clusters

The simplest definition of a 'Cluster' is the grouping of businesses with a common interest located in the same geographical area.

This clustering together of interrelated business is encouraged by a wide range of factors, including proximity to suppliers, markets, a skilled workforce, specific geographical conditions and access to finance including public money. When a sufficient number of businesses come together a critical mass is achieved, which in turn provides additional benefits to the businesses located there.

An agglomeration of businesses focused on one activity draws in other businesses of a similar nature or suppliers of services to those businesses. A skilled workforce and strong knowledge base starts to build up around the Cluster. Educational institutions will also begin to specialise in the activity of the Cluster to bring more skilled workers. This level of expertise encourages innovation, start up businesses and draws venture capital into the Cluster encouraging further growth.

Similarly, we expect the development and demonstration of CCS will result in these types of interactions between companies and educational institutions through partnerships and people and provide a stimulus leading to the realisation of the potential wider economic benefits.

6.5 Clearly the CCS demonstration projects themselves will already have some of the features known to seed business clusters and each of the projects offer the potential to be a hub for a wider industrial CCS cluster. The projects could stimulate cluster development by encouraging other organisations to move or set up in the locality to share expertise and experience. Indeed this is already happening, as illustrated by Scottish Power's parent company Iberdrola's recent announcement that the UK was to be its global centre of excellence for CCS. However, the CCS demonstration projects may be able to do more to encourage this process, perhaps by giving organisations access to facilities for testing new and advanced CCS devices or materials. Information exchanges and user group networks also need to be fostered and encouraged around the demonstration projects.

6.6 The Cambridge IT and biotechnology cluster is probably the best known example of a business cluster in the UK, but there are many others in areas such as motor vehicles, software design and pharmaceuticals (see Box 6.2).

6.7 The Government places great importance in developing strong and self sustaining CCS businesses in the UK and would welcome suggestions

on how to adapt and build on our CCS demonstration programme of up to four projects to maximise the business cluster benefit.

Box: 6.2 The Cambridge Case

The 'Cambridge Cluster' is renowned across the world as a key area for business start ups in telecommunications and biotechnology and is the source of around 25% of the UK's high technology start-ups and attracts around 7% of European venture capital. .

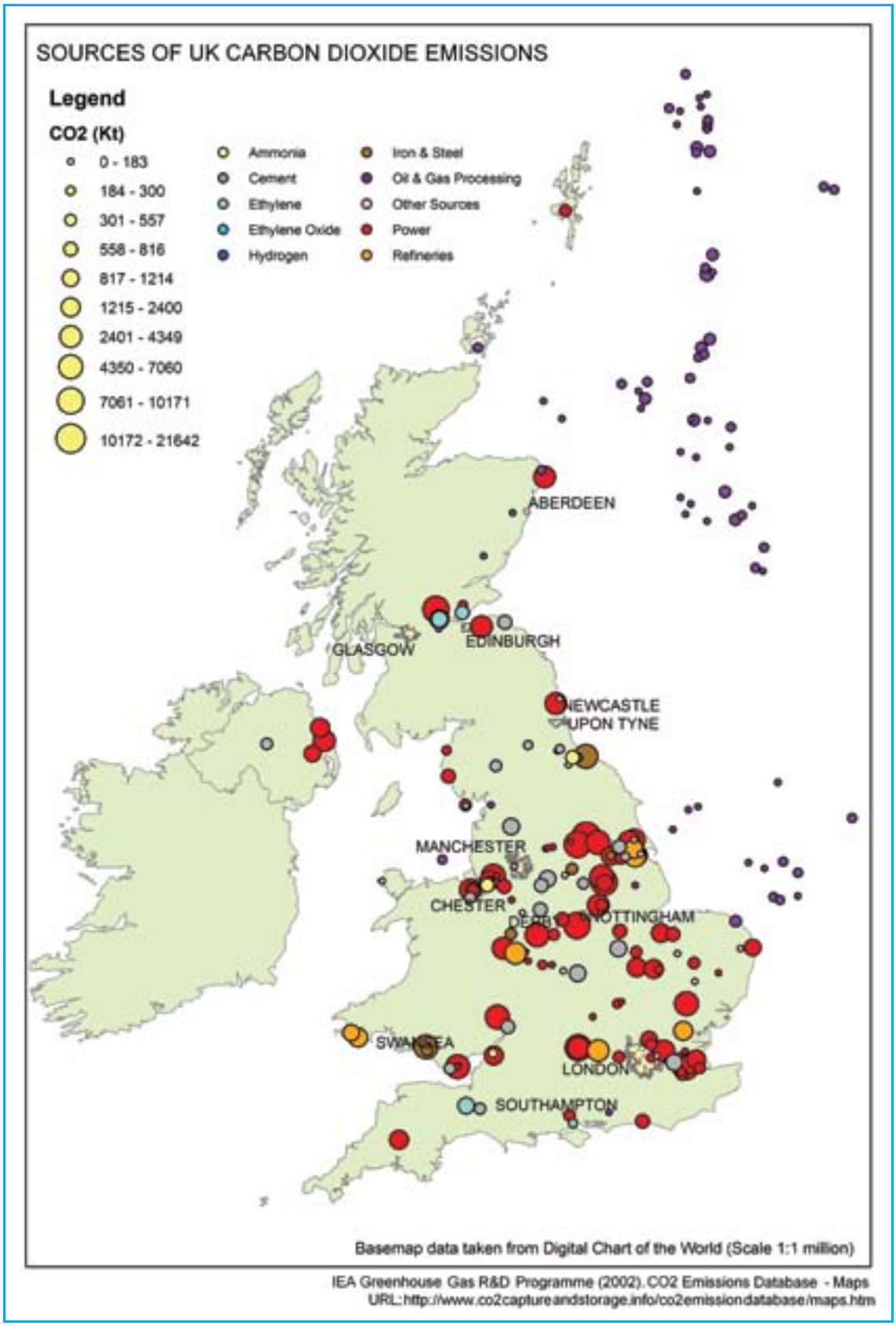
The Cluster began in 1970 when Trinity College opened one of the first science parks in the UK. This saw steady growth in the area but the area did not properly take off until the 1980's due to a variety of factors. The strong links to the University with its ability to attract the best students from around the world and its willingness to allow members of staff to develop ideas commercially provided a strong knowledge and skill base.

Cambridge University, as an internationally recognised brand, also helped draw in the best entrepreneurs. The establishment of key consultancies such as Cambridge Consultants attracted highly skilled individuals and created an environment where other companies were readily spun off. The area also gained the interest of venture capitalists who could provide the finance for this spin off culture.

The Cambridge Network also played an important role, by bringing together individuals from across multiple disciplines, facilitating the cross fertilisation of ideas, and maintaining links with the University's international alumni ensuring strong links across the world.

Developing infrastructure to support the expansion of CCS

6.8 There is clearly a strategic role for Government in establishing the regulatory and market frameworks within which the infrastructure will grow. Sources of carbon dioxide in the UK are clustered around relatively few centres of significant industrial activity: the Thames Estuary, Humberside, Merseyside, the Firth of Forth, Teesside and Tyneside. Similarly, potential storage sites for carbon dioxide are concentrated in the North Sea, in depleted oil and gas fields and saline aquifers, with further storage opportunities available in the Irish Sea. Looking ahead over the coming decades, we envisage the development of a carbon dioxide pipeline transport infrastructure linking carbon dioxide emitters, both power stations and other large industrial plant, with carbon dioxide storage sites. This means that it is essential for Government to consider the best strategic approach to facilitate optimal clustering of CCS investment.


SOURCES OF UK CARBON DIOXIDE EMISSIONS
Legend
CO2 (Kt)
0 - 183
184 - 300
301 - 557
558 - 816
817 - 1214
1215 - 2400
2401 - 4349
4350 - 7060
7061 - 10171
10172 - 21642
Ammonia
Cement
Ethylene
Ethylene Oxide
Hydrogen
Iron & Steel
Oil & Gas Processing
Other Sources
Power
Refineries
ABERDEEN
GLASGOW
EDINBURGH
NEWCASTLE UPON TYNE
MANCHESTER
CHESTER
NOTTINGHAM
SWANSEA
LONDON
SOUTHAMPTON
Basemap data taken from Digital Chart of the World (Scale 1:1 million)
IEA Greenhouse Gas R&D Programme (2002). CO2 Emissions Database - Maps
URL: http://www.co2captureandstorage.info/co2emissiondatabase/maps.htm

6.9 Studies have already been undertaken to look at potential carbon dioxide transport routes and storage sites. For example, the North Sea Basin Task Force, of which the UK is a member, published an initial study on North Sea networks last year with further work announced by the UK and Norway on 28 May[31]; some of the Regional Development Agencies have commissioned studies to look at the opportunities for their individual regions, such as Yorkshire Forward's report on "A Carbon Capture and Storage Network for Yorkshire and Humber"[32]; and a study by the Scottish Centre for Carbon Storage considering "Opportunities for Carbon Dioxide Storage around Scotland"[33].

6.10 These studies have found that the development of transport networks, which would collect the carbon dioxide from several different sources located in the same area, offers a more cost effective approach than construction of separate pipelines carrying carbon dioxide from each emitter to a storage site (so-called point to point).

6.11 We need to consider how new carbon dioxide transport infrastructure might be developed over the coming decades, including who will construct, own and operate the infrastructure. For example, we need to explore the extent to which the different stages of the CCS chain – capture, transport and storage – might be owned and operated by different organisations and, in that case, how the CCS chain would be integrated. We have started to consider these issues, and will continue to explore them through our wider programme of work on CCS.

The contribution of the UK CCS demonstration programme

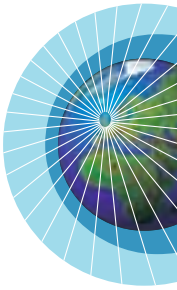
6.12 As a first step, we have considered if there are actions that should be taken as part of our CCS demonstration programme of up to four projects to lay the groundwork for a future carbon dioxide infrastructure network. Key issues include whether we should aim to encourage network development by co-locating CCS demonstration projects in particular regions and by providing financial support for over-sized pipeline capacity as part of the demonstration programme.

Co-location of CCS demonstration projects

6.13 Co-location of CCS demonstration projects could help to establish a carbon dioxide transport network in that area, and yield some direct cost savings for the CCS demonstration programme through shared transport and storage infrastructure. However, co-location of funded CCS demonstration projects could also significantly weaken competitive pressure given that the number of planned sites for power stations in

31 http://www.nsbtf.org/documents/Storing_C02_under_the_North_Sea_Basin.pdf
32 http://www.yorkshire-forward.com//sites/default/files/documents/Carbon%20Capture.pdf
33 http://www.geos.ed.ac.uk/sccs/regional-study/

any given region are likely to be limited; the potential benefits need to be balanced against the need to achieve value for money from the CCS demonstration programme. We therefore seek views on whether it would be desirable either to specify in advance the location of CCS demonstration projects or whether they should be co-located.



Oversized pipelines

6.14 It would be possible to construct pipelines larger than needed solely to transport the carbon dioxide from a CCS demonstration project, in the expectation that the additional capacity would be needed as CCS becomes more widely deployed.

6.15 Developers could, in principle, choose to construct oversized pipelines in order to realise a commercial opportunity of owning pipes which could be used as CCS deployment increases. However, without appropriate incentives developers might be reluctant to do this unless they can identify alternative sources of funding – either from Government or elsewhere. This would ultimately be a commercial decision to be taken by developers.

6.16 We have therefore considered whether CCS demonstration projects should receive financial support to over-size pipelines as a first step towards the development of regional transport networks. Clearly this would involve extra expenditure at the demonstration stage and we need to consider whether this is an effective use of financial support, particularly as the costs would be met through the levy on electricity suppliers. The additional expenditure would also have public affordability considerations.

6.17 Our initial view is that our actions should be focused on facilitating private investment in oversized pipelines. Through the proposals in this document and our wider programme of work to promote CCS, we have given investors a very clear signal of our expectation that CCS will start to be more widely deployed in the early 2020s.

6.18 We will therefore consider further how private investors can best be enabled to finance over-sizing of the pipelines planned for each CCS demonstration should they wish to do so. One approach would be to have an "open season" bidding arrangement for pipeline capacity, which would make it compulsory for demonstration projects to permit third party private investment in additional capacity at average or marginal pipeline costs and for the installation of taps to provide access to this additional capacity.

6.19 DECC has commissioned a study to explore some of these issues which is published alongside this consultation[34].

34 Developing a regulatory framework for CCS transportation infrastructure. www.decc.gov.uk

6.20 We will further consider issues related to co-location of CCS demonstration projects and over-sizing infrastructure in more depth during 2009, working with RDAs and others who are engaged in this area.

6.21 In addition, the EU is undertaking studies on carbon dioxide transport networks, and may consider possible funding of transport networks as part of the next EU Budget Perspective starting in 2013. We will work closely with other EU member states on this work.

Retaining momentum in CCS innovation

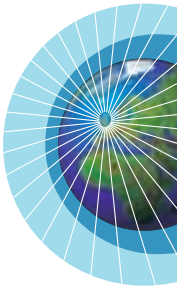
6.22 We recognise that, while the proposals for demonstration and deployment of CCS represent a substantive package of measures, it is not all that is required to achieve our clean coal vision or wider use of CCS on other installations. We are, in parallel with the development of a new framework for clean coal, taking forward a wider programme of work to support CCS development and deployment within the UK and globally. This process is being guided by our Advisory Committee on Carbon Abatement Technologies (ACCAT) which recently produced recommendations for taking the UK programme forward[35]. We plan to publish a CCS strategy later in 2009 that will consider: international development of CCS, including in the EU; UK business opportunities and jobs; infrastructure development; skills; capacity building and other supply chain constraints; and technology development.

6.23 The Government supports the development of a wide variety of CCS components through its support for research, development and early small-scale demonstration via the Technology Strategy Board (TSB), the Energy Technologies Institute (ETI) and the Environmental Transformation Fund (ETF). These programmes complement the full scale demonstration programme set out here and provide opportunities for the development of new and improved components and materials, including next generation technologies.

6.24 The Technology Strategy Board has a carbon abatement technology portfolio with a total project value of about £14.5m. DECC's Environmental Transformation Fund (ETF) includes support for CCS through the Carbon Abatement Technologies Demonstration Programme. We are taking forward these programmes via a joint ETF/TSB and Northern Way call for project proposals in Carbon Abatement Technologies, including CCS, in June 2009. This call is worth some £15m and brings together support for development and early small scale demonstration which will maximise the benefits of public expenditure and provide a simple single route to funding for these technologies.

35 "Accelerating the deployment of carbon abatement technologies – with special focus on carbon capture and storage, advisory document from ACCAT, February 2009; www.berr.gov.uk/files/file.0419.pdf

6.25 The Energy Technologies Institute published its technology strategy in January 2009 which includes CCS. The ETI has already launched three calls in the areas of offshore wind, marine and distributed energy technologies and is now considering its plans for CCS including next generation capture technologies, modelling and storage.



6.26 To enhance leadership for the low carbon energy generation sector, we are focusing on how the Government could improve support to accelerate the development of low carbon energy generating technologies by coordination of funding and policy measures.

Question 6.1

What are your views on how the CCS demonstration projects could make the most cost-effective contribution to future carbon dioxide infrastructure? Please provide evidence to support your views.

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.

Question 6.3

Are there any other actions that the Government should consider taking at this stage to prepare for the full commercial deployment of CCS? Please provide evidence to support your views.

Annex 1: The Consultation Code of Practice Criteria

1. Formal consultation should take place at a stage when there is scope to influence policy outcome.

2. Consultation should normally last for at least 12 weeks with consideration given to longer timescales where feasible and sensible.

3. Consultation documents should be clear about the consultation process, what is being proposed, the scope to influence and the expected costs and benefits of the proposals.

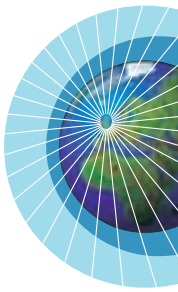
4. Consultation exercise should be designed to be accessible to, and clearly targeted at, those people the exercise is intended to reach.

5. Keeping the burden of consultation to a minimum is essential if consultations are to be effective and if consultees' buy-in to the process is to be obtained.

6. Consultation responses should be analysed carefully and clear feedback should be provided to participants following the consultation.

7. Officials running consultations should seek guidance in how to run an effective consultation exercise and share what they have learned from the experience.

Annex 2: List of bodies invited to respond to this consultation document



Advanced Power UK
Advantage West Midlands
Advisory Committee on Carbon Abatement Technologies (ACCAT)
Air Products plc
Alcan Inc
Alstom
AMEC
ARUP
Association for UK Coal Importers
Association of British Offshore Industries
Association of Electricity Producers
Association of Geotechnical and Geoenvironmental Specialists
Association of Insurance and Risk Managers
Association of Investment Trust Companies
Association of UK Coal Importers

BBL Company
Bellona
BG group
BOC gases
British Cement Association
British Chamber of Commerce
British Ecology Society
British Energy
British Geological Survey
British Insurance Brokers Association
British Marine Federation
British Petroleum Co. plc
British Wind Energy Association

Camco Global
Carbon Capture and Storage Association
Carbon Trust
Centre for Environment, Fisheries and Aquaculture Science
Centrica plc
Chamber of Shipping
Charted Institute of Environmental Health
Client Earth
Clinton Foundation
CO2 DeepStore
Coal Authority
Combined Heat and Power Association

Confederation of British Industry (CBI)
Confederation of UK Coal Producers
Conoco Phillips
Corus
Crown Estate Commissioners

DETINI
Doosan Babcock
Drax Power Ltd

East Midlands Development Agency
East of England Development Agency
EDF Energy
Element Energy
Encore Oil
ENER.G
Energy Industries Council
Energy Institute
Energy Intensive Users Group
Energy Networks Association
Energy Savings Trust
Energy Research Partnership
Energywatch
English Heritage
Environment Agency
Environment Council
Environmental Industries Commission
Environmental Industries Council
Environmental Law Centre
Environmental Law Foundation
E.ON UK
EPSRC
Exxon Mobil

Federation of Environmental Trade Associations
Forum for the Future
Friends of the Earth

Gas Forum
GE Energy
Geological Society, The
Green Alliance
Greenpeace

Health and Safety Commission
Hydrogen Energy

Imperial College

Institute of Chemical Engineers
Institute of Ecology and Environmental Management
Institute of Environmental Management and Assessment
Institute of Environmental Science
Institute for European Environmental Policy
Institute of Marine Engineering, Science and Technology
Institution of Mining and Mechanical Engineers
International Association of Oil and Gas Producers
International Energy Agency

Lafarge UK
Liquid Petroleum Gas Association
Local Government Association
London Development Agency

Marathon Oil
Marine Conservation Society
Marine Fisheries Agency Marine Stewardship Council
Maritime and Coastguard Agency

National Federation of Fishermen's Organisations
National Grid
National Trust, The
Natural England
Newcastle University
North West Regional Development Agency
NUMAST

Ofgem
Oil and Gas Independent Association
Oil & Gas UK
One North East

Parliamentary Office of Science and Technology
PB Power
Peel Holdings
Pipeline Industries Guild
Planning and Environment Bar Council
Plymouth Marine Laboratory
Port of London Authority
Powerfuels Power Ltd
Powergen plc
Poyry
Progressive Energy

Royal Commission on Environmental Pollution
Royal Society for the Protection of Birds
RPS Energy
RWE npower

Scottish and Southern Energy
Scottish Coal Scottish Council for Development and Industry
Scottish Enterprise
Scottish Environmental Industries Association
Scottish Environment Protection Agency
Scottish Natural Heritage
Scottish Power
Shell UK Ltd
SITA UK
Society for the Environment Society of British Gas Industries
Society of Maritime Industries Society for Underwater Technology
South East England Development Agency (SEEDA)
South West Regional Development Agency
Sussex Energy group

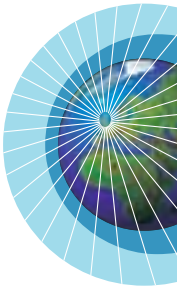
Total
Town and Country Planning Association
Trinity House
TUC
Tullow Oil

UK Coal Mining
UK Environmental Law Association
UK Forum for Environmental Industries
UK Major Ports Group Ltd
UK Offshore Operators Association
UK Onshore Oil Operators Association
UK Petroleum Industry Association Ltd
University of Edinburgh

Welsh Assembly Government
Welsh Federation of Fishermen's Associations
Welsh Power
World Coal Institute
World Wildlife Fund UK

Yorkshire Forward

Annex 3: Extracts of 'key information' from draft Guidance on Carbon Capture Readiness and Applications under Section 36 of the Electricity Act 1989



Space

In order to demonstrate that the proposed space is suitable and that development can be certified as CCR, operators should include outline site plans (drawings) in their application for s. 36 EA consent. The site plans, which will be public documents, will need to be more detailed than those currently submitted with s. 36 EA applications to enable the Environment Agency to advise Ministers that the proposed plant layout is suitable for subsequent CCS installation. The site plans should be sufficiently detailed to show:

- the footfall of the combustion plant;
- the location of the capture plant;
- the location of the carbon dioxide compression equipment;
- the location of any chemical storage facilities; and
- the exit point for carbon dioxide pipelines from the site.

Conceptual diagrams and a description, explaining how the space will used, should also be submitted. Basic calculations using the known volumes of carbon dioxide which will have to be processed could usefully be included in this description to justify the size of the vessels and processing equipment chosen.

Approximate minimum land footprint for some types of carbon dioxide capture plant

	CCGT with post-combustion capture	CCGT with pre-combustion capture	CCGT with oxy-combustion	USCPF with post-combustion capture	IGCC with capture	USCPF with oxy-combustion
Site dimensions – generation equipment (m)	170 x 140	170 x 140	170 x 140	400 x 400	475 x 375	400 x 400
Site dimensions – CO_2 capture equipment (m)	250 x 150	175 x 150	80 x 120	127 x 75		80 x 120
Capture plant site footprint (m^2)	62,000	50,000	34,000	170,000	180,000	170,000

Acronyms: CCGT – combined cycle gas turbine; IGCC – integrated gasification combined cycle; USCPF – ultra-supercritical pulverised fuel

Technical Feasibility of Retrofitting CCS Equipment

Government envisages that the technical feasibility study for retrofitting CCS equipment will take the form of a written report and accompanying plant designs which:

- make clear which capture technology at the time of the s. 36 EA application the applicant thinks they might fit in the future; and
- provide sufficient detail to enable the Environment Agency to advise the Secretary of State on whether the applicant had sufficiently demonstrated there were no currently foreseeable technical barriers to subsequent retrofit of the declared capture technology.

Applicants are directed to the IEA reference document 11 on capture technologies and to the advisory checklists when preparing their technical assessment of the feasibility of retrofitting carbon capture equipment.

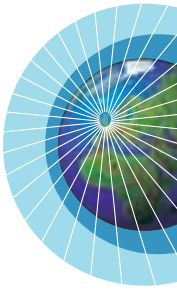
Storage

Demonstration of the storage component of CCR should involve:

- identification of a possible storage area, by delineating the geographical area which includes at least two oil, or gas, gas/condensate fields, or saline aquifers listed as "viable" or "realistic" for carbon dioxide storage in the DTI 2006 study;

- alternatively if an applicant wishes to suggest a storage area based on different criteria we would expect them to provide an equivalent degree of certainty to that provided in the DTI study or other similar peer reviewed material;

- a short summary including an estimate of the total capacity of the fields in the storage area, as compared with total volume of carbon dioxide emitted during the estimated plant lifetime.



Transport Technical Feasibility Study

The transport feasibility study should include a marked map at a scale sufficiently large for the proposed route corridors to be clear and a written report with sufficient detail to:

- identify the preferred form and route or routes for transport from the exit point from the site to the point where the carbon dioxide goes offshore. The route plan can be in an up to 1 km wide corridor for the first 10 km off the site (where options to alter the route will be more limited) and in an up to 10 km broad corridor thereafter to the chosen point(s) for the pipeline going offshore or for the carbon dioxide going on board ship. The report also needs to consider briefly any regulatory, safety and environmental issues with the transit point between land and sea;

- consider the offshore transport route from the transit point offshore to the storage area and demonstrate there are no barriers to the transport of the carbon dioxide by the declared preferred method into any of the fields/ aquifers in this storage area;

- consider any potential barriers (including safety and environmental considerations) to such a form(s) of transport and route(s); and

- demonstrate a reasonable likelihood that such barriers could be overcome on the basis of known factors at the time of the feasibility study.

Annex 4: The economics of operating a coal power station with CCS

Companies face various risks in the construction and operation of a power station. When assessing whether to invest in new build, companies require confidence that the expected revenues exceed the expected costs over the investment's lifetime, taking into account various risks on both the cost side and the revenue side. These risks are summarised in the table below:

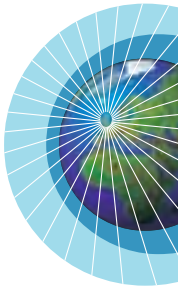
	Price Risks	Technical Risks
Cost-side	• Fuel Price • CO_2 Price	• Capital Cost • Operation/Maintenance Cost • Decommissioning • Regulation e.g. upfront technical requirements
Revenue-side	• Electricity Price	• Utilisation timing • Utilisation levels • Build time • Regulation e.g. limits on operation

Installation and operation of the CCS chain will significantly increase the capital, operating and maintenance costs of a power station. For example, to produce the same electricity output, the IPCC estimated that a pulverised coal power station with CCS would require 24 to 40% more fuel than one without[36]. On the other hand, cost savings arise because the operator does not need to submit an EU ETS allowance for carbon dioxide that is stored. So, once CCS is a proven technology, the principal issue for an investor is whether the EU ETS savings more than offset the additional capital and operating costs of CCS compared to conventional fossil fuel generation.

At the demonstration stage, there are a number of additional risks investors face on the technical side. For example: the power station could cost more to build, or take longer to build, than expected; operating and maintenance costs could be greater than expected; and the CCS chain might impact on the operation of the power station in ways that are not expected (e.g. there is a risk that a CCS power station may not be able to increase its output as quickly as a power station without CCS in order to take advantage of short-term price spikes). Finally, there are risks around the introduction of new regulation by Government, such as the proposals in this consultation, which could impact on the operation and profitability of the power station.

36 IPCC, 'Special Report on Carbon Capture and Storage', September 2005.

Annex 5: Acronyms and Abbreviations



Investors will incorporate these uncertainties into their decisions by applying a risk premium or contingency into their investment appraisals.

AP	Additional Payment
BAT	Best Available Technology
BREF	BAT Reference Documents
CCC	Committee on Climate Change
CCGT	Combine Cycle Gas Turbine
CCR	Carbon Capture Readiness
CCS	Carbon Capture & Storage
CFD	Contract for Differences
CHP	Combined Heat & Power
CO2	Carbon Dioxide
CSLF	Carbon Sequestration Leadership Forum
DECC	Department of Energy & Climate Change
DIUS	Department of Innovation, Universities & Skills
DPA	Data Protection Act 1998
DTI	Department of Trade and Industry
EEPR	European Energy Programme for Recovery
ELV	Emissions Limit Value
EPS	Emissions Performance Standard
ETF	Environmental Transformation Fund
ETI	Energy Technology Institute
ETS	Emissions Trading Scheme
EU	European Union
FEED	Front End Engineering and Design
FIT	Feed in Tariff
FOIA	Freedom of Information Act 2000
GW	Gigawatt
HSC	Hazardous Substance Consent
IEA	International Energy Agency
IGCC	Integrated Coal Gasification Combined Cycle
IPC	Infrastructure Planning Commission
IPPC	EU Integrated Pollution Protection and Control Directive

LCPD	Large Combustion Plants Directive
MW	Megawatt
NERP	National Emissions Reduction Plan
NGO	Non-Governmental Organisation
NZEC	EU China Near Zero Emissions Coal Initiative
R&D	Research and Development
RO	Renewables Obligation
ROC	Renewables Obligation Certificate
SEA	Strategic Environmental Assessment
SEPA	Scottish Environmental Protection Agency
TSB	Technology Strategy Board
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
USCPF	Ultra-Supercritical Pulverised Fuel
ZEP	Zero Emission Fossil Fuel Power Plant

Department of Energy and Climate Change. www.decc.gov.uk