

Summary: Intervention & Options

Department /Agency: DECC	Title: Impact Assessment of the Carbon Capture Readiness requirements described in the Government response to the “Towards Carbon Capture and Storage” consultation.	
Stage: Final	Version: 1	Date: May 2009
Related Publications: (1) “Towards Carbon Capture and Storage: Government response to Consultation. April 2009 (2) “Towards Carbon Capture and Storage” a consultation document including the partial impact assessment. June 2008 (3) Text of the agreed Directive (2009/31).of the European Parliament and of the Council on the geological storage of carbon dioxide.		

Available to view or download at:

- (1) <http://www.decc.gov.uk/en/content/cms/consultations/open/open.aspx>
- (2) <http://www.berr.gov.uk/files/file46810.pdf>
- (3) http://ec.europa.eu/environment/climat/ccs/pdf/st03739_en08.pdf

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What is the problem under consideration? Why is government intervention necessary?

The partial impact assessment on the draft Directive looked at the options for “carbon capture readiness “(CCR). The original policy proposal by the EU was aimed at reducing the risk of some combustion (primarily fossil fuelled) power plant built after 2010 being retired prematurely because they could not be retrofitted with CCS. Government intervention on CCR is therefore necessary to insure against such a scenario.

The partial impact assessment prepared and published as part of the consultation in June 2008 demonstrated that a policy of requiring CCR was a low cost and effective insurance to reduce the real risk of major economic assets being prematurely closed because they would not be able to retrofit the chain of carbon capture and storage technologies (CCS) cost effectively after the technologies are proven.

This final impact assessment also takes account of the relevant points from the many responses to the consultation and the EU Directive.

Negotiations in the EU have now concluded. The UK is required, as a minimum, to implement the agreed EU proposals on CCR in Article 34 (formerly 32) i.e. this requires technical assessments of three of the four factors that together can make a plant CCR - storage, the technical feasibility of retrofitting and transport, and also economic assessments of the latter two factors. Only if all are positive, must an EU government require the applicant for a new combustion plant at or over 300 MWe to leave space (the fourth CCR factor) on the site. In effect the EU Directive allows an EU government to require none, some or all of its new affected combustion plants to be CCR. So the UK must as a minimum build on the “do nothing” baseline by adding in the costs of the 5 assessments required by the EU Directive.

What are the policy objectives and the intended effects?

The policy objective is to ensure that new large power plants at or over 300 MW electrical capacity avoid the situation of being forced to close prematurely due to pressure from the carbon market and /or regulatory requirements for CCS. Any new combustion plant consented and built as CCR prevents this possibility

What policy options have been considered? Please justify any preferred option.

The following options were considered:

- 1) Do nothing additional to the existing EU Emissions Trading Scheme (ETS) driver i.e. the baseline scenario pre the agreed Directive. This remains the baseline at the final stage against which to judge the costs and benefits of the other options.
- 2) Require all new combustion plants over 300MWe, consented from 2010 at the latest, to be built carbon capture ready and to maintain that as a living status until they apply to fit CCS to the plant.
- 3) Raise awareness of the risk of premature closure after 2020 for power plants consented after 2010 unless they can retrofit CCS. This would largely be achieved by the EU, now mandatory, requirements in the agreed Directive for 5 assessments for each new combustion plant at or over 300MWe. Since the EU does not require that space is left in all circumstances, many new combustion plants built across the EU may well not be CCR, with the risks that entails.

Responses to the consultation, the imperatives of the UK's 80% emission reduction target for 2050 and the impact this has on all types of new combustion station over their lengthy lifetime means the government chosen policy is option 2, a robust and living interpretation of CCR.

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects?

Article 27 of the agreed Directive requires Member States, on the basis of a questionnaire to be designed by the Commission, to report back to them on the implementation of the Directive as a whole by 30 June 2011 and every three years thereafter.

At national level, since the government intends to require plants consented as CCR to review that status against any technical and regulatory developments both when it begins generating electricity to the grid and every two years thereafter, we will have a sound information basis on which to make both the required reports to the EU and to review actual costs and benefits.

Ministerial Sign-off For the final stage impact Assessment:

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister:



Date: 27 May 2009

Summary: Analysis & Evidence

Policy Option: 1

Description: Do Nothing extra to ETS

COSTS	ANNUAL COSTS		Description and scale of key monetised costs by 'main affected groups' None since this is the "business as usual" option.
	One-off	Yrs	
	£0		
	Average Annual Cost (excluding one-off)		
	£0		Total Cost (PV) £0
Other key non-monetised costs by 'main affected groups' : None.			

BENEFITS	ANNUAL BENEFITS		Description and scale of key monetised benefits by 'main affected groups' None since "business as usual" option.
	One-off	Yrs	
	£0		
	Average Annual Benefit (excluding one-off)		
	£ 0		Total Benefit (PV) £0
Other key non-monetised benefits by 'main affected groups'. • None since this is the "business as usual" option			

Key Assumptions/Sensitivities/Risks

- Assumption that we will know if CCS has been proven as a technology chain by 2020
- Risk that because CCR was not considered at the build stage by a percentage of new fossil power stations built between 2010 and 2020 they would prove unable to be retrofitted with CCS cost effectively and so would need to close prematurely.
- The main risk is that the EU or the UK chose to impose CCS on fossil fuel generation plants at some point in next 20 years and to extend the requirement retrospectively to all power plants constructed after 2010.
- An additional risk is the EU ETS price could eventually make it uneconomic for certain fossil fuel plants to run without CCS, meaning that those unable to retrofit CCS would have to close.

Price Base Year 2010	Time Period Years 10-20 years	Net Benefit Range (NPV) £ 0	NET BENEFIT (NPV Best estimate) £ 0
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What is the geographic coverage of the policy/option?	England and Wales
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On what date will the policy be implemented?		By 2010.		
Which organisation(s) will enforce the policy?		N/A as no enforcement required		
What is the total annual cost of enforcement for these organisations?		£ N/A		
Does enforcement comply with Hampton principles?		N/A		
Will implementation go beyond minimum EU requirements?		N/A		
What is the value of the proposed offsetting measure per		£ N/A		
What is the value of changes in greenhouse gas		£ N/A		
Will the proposal have a significant impact on		No		
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium	Large
Are any of these organisations exempt?	N/A	N/A	N/A	No
Impact on Admin Burdens Baseline (2005 Prices)		(Increase-Decrease)		
These are for the year 2010				
Increase	£ 0	Decrease	£ 0	Net £ 0
Key:	Annual costs and benefits: Constant Prices		(Net) Present Value	

Summary: Analysis & Evidence

Policy Option: 2

Description: Requiring new combustion power stations at or over 300MWe to be built Carbon Capture Ready from 2009

COSTS	ANNUAL COSTS		Description and scale of key monetised costs by 'main affected groups' Estimated £0.94-1.7M per power station for capture ready costs at consenting and building stage. Includes £30k x3 (£0.1M) for each station for reviews. No ongoing running costs.
	One-off	Yrs	
	£ 0.94-1.7M per plant x1 plant per year	10	Assuming 1.0GW average combustion plant size and that 10-14GW are built between 2010-20.
	Average Annual Cost		
	£ 1.0-2.4M		Total Cost (PV) £8-20M
Other key non-monetised costs by 'main affected groups' : none			

BENEFITS	ANNUAL BENEFITS		Description and scale of key monetised benefits by 'main affected groups' The benefit is zero if CCS is not implemented.
	One-off	Yrs	
	£0 or 200-400M	Post 2020	If CCS is required after 2020 the benefit of avoiding premature closure of 1GW of power station capacity unable to fit CCS is estimated at £400-800M. The number of power stations that could be so affected is uncertain but for illustrative purposes this analysis has assumed a capacity of 0.5GW
	Average Annual Benefit (excluding one-off)		
	£ N/A		Total Benefit (PV) £ Zero or £200 - 400M
Other key non-monetised benefits by 'main affected groups': Industry benefits from clear government signals and ongoing reminders of CCR required re-assessments. An additional benefit is avoiding premature closure from the risk that the EU ETS price could eventually make it uneconomic for certain fossil fuel plants to run without CCS.			

What is the geographic coverage of the policy/option?	England and Wales			
On what date will the policy be implemented?	By 2010			
Which organisation(s) will enforce the policy?	DECC; SE, and Northern Ireland government			
What is the total annual cost of enforcement for these organisations?	£15k per consented application so say £30-45k per year			
Does enforcement comply with Hampton principles?	Yes			
Will implementation go beyond minimum EU requirements?	Yes, since for EU after mandatory assessments not all will be required to be CCR			
What is the value of the proposed offsetting measure per	£ 0			
What is the value of changes in greenhouse gas	£ 0			
Will the proposal have a significant impact on	No			
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium	Large
Are any of these organisations exempt?	N/A	N/A	N/A	No
Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)				
Increase of	£ 4.2-10.6M	Decrease of	£ 0	Net Impact £ 4.2 – 10.6M
Key:	Annual costs and benefits: Constant Prices			(Net) Present Value

Key Assumptions/Sensitivities/Risks			
<ul style="list-style-type: none"> Assume that a CCR policy would be in effect from 2010 up to no later than 2030 (by which stage CCS on new stations is likely to be technically and commercially viable). Assume that we will know if CCS has been proven as a technology chain by 2020. Assume that about 5-10% new power station capacity (if there is no CCR) built between 2010 and 2015 would be unable to retrofit CCS. <p>Risk: Some potential locations may no longer be suitable, and alternative sites could be more expensive. This potential impact has not been costed.</p>			
Price Base Year 2010	Time Period Years 10-20 years	Net Benefit Range (NPV) £ -20M or +400M	NET BENEFIT (NPV Best estimate) £N/A

Summary: Analysis & Evidence

Policy Option: 3

Description: Required EU assessments but not CCR as part of raising awareness of the risk of premature closure in 2020 for power plant built after 2010 unless they can retrofit CCS

COSTS	ANNUAL COSTS		<p>Description and scale of key monetised costs by 'main affected groups'</p> <p>Industry- Estimated £0.35-0.7M per power station for capture ready assessments only i.e. excluding land costs and ongoing assessments, as minimum requirement by EU at consenting stage.</p> <p>The total cost assumes 10-14GW of new fossil fuel capacity is built between 2010 and 2020 and 4 out of 5 power stations respond to encouragement by leaving space following assessments so becoming CCR, but that 1 in 5 don't</p> <p>No ongoing running costs.</p>
	One-off	Yrs	
	£0.8-1.5M per station	10	
	Average Annual Cost		
	£0.8-2.1M		<p>Total Cost (PV) £7-18M</p>
<p>Other key non-monetised costs by 'main affected groups'</p> <ul style="list-style-type: none"> HMG – cost of ongoing information and persuasion campaign to limited group, minimal (£5k). 			

BENEFITS	ANNUAL BENEFITS		<p>Description and scale of key monetised benefits by 'main affected groups'</p> <p>The benefit is zero if CCS is not implemented.</p> <p>If CCS is required after 2020 the benefit of avoiding premature closure of 0.5 GW of power station capacity unable to fit CCS is estimated at £200-400M. The benefit is less certain than for Option 2 since a generator may risk having a non-CCR plant. Assuming for illustrative purposes this has a probability of 20%, the potential benefit is only 80% of Option 2 (i.e. £160-320M).</p>
	One-off	Yrs	
	£0 or 160-320M	Post 2020	
	Average Annual Benefit (excluding one-off)		
	£ N/A		<p>Total Benefit (PV) £ Zero or 160-320M</p>

Other **key non-monetised benefits** by 'main affected groups'

EU signal of expectation of CCS in future by requiring assessments to encourage industry to think through CCR issues, but leaves market free to make decisions on what plant to build and whether to make it CCR.

Key Assumptions/Sensitivities/Risks			
<ul style="list-style-type: none"> Assume that we are likely to know if CCS has been proven as a technology chain by 2020. Assume that there is a 20% probability a generator would chose not to build a new plant CCR in the 2010-2015 period and so it would be unable to retrofit CCS. 			
Price Base Year 2010	Time Period Years 10-20 years	Net Benefit Range (NPV) £ -18 to +320M	NET BENEFIT (NPV Best estimate) £N/A

What is the geographic coverage of the policy/option?	England and Wales
On what date will the policy be implemented?	By 2010
Which organisation(s) will enforce the policy?	DECC; SE, and Northern Ireland government
What is the total annual cost of enforcement for these organisations?	£ 15k per application whether or not space is then left so £30-45k per
Does enforcement comply with Hampton principles?	Yes
Will implementation go beyond minimum EU requirements?	No, but could be implemented in England and Wales earlier than EU's 2011 implementation deadline
What is the value of the proposed offsetting measure per	£ 0
What is the value of changes in greenhouse gas	£ 0
Will the proposal have a significant impact on	No
Annual cost (£-£) per organisation (excluding one-off)	Micro Small Medium Large
Are any of these organisations exempt?	N/A N/A N/A No

Impact on Admin Burdens Baseline (2005 Prices)				(Increase - Decrease)	
Increase of	£ 4.2-10.6M	Decrease of	£ 0	Net Impact	£ 4.2-10.6M

Key:	Annual costs and benefits: Constant Prices	(Net) Present Value
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1. Strategic Overview

Slowing and then reversing the rate of climate change is a crucial issue worldwide. The UK has a target of a 34% reduction in greenhouse gases compared to 1990 levels in 2018-2022 and a long-term target to reduce emissions by at least 80% by 2050. The EU Emissions Trading Scheme (ETS) is an innovative market based mechanism to reward low carbon technologies across the European Union. The latter is designed to drive energy market choices towards low carbon options by gradually increasing the costs of emitting carbon, while still enabling other goals such as diversity and so security of energy supplies to be taken into account.

Carbon Capture and Storage (CCS) is potentially one of the most useful technologies for reducing CO₂ emissions, with a range of capture methods approaching the demonstration stage around the world. No one has yet demonstrated the full technology chain from capture, through transport to long term storage (whether offshore or under land) on a power station. The widespread deployment of CCS – once proven at full-scale - is over a decade away, but it is hoped that it will be the key CO₂ reduction tool globally post 2020.

Given the long life cycle of large scale combustion stations, especially coal and gas, maintaining a real option for generators to be able to retrofit CCS at a later date, by requiring them from now on to design new large stations so they are carbon capture ready (CCR), should make economic sense for developers as we move towards a low carbon economy. CCR also signals both the government's commitment to carbon reduction and their support for the development of this new technology which has potential worldwide application.

2. The Issue

There is concern on the part of both industry and government that the construction of new fossil fuel electricity generation plants might “lock in” carbon dioxide (CO₂) emissions since the operating lifetimes of such plant are typically 30 years for a gas plant and 40-50 years for coal. One way to address this problem is to require such plant to be built in such a way (i.e. CCR) that there is much greater certainty that technically they could be retrofitted with CCS once this is proven at full-scale. In effect CCR keeps open the option of fitting CCS later and also more cheaply than otherwise might be the case, thus avoiding at one extreme carbon lock- in and at the other premature closure of non-CCS plant.

For the operator an inability to fit CCS at a later date might lead to the premature retirement of plant and significant wasted investment (“stranded assets”). This would be so either if they cannot fit CCS if it becomes mandatory or if they cannot obtain a sufficiently high price for the electricity generated from that plant to cover the purchase of the necessary carbon emission allowances. We expect their price to rise as the EU’s overall CO₂ cap under the Emission’s Trading Scheme (ETS) tightens over time. For the government and society such outcomes would have implications for the diversity and thus longer term security of the UK’s electricity supplies, and could impose additional resource costs for replacement plant, with consequent deleterious impacts on consumers and the wider economy.

Avoiding potential “carbon lock-in” is particularly crucial at present because the UK needs to build and get operational about 10-14GW of new fossil capacity by 2020 - equivalent to about 15-20% of our current total electricity generating capacity - to replace retiring electricity generating capacity. While we are striving to meet the target of getting 15% of total energy consumed from renewable sources by 2020, of which electricity will be a large share, and increasing energy efficiency, the government believes that the UK still needs a wide range of types of generating plant, both fossil fuel and non-fossil fuel, to replace this retiring capacity and ensure diversity and hence security of supply.¹ It is however for operators to propose what size and type of power plant to put forward for government consent. But we expect applications for s.36 Electricity Act 1989 consents (hereinafter s.36 EA) to cover a wide range of types - low carbon options like CHP plants, wind farms on and off shore, more energy from waste and biomass plants, nuclear plants, and large gas and coal fired generating stations (also with or without CHP)².

For fossil fuel plant in particular, requiring CCR would ensure that, once carbon capture technologies (post and pre-combustion or oxy-fuel) and the technology chain from capture through transport to storage is proven, an operator can then make a reasoned judgment, depending on the regulatory regime, between: installing CCS on these plants, choosing to buy year - on- year increasingly expensive carbon allowances as the EU’s ETS’s overall cap on CO₂ emissions steadily reduces or closing the plant down before the end of its originally planned economic life.

The issue is thus whether a mandatory CCR requirement is the most appropriate method at this stage for addressing the risk of carbon lock-in and its potential consequences for all types of combustion plants at or over 300 MWe.

Art.34 of the Directive on the geological storage of CO₂, agreed by the European Council and the European Parliament in December 2008,³ requires that all

¹ See *Meeting the Energy Challenge. A White Paper on Energy*. DTI May 2007. Sections 10.18-24 and Annex B in particular, cited as EWP. Available at: http://www.dtistats.net/ewp/ewp_full.pdf

² But probably excluding any new oil plants, given oil’s long history of price volatility

³ The Pre official journal text of this Directive is available at: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2008-0612+0+DOC+XML+V0//EN&language=EN#top>

applicants for consents to build new combustion plants at or over 300MWe provide assessments of three of the four CCR factors - storage, transport and the technical feasibility of retro-fitting, and economic assessments of the latter two factors. Only if all these assessments are favourable, must the Member State then require the operator to leave suitable space on the new plant to enable the later fitting of CCS. This allows Member States to require some, all or none of their new combustion stations at or over 300MWe to be CCR. The Directive requires that Member States implement it within two years from the date of its formal publication.

The UK government has decided that, given the urgency of the need to combat climate change, it will require all applicants for new combustion stations of the size laid down by the EU to provide not only the required EU assessments, but also to leave appropriate space thereby ensuring that all are CCR. This new policy will take effect immediately it is announced and also cover any consents currently being processed. Additionally ongoing reporting will be required to ensure that CCR remains a living state given that the technology and regulatory regimes for CCS are still being developed. This gives operators a clearer signal about the inevitability of CCS and ensures a level playing field between operators of different types of carbon emitting plant.

3. Objectives

What does CCR mean and what plants are affected?

The definition of CCR in the agreed EU Directive comprises four factors, based on a technical, peer reviewed engineering study for the International Energy Agency (IEA)⁴. This IEA document suggested that, at the current state of development of CCS, only the following generic factors were technically and economically justified in defining CCR:

- i) provision of suitable space on the installation site for the equipment necessary for subsequent capture and compression of the CO₂.
- ii) conduct an assessment of: the availability of suitable storage sites and
- iii) suitable transport facilities for the CO₂, and
- iv) of the technical feasibility of retrofitting CO₂ capture equipment.

The European Commission adopted this four factor CCR definition for Art 34 of the agreed Directive. The UK's "Towards Carbon Capture and Storage" consultation of June 2008 explored in more detail what these factors might mean in practice⁵.

Costs of being CCR for various types of combustion plant

⁴ CO₂ capture ready plants, IEA GHG Programme Report 2007/4, May 2007

⁵ Available at : <http://www.berr.gov.uk/files/file46810.pdf>

Data on the costs of making the necessary CCR factor assessments and the costs of leaving space (i.e. to ensure CCR) for new large power generation plants are limited at present since no operator has yet had to comply with CCR as defined above. Analysis is further hampered because costs will inevitably vary as a result of different combustion plant locations, type and size. Therefore the values presented in this impact assessment, even with the refinements helpfully offered in the response to the consultation, can only be indicative of the likely costs involved.

In relation to the overall capital costs of planning and building a typical new 800MW gas plant (estimated cost ~£520m), or a 1600MW similarly sized supercritical coal power plant (estimated ~£2000m) the direct costs of the proposed CCR requirements are likely to be small.

In terms of *space* required, the foot-print of CO₂ capture facilities, including compressors, is estimated at around 40% of that of a coal power station (i.e. the main building excluding ancillary cooling towers, electrical substations, fuel storage, etc.). This would amount to about 5-6 hectares for a new ~1.6-2GW supercritical coal fired station. With agricultural/industrial development land costing £100-150k/hectare the cost would be about £500-900k per power station. These space costs account for under 0.1-0.2% of the total capital cost of an average fossil fuel plant. We expect the space required would not be significantly different for an equivalent sized gas station, with land costs being similar⁶.

The cost of assessing the *technical feasibility* of being ready for CO₂ capture will depend on the degree of detail demanded. As it applies only to new stations, in effect this is an additional design factor that can relatively easily be taken into account at all stages through from the earliest initial designs to the final detailed ones, once the operator has decided on the type of capture technology they envisage installing. Informal discussions with industry and academics suggest taking this into account might add between £200-500k per power station⁷ to design costs for an outline solution.

The costs of undertaking a feasibility study on the potential off site *transport* of supercritical CO₂ is thought to be about £50-100k to help identify the most feasible route(s) and to identify potential barriers. In part this is because the health and safety regimes and regulatory regimes for any pipelines (if this transport method is chosen) or indeed by ship are still being researched and developed.

⁶ Land for CCS facilities is likely to be available already within the boundaries of most large existing coal power plant since they used to have to have considerable space to store many weeks of coal stocks. However, this land could have other uses and therefore its value has been included as an opportunity cost.

⁷ Some in industry felt that higher costs of £0.5-2.0M were more realistic for this level of CCR assessment study. However, based on the costs of the inevitably more complex task of studying CCS for some existing plants in India and the assistance given by the draft guidance document, we felt that this suggested level for additional costs caused by CCR was likely to be significantly too high.

In terms of CO₂ storage, again a feasibility study would be required which could draw on the research already done by (then) DTI and others to identify offshore storage areas which could potentially be used. But again, given the considerable uncertainties as to the regulatory regime and yet to be defined health and safety issues, the operator would only be required to provide an outline solution at this stage. This suggests modest costs of around £50k per station.

The two economic assessments - inevitably partial - required are estimated to cost up to £40-50k in total.

In order to ensure that CCR remains a living state as technical and regulatory systems for CCS develop, Ministers have decided to require some ongoing re-assessments of the technical aspects of CCR. We are assuming that, since an assessment will be required at the point when a CCR consented station begins to generate electricity onto the grid and every two years thereafter, this means an average of 3 assessments per built consented plant are likely before a plant moves to CCS. Based on an assessment of £30k per assessment suggests £0.1 M is a reasonable assessment of the ongoing costs.

So overall the costs of a CCR requirement per new combustion power station are expected to be in the range:

1. Additional Land	£0.5 - 0.9 M
2. Feasibility of retro-fitting assessment	£0.2 - 0.5M
3. Storage and transport assessments	£0.1 - 0.15M
4. Economic assessments	£0.04 - 0.05M
5. Ongoing assessments	£0.10M
TOTAL	£0.94 – 1.7M

This is equivalent to less than 0.1% of the capital cost of a 1.6GW coal fired power station and about 0.3% of the capital cost of an 800MW gas fired power station.

Of the costs listed above, all those except the additional land count as administrative burden. These assessments total £0.44-0.8M per new combustion power station. Assuming 10-14 plants, the administrative burden is £4.4-10.6M when deflated to 2005 prices.

4. Options Identified

In any impact assessment, the purpose of identifying options, some hypothetical, is to look at what the consequences might be of each of them to provide a clearer picture of the relative costs and benefits to aid evidence based decision making. The context is that CCS has still to be demonstrated at full-scale, particularly for electricity generation, and the licensing and regulatory frameworks needed to control its deployment and operation are not yet in place.

Consequently the knowledge base does not yet exist to enable investors to make fully informed decisions on the relative cost, performance and reliability of CCS when compared to combustion plant without CCS and other non-fossil fuel alternatives. In these circumstances some investors may choose to build plants that cannot be retrofitted with CCS, either due to location or design. They therefore run the risk at a later date of being forced to close these plants prematurely either because of the introduction of an EU requirement to fit CCS including retrospectively or because under the ETS carbon prices increase to the point that production at a specific plant is no longer cost competitive. Any such premature closures will add additional resource costs to the system in building replacement capacity, and these costs would ultimately fall on the final consumer.

Three options were constructed to address the above potential information and legislative uncertainty in the original partial impact assessment and have now been modified in the light of certainty about the EU's minimum requirements :

- (i) do nothing additional to the ETS system (the pre existing position prior to the Directive);
- (ii) require large combustion plant (at or over 300MWe) to undertake assessments and leave space from say 2010 (the government's proposed requirement); and
- (iii) undertake the minimum required EU assessments, but do not require operators to leave space (i.e. not CCR), as a way of raising awareness of the risk of premature closure in 2020 for power plants consented and built after 2010 unless they can retrofit CCS. (This replaces the *awareness raising campaign option of the partial impact assessment*)

In respect of **Option 1**, the main current policy measure in the UK (and EU) for encouraging reductions in CO₂ emissions from large combustion power plant is the relatively recently introduced EU Emissions Trading Scheme (ETS). This is a market based system - unique in the world - by which large power plant are required to pay for emissions allowances to cover the CO₂ they release into the atmosphere. Consequently decisions on the construction of future large combustion power plant, and the type of fuel to be used, are influenced by investors' views of:

- a) the future price of ETS allowances in a market where the availability of these allowances will decline as the ETS cap bites ever sharper;

- b) the likely relative cost of alternative fossil fuels; and
- c) their assessment of the risk of mandatory CCS at some future stage.

It can be argued that the ETS is sufficient to ensure the deployment of CCS, once the technology has been demonstrated, when the ETS carbon price makes this commercially viable and that no further action is needed. (Option 1- the Do Nothing Extra Option).

For **Option 2**, we have taken the government's agreed response to last year's consultation on the then draft Directive. This requires all new combustion plants consented in England and Wales from the date of the announcement to undertake the EU's required assessments and to leave appropriate space in all cases. This was the core assumption on which we consulted. (Option 2- the government's proposed CCR policy)

Option 3 was a variant of Option 1 in which investors are provided with clear information on the risks of not meeting a CCR requirement, but CCR is not made mandatory on new large generation plant. This is close to what has emerged from the EU negotiations as the EU's minimum requirement of some required assessments from all applicants for new plants, but no mandatory requirement for them to leave space and therefore in total not to be CCR. This helps alert applicants to the risk of further EU legislation affecting CCS, including the possibility of a retrospective requirement on existing plants built after the Directive comes into effect, assumed to be 2010, but without any compensation.

The background to this last element in Option 3 is that in 2007 the European Commission Communication on Sustainable Fossil Fuels proposed that from 2020 CCS should be mandatory on new fossil fuelled power stations including those built from 2015⁸. However, while the EU Council indicated that such a mandate merited further consideration, it recognised that first CCS needed to be proven and the timing uncertainties of that. So the Energy Plan approved at the March 2007 European Council records: "Aware of the huge possible global benefits of a sustainable use of fossil fuels, the European Council ...urges Member States and the Commission to work towards strengthening R & D and developing the necessary technical, economic and regulatory framework to bring environmentally safe carbon capture and sequestration (CCS) to deployment with new fossil-fuel power plants, if possible by 2020"⁹. The agreed Directive gives a further signal of the importance that the EU attaches to the need for progress on CCS and the possibility of retrospective requirements. We have therefore assumed, for the purposes of Option 3 that in 2020 the CCS technology chain is technically proven and that the EU would require CCS to be fitted to all large power plants built since 2010.

⁸ Sustainable power generation from fossil fuels: aiming for near-zero emissions from coal after 2020. COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT COM (2006) 843 final. Available at : <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0843:FIN:EN:HTML>

⁹ Presidency Conclusions, Annex 1 section v available at: http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/93135.pdf

5. Analysing the Options

The previous section shows that each option needs to be assessed against two hypothetical scenarios:

1. the EU ETS context in which future CO₂ emissions reduction is left to existing measures, basically the ETS and the EU's renewable energy target.
2. a CCS mandate in which the EU or UK government is assumed to introduce legislation in 2020 or thereabouts requiring CCS to be fitted to all large combustion plant, including retrospectively to those from 2010.

Option 1: Do nothing extra over ETS

Under this option the government would not introduce any mandatory CCR requirement for the licensing of any large combustion electricity generating plant. Investors would decide what plant to build and whether to make them CCR purely on the basis of their views on: (i) future market prices for fossil fuels; (ii) the future price of carbon allowances in the ETS, and (iii) the potential for CCS to be made compulsory by the EU or national government at some stage during the life time of their plant.

Benefits

The benefit of this option is that it ensures that no potential site for a new fossil fuel power station is excluded on the grounds of not being capable of ultimately being able to fit CCS. This could lead to marginally higher build levels for fossil fuel power stations relative to Option 2, where all new combustion (mostly fossil fuel) plants must be CCR, but it also increases the risk of fossil fuel plants having to close prematurely (see below).

Costs

This option does not impose any additional costs on the owners and/or operators of large fossil fuelled power plant as it represents the “business as usual” option.

There are however potential risks with this option.

The ETS scenario - The main risk without a CCR requirement is the possibility that one or more combustion plants built between 2010 and 2020 would need to be closed prematurely at some stage after 2020 because they cannot be retrofitted with CCS and cannot be operated economically without CCS at the then prevailing carbon price. There would then be the cost to society of having to replace the generating capacity earlier than they otherwise would. Current evidence suggests retrofitting CO₂ capture technologies is likely to be technically possible on most (but not all) power stations, even without the prior application of

a CCR requirement¹⁰. However some (more probably the gas stations which tend to have a smaller space footprint than the coal ones) may not have adequate space for the equipment to capture CO₂. It is also possible that a limited number of plants could be located in areas where CO₂ transport off site is not possible (for example if there is no viable pipeline route to take the CO₂ to storage) or cannot comply with as yet undefined safety requirements.

Therefore the issues are:

- (a) when is the ETS allowance price likely to rise to the level needed to make CCS economic for a particular fuel type and location, and
- (b) what are the prospects for combustion power plant that cannot be retrofitted with CCS in such a market?

Estimates for the cost of carbon in the ETS in 2020 range between €35-45/t CO₂¹¹. These estimates are sensitive to assumptions on future gas and coal prices and the impact of the EU's target for deployment of renewable energy. For example, allowance prices could exceed this range with high gas prices or fall below this range, depending on how much of the renewable energy target is met through electricity generation (as opposed to other ways e.g. biofuels in transport). In the absence of more detailed analysis, this impact assessment has worked with the range given above, which needs to be compared to the costs of retrofitting CCS to coal and gas fired power plant that range from €50-60/t CO₂ and €80-90/tCO₂ respectively¹² once the technology is fully proven. Therefore if the ETS trades as currently estimated, it will not incentivise the deployment of CCS until after 2020. Analysis for DECC has suggested that CCS deployment could commence shortly after 2020 with high gas prices, but could be delayed up to 2030 with low gas prices¹³.

Even though the EU ETS price could eventually make it uneconomic for certain fossil fuel plants to run without CCS, meaning that those unable to retrofit CCS would have to close, investors will be able to form an expectation of when the EU ETS price will force CCS retrofit well in advance. This will give them time to mitigate the extent of their losses from the power station having to close, e.g. by running the station at high load factors in the years prior to the plant becoming uneconomic due to EU ETS or pursuing other technologies besides CCS as a means of mitigating high EU ETS prices to enable the plant to keep running.

Alternatively in the CCS Mandate scenario, we have assumed such a mandate would need to be announced some years in advance of its implementation, and

¹⁰ This view is based on the assumption that most large combustion power stations will have the space available to fit CO₂ capture and compression equipment and are located such that there will be a viable route to transport the CO₂ to a suitable storage. Without CCR at the planning and design phase such a retrofit may be more complex and costly, but this might be mitigated if new and improved 2nd generation CCS technologies were to emerge by 2020.

¹¹ Accompanying document to the proposal for a directive of the European Parliament and of the Council on the geological storage of carbon dioxide. Impact Assessment. COM (2008) x .pp. 45-48 available at : http://ec.europa.eu/environment/climat/ccs/pdf/ccs_ia_jan2008.pdf

¹² Estimates based on BERR cost and performance data published in the Energy Review 2006

¹³ Implementation of the EU 2020 renewable target in the UK electricity sector, Redpoint et al, June 2008 (http://renewableconsultation.berr.gov.uk/related_documents)

therefore no plant consented after the announcement should be caught unawares by a CCS mandate. Therefore in this case there appears to be little if any risk from not implementing a CCR requirement in 2010.

However, should the EU or UK decide to impose a CCS mandatory requirement retrospectively to plant constructed after say 2010, some 6-9GW of capacity would be caught by this requirement. (This issue, and the associated risks and costs it could introduce, are considered under Option 2).

In summary there is some risk of stranded assets due to a rising EU ETS price under the “do nothing extra option”. However, the evolving EU ETS price will allow investors to form an expectation as to when plant will become uneconomic without CCS. Furthermore this option does not prescribe CCS only for fossil fuel plants. This means that plants can take steps either to reduce the value of the assets that are stranded e.g. by running plants at high load factors in the years before the EU ETS price makes the plant uneconomic, or to consider other ways of mitigating the high EU ETS price e.g. increased biomass co-firing. There would be a greater risk of stranded assets if the EU or UK should choose to impose CCS on fossil fuel generation plant at some later date and to extend it retrospectively to all power plants constructed after 2010. Option 1 does not mitigate this risk.

Option 2: Require all new at or over 300MWe combustion plant to be built CCR from 2010

Under this option the government requires all large power generating combustion plant consented from 2010 to be technically capable of being retrofitted with some type of CO₂ capture equipment, to have sufficient land available to accommodate the capture equipment and to have assessed the feasibility of moving the compressed or supercritical CO₂ off-site and storing it safely. The UK government’s proposed position is based on, but goes beyond the EU’s agreed Directive requirements. The EU gives governments discretion to require space depending on their views of the outcomes of the assessments required of plant applicants in respect of three of the four factors of CCR. This could result in some, all or no new combustion plants in the EU being consented and built CCR.

Benefits

The main benefit of applying a CCR requirement to plant consented from 2010 would be to enable operators to exercise real choice at a later date as between fitting CCS once proven or paying for increasingly expensive ETS allowances. Equally it also insures operators against any possible later retrospective mandatory requirement, whether imposed by the EU or the UK, to fit CCS to fossil fuel plant consented from 2010. In this case there is a risk that, without a CCR requirement, some plants built between 2010 and the announcement of the intention to introduce a mandate in 2020 would not be able to retrofit CCS.

Projections for BERR (now DECC) anticipate 6-9GW of fossil fuelled power plant being consented and built between 2010 and 2015.¹⁴

While even without a formal CCR requirement, it is probable that most fossil fuel plant could be capable - even if at increased cost- of being retrofitting with CCS, issues to do with the plant's location, off site transport and the as yet unspecified safety requirements lead to a reasonable assumption that perhaps 5-10% of capacity, say 0.5GW, might be unable to retrofit CCS. In this case the benefit of a CCR requirement would be to avoid a capital cost write-off of £400-800M per 1GW (NPV 2010) with the range reflecting the difference in capital cost of gas and coal fired capacity.

A CCR requirement would also be beneficial if a rising EU ETS price forced some plants that could not be retrofitted with CCS to close. The capital cost write-offs that a CCR requirement avoided in this scenario would almost certainly be less than those with a retrospective CCS mandate, since plants would have time to plan to either reduce the value of the stranded assets, or even avoid being left with stranded assets using some technology other than CCS.

Therefore, overall the benefit of this option would be zero without a CCS mandate applied to combustion power plant consented and built between 2010 and the announcement of the intention to introduce a mandate (assumed to be 2015 for the purpose of this analysis) and £200-400M if a CCS mandate were introduced and applied to plant consented and built after 2010. The probability of each of these alternative outcomes is not known at present, which illustrates how a CCR requirement should be regarded as a method for minimising risk in an uncertain future.

Even if Government did retrospectively mandate CCS, this option would protect power plant investors against the risk of stranded assets, since all new plant could retrofit CCS. This would guard against a 'cliff edge' in electricity capacity caused by plant unable to retrofit CCS having to close by a certain date

Costs

The cost per plant of implementing a CCR requirement has been considered previously (see section 3). Projections for BERR (now DECC) anticipate 10-14GW of new fossil fuelled power generation capacity being built between 2010 and 2020. Applying a CCR requirement to all this capacity would cost between £8 -20M (NPV 2010).

Effectively these costs are buying an insurance policy that CCS can be deployed without the risk of incurring the substantial costs of having to prematurely retire a limited amount of fossil generation capacity if CCS were to be made mandatory from 2020 on plant built after 2010.

¹⁴ For the purpose of this analysis it has been assumed that the intention to introduce a mandate would be made in 2015 so that plant consented after this date would be able to prepare for the CCS requirement.

Imposing a space condition on all new combustion plant could make some potential sites unsuitable. If companies could not find alternative sites, this would marginally reduce their ability to build new capacity; it is also a possible risk that any potential alternative site could be more expensive. These potential impacts have not been costed.

If CCR requirements set by Government above the EU minimum level give the impression that CCS may be mandated in the future, investors may see fossil fuel plant as a riskier investment, since mandating may require plant to retrofit CCS before the EU ETS price makes it economically attractive. This could lead to lower levels of fossil fuel build relative to the Do Nothing Extra scenario, a more restricted generation mix with a lower ability to respond to fluctuations in supply and so meet fluctuating demand.

Option 3: Do EU minimum assessments, but no space requirement i.e. not CCR, as a way of raising awareness of the risk of premature closure in 2020 for combustion power plants built after 2010 unless they can retrofit CCS

Under this option the UK government would, as required by the agreed EU Directive, require all applicants for new combustion plants at or over 300MWe to do the EU's required assessments. However, given the inevitable uncertainties on what can only be partial economic assessments, it would not require any consented plant to leave space for subsequent CCS i.e. not be CCR. It would be for commercial decision by the applicant to do so –or not – as they deem most cost effective.

Benefits

This option would give a signal (though less strongly than Option 2) to the market on both the EU and domestic government's hopes for CCS and the possibility of further, and possibly retrospective measures to drive CCS. However investors would be left to decide on: what measures are needed and what costs to incur in order to ensure their plants can be retrofitted with CCS; or to take the risk that CCS will not be required at a later date; or to build alternative non-fossil fuel generation plants.

The main benefit is to reduce the risk as compared with option 1 of new combustion plant's not being able to retrofit CCS and consequently having to shutdown prematurely should CCS be made mandatory on plant consented after 2010. Another benefit would be if this option avoided stranded assets due to the rising EU ETS price: however, this benefit would be less, since plant could take steps to reduce the value of the stranded assets, or to mitigate the high EU ETS price, and keep the plant running for longer, by means other than CCS. Since this option is less certain to avoid stranded assets than Option 2 (i.e. some generators may still choose, having done the assessments, to take the risk of building plant that cannot be retrofitted with CCS) the benefit will also be less than in Option 2.

Therefore as for Option 2, the overall benefit of this option would be zero if there were no CCS mandate applied retrospectively to combustion power plant consented and built between 2010 and 2015, and £160-320M if a CCS mandate were to be introduced and applied retrospectively to plant consented and built after 2010¹⁵. The probability of either of these alternative outcomes is not known at present, which illustrates again how a CCR requirement should be regarded as a method for minimising risk in an uncertain future.

This Option would also allow investors to go ahead with projects on a few sites where space does not permit CCR (or ultimately CCS). This could marginally increase the number of possible sites for fossil fuel stations (although if investors did build power stations that could not subsequently be fitted with CCS, they would face the risk of stranded assets).

Costs

The cost of undertaking the EU assessment requirements alone is estimated at £0.35-0.7M for each combustion plant. On the assumption that 80% would chose to leave appropriate space (enabling them to be CCR and retrospectively fit CCS), the further costs incurred might then on average be the 80-90% of the cost of implementing CCR on all new fossil fuelled power plant, amounting to £7-18M (NPV2010)

If investors built non-CCR plants that were then unable to retrofit CCS when they were required, or when it became economically attractive, to do so, they would be left with costly stranded assets.

If investors felt that this Option sent out a strong message that CCS retrofitting would be required by Government in the future, and that such retrofitting would be required before the EU ETS price made it economically attractive, this might make investing in fossil fuel plant less attractive, and hence reduce levels of fossil fuel build.

6. Risk

Mandatory CCR is a relatively low cost way of managing three key uncertainties and their associated risks:

- i) the future technical performance and cost of CCS applied to new fossil fuel and other large combustion power plant;
- ii) the future trajectory of ETS allowance prices; and
- iii) the potential for additional measures by the EU or UK government to encourage or require CCS.

¹⁵ Assuming purely arbitrarily for illustrative purposes a 20% probability that a generator would choose to risk building a plant that is not retrofittable with CCS, the benefit of this option would be 80% of Option 2.

The main associated risk is that some fossil fuelled power plant built between about 2010 and 2015 may need to be retired prematurely with associated resource costs for replacement capacity and implications for security of supply.

The analysis set out above has shown that there is some risk associated with ii) the future ETS allowance prices. Inability to retrofit CCS would most likely occur in new plant built between 2010-2015, when a relatively weak ETS price signal and uncertainty over the performance of CCS (risk i) above) may discourage an effort to be CCR (if not specifically required). Even if these plants could not retrofit CCS, the EU ETS price would give them an expectation of when it would become uneconomic to run the plant without CCS well before this date actually arrived. This would allow the plant to plan to mitigate their losses, e.g. by running the plant at higher load factors in the years before closure, or by seeking other, non-CCS ways of extending the life of the plant. Those consented and built after 2015 are likely to have a much clearer information base against which to judge whether or not to meet CCR requirements and therefore information failure should not apply to post 2015 plant.

The main risk to be managed by CCR is that associated with iii) above i.e. the risk that either the EU or UK government decide to require CCS from 2020 and back date this to apply to all plant built after 2010. An alternative way of considering this is that the cost of CCR is a relatively low cost risk insurance to pass through to consumers via electricity prices to avoid any stranded assets (if built after 2010) as a result of later policy change.

7. Enforcement

The responsibility for ensuring decisions are taken on energy policy on carbon capture readiness rests with the Secretary of State for Energy and Climate Change, while implementation rests with him for England and Wales, with Scottish Ministers in Scotland and with the Northern Ireland government there.

The government agrees, as a result of the concluded consultation to which this impact assessment is linked, that the implementation of any future requirement for CCR should be through s.36 consent procedure under the Electricity Act 1989 in respect of combustion power generating stations at or over 300MWe, as laid down by the agreed EU Directive. This is a well established procedure involving the relevant local authority, a full public consultation by them, input from a range of statutory advisory bodies and an ongoing dialogue between the developer, the Department (or Scottish Executive or Northern Ireland government), the local authority and statutory bodies and other interested stakeholders to explain, develop and refine any proposal for a new plant. This is designed to ensure the plans and any consent conditions, including CCR, are thoroughly understood, legally compliant in every respect and are implementable.

8. Recommendation and summary table of costs and benefit for the options

The table below summarises the estimates of economic costs and benefits of the three options considered in section 5 above.

Our estimates do not attempt to quantify the security of supply costs and benefits of the Options. However, there are two main ways in which these Options impact on security of supply. They can influence fossil fuel power station build rates and they can also impact on their closure dates.

Option 1 (Do Nothing Extra) is most likely to lead to new fossil fuel build as it makes no restriction on the sites that can be used to build a new combustion power station. However, it is also the most likely to lead to the premature closure of a new power station once carbon prices make its operation uneconomic.

Option 2 might to lead to lower levels of fossil fuel build, but completely eliminates the risk of premature closures.

Option 3 does not explicitly require sites to be CCR, but it sends a message regarding the EU and the Government's expectations for CCS. Investors may therefore decide not to build on sites that are not CCR, to counteract the risk that CCS retrofitting may be required in the future. However, this policy does not eliminate entirely the risk of premature closures.

Option1's costs – as the current baseline - are zero, but so are the benefits.

The value of the benefits estimated for Option 2 is either zero without a CCS mandate applied retrospectively to combustion power plants consented and built after 2010, and £200-400M if a CCS mandate were introduced and applied to plant consented after 2010. The probability of each of these alternative outcomes is not known at present, which illustrates how a CCR requirement should be regarded as a method for minimising risk in an uncertain future. For Option 3, although the mandatory EU assessments of three factors of CCR are required, because space is not mandatory, it does not have the same certainty of ensuring that CCS could be retrofitted to post 2010 consented plant. So the benefits are less that Option 2, either zero without a CCS mandate applied to power plant consented and built between 2010 and 2015, and £160-320M if a CCS mandate was introduced and applied to plant consented and built after 2010.

For operators the costs involved of CCR - option 2- represent a small risk insurance policy for ensuring either they can move to CCS once there is a proven technology chain and the economics are viable or that they avoid the risk of stranded assets if they cannot retrofit if required to by any subsequent EU imposition of mandatory CCS. **We are therefore recommending Option 2.**

Option	Cost £M (NPV 2010)	Benefit £M (NPV 2010)
1. Do nothing extra to ETS	0	0
2. Require all large power generating combustion plant (including large CHP) to be built CCR from 2010.	8-20	0 <u>or</u> 200-400
3. Implement minimum EU CCR assessment requirements only as way of raising awareness of the risk of premature closure in 2020 for power plants built after 2010 unless they are CCR and so can retrofit CCS	7-18	0 <u>or</u> 160-320

9. Implementation

This impact assessment deals only with implementation in England and Wales, since responsibility for implementation in their territories lies with the Scottish Executive and the Northern Ireland government respectively.

This new policy will be implemented gradually as operators put forward s. 36 Electricity Act applications for new combustion plants at or over 300MWe and , after review of their application, a CCR clause is included in any such consent.

In England and Wales, the Environment Agency would be the key statutory agency involved in advising the Secretary of State on the adequacy both of the space proposed by the operator and of the study on the technical feasibility of retro-fitting. This reflects their technical expertise and close involvement with the planning, building and monitoring of aspects of the operation of power stations. For the transport study, we expect the Health and Safety Executive to be the key advisory body, given their responsibility for the Hazardous Pipelines Regulations, while the Oil and Gas Division of the Department for Energy and Climate Change (DECC) will draw on their long experience of relevant geology to advise on the storage proposals. DECC economists will advise on the two required economic assessments.

The existing Guidance for applicants for s. 36 EA consent will be supplemented to provide specific guidance on what an applicant would need to do to satisfy the four proposed underlying factors for CCR in a way that reflects the government's policy decisions on CCR. We would also expect such Guidance, on which we

will consult prior to its finalisation, to be refined progressively in future years as capture technologies develop through to full scale implementation and as safety and other regulatory issues are researched and defined for the capture, transport and storage stages.

We recognise that there are additional costs for a plant's developer in implementing a CCR condition (in the range of £0.94-1.7M, see options section above). However this single up front costs for most types of plant is both very small in relation to its total capital cost and has the significant benefit of guaranteeing the operator can avoid the long term and significant cost of carbon lock – in. This recognition has already led several recent applicants for new gas stations, as part of their dialogue with BERR (and now DECC), as a first step towards CCR to reach agreement on a space condition as part of their s. 36 EA consent.

10. Other costs

Other costs from this policy would fall on:

- consumers since the additional cost of CCR would have to be reflected in higher electricity prices, though the effect would be minimal given the low estimated CCR costs;
- DECC¹⁶ since it would add an extra degree of complexity to the assessment and dialogue process prior to any consent. An estimated £6600 per power plant application (2007 rates) for England and Wales;
- DECC for the preparation of the report that, every 3 years, the EU requires the government to submit on progress of the Directive. We estimate this would cost around £500 (2007 rates) in internal administrative costs in respect of CCR;
- similar levels of administration costs for any new affected combustion power plant in Scotland and Northern Ireland;
- the Environment Agency since they would be required to advise on both the initial design drawings for space and the feasibility of retrofitting study, increasing the workload they already have in respect of consents. They estimate this will cost around £5000 per application;

¹⁶ The Planning Act 2008 will transfer from DECC to the new Infrastructure Planning Commission (IPC) the consenting functions under s 36 of the Electricity Act 1989 during 2010. Consequently after that date the costs of this policy assigned to BERR for England and Wales would fall on the IPC.

- an estimated similar additional cost per application for advice from the Scottish Environmental Protection Agency (SEPA) and the technical advisory body for the Northern Ireland Government;
- the HSE for their role in advising (at an estimated additional cost of £1500 per application) in England, Wales and Scotland on the CCR transport study in addition to existing work on consents; and
- the Oil and Gas directorate of DECC for their role in advising on the CCR storage study and DECC economists for the two economic studies.

11. Monitoring and Evaluation

The agreed Directive (Article 27) requires us to submit every three years a report on the progress on various aspects relating to the deep geological storage of CO₂, with the first report due by June 2011. The Directive's review clause (Article 38) also requires the Commission to re-assess by June 2015 various specified aspects of the agreed Directive, including the provisions of article 34 (on CCR).

CCR is a preparatory stage to carbon capture and storage (CCS) with both the technology and regulatory regime still evolving. Consequently, to ensure CCR remains a living state the government's policy is to ensure that an operator with a CCR clause in their s. 36 Electricity Act consent reports on the maintenance of that CCR state at the point when their station starts to supply electricity to the grid and every two years thereafter.

These reports will assist the UK, in a more informed manner, to ensure that the regulation is proportionate and relevant and also provide more up to date reports to the Commission as required by the Directive.

12. Specific Impact Tests

Competition Assessment

Electricity is a homogenous product. It can be produced using a number of very different technologies including renewables of all types, energy from waste plants, biomass, fossil fuels, nuclear etc. The electricity generation market in the UK is highly competitive – indeed a 2005 research report¹⁷ shows the UK as the most competitive national market for electricity in the EU - and involves both long-standing competitors and new market entrants. It benefits from a greater degree of liberalisation as compared with other EU energy markets.

¹⁷ Energy market Competition in the EU and G7: preliminary 2005 rankings. Oxera. Available at <http://www.berr.gov.uk/files/file35324.pdf>

The energy sector is responsible for 40% of the UK's emissions overall (2006) and, as we work towards the UK target of a 34% reduction in greenhouse gases compared to 1990 levels in 2018-2022 and a long-term target to reduce emissions by at least 80% by 2050 the electricity sector has a key and early role to play in greenhouse gas reductions.

Concern about climate change has already led to the introduction of a number of measures into the electricity supply market in order to help the UK meet its EU greenhouse gas reduction targets. The renewables target of 15% of energy consumed by 2020 is underpinned by a Renewables Obligation which requires licensed electricity suppliers to buy an increasing proportion of their electricity sales from renewable sources or pay a penalty¹⁸. This already impacts on fossil fuel plant operators as major suppliers. But they are most affected by the EU's Emissions Trading Scheme (ETS). This aims to internalise the long term costs of carbon emitted through a series of tightening caps on EU emissions linked, for those covered by the scheme, to allowances whose price depends on supply (as fixed by the cap) and demand from generators. This increase in ETS prices will be the key economic factor which drives operators to fit CCS once it is proven. But they will find it more feasible to make this choice if they expend the relatively small sums (£0.94-1.7M) to make any new plants CCR at the point when they are built.

We are also in the early stages of a period of considerable change in the sector as the government aims to incentivise a shift towards lower carbon options, helping to promote the development of CCS technology amongst other things. In addition, a significant volume of older capacity is expected to close by end 2015 because of EU emissions regulations, so we estimate a need for 30-35 GW of new capacity in the next 2 decades. Replacing this capacity in such a way as to maintain, and if possible enhance, the UK's security of electricity supply is vital to our economic well being as a nation competing in an increasingly globalised economy and to the well being of all our citizens. To replace this capacity will require not only meeting the 15% renewables target and a range of measures to increase energy efficiency, but also building a wide range of other types of plant as the 2007 EWP made clear.

Mandatory CCR on combustion plants of types covered by the LCPD (biomass, CHP, coal, gas and oil) will relatively disadvantage those who build new combustion plants over the proposed 300MWe threshold. We expect these to comprise new gas and coal stations, but not oil given the current high price and the longstanding volatility in this fuel. As now, we expect the vast majority of biomass and CHP plants to be under the 300MWe threshold and therefore unaffected.

Having reviewed the OFT'S "Completing Competition Assessments in Impact Assessment"¹⁹ and its four key questions, it is clear that, while the extra costs

¹⁸ EWP p.147

¹⁹ Available at http://www.of.gov.uk/shared_of/reports/comp_policy/oft876.pdf. The 4 key questions relate to direct or indirect limits on the range of suppliers; any limitations on their ability to compete; or their incentive to compete.

that CCR would impose do fall on a sub-set of electricity generators - fossil fuel ones, the largest CHP standalone and biomass plant operators - the 300MWe threshold means such a policy is unlikely to lead to a limitation, directly or indirectly, on the number or range of suppliers in the electricity market overall. This is because such plants of over 300MWe size are only operated by large companies most of whom already have a diversified power generation portfolio.

Against this, the scale of costs imposed by the CCR requirement (up to 0.3% on the capital investment costs only) is so small as to be negligible and should therefore not impact on competition in the electricity supply market as a whole.

This CCR policy bears upon all players in the fossil fuel power generation market and so does not change the existing relative advantage between gas and coal. Both types would - under the proposed national proposals building on those of the EU - be required to be CCR. The Commission in their impact assessment on the draft Directive estimated that across the EU, if there had in the past been this 300MWe threshold, it would have caught all but 2% of fossil fuel generating plants.

The Commission did not specifically address the issue of standalone Combined Heat and Power (CHP) plants (70% fuelled by gas) which are impacted by the proposal directly if they are over 300MWe. Nor did they acknowledge the potential conflict between the carbon reduction effect that it is hoped in the future CCS could deliver and the greater thermal efficiency and so carbon reductions that CHP plants can deliver now, as well as help meet any potential future heat targets that are currently being explored.

While we expect the vast majority of standalone CHP stations to continue to be significantly below the 300MWe threshold, CCR may disincentivise the largest stations and drive any standalone CHP plants, which might otherwise be just above that level, below it to avoid the extra CCR investment costs. However the impact on reaching the UK's challenging CHP target was judged to be minimal. Responses to the consultation did not suggest this analysis was wrong.

We postulated that a greater disincentive impact might be felt on the planning of CHP plants which might otherwise have been added to new power generating stations. The government has taken a range of measures to incentivise CHP developments, aiming for its current target of 10GW of "Good Quality" CHP (defined as a scheme that reduces CO₂ emissions by more than 30%) by 2010. As part of this move to lower carbon generation, government has required since November 2000 that developers seeking consent on all generating schemes above 10 MW must show they have seriously explored CHP. However, CHP plants need to be relatively close to the user(s) of the heat output (within about 5 miles, though further is feasible if the extra costs of booster stations for re-heating are economic) so many recent fossil fuel plants do not have CHP attached since there are no sufficiently close by purchasers of the heat output. While the space required for CHP, if coupled with the space requirements for CCR, may be too great for a few planned stations to accommodate and still be cost effective, we expect there only to be the rare case where a station with

planned CHP (more likely to be a gas station where existing sites tend to be more restricted) cannot proceed because of the CCR space requirements.

The costs of CCR, an estimated £0.94-1.7M up front costs for each new station, will impact on **consumer prices** since the operators will seek to recover these costs through the prices they bid for in the wholesale market. The effect however will be very slight given the small amount (0.1-0.3%) that we estimate that CCR would add to the capital costs of any new fossil fuel generating station, while there are no implications for their ongoing operational costs.

Sustainable Development Assessment

The government is committed, as the Energy White Paper 2007 (EWP p.8) made clear, to:

- delivering energy security; and
- accelerating the transition to a low carbon economy, with the government committed to achieving an 80% carbon emissions reduction target by 2050.

Both these factors underpin a more sustainable development path for the UK. CCR supports both these objectives. Firstly, contributing to energy security by, at relatively low cost, keeping choices open for operators so they can avoid carbon lock-in and stranded assets within the lifetime of their investment. This reduces the possibility of a plant's having to close down prematurely and thus reducing energy security.

Secondly, amongst a range of other initiatives to move towards a low carbon economy, the government is supporting the development of carbon capture and storage technology (CCS) as it is perceived as the most promising carbon reduction technology available in the near future, although it has yet to be demonstrated anywhere in the world as a chain and capture technology has yet to be demonstrated at commercial scale. The UK government is committed to demonstrating the CCS technology chain through from capture, via transport to long term (undersea) storage and expects to be amongst the first in the world to do so. The public competition for demonstration funding was launched in November 2007 with the plan being that the demonstration plant would start operating during 2014. By supporting the mandating of CCR, government is giving a further signal as to the importance it attaches to supporting the development of this carbon reducing technology.

Carbon Assessment

CCR in itself has no direct impact on carbon levels. However it is intended to ensure greater choice subsequently in fitting carbon capture and storage (CCS) technology which is forecast to reduce emissions from fossil fuel power stations by up to 90%²⁰.

²⁰ Intergovernmental Panel on Climate Change. *Special Report on Carbon Capture and Storage. Summary for Policy Makers*. p.4. Available at http://www.ipcc.ch/pdf/special-reports/srccs/srccs_summaryforpolicymakers.pdf

Human Rights Assessment

Very occasionally the Secretary of State is asked to issue a Compulsory Planning Order (CPO) in respect of land needed for a power station and its access. Since because of CCR some sites would need to be up to about 40% larger to accommodate the technology needed to cool and condense CO₂, it would be reasonable to assume that CPOs will become proportionately more frequent. However we would still expect this to be at very low levels- only two CPOs have been made for power station sites in the last 20 years.

CPOs could infringe the Article 6 rights of directly affected individuals e.g. the owner of the land needed. However a well established process already exists to evaluate and balance the private interest with the public benefit. There is no reason to suppose that the existing system could not deal appropriately with a slight increase in this very low volume.

Equally it can be argued that land being considered for a power station induces planning blight which affects the property prices and rights of individual owners. The Town and Country Planning Act 1990 in England and Wales (and for Scotland the Town and Country Planning Act 1997) already provide established mechanisms for resolving these issues.

Small Firms Impact Test

This proposal would have no impact on small firms since all the types of plant covered by the proposal would need to be at or over 300 MWe. In this large scale plant segment of the market only large firms operate since the capital requirements for building these plants run into hundreds of millions of pounds sterling. However, were there to be security of supply problems in the future as a result of not proceeding with CCR, small and medium sized firms (those employing 250 or less staff) would be impacted along with large firms and consumers. Enterprise Directorate concurs with this view.

Legal Aid

The proposals would not introduce new criminal sanctions or civil penalties and therefore would not increase the workload of courts or demands for legal aid.

Other environment

As CCR is largely an enabling planning process preparatory to any subsequent build (which would only come with a decision to move to CCS), it is difficult to envisage what the other environmental impacts, beyond for example a slightly larger site, might be.

Health Impact assessment

The proposals raise no health issues as CCR in itself has no immediate impact on emissions of any gases from combustion stations.

Race Equality

This policy will not impact on race equality as the proposed policy impacts on business and the indirect impact on consumers (through marginally higher electricity prices to recoup the higher capital costs) would fall equally on all electricity users.

Disability Equality

This policy will not impact on disability equality as the proposed policy impacts on business and the indirect impact on consumers (through marginally higher electricity prices to recoup the higher capital costs) would fall equally on all electricity users.

Gender Equality

This policy will not impact on gender equality as the proposed policy impacts on business and the indirect impact on consumers (through marginally higher electricity prices to recoup the higher capital costs) would fall equally on all electricity users.

Rural Proofing

The proposals, which are in part designed to improve the security of energy supplies, would benefit households in rural as in urban areas. Were there to be security of supply consequences as a result of government inaction, both rural and urban areas would equally feel the impact.

Specific Impact Tests: Checklist

Type of testing undertaken	<i>Results in Evidence Base?</i>	<i>Results annexed?</i>
Competition Assessment	Briefly but more fully here	Yes
Small Firms Impact Test	No	Yes
Legal Aid	No	Yes
Sustainable Development	No	Yes
Carbon Assessment	No	Yes
Other Environment	No	Yes
Health Impact Assessment	No	Yes
Race Equality	No	Yes
Disability Equality	No	Yes
Gender Equality	No	Yes
Human Rights	No	Yes
Rural Proofing	No	Yes