

Summary: Intervention & Options

Department /Agency:

Department for the Environment, Food and Rural Affairs

Title:

Impact Assessment of the Climate Change Bill

Stage: Final

Version: 3

Date: 05 November 2007

Related Publications: MARKAL Macro analysis of long run costs of climate change mitigation targets available from <http://www.defra.gov.uk/environment/climatechange/research/index.htm>

Available to view or download at:

<http://www.defra.gov.uk/environment/climatechange/uk/legislation/index.htm>

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

Climate change is the result of the externality created by the emission of greenhouse gases to the atmosphere. Those who emit do not have to bear directly the full cost of their actions. The global causes and consequences of climate change, coupled with the long term and persistent nature of the impacts, highlights the need for government intervention. The Bill will create a framework which enables the UK to meet its domestic targets as well as ensuring the UK can meet its existing and future international commitments.

What are the policy objectives and the intended effects?

To avoid the impacts of dangerous climate change in an economically sound way. In particular by:
Demonstrating the UK's leadership in tackling climate change - to increase the chances of a binding international emissions reduction agreement that would stabilize concentrations of greenhouse gases at a level that would avoid dangerous climate change;
Establishing an economically credible emissions reduction pathway to 2050; and
Providing greater clarity and predictability for UK industry to plan effectively for, and invest in, a low-carbon economy.

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

Current system of non-statutory targets does not provide sufficient predictability to households and firms about the level and timing of emissions reductions required to meet the UK's commitments to tackle climate change.


The Bill establishes a new framework for supporting emissions reductions. Provisions in the bill balance the need to provide greater predictability for households and firms to invest in a low-carbon technology, while retaining flexibility to allow for unexpected events and inherent uncertainty that may increase or reduce the cost of reducing greenhouse gases.

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects? Statutory annual reports will evaluate the UK's progress in meeting its targets and carbon reduction budgets.

Ministerial Sign-off For final proposal/implementation stage Impact Assessments:

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: 07 November 2007

Summary: Analysis & Evidence

Policy Option:	Description: Statutory targets and carbon budgets for emissions reductions. Formation of the Committee on Climate Change to advise on budgets.
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COSTS	ANNUAL COSTS		Description and scale of key monetised costs by 'main affected groups' Figures presented are a partial measure of the long-run costs of tackling climate change based on a range of 0.3 to 1.5% reduction in GDP in 2050. The actual cost of mitigation will depend on the policies implemented to reach the emissions reduction targets. Upper end of the range assumes no technological change post 2010.
	One-off (Transition)	Yrs	
	£	43	
	Average Annual Cost (excluding one-off)		
	£ 1.6 to 12.0 bn		Total Cost (PV) £ 30 to 205 bn
Other key non-monetised costs by 'main affected groups' Figures above do not include the full range of costs, in particular it does not include the short-term transition costs. Therefore, overall costs could be higher than those estimated by the long-term modelling. Overall the costs will depend on the specific policies put in place to implement the carbon budgets.			

BENEFITS	ANNUAL BENEFITS		Description and scale of key monetised benefits by 'main affected groups' These estimates do not include the full range of benefits expected from the Bill such as reduced mitigation costs from greater predictability, and the potential for UK leadership to increase the chances of a multi-lateral agreement to tackle climate change. Benefits are therefore likely to be higher.
	One-off	Yrs	
	£	43	
	Average Annual Benefit (excluding one-off)		
	£ 5.6 to 7.5 bn		Total Benefit (PV) £ 82 to 110 bn
Other key non-monetised benefits by 'main affected groups' The framework will provide greater predictability for households and firms to plan for and invest in a low-carbon economy. Statutory emissions reduction targets will demonstrate the UK's leadership, and may increase the chances of achieving a multi-lateral agreement consistent with the UK's stabilization objective.			

Key Assumptions/Sensitivities/Risks Figures presented are indicative estimates the impact of achieving the statutory 2050 target, not of achieving specific carbon budgets. The precise costs will depend on: fossil fuel prices; the cost and availability of low-carbon technologies; degree of multilateral action; choice of policies; and, when abatement occurs.

Price Base Year 2007	Time Period Years 43	Net Benefit Range (NPV) £ -95 to 52 billion	NET BENEFIT (NPV Best estimate) £ N/A see range
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What is the geographic coverage of the policy/option?		United Kingdom	
On what date will the policy be implemented?		After Royal Assent	
Which organisation(s) will enforce the policy?		Parliament/courts	
What is the total annual cost of enforcement for these organisations?		£ N/A	
Does enforcement comply with Hampton principles?		Yes	
Will implementation go beyond minimum EU requirements?		N/A	
What is the value of the proposed offsetting measure per year?		£ N/A	
What is the value of changes in greenhouse gas emissions?		£ 82 to 110 bn	
Will the proposal have a significant impact on competition?		Yes/No	
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium Large
Are any of these organisations exempt?	No	No	N/A N/A

Impact on Admin Burdens Baseline (2005 Prices)		(Increase - Decrease)	
Increase of	£ N/A	Decrease of	£ N/A
		Net Impact	£ N/A

Key: Annual costs and benefits: Constant Prices (Net) Present Value

1. Purpose and intended effect

1.0.1 This is an Impact Assessment of the proposed measures in the Climate Change Bill. Section 2 presents illustrative estimates of the costs and benefits of the UK reducing greenhouse gas emissions. Section 3 contains a detailed analysis of the impact of the measures proposed in the Bill.

1.1 Objectives

- 1.1.1 The Climate Change Bill is intended to create a legislative framework for the effective management and delivery of policies to tackle climate change, in particular by:
- establishing an economically credible emissions reduction pathway to 2050, by putting into statute medium and long-term targets and a system of carbon budgets which will constrain the total amount of emissions in a given time period.
 - providing greater clarity and predictability for UK industry to plan effectively for, and invest in, a low-carbon economy;
 - providing a strong evidence-base and expertise to underpin statutory targets; and,
 - strengthening the Government's overall approach to adaptation.
- 1.1.2 In addition, the Bill is intended to strengthen the UK's leadership internationally to help raise the ambition and urgency of collective action to tackle climate change.

Supplementary provisions

- 1.1.3 In addition to the main framework provisions the Bill also contains supplementary provisions to enable some specific policies and powers that will contribute to tackling climate change. For example, the Bill contains provisions to reduce the administrative and compliance costs of the Renewable Transport Fuels Obligation, which aims to reduce the carbon emissions from road transport by obliging fuel suppliers to include 5% biofuels in transport fuels sold. Annex A summarises the impacts of the provisions relating to the Renewable Transport Fuels Obligation contained in the Bill. The Bill also provides a power to pilot local authority incentives for household waste minimisation and recycling, in order to reduce waste to landfill. The impacts of the Renewable Transport Fuels Policy are considered as part of a separate Impact Assessment.¹
- 1.1.4 The Bill also contains enabling powers to establish trading schemes, including specific powers relating to the introduction of the Carbon Reduction Commitment, which was announced as part of the 2007 Energy White Paper. Annex B provides a summary of the impacts from the specific powers in the Bill relating to the CRC.

1.2 Background

International and scientific context

1.2.1 There is an overwhelming body of scientific evidence highlighting the serious and urgent nature of climate change, largely due to emissions of greenhouse gases (GHGs²) as a result of human activities such as the combustion of fossil fuels and changing patterns of land use. The most recent Intergovernmental Panel on Climate Change (IPCC)

¹ The impact assessment for the RTFO is available at http://www.opsi.gov.uk/si/si2007/draft/em/uksidem_9780110788180_en.pdf.

² A glossary of terms is provided in Annex C.

report³ shows conclusively that the debate over the science of climate change has moved on from whether or not it is happening to what we need to do about it.

- 1.2.2 The international community has already begun a coordinated response to the challenge. The UN Framework Convention on Climate Change has a key objective of the "stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".⁴
- 1.2.3 The Kyoto Protocol, which aims to reduce greenhouse gas emissions by 'Annex I' Parties (a number of industrialised countries including the UK, other European Union (EU) member states, Canada and Japan), was agreed in December 1997. Under the Protocol, Annex I Parties agreed to reduce their collective greenhouse gas emissions by 5.2% between 2008 and 2012 (compared to the year 1990).⁵ However, as the Stern Review amply demonstrated, it is now clear that international cooperation must go much further to stabilise greenhouse gases concentrations at levels which will avoid unacceptable levels of environmental risk.
- 1.2.4 Our next key objective at international level is the agreement in 2009 of a global and comprehensive post-2012 agreement, which should build upon and broaden the Kyoto Protocol architecture and provide a fair and flexible framework for the widest possible participation. All countries should be invited to contribute to the efforts under this framework according to their differentiated responsibilities and respective capabilities.
- 1.2.5 It is imperative to build on these international frameworks. Leadership must come from the major developed economies, such as the UK which have been responsible for the majority of the historic rise in greenhouse gas concentrations, generally have higher per capita emissions, and have income levels and the technological capacity to lead the necessary investment. The Stern Review estimated that developed countries should take responsibility for greenhouse gas emissions reductions of between 60 and 80% (compared with 1990 levels) by 2050.
- 1.2.6 At the March 2007 EU Spring Council, Heads of Government agreed an ambitious, independent binding target to reduce Europe's greenhouse gas emissions by at least 20% by 2020 (compared to 1990 levels) and increase this commitment to a 30% reduction as part of an international agreement. The adoption of the 30% reduction target would be contingent on other developed countries committing themselves to comparable emissions reductions and economically more advanced developing countries contributing adequately according to their responsibilities and respective capabilities. EU Heads of Government agreed the long-term objective of collectively reducing emissions by between 60% and 80% by 2050 compared to 1990.
- 1.2.7 The UK has been at the forefront of diplomatic solutions and policy development as well as in research to combat the threat of climate change, in particular by:
 - putting climate change on top of its agenda for the dual presidencies of the G8 and the EU in 2005, resulting in the establishment of the Gleneagles Dialogue on Climate Change and Sustainable Development;
 - working with the World Bank and the multilateral development banks to drive investment in low-carbon energy sources, energy efficiency and adaptation to climate change in developing countries;

³ Working Group I Contribution to the Fourth Assessment Report: *Climate Change 2007: The Physical Science Basis*. All Fourth Assessment Report documents are available from : <http://www.ipcc.ch>.

⁴ Article 2 of the 1992 United Nations Framework Convention on Climate Change

⁵ 1990 is the base year for carbon dioxide, methane and nitrous oxide. For the other greenhouse gases in the Kyoto basket (known as F-gases) the base year is 1995

- promoting cooperation on technology transfer, for example as part of strategic 'Dialogues' with India and China;
- accepting relatively high burden sharing agreements under the Kyoto Protocol commitments as well as in Phase I and Phase II national allocation agreements under the EU-ETS;
- encouraging development of wider EU policies to tackle greenhouse gas emissions including through regulation of certain fluorinated gases, and a suite of energy efficiency performance standards; and,
- developing our collective understanding of the costs and risks by sponsoring research into both mitigation and adaptation, for example by the recent Stern Review, and through funding (since 1997) of the UK Climate Impacts Programme, which brings together the scientific evidence for climate change impacts and adaptation in the UK.

Managing domestic policy in the context of international uncertainty

- 1.2.8 Currently, there is significant uncertainty surrounding the degree of climate change mitigation that will be undertaken in the future. This is, in part, because of the continuing negotiations on an international agreement beyond 2012 within the UNFCCC and Kyoto Protocol. Uncertainty is also generated because there is, as yet, no defined commitment as part of further phases of the EU-ETS. Such uncertainty is likely to increase the returns required by households and particularly firms when making low-carbon investment decisions, risking continued high levels of investments in carbon-intensive capital.
- 1.2.9 The Bill proposes to enshrine domestic commitments in statute. It is essential that these commitments are reinforced by the implementation of credible policies, such as those set out as part of the 2007 Energy White Paper and those which will be set out in the proposals for meeting budgets. The combination of statutory emissions reduction targets and credible policies would in turn increase predictability for UK households and firms to plan and invest for a low carbon economy. Statutory commitments to reduce emissions by at least 60% will demonstrate the Government's ambition to equip the UK with the conditions necessary for a successful transition to a low carbon economy.
- 1.2.10 The mitigation framework provided by the Bill aims to balance the objectives of facilitating ambitious policies, maximising the predictability for UK households and firms, and retaining sufficient flexibility to ensure that mitigation is not unnecessarily costly. Flexibility is required to mitigate the unpredictability around future emissions projections. Emissions could be higher or lower depending on a number of factors such as fossil fuel prices, carbon prices and the timing of policy delivery.
- 1.2.11 The Bill is structured to provide this flexibility, setting a framework to motivate and enable policy action without being prescriptive about how the framework should be applied. It provides flexibility by allowing unused quotas to be 'banked' to the next budget, and limited ability to borrow to bring forward emissions allocations from future budgets. The Bill also allows emissions reductions to be achieved overseas through trading and purchasing of international emissions reduction credits, thereby utilising least-cost global abatement options (these mechanisms are discussed further in Section 3).

Rationale for Government intervention

- 1.2.12 Climate change is the result of the externality created by the emission of greenhouse gases to the atmosphere. Those who produce greenhouse gas emissions do not face

directly the full consequences of their actions. In addition, climate change has a number of features that together distinguish it from other environmental problems:

- it is global in its causes and consequences;
- the impacts of climate change are long-term and persistent;
- there are uncertainties and risks in the economic impacts; and
- there is a serious risk of major, irreversible change with non-marginal economic effects.

1.2.13 The nature of the externality suggests that individual efforts alone will not be sufficient to lead to an optimal reduction in emissions. Government intervention will be required to limit global emissions to a level that is consistent with avoiding dangerous climate change. The contrast between, in the long-run, the higher costs of inaction and the lower cost of action provide a fundamental rationale for the Government's proposals in the Climate Change Bill.

1.2.14 The Stern Review estimates that the cost of inaction on climate change significantly outweighs the expected cost of coordinated global action. Without effort to tackle climate change, the Review predicts that the loss of GDP from climate change could cost the global economy significantly more than the global cost of action to stabilise atmospheric concentrations of greenhouse gases (at 550ppm carbon dioxide equivalent (CO₂e)). The Stern Review set out three essential elements of policy required for an effective global response:

- i) Establishment of a carbon price: consumers and producers must bear the full cost of consumption or production decisions, including the external costs of climate change from emissions of carbon dioxide (CO₂) or other greenhouse gases, in order that markets encourage socially optimal economic behaviour. It is desirable that this price should apply universally as well as be credible, flexible and be subject to a degree of predictability over time. Credible, predictable policy frameworks are necessary to drive sufficient investment, essential for transition to a low-carbon economy. However, the underlying uncertainties that are inherent in understanding the problem of climate change means that any framework also needs to be flexible to allow decision makers to make adjustments in light of new information or unexpected events.
- ii) Promotion of innovation in low-carbon technologies: technological developments are needed to increase cost effective mitigation potential in the long run. Uncertainties and costs surrounding the development and deployment of the technologies to address it (as well as the environmental risks associated with ineffective mitigation) are substantial. This points to the need for close cooperation between governments and industry to support the development and diffusion of a portfolio of low-carbon technology options.
- iii) Overcoming market barriers and failures that restrict the transmission of incentives in markets affecting energy demand are needed to increase cost effective mitigation potential in the short and medium run, particularly in relation to uncovering greater energy efficiency savings. These include: hidden and transaction costs; lack of information about available options; capital constraints and misaligned incentives; as well as behavioural and organisational factors affecting economic rationality in decision-making.

Limits to the analysis in this Impact Assessment

1.2.15 This Impact Assessment contains a high-level discussion of the costs and benefits of UK action to mitigate climate change to a degree consistent with the Government's established medium and long term objectives, together with analysis of the key drivers

and uncertainties surrounding these assessments which inform the detailed proposals within the Bill. However, the proposals contained within the Bill do not pre-judge the trajectory and specific policies required to achieve these goals.

- 1.2.16 The Government will set out its proposals and policies for meeting each of the five-year budgets. Any new policies put forward will be subject to a separate Impact Assessment at the appropriate time which will look in detail at the costs, benefits and impacts of the specific policy.

2. Illustrative Costs and Benefits of Tackling Climate Change

2.0.1 This section sets out a high level discussion of the:

- illustrative benefits and costs of action to deliver the proposed statutory emissions reduction of at least 60% by 2050 and 26-32% by 2020 (compared to 1990 levels), through domestic and international effort;
- key uncertainties and sensitivities surrounding these assessments; and,
- potential distributional impacts across different sectors of the UK.

2.0.2 However, it is important to note again that the Bill does not provide for either the precise trajectory or the policy mix towards achieving these targets, rather it creates a framework for managing the transition to a low-carbon economy. The impacts are likely to be influenced by detailed decisions regarding the size of overall carbon budgets and the balance of policies to deliver them. These will be the subject of further and more detailed Impact Assessments, which will be produced before carbon budgets are set, and when designing individual policy measures to deliver emissions reductions.

2.1 Outlining the costs of UK action to reduce climate change

2.1.1 This section draws on a range of different modelling results applicable to both the UK economy and, in some circumstances, drawing on analogous mitigation cost studies in other developed countries. This includes research undertaken as part of the Stern Review, together with analysis conducted for the 2007 Energy White Paper (in particular, a newly developed MARKAL-Macro model which focuses on long run mitigation costs of meeting the 2050 target, as well as a study conducted by Oxford Economics to explore the potential short run adjustment costs of meeting a 2020 target). Technical issues surrounding the use of these and wider generic approaches to modelling mitigation costs are outlined in Box 1 below.

2.1.2 It is important to emphasise that projections based on models are inherently uncertain, especially over the long term. Therefore, the modelling results cited are intended only to illustrate possible costs rather than predict precise outcomes. As such, any results must be carefully interpreted when designing policy and the inherent degree of uncertainty surrounding these has implications for the desirable level of flexibility within the overall framework (discussed in Section 3).

Box 1: Using Modelling to Estimate Costs

Technology ‘bottom up’ models, such as the UK MARKAL and MARKAL-Macro models are useful in understanding long run costs of climate change mitigation. They are based on highly detailed assumptions regarding the potential costs of future technologies.

- The UK MARKAL model is a dynamic energy optimisation model that minimises the total cost of the energy system over a 50 year plus horizon. It provides valuable insights into the technical options and costs of carbon abatement between now and 2050. It has been substantially updated since 2003 with more detailed information and revised assumptions on technology costs and processes as part of a joint DTI/DEFRA sponsored project with the UK Energy Research Centre (UKERC) and Policy Studies Institute (PSI).⁶
- This project also developed the MARKAL-Macro model, which links the detailed characterisation of the standard UK MARKAL with a ‘top down’ macroeconomic component. This model allows households and firms to reduce their demand for energy in response to higher prices (a response not available in the 2003 iteration). It also facilitates the explicit calculation of the macroeconomic variables such as GDP impacts, which was calculated ‘off model’ in the 2003 study.

The MARKAL and MARKAL-Macro models are particularly useful in exploring the energy system in the long-term. As a UK only model, the MM model cannot capture trade and competitiveness impacts. In addition, the model describes the economy in equilibrium, and therefore is unable to capture transition costs that might occur as the economy adjusts to changes in energy policy. It is also somewhat limited in its ability to capture the obstacles that, in reality, can slow uptake of cost effective abatement or which make it more expensive, such as information barriers and policy costs. It may therefore be expected to produce lower-bound estimates of the costs of carbon abatement in 2050.

Macroeconomic models, whose focus is on the short-run dynamics, are better suited to capturing transitional costs as well as competitiveness effects associated with any policy change. As such analysis using a suite of models, developed by consultants Oxford Economics, explores the potential short-run adjustment costs associated with moving to a low-carbon economy up to 2020. However, insofar as macroeconomic models such as the Oxford Economic Models do not have the technological detail of ‘bottom up’ models such as the MARKAL they have the potential to overestimate the potential GDP impacts by overlooking the potential for cost-effective abatement options.⁷

When considering the results of such macroeconomic models it is desirable to compare those which include induced technological change with those where this factor is exogenous. In the case of the former, mitigation commitment frameworks which establish a value for greenhouse gas reductions as well as incentives to increase Government or private sector expenditure on research and development, impact on the speed of technological development and the resulting abatement costs. The latter class of models, which do not account for these factors, tend to produce relatively higher cost assessments. A study commissioned by the Stern Review found that the inclusion of induced technical change could lower the estimated costs of stabilisation by one or two percentage points of global GDP by 2030.⁸

Illustrating long run cost impacts up to 2050

2.1.3 The Stern Review concluded that, based on an extensive review of the current literature, the long run costs of global action to stabilise atmospheric greenhouse gas concentrations at 550ppm CO₂e are expected to be around 1% of GDP by 2050, within a range of +/-3%. Coordinated multilateral action, with good policy design and flexibility over where, when and what emissions are reduced are essential to keep costs this low.

⁶ More detailed papers on the development of the MARKAL and MARKAL-Macro model available from the UKERC website <http://www.ukerc.ac.uk/content/view/142/112/>

⁷ The full report by Oxford Economics is published at <http://www.berr.gov.uk/files/file38978.pdf>

⁸ Barker T. *et al.*, A report prepared for the HM Treasury Stern Review on “The economics of climate change” The Costs of Greenhouse Gas Mitigation with Induced Technological Change: A Meta-Analysis of Estimates in the Literature http://www.hm-treasury.gov.uk/media/8A7/01/ster_review_supporting_technical_material_terry_barker_231006.pdf

This range is substantially lower than the expected costs of 'do nothing' to reduce climate change, estimated at between 5% and 20% of global GDP now and forever.⁹

- 2.1.4 The 2003 Energy White Paper used the 'bottom up' UK MARKAL model to estimate long run mitigation costs. It concluded that, based on a wide range of sensitivity analyses, the expected costs of reducing carbon emissions by 60% by 2050 were approximately equal to between a 0.5% and 2% permanent reduction in GDP in 2050.¹⁰ Since 2003, the MARKAL model has been substantially updated, and supplemented by the development of a new MARKAL-Macro model which allows for changes in energy demand as a result of variation in energy prices, and facilitates the explicit calculation of the macroeconomic variables such as GDP impacts (see Box 1 for details on both models).
- 2.1.5 Analysis using the MARKAL-Macro model indicates that the long run costs of reducing carbon emissions by 60% by 2050 are around 0.7% of GDP by 2050 in the central fossil fuel price scenario, falling to 0.3% of GDP by 2050 in the high fossil fuel price scenario.
- 2.1.6 As in the analysis for the 2003 Energy White Paper, the cost and availability of low-carbon technologies is important in keeping costs low: the new MARKAL-Macro analysis suggests that costs could rise up to 1.5% of GDP in 2050 if innovation is restricted.¹¹ This is within the range of global costs indicated by Stern, though lower than the upper limit of the 2003 analysis.¹² Two important factors affecting this are the potential for the model to capture the reduction in the demand for energy services (in response to energy price increases), and the impact of higher fossil fuel price forecasts (compared to those forecast in 2003).
- 2.1.7 It is possible to calculate the present value of the cumulative cost of reducing emissions by 60% by 2050. Expressed in terms of present value, the reduction in GDP (between 0.3% to 1.5% in 2050) using the range of assumptions presented above would be in the order of £30 to £205 billion. Higher fuel prices would decrease the costs of reducing emissions, while slower technological change would make tackling climate change more costly.
- 2.1.8 The estimated monetary costs presented above represent only a partial estimate of the costs of reducing emissions. The costs of transitioning to a low-carbon economy are not included in this range and may be significant. Transition costs are discussed in paragraph 2.1.11 below. Due to differences in the modelling approaches between long-run and short-run costs it is not possible to provide an estimate of the transition costs on a consistent basis with the monetary value of the long-run costs given above. Therefore the monetary costs presented above must be treated with caution. The actual cost of mitigation will depend on the policies implemented to reach the emissions reduction targets.

⁹ The cost assessments outlined by the Stern Review are expressed in terms of a balanced growth equivalent. This measures the welfare of action or inaction in response to climate change arising from an impact on consumption over time, in terms of the amount of consumption today which would deliver the same amount of utility. As such, this is a slightly different measure from the GDP indicator used in relation to the UK long run and transition cost modelling.

¹⁰ In the 2003 analysis, GDP impacts were estimated 'off model' and are not directly comparable with the MARKAL-MACRO estimates (see Box 1).

¹¹ All analysis done reflects a range of different scenarios and assumptions including scenarios where the option of investing in some technologies, for example new nuclear, is prevented. In particular, in the upper range scenario, post 2010 'vintages' of efficient end-use technologies and measures, as well as the power sector and other upstream technologies, are restricted from the model.

¹² The upper limit in the 2003 analysis was based on assuming restricted innovation on all technologies but also excluding some technologies altogether.

Illustrating transition costs in the short and medium term

2.1.9 Transforming the carbon intensity of all key markets affecting energy demand, such as electricity, heat, and transport, requires investment in new capital and processes as well as ongoing long run technological development. However, in addition to the long run costs illustrated in the previous section, it is likely that there will be short and medium run costs, in terms of reduced consumption, output and employment, for example:

- carbon intensive sectors of the economy are likely to contract from the imposition of more rigorous carbon constraints (although others may benefit); this may result, for example, in some structural adjustment in employment patterns;
- households and firms may need to replace capital prematurely in response to new financial incentives to conserve energy or switch fuels, increasing production and consumption costs; and
- households and firms may incur additional transaction costs associated with shifting patterns of production and consumption, for example arising from the need to acquire information or develop skills in relation to new technologies.

2.1.10 As outlined in Box 1, macroeconomic models which focus on the short-run dynamics are better suited to capturing these transitional costs than 'bottom up' models referred to in the previous section.

2.1.11 Macroeconomic analysis conducted by Oxford Economics as part of the 2007 Energy White Paper¹³, is helpful in illustrating the potential short-run adjustment costs associated with moving to a low carbon economy up to 2020. In particular, it considers the potential economic costs of the introduction of a *purely illustrative* carbon price on all sectors sufficient to achieve constant annual reductions (i.e. a 'straight line' trajectory) towards an overall carbon emissions reduction of 30% by 2020 (based on 1990 levels). The analysis suggests that the transition costs could be 1.3% to 2% of GDP in 2020¹⁴.

2.1.12 Any assessment of the UK transition costs needs to be put in the context of a wider (though limited) pool of analysis that focuses on the dynamic costs of mitigation policy in the UK and in other developed countries. Much of the analysis on transition costs has focused on the attempts of developed countries to meet their Kyoto Protocol targets. Based on a review of a wide range of studies, the IPCC concluded in its Third Assessment Report (2001) that the cost of implementing Kyoto in 2010 for Annex I countries was in the range 0.2 to 2% of GDP without the use of the flexible mechanisms (trading between Annex B countries¹⁵) and 0.1 to 1.1% of GDP with these mechanisms in place. However, these figures may be over estimates, as they don't allow for cost effective reductions in methane, nitrous oxide and fluorinated gases.

2.1.13 US studies of transition costs have tended to suggest that transition costs could be more substantial. One study of US Kyoto compliance costs indicated transition costs of as much as 3.4% by 2010 and 0.2% in 2020.¹⁶ However, it is likely that these are over estimates due to the fact that the analysis did not allow for induced technology changes, used high emissions baselines and assumed limited policy flexibility (not reflected in the Kyoto framework). Nordhaus famously estimated that the US would face a cost of meeting Kyoto which was more than the global total for the other Annex I countries. This high cost of the Kyoto Protocol to the US arose because CO₂ emissions were projected

¹³ Available at <http://www.berr.gov.uk/files/file38978.pdf>

¹⁴ These costs show that GDP in 2020 would be 1% to 2% lower than under the baseline.

¹⁵ The group of countries included in Annex B of the Kyoto Protocol that have agreed to a target for their greenhouse gas emissions.

¹⁶ Energy Information Administration (1998)

to grow much more rapidly in the US than in other regions, so containing emissions would prove much more expensive.

2.1.14 However, these short term costs will depend on a number of factors, including the absolute level of 'effort' required to achieve a target, the relative effort compared to other countries and regions, fossil fuel prices and the level of technological change and speed of adjustment to higher prices. The potential importance of these factors is discussed in the next section.

2.1.15 Analysis for the UK indicates that the long run costs of achieving significant reductions in CO₂ emissions are within the range identified by the Stern Review (which estimated that the long run costs of global action to stabilise atmospheric greenhouse gas concentrations at 550ppm CO₂e are likely to be around 1% of GDP by 2050, within a range of +/- 3%).

2.1.16 Short and medium run (i.e. to 2020) transition costs could be in the upper end of the range indicated by the Stern Review, although these are highly dependent on the choice of transition path as well as the policy mix. It is important to note the substantial uncertainties surrounding assessments of the precise costs (which are outlined in Section 2.2).

2.2 Outlining the Key Cost Uncertainties and Sensitivities

2.2.1 This section outlines analysis surrounding the sensitivity of the cost assessments outlined in the previous section to a number of key uncertainties including the:

- choice of emissions reductions pathway;
- degree of international commitment to reduce greenhouse gas emissions including the relative effort between countries and regions;
- cost and availability of low-carbon or energy efficient technologies;
- cost of fossil fuels; and,
- the level of the 2050 target for emissions reductions.

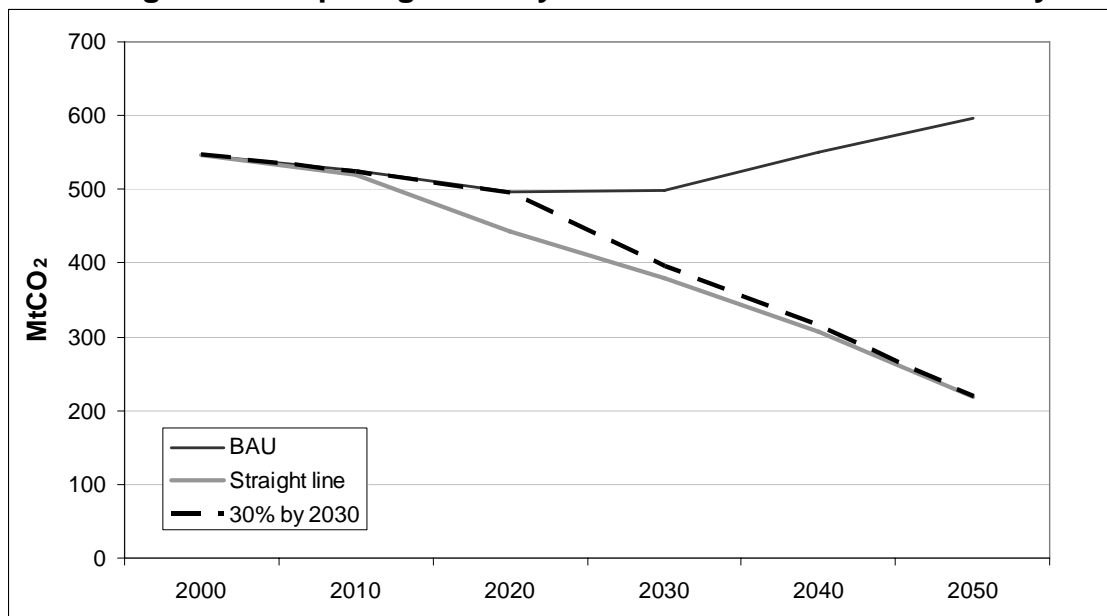
2.2.2 This is intended to inform more detailed decisions surrounding the development of the proposed carbon management framework.

Pathways to transition

2.2.3 The timing and pathway of emissions reductions towards an overall objective is likely to impact on costs. Results from the MARKAL-Macro model compare the long run costs of two different pathways to achieving a 60% reduction by 2050. In particular, a 'straight line' trajectory from 2010; and one where the model achieves 30% reductions (based on 1990 levels) by 2030,¹⁷ and thereafter falling in a straight line to 2050. These different pathways, and the difference in emissions from the Business As Usual (BAU) scenario are shown in the Figure 1.

¹⁷ These constraints are applied in an attempt to replicate realistic options for abatement. Without any intermediate constraints the model might choose a path where all efforts are made towards the end of the period, which would, however, imply an unrealistic pattern of asset replacement and might also create some computational problems in the model.

Figure 1 Comparing Pathways to 60% emissions reduction by 2050



2.2.4 These results suggest that following a tougher ‘straight line’ abatement profile could result in higher marginal and total costs in the short and medium term (i.e. up to 2030). However, the analysis suggests that if action to reduce carbon emissions is delayed then marginal costs in the longer run are expected to be higher. Furthermore, delaying action implies that less carbon is abated overall.

2.2.5 Analysis using the Oxford Economics model indicates a relatively high sensitivity of short and medium run adjustment costs to the choice of two different, *purely illustrative*, pathways to an overall CO₂ emissions reduction of 30% by 2020 (based on 1990 levels). It indicated that the total cumulative discounted GDP costs over the period 2007-2020 were over double (around 1.6% GDP) in the case of a ‘big bang’ scenario, in which a large immediate carbon price is imposed on all sectors, compared to the case of a smoothed introduction of a carbon price (around 0.8% GDP), designed to achieve a ‘straight line’ emissions reduction trajectory up to 2020.

Degree of international effort

2.2.6 The proposals within the Bill set unilateral targets in statute for the UK to take responsibility for a share of the global mitigation effort. However, it is likely that the resulting transition costs will be affected by the degree of wider international commitment as this may affect, for example, the size of markets for individual low-carbon technologies as well as the wider macroeconomic conditions affecting the UK. However, there remains some uncertainty surrounding the exact nature of the impact of differing degrees of multilateralism on mitigation costs.

2.2.7 Recent work for the Australian government¹⁸ showed relatively low impacts of differing degrees of international commitment on domestic mitigation costs. However, research by the IPCC found relatively high risks of asymmetric mitigation action resulting in the transfer of productive capital to countries without carbon policies, known as ‘carbon leakage’.¹⁹ It is likely that different approaches to modelling technological change account for some of these differences (outlined in Box 1).

¹⁸ Energy Futures forum <http://www.csiro.au/files/files/pbd1.pdf>

¹⁹ IPCC (2001) Third Assessment Report, using Computational General Equilibrium models with exogenous technological change, estimated leakage rates for the first Kyoto period through uniform carbon taxes of between 5-20%. Babiker (2005) produced much higher leakage estimates ranging from 25 to over 100%; implying significant losses of competitiveness for OECD countries using a global general equilibrium model.

2.2.8 The Oxford Economics modelling looked at the macroeconomic impacts on the UK of different degrees of EU and international effort by 2020. This work suggests that short run costs to the UK could be slightly magnified in the event of more symmetric European and international action, due to the initial negative impacts of foreign efforts on external demand for UK exports. However, in the medium run (i.e. by 2020) costs to the UK might be lower, due to smaller competitiveness effects.

Cost and availability of low-carbon or energy efficient technologies

2.2.9 Mitigation costs for a given emissions reduction trajectory are likely to be heavily influenced by the availability and costs of key abatement technologies. Furthermore, the speed of technological development is itself likely to be influenced by the decisions of policy makers regarding the overall commitment framework (which establishes a value to greenhouse gas reductions as well as incentivising Government or private sector expenditure on research and development). A study commissioned by the Stern Review found that the inclusion of induced technological change within modelling exercises could lower the estimated costs of stabilisation by one or two percentage points of GDP by 2030.²⁰

2.2.10 Results from the Oxford Economics modelling suggest that induced technological change can affect the magnitude of costs in the short-term of meeting a reduction in emissions by 2020. For example, sensitivity analysis in which faster technological change in response to carbon prices was assumed suggested that the cost of mitigation would be 13% lower. Conversely, if technological change is not responsive to higher carbon prices, costs of mitigation would be 7% more.²¹

2.2.11 Analysis using the MARKAL-Macro model examined the sensitivity of costs in the long term to the level of innovation and availability of low-carbon technologies, including both end-use and generation technologies. This work suggests that the long term (to 2050) GDP impact could be significantly higher in a scenario where there were no developments in technological innovation beyond 2010, i.e. 1.5% compared with 0.7% in the central case.²²

The cost of fossil fuels

2.2.12 The long run levels as well as short term fluctuations in fossil fuel prices are key uncertainties affecting energy markets. In general, relatively low fossil fuel prices increase abatement costs as low-carbon alternatives become relatively more expensive, and as demand for energy increases in response to low prices. In the electricity generation sector the relative prices between the different fossil fuels, particularly coal and gas, is an important factor in determining which is used. Modelling these scenarios suggests:

- GDP costs of long-run mitigation to achieve a 60% reduction in emissions in 2050 are cut by more than half in the case of high fuel price scenarios, i.e. from 0.7% reduction in GDP by 2050 in the central case to a 0.3% reduction in the case of high prices;²³ and

²⁰ Barker T. *et al.* (2006)

²¹ This sensitivity analysis was conducted around a purely illustrative 30% reduction of emissions in 2020, meaning absolute changes in GDP are not comparable to the other transition cost figures cited.

²² The restricted innovation scenario, fewer efficient end-use technologies are available, and learning improvements in technologies are not allowed post 2010.

²³ Analysis using MARKAL-Macro. Conversely, however, the low fuel price scenario is the same cost as the central, 0.7% GDP in 2050. This is because, although all fuels are cheaper, the relative price change makes gas more competitive than coal resulting in lower emissions than in the central case.

- short and medium run transition GDP costs in 2020 of achieving 30% emissions reductions could increase (up to 2% of GDP by 2020) under low fossil fuel prices but fall to 1.3% in the event of high fuel prices.²⁴

Uncertainty and policy design

- 2.2.13 **The analysis presented in this section suggests costs of mitigation are highly sensitive to the choice of emissions reduction pathway as well as assumptions regarding technology costs and, in addition, are moderately sensitive to those regarding fuel prices. However, the underlying sensitivity of mitigation costs to differing degrees of mitigation by other countries is less well understood.**
- 2.2.14 **The extent of these sensitivities implies the desirability of a flexible policy framework which actively assesses, manages and, where necessary, reviews the optimal pathway and delivery of transition to a low-carbon economy in light of a wide range of factors including: the degree of international commitment to reduce greenhouse gas emissions; the cost and availability of low-carbon or energy efficient technologies; and the cost of fossil fuels. Detailed policy design issues are set out and discussed in Section 3 in the light of these uncertainties.**

The level of the 2050 target

- 2.2.15 The level of the long-term emissions reduction target in 2050 will be the most important factor in determining the scale of the environmental, social and economic impacts of the Bill.
- 2.2.16 A more stringent emissions reduction target may increase the chances of stabilising atmospheric concentrations of greenhouse gases within the range examined by the Stern Review. It will also demonstrate the UK's commitment to tackling climate change and to take responsibility for emissions. The UK's ability to demonstrate leadership may be important in helping to secure further international agreements to tackle climate change.
- 2.2.17 More stringent targets will require more aggressive policies to enable emissions reductions to happen sooner. This will create greater incentives for households and firms to increase energy efficiency and may drive further improvements in technological innovation. This may provide greater opportunities for the UK to benefit from the development of a low carbon economy.
- 2.2.18 Reducing emissions further is likely to increase the level and range of potential economic and social costs of mitigation. Further analysis following the 2007 Energy White Paper has examined the potential impact of a more ambitious emissions reduction target for 2050. Analysis using the MARKAL-Macro model has looked at the anticipated costs of meeting a 70% or 80% CO₂ reduction from 1990 levels. Under an 80% reduction scenario, costs have been estimated to be between 1.1% to 2.6% of GDP in 2050, depending on the assumed level of future technological change, fossil fuel prices and availability of particular technologies. Limited sensitivities have been conducted for a 70% reduction scenario. Using central fuel price assumptions the long run costs of reducing carbon emissions by 70% by 2050 are expected to be 1.1% of GDP in 2050, which is comparable with the 0.7% estimated for a 60% reduction.

²⁴ Evaluated on the basis of a 'straight line' trajectory towards an overall carbon emissions reduction of 30% by 2020 (incorporating the continuation of the EU-ETS post 2012 in the baseline, contributing to a 17% reduction in emissions from 1990 levels).

2.2.19 The MARKAL-Macro model assumes that there is perfect information about future carbon prices available ensuring that the correct decisions are always taken about which technologies to use. This means the GDP impacts should be interpreted as the low end of the range of possible costs. As a UK only model, no competitiveness impacts are measured. This may become more significant if the UK adopts an emissions reduction target that goes significantly beyond the level of ambition of other countries.

2.2.20 Modelling results for more stringent emissions reduction targets must be interpreted with caution. Placing greater constraints on emissions in the MARKAL-Macro model will force the model to choose a different mix of technologies to meet energy demand. With a lower emissions target, existing high-carbon technologies can be used only to meet a smaller proportion of the energy demand. This increases the sensitivity of the results of the model to the assumptions used in the model regarding the future technical feasibility and availability of certain technologies. Therefore further analysis will be required to explore in more detail the technical implications of more stringent emissions reductions.

2.2.21 Given the uncertainty surrounding the implications of higher targets, the Bill proposes that the 2050 target be set to provide a reduction in emissions of at least a 60%. Insufficient analysis is currently available to allow a full consideration of the costs and benefits of moving to a more stringent target immediately. Moving to a higher target now, without understanding the potential impacts, increases the chances of setting carbon budgets that are unachievable, which would damage the certainty provided by the framework.

2.2.22 The Bill requires that the Government seeks the advice of the Committee on Climate Change (the Committee), to be established under the provisions of the Bill, before any amendment of the 2050 target. The Prime Minister has announced that the Government will ask the Committee to report on whether the 2050 target of a reduction in emissions by at least 60% should be even stronger still.

2.3 Estimating Distributional Effects

2.3.1 The impacts of climate change mitigation policies are likely to be unevenly distributed across sectors and households. The distributional impacts will be affected by the extent to which the UK acts unilaterally and by the particular policy mechanisms used in each sector. As mitigating climate change is a relatively new objective for Government, there are not yet any substantial *ex-post* (i.e. retrospective) econometric analyses that illustrate the distributional and employment effects induced by mitigation policies. As such, much analysis of these potential effects is based on theoretical reasoning and simulation studies which must be interpreted cautiously. This section discusses the possible distributional impacts of achieving the headline targets proposed in the Bill.

Energy intensive industries

2.3.2 The Stern Review suggests that industrial sectors which have high energy-intensities of production and that are highly exposed to international competition are likely to experience the most adverse impacts on output and employment. The Stern Review analysed the potential effects of implementing a carbon price of £70/tC on the UK economy using input output tables.²⁵ It found that energy intensive sectors are most likely to be adversely affected by mitigation policies. However, it also found that only six²⁶ of the 123 UK sectors were projected to face an increase in variable costs of 5% or more from higher energy costs as a result of carbon pricing. This is because many

²⁵ Stern Review, Chapter 11.

²⁶ Sectors identified were gas supply and distribution; electricity production and distribution; refined petroleum; cement; fertilisers; and fishing. Combined these sectors account for 1.82% of the UK's output.

sectors tend to trade mostly inside the EU. For example, trade intensity falls seven-fold in the cement industry when restricted to non-EU countries and four-fold in pulp and paper, plastics and fibres. As such, mitigation through the EU-ETS (and other policies such as EU wide regulation) which establish a single carbon price across the trading block have the potential substantially to substantially reduce the risk of competitiveness impacts.

2.3.3 Overall, research undertaken as part of the 2007 Energy White Paper suggests that the imposition of carbon constraints may cause some structural adjustment in the economy, with output and employment re-allocated from energy intensive to non-energy intensive sectors. The analysis suggests that working cooperatively, and especially through the EU-ETS, minimises the effects on those sectors exposed to international competition. Further analysis, considering the impact under a scenario where a carbon price is imposed more symmetrically across the EU, which better reflects the UK's current mitigation strategy which places primacy on the EU-ETS for these sectors, shows reduced structural effects and competitiveness risks.

Non-energy intensive sectors

2.3.4 Climate change mitigation policies may have some impact on less energy intensive areas of the economy, predominantly those in the service sector. However, the extent of this impact is likely to be limited by the fact that these sectors typically have a very low ratio of energy costs to output - often less than 2% (compared to typical labour costs in the region of 26%).²⁷ As such, a marginal increase in energy prices as a result of the introduction of a carbon price is unlikely to have a substantial impact on overall production costs, especially when considered in the context of natural fluctuations in the fuel markets (see next section on energy prices and consumers). Any cost increases could be offset partially by inducements to innovate and use energy more efficiently (see section in on encouraging innovation and resource efficiency).

2.3.5 Some sectors of the UK may be well placed to benefit from its early action, such as environmental consultancy services. As a major provider of financial services, it is likely that the UK, and particularly London, will benefit from growth in an international carbon market: city industrial and financial experts have quickly developed expertise in forecasting and hedging carbon prices and developing futures markets which support the operations of the EU-ETS.

Consumers and energy prices

2.3.6 Carbon abatement will entail some costs and can therefore increase energy prices. The existence of the EU-ETS is, for example, having an impact on electricity prices in the UK because electricity generators can pass on the cost of carbon allowances to consumers. Overall costs can be minimised by setting the right policies in place to incentivise the most cost-effective methods of mitigation. The size of the impact depends on the scale of effort to deliver carbon savings across the EU, when these emission reductions occur, and the degree of pass-through of the carbon price.

2.3.7 Climate change mitigation policies will affect the users of energy intensive products as, ultimately, all costs of energy price rises will be borne by consumers. However, analysis conducted by the Stern Review suggests that cost increases may not necessarily be that large for households. The input output analysis identified a 0.9% long run increase in consumer prices arising from a £70/tC carbon price.²⁸ Furthermore, climate change

²⁷ 2005 estimate in Annual Business Inquiry (see <http://www.statistics.gov.uk/abi/>)

²⁸ Stern Review Chapter 11.

mitigation policies may incentivise the take up of cost effective energy saving technologies among energy users. While it can be argued that measures to mitigate climate change will increase the number of households exposed to fuel poverty, the extent of this could be limited by energy efficiency inducements as well as carefully targeted policies to address such secondary effects. The Committee (in advising on carbon budgets) and the Government (in setting them) will have regard to this issue when implementing the framework.

Encouraging innovation and resource efficiency

2.3.8 The potentially negative impact of mitigation policies as a result of higher energy prices (leading to a potential increase in fuel poverty) and reduced growth may be offset by induced improvements in energy efficiency. Analysis attributed positive macroeconomic effects to energy efficiency policies implemented as part of the Climate Change Programme in the form of lower inflation and higher output, in particular: a 0.3% reduction in the annual growth rate of prices (i.e. lower inflation) for 2005-10 and a 0.1% increase in the annual GDP growth rate for 2005-10.²⁹ Analysis in the 2007 Energy White Paper identified significant cost effective abatement potential across the UK economy. It is likely that further policies could help uncover further economic benefits. For example, analysis of the potential impacts of the Carbon Reduction Commitment³⁰ suggested that there was significant, untapped cost effective potential for emission reductions in large, non-energy intensive organisations (up to 11% of current emissions from the sector). Energy efficiency measures are clearly an important policy tool, with reduced energy use having not just macroeconomic benefits but important co-benefits such as reduced fuel poverty and increased energy security. Such considerations are key when considering the unilateral nature of the emissions reduction framework.

2.3.9 Furthermore, some academics challenge the traditional theoretical view that early adopters of climate change mitigation policies adversely impact on their industries by creating additional costs. Porter identifies examples of environment regulation/policies which lead to innovation by creating pressures that encourage firms to look for 'cleaner' and/or more efficient production technologies and processes.³¹ Denmark's success in wind energy is often cited as a case of regulation-led innovation, creating both local jobs and expertise that has been exported globally. The overall costs of regulation depend on the precise policy context. However, it is likely that performance standards induce the creation and adoption of new technologies although at some real opportunity cost.³²

The choice of policy mix

2.3.10 The choice of policy instrument is also likely to have a significant distributional effect: regulation, market mechanisms or fiscal measures will have divergent distributional impacts. However, even within these particular tools different designs are likely to have markedly different sectoral impacts. For example, the allocation methodology used by an emissions trading scheme will have large distributional impacts. When allowances

²⁹ Barker et al., The Macro-Economic Rebound Effect and the UK Economy, A report to DEFRA May 2006. http://www.defra.gov.uk/science/Project_Data/DocumentLibrary/EE01015/EE01015_3554_FRP.pdf

³⁰ 'Energy Efficiency and Trading Part II: Options for the implementation of New Mandatory UK Emissions Trading'. NERA consulting 2006.

³¹ M. E. Porter, C. van der Linde, (1995), "Toward a New Conception of the Environment-Competitiveness Relationship", *Journal of Economic Perspectives*, Fall 1995, pp. 97-118.

³² See, for example, Palmer, K., W.E. Oates and P.R. Portney (1995): 'Tightening environmental standards: The benefit-cost or the no-cost paradigm?' *Journal of Economic Perspectives* 9:119-132

are grandfathered³³ there is scope for some emitters to make windfall profits by passing on the (opportunity) cost of the allowances despite receiving costless emissions allocation rights. Analysis by the Department for Business, Enterprise and Regulatory Reform (BERR) has estimated that the large electricity generators could have gained £1.2 - £1.3 billion in 2005 arising from grandfathering of emission allowances under the EU-ETS.

- 2.3.11 **Overall, the distribution of impacts from implementing the proposed carbon management framework is likely to be uneven. A small number of energy intensive industries (particularly those exposed to international competition), may be affected potentially more significantly while less energy intensive areas of the economy, such as services and residential, are likely to be much less affected. Other sectors, such as environmental consultancy and financial services, may have opportunities to benefit from more robust mitigation frameworks, especially if these are replicated internationally.**
- 2.3.12 **The degree to which UK mitigation is replicated internationally is likely to have an important influence on the distribution of costs, particularly for sectors which are exposed to high degrees of international competition.**

2.4 Potential size of benefits from reducing CO₂ emissions

- 2.4.1 For indicative purposes only, it is possible to use the Shadow Price of Carbon³⁴ to place an indicative monetary value on the emissions reductions that would occur under a 60% emissions reduction target. The Shadow Price of Carbon captures the damage cost of climate change caused by each additional tonne of greenhouse gas emitted. These calculations rely on the profiles of emissions reductions taken from the MARKAL-Macro modelling to give the cumulative benefits of lower emissions from the targets set in the Bill. This suggests the present value³⁵ of the benefits, using a 5% sensitivity range, would be in the order of £82 to £110 billion, depending on assumptions regarding the level of technological change and the prices of fossil fuels. However, this does not capture the full benefits from the measures proposed in the Bill, but simply provides an indicative estimate of the lower bound benefits to the UK of the emissions reductions, using the Government's established methods for valuing changes in greenhouse gas emissions.
- 2.4.2 It is important to note however that this range does not capture the full potential benefits of reducing climate change. By demonstrating leadership in establishing statutory commitments to reduce emissions, the UK may increase the probability that a multi-lateral agreement can be reached that sets targets which are consistent with a stabilisation trajectory which would avoid dangerous climate change. However, the estimates above do not include any allowance for additional emissions brought about by such an agreement.

³³ Grandfathering involves allocating allowances to firms on the basis of their past emissions. Firms that polluted more in the past would have larger shares. Grandfathering has the disadvantage of favouring existing firms and creating barriers to entry by new firms wanting to set up.

³⁴ See DEFRA's interim guidance at <http://www.defra.gov.uk/environment/climatechange/research/carboncost/step1.htm>

³⁵ The value of future emissions reductions has been discounted at 3.5% per annum according to the method required in the Shadow Price of Carbon guidance.

- 2.4.3 In addition, no estimate of the benefits from greater predictability to households and firms has been attempted. The value of this will depend on the mix of policies implemented by Government to meet the agreed carbon budgets. No assessment of the potential ancillary effects from domestic mitigation policy, such as improved public health, increased energy security, and reduced fuel poverty, has been estimated.
- 2.4.4 **Overall, analysis suggests that there is a strong case for making emissions reductions, compared to the potential costs of doing nothing to combat climate change. The exact costs and benefits from reducing emissions will depend on the trajectory of emissions reductions and the mix of policies chosen to reduce climate change. There is a strong case for a more robust policy framework to provide greater clarity and predictability for UK industry to plan effectively for, and invest, in a low-carbon economy. The Bill will demonstrate the UK's leadership internationally, to help foster the conditions for broader and deeper international cooperation. A more stringent 2050 target for emissions reductions would increase the level of benefits, while also increasing the cost of mitigation.**

3. Detailed Analysis of Measures

3.0.1 This section sets out a detailed assessment of the impacts from the provisions contained in the Bill to establish a framework for the management of climate change policies. Detailed analysis of the impacts of the Government's preferred solutions are presented. The Partial RIA for the draft Bill provided an analysis of the full range of options considered as part of the development of the provisions in the Bill. Further details on the impacts of the Renewable Transport Fuels Obligation³⁶ and the Waste Incentives for Local Authorities can be found in their respective Impact Assessments.

3.1 *Establishing a framework for Climate Change policy*

3.1.1 The Bill proposes a clear framework for the management and delivery of climate change policies. The framework is intended to support the ambitious targets for emissions reductions outlined in Section 2.

Creating greater predictability for investors

3.1.2 Policy instruments such as taxation, trading schemes or regulation create a price for emissions. This price provides an incentive for investment in less carbon intensive capital as well as innovation in the development of longer term technological and behavioural solutions. If there is uncertainty around the future price for emissions, firms may require a higher return on low carbon investments. Firms may therefore choose to continue to invest in carbon intensive plant, which may be inefficient as it will result in higher levels of carbon intensive capital in the future.³⁷ This is an especially important factor in markets which are currently investing heavily in long lived capital, such as electricity generation and buildings. This may result in the need to undertake potentially expensive early capital retirement programmes or abate more aggressively in other sectors at higher cost in the future. In such cases, Government can help signal expectations about the future carbon price through a credible, flexible framework for climate change policy.

3.1.3 The Bill proposes to enshrine domestic commitments in statute. This would reduce uncertainty surrounding the intention of Government to institute domestic policies to realise these goals. As such, it would increase predictability for UK households and particularly firms investing in the UK. However, it is essential that these commitments are reinforced by the implementation of credible policies, which clearly demonstrate capacity to deliver these objectives.

3.1.4 In short the Bill will help households and firms form expectations as to the long run existence of a carbon price, but there are limitations to its capacity to confer certainty on this issue.

Promoting conditions for international cooperation through domestic leadership

3.1.5 Climate change is an international collective problem which requires cooperation in order to minimise both environmental risk and mitigation costs. However, cooperation is

³⁶ Details of the impacts of the RTFO provisions contained in the bill are set out in Annex A.

³⁷ Blyth, W., and M. Yang (2006): 'The effect of price controls on investment incentives', presentation to the Sixth Annual Workshop on Greenhouse Gas Emission Trading, Paris: IEA/IETA /EPRI, September 2006, available from <http://www.iea.org/Textbase/work/2006/ghget/Blyth.pdf>; Blyth, W. and M. Yang (forthcoming), 'Impact of climate change policy uncertainty on power generation investments', Paris: IEA.

affected by market failures which lead to the under-provision of public goods³⁸ where individuals or countries face an incentive to free-ride on the actions of others.³⁹ This leads to the risk that countries will try and avoid reducing emissions (and incurring associated costs), while benefiting from mitigation commitments of others.

- 3.1.6 Game theory, and in particular the Prisoner's Dilemma game, illustrates that countries have the incentive to free ride on the abatement of others, with the result being that everybody is worse off than if they had cooperated. However, analysis of this game also suggests it is possible to sustain cooperation if the game is repeated, for example where a series of commitment phases are required to stabilise atmospheric greenhouse gas concentrations.
- 3.1.7 By placing domestic commitments in statute, the UK Government is signalling its intention to seek a low greenhouse gas concentration outcome and not to free ride on any commitments of other countries. This may help influence overall global outcomes, particularly if the strategy is replicated by others, for example across the wider EU.
- 3.1.8 Stabilising atmospheric greenhouse gas concentrations is likely to require cooperation across multiple commitment phases. There is evidence that countries are starting to adopt strategies of conditional co-operation, in which they contribute more to the provision of a public good the more others contribute: for example, at the Spring European Council on 8/9 March 2007, EU Heads of Government agreed an ambitious, independent binding target to reduce Europe's greenhouse gas emissions by at least 20% by 2020 (compared to 1990 levels) and increase this commitment to a 30% reduction as part of an international agreement. The UK can help build consensus within the EU, and to a lesser extent internationally, aimed at creating a critical mass towards such deeper cooperation.
- 3.1.9 The Stern Review suggested that developed countries should take responsibility for greenhouse gas emissions reductions of between 60 and 80% from 1990 levels by 2050. Without such commitment from developed countries, securing a future multilateral global framework will be impossible.
- 3.1.10 The UK, along with other developed countries, therefore has an important opportunity to build a consensus towards strong international collective action.

Strengthening the framework for adaptation

- 3.1.11 The Bill requires the UK Government to take two main steps in relation to adapting to the impacts of climate change:
- Publication of a UK risk report at least every 5 years; and
 - Publication of an adaptation programme covering England and reserved matters, which must contribute to sustainable development.
- 3.1.12 The Bill places a duty on the Government to regularly report on the risks of the impacts of climate change for the UK, and on the Government's proposals and policies for adapting to climate change. This will provide a framework for making clear the actions

³⁸ A public good is a good that is non-rival where the consumption of such a good by one individual does not reduce the amount of the good available for consumption by others. The term public good is often used to refer to goods that are non-excludable as well as non-rival. This means it is not possible to exclude individuals from the good's consumption.

being taken to tackle the now unavoidable effects of climate change, and to provide greater predictability for UK households and firms.

- 3.1.13 The publication of an adaptation programme which would take the identified risks into account and was then implemented fully could have significant long-term benefits, minimising environmental, social and economic impacts related to climate change.
- 3.1.14 A quantitative analysis of the associated benefits of potential adaptation measures is not provided here, as the duty relates to the reporting of measures rather than their implementation. It is envisaged that significant adaptation measures would themselves be accompanied by Impact Assessments before implementation.

3.2 Provisions for the Management of Climate Change policy

- 3.2.1 This section provides a qualitative description of the impacts of the package of measures proposed in the Bill. This is principally because the detailed quantitative costs and benefits will depend on the precise emissions reduction pathway and carbon budgets set, and the ways in which this reduction pathway is intended to be met. It is therefore crucial that on recommending and setting budgets, the Committee and Government respectively provide an assessment of the costs and benefits of achieving the budgets.

Issue 1 – Provisions for establishing the long term targets and trajectories.

- 3.2.2 It is desirable that the Government's framework should establish credible, flexible and predictable mitigation objectives. Credible policy frameworks are needed to drive sufficient low-carbon investment which is essential for the transition to a low-carbon economy. However, the underlying uncertainties outlined in Section 2.2 mean that any framework needs to be flexible to allow decision-makers to respond to unexpected circumstances or revised information affecting the relative costs of actions and inaction.
- 3.2.4 The current system of non-statutory targets arguably does not provide a strong enough framework to give UK households and firms an unquestionable assurance that the Government is committed to ensuring long-term emissions reductions. This is likely to reduce the willingness of firms and households to make the investments needed for the transition to a low-carbon economy, and may increase the cost of mitigating climate change.
- 3.2.5 The Bill proposes a statutory target to reduce CO₂ emissions by at least 60%, through domestic and international effort, by 2050 (compared to 1990 levels) and, in addition, a system of statutory five-yearly 'carbon budgets', to be placed in secondary legislation for at least three periods (15 years) ahead, in order to provide a medium-term trajectory towards the delivery of the 2050 target. The "carbon budget" would place a limit on the aggregate quantity of CO₂ emissions permitted over a five year period.
- 3.2.6 Carbon budgets would initially be established for the periods 2008-12 (consistent with the first Kyoto Protocol commitment period), 2013-17 and 2018-22. The budget for 2018-22 would be set consistent with the Government's existing target range of a 26-32% cut in emissions by 2020, providing a firm legislative boundary for the trajectory to 2050.
- 3.2.7 The Government of the day would be directly accountable to Parliament for the delivery of both the 2050 target and the achievement of the five-year budgets. In the event that either budgets were exceeded or the target not met, Government would be liable for judicial review, and would have to provide an explanation to Parliament. In addition, placing these objectives in legislation means that Parliamentary approval would be

required in order to amend them. More detailed analysis of the circumstances in which these targets and budgets might be amended is provided in Issue 3 below.

Benefits:

- 3.2.8 A system of statutory targets, supported by five-yearly carbon budgets established three periods (15 years) ahead, will enhance the level of predictability for households and firms making longer term investment decisions and actions to reduce their CO₂ emissions. This system would establish a more clearly defined trajectory towards a low-carbon economy, and may allow emissions reductions to be achieved at a lower cost. Statutory targets will also provide Parliamentary controls over the long-run emissions targets and their revision. This is particularly important given the current lack of an international agreement extending beyond 2012.
- 3.2.9 Carbon budgets will be set with a view to achieving an appropriate balance between social and economic costs and benefits (illustrative impacts of different trajectories on mitigation costs are outlined in Section 2.2). They thus retain some inherent flexibility to allow Government to manage policy in response to, for example variations affecting energy demand (particularly if such unexpected events occur early in a budget period), whilst at the same time ensuring that every tonne of CO₂ counts towards the budgets. Section 3.3 considers mechanisms for the provision of additional flexibility. The first Kyoto phase and Phases I and II of the EU-ETS are also expressed in terms of average annual emissions over a five-year period (2008-2012).
- 3.2.10 Furthermore, this approach creates a policy framework to enable the UK to demonstrate leadership, thereby helping to foster the conditions for further international cooperation, in a way which is consistent with international emissions reduction obligations under the Kyoto Protocol and as part of the EU-ETS. The UK's demonstration of leadership may increase the chances that a multi-lateral agreement can be reached that is consistent with the long-term aim of avoiding dangerous climate change.

Costs:

- 3.2.11 The likely range of cost associated with achieving long run emissions reductions are discussed in detail in Section 2. The cost of making a binding commitment will depend on the level of flexibility that is retained in the framework to mitigate the impact of the uncertainties, such as fuel prices and unexpected events that could result in higher or lower emissions than expected. The costs and benefits of the flexibility mechanisms are discussed in Section 3.3. These mainly relate to the administration cost of amending a target if required in the future, in the light of significant developments in climate science or in international law of policy.

Box 2: Setting annual targets or milestones for emissions reductions.

The length of time over which the budget is set will determine the flexibility and credibility of the framework.

Annual targets would constrain the discretion of policy makers to respond to changes in both the medium and long run expected cost of mitigation. In the short-term, actual emissions are affected by a large number of factors that can cause emissions to rise or fall unexpectedly (such as an unexpectedly cold winter leading to higher-than-expected heating fuel demand). These fluctuations might require the Government to adopt additional measures at short notice to ensure that annual emissions budgets are met. Purchasing additional emissions reduction credits at short notice to cover annual fluctuations may increase the overall cost of mitigation. This has the potential to reduce the credibility in the policy framework because households and firms may perceive that a Government has an incentive to focus on short term mitigation objectives rather than consider longer term policies that would tackle climate change more cost effectively.

A longer period of 5 years for carbon budgets is therefore preferred, as this balances the need to provide short term flexibility with long a run commitment to emissions reductions.

With a system of multi-year carbon budgets it is possible to set a series of ‘milestones’ to demonstrate progress within a budget. Unlike annual budgets, milestones would not impose a binding constraint on emissions in a particular year, but would give an indication of whether the UK was on course to meet the emissions reductions set by a target.

As with annual budgets, annual milestones would create incentives to focus on short term variations in emissions at the expense of setting a mix of policies that will achieve the Government’s objectives at least cost. This too would undermine the ability of households and firms to predict the Government’s future intentions.

Issue 2: Establishment of the Committee on Climate Change

- 3.2.12 There are potentially a number of different pathways to the proposed statutory targets in 2020 and 2050. The choice between these pathways is likely to impact on the overall costs of mitigation and the achievement of a range of other economic, social and policy objectives, as well as the UK’s ability to show international leadership in climate change mitigation. Balancing these considerations is a complex and technical task – evaluating climate change costs and uncertainties is a rapidly developing area of research and one which requires highly specialised skills.
- 3.2.13 In establishing mitigation objectives, the Government needs to balance evidence from a range of sources on the potential costs and benefits of action, factoring in the impacts on wider policy objectives such as maintaining secure energy supplies and promoting economic prosperity.
- 3.2.14 The Committee will advise Government on the level of the carbon budgets and therefore the shape of the optimal trajectory towards the achievement of the 2020 and 2050 targets, based on detailed analysis of the dynamic costs and benefits of abatement.
- 3.2.15 In forming its advice, the Committee will be required to consider a broad set of factors (which the Government itself will take into account when actually setting the budgets). It is envisaged that this broad range of factors will ensure that the Committee’s advice is comprehensive and does not seek to achieve emissions reductions at the expense of economic growth or other objectives. In order to increase transparency and accountability the Committee will be required to publish its advice and supporting analysis to Government on the level of the carbon budgets, as well as the minutes of the Committee’s meetings.
- 3.2.16 As well as advising the Government on the optimal trajectory, the Committee will be required to advise the Government in relation to:
- any Government review of the targets in the Bill;
 - the balance of emissions reduction effort to be achieved overseas and domestically;
 - the respective contributions towards meeting the budgets of those sectors covered by trading schemes, and other sectors;
 - any use of banking and borrowing facilities and,
 - any other issue on request from the Government.

Benefits:

- 3.2.17 The establishment of the Committee to advise on the pathway towards the achievement of the 2020 and 2050 statutory targets will have a number of key potential benefits. It

will strengthen the institutional structure through which to improve the way the UK manages carbon in the economy by:

- increasing transparency surrounding the determination of a carbon abatement pathway (a process currently influenced by a range of different stakeholders in a way which is not always visible to the public); and
- ensuring broad and explicit representation from a range of stakeholder groups to ensure a full understanding of the complex matrix of costs, benefits and risks associated with action to mitigate climate change.⁴⁰

3.2.18 In addition, the Committee will provide independent advice to Parliament on the progress that has been made towards meeting the statutory emissions reductions (considered later under Issue 10).

Costs:

3.2.19 There will be resource costs associated with the establishment of a new independent body to cover, for example, remuneration and related costs of committee members and its secretariat, and the management of office facilities. Overall, these are estimated to be in the region of £1.6 million in 2007/08 (while the Committee is in shadow form as a non-statutory body) and £2.6 million⁴¹ annually once it becomes a statutory body. The Committee will be funded by the UK Government and the Devolved Administrations. Table 1 below provides a short breakdown of these expected costs.

Table 1: Outline of Estimated First Year and Ongoing Costs of Committee on Climate Change

Function	2007/08 (Shadow Committee)**	Ongoing costs - (post Royal Assent)*
Secretariat	£680,000	£1,300,000
Committee	£62,000	£210,000
Research	£750,000	£500,000
Running costs	£132,000	£300,000
Accommodation	-	£270,000
Corporate identity***	-	£150,000
total	£1,624,000	£2,730,000

Notes

*Ongoing costs are only estimates at this stage.

** To enable the Committee to provide its advice on the first three carbon budgets before 1st September 2008 as required by the Bill, the Committee is being set up in shadow form ahead of Royal Assent. 2007/08 costs reflect that the shadow Committee secretariat and members will only be in place part way through the year.

***Corporate identity costs will only be incurred in 2008/09, when the Committee becomes a statutory body after Royal Assent.

⁴⁰ It is intended that the Committee would be staffed by a highly analytical Secretariat, and a Board made up of members reflecting expertise in areas relevant to calculating the abatement pathway: business competitiveness; climate change policy; climate science; differences in circumstances between England, Wales, Scotland and Northern Ireland and the capacity of national authorities to take action in relation to, climate change; economic analysis and forecasting; emissions trading; energy production and supply; financial investment; technology development and diffusion.

⁴¹ First year costs are expected to be £2.73 million including the one off cost £150,000 for establishing the Committee's corporate identity. The budget for the following year is estimated to be £2.6 million.

Issue 3: Review of statutory targets and/or interim budgets

- 3.2.20 It is important to consider whether, and in what circumstances the proposed system of unilateral statutory targets and budgets could be amended in the context of managing environmental risk, economic cost and wider policy objectives effectively.
- 3.2.21 The Bill proposes the Government would have the ability to review the 2050 and 2020 statutory targets in the light of significant developments in climate science or in international law or policy. For example, a review might be exercised in the event that a new multilateral agreement requires the UK to adopt more stringent emissions reduction targets. Alternatively, changes in our understanding of climate science might imply the need for higher or lower degrees of emissions reductions internationally, which would need to be reflected in the domestic framework.
- 3.2.22 There would be some flexibility to amend statutory carbon budgets as a result of significant changes affecting the basis upon which the Secretary of State originally set, or last amended, the budgets. So, for example, the Government could seek agreement from Parliament to re-profile (i.e. amend) the carbon budgets, so that emissions reductions could be spread over a longer timeframe, if it became clear that the emissions forecasts used when a budget had initially been set proved to be significantly inaccurate. This could result from large changes in the price of gas on international markets, or the pace of development in a new technology such as carbon capture and storage, such that the only policy options available to meet a budget would result in unacceptable economic costs. However, to ensure credibility and minimize the impact on expectations, the same Parliamentary process would be used for amending budgets as was used to set them in the first place.

Benefits:

- 3.2.23 The capacity to review budgets or targets would enable policy makers to:
- minimise economic and social costs and competitiveness risks arising from significant changes to key drivers of mitigation costs; and,
 - continue to demonstrate international leadership in the light of revised assessments surrounding environmental risk.
- 3.2.24 The Government's decision as to whether to exercise a review for either the statutory targets or budgets would be subject to Parliamentary approval under the affirmative resolution procedure. In the case of amending carbon budgets, the Government would also be required to seek advice from the Committee.⁴² Overall, given the political and Parliamentary risks and constraints surrounding the execution of any review clause, it is likely that the adverse impact of such a mechanism on certainty would be limited.

Costs:

- 3.2.25 Having no facility to amend targets would provide households and firms with the greatest degree of certainty surrounding the intention of Government to manage policies designed to deliver a defined level of emissions reductions in a particular time period. However, the understanding of the level of environmental, economic and social risk for given concentration levels of greenhouse gases is still developing. Tightly restricting the capacity of the Government to amend either the long run or interim target might result in exposure to undesirable economic costs or competitiveness risks, and raise the costs of

⁴² The statutory targets could be changed by the Government only after seeking the advice of the Committee on Climate Change.

tackling climate change. This may potentially reduce the credibility in the framework as a whole.

3.2.26 A facility to review targets reduces the predictability for households and firms about the long run scale and timing of the Government's objectives to reduce emissions. This may increase the overall cost of reaching a given mitigation goal as households and firms may delay the decision to invest in low-carbon technologies.

Issue 4: Retaining the flexibility to move to a greenhouse gas target.

3.2.27 Climate change is caused by various greenhouse gases. The Kyoto Protocol applies to emissions of a basket of six greenhouse gases⁴³: Carbon Dioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur Hexafluoride (SF₆). Non-CO₂ greenhouse gas emissions arise from a number of sources including agriculture and land use change (largely methane from livestock), and industrial process emissions, for example in the cement and paper industries.

3.2.28 Collectively, non-CO₂ emissions accounted for approximately 15% of the UK's overall impact on climate change in 2005. It is therefore important to consider whether the UK's emissions reduction framework should include these other greenhouse gases.

3.2.29 The Bill proposes that the system of 5 year budgets together with statutory targets for emissions reductions in 2020 and 2050 would for now apply only to CO₂. However, the Bill provides a review clause, with the option of allowing the long-term targets to be revised to apply to a wider set of greenhouse gases in the future.

Benefits:

3.2.30 There are potentially strong scientific and economic arguments in favour of defining the UK's long term goal in terms of greenhouse gases. A multi greenhouse gas target would incentivise the least cost abatement across the basket of greenhouse gases, ensuring that greater reductions can be achieved for a given cost; Chapter 10 of the recent Stern Review identified this as a desirable feature of emissions reduction frameworks. It would remove a perverse economic incentive to focus on CO₂ reductions only even if it were economically or scientifically rational to take firmer action on other gases.

3.2.31 A decision to exclude non-CO₂ gases would mean that approximately 15% of the UK's impact on climate change would not be covered by the proposed carbon management framework.

Costs:

3.2.32 There is a lack of detailed analysis to support the decision on setting a long-term greenhouse gas target. While there is an extensive body of analysis supporting the current targets for CO₂ there is currently insufficient understanding of the potential economic and environmental impacts of moving to a greenhouse gas target. This risks setting a target for greenhouse gas emissions before understanding the full costs of mitigation, resulting in additional costs of tackling climate change.

3.2.33 Additional domestic non-CO₂ abatement is expected to become difficult and costly⁴⁴. A range of international and domestic policies have already delivered substantial

⁴³ Hydrofluorocarbons (HFCs) are haloalkanes – alkanes where some hydrogen atoms are replaced by fluorine. Perfluorocarbons (PFCs) are compounds containing just fluorine and carbon.

⁴⁴ See for example, a recent AEAT study on reducing Methane and HFC emissions from four selected sectors - <http://www.defra.gov.uk/environment/climatechange/trading/uk/pdf/aeat-reducing-emissions-report.pdf>

reductions in non-CO₂ emissions in recent years: there has been a 44% reduction in non-CO₂ emissions between 1990 and 2005, expected to reach 50% by 2020. Box 3 outlines some of these policies in more detail.

Conclusions:

3.2.34 There are potentially strong grounds to include other greenhouse gases in the emissions reduction targets. However, given the existing level of analysis, a full consideration of the potential economic, social and environmental impacts is necessary before a decision can be made. Retaining the ability to include other greenhouse gases at a later stage will increase the flexibility of the framework to respond when further analysis of the impacts has been conducted.

Box 3: Tackling Non- CO₂ Emissions

There are a wide range of policies, implemented domestically and through the EU and other forums for international cooperation, designed to tackle non-CO₂ emissions, for example:

- **Methane** is the second most important GHG in the UK after CO₂, contributing 12 per cent of the UK's total emissions of GHGs in 1990. Methane emissions fell by approximately 60% between 1990 and 2005, driven in part by the EU Landfill Directive which imposes strict engineering requirements on landfills, a major source of methane emissions. UK implementation of the Directive aims to reduce the amount of biodegradable municipal waste landfilled to 75%, 50% and 35% of the total amount of waste produced in 1995 by 2010, 2013 and 2020 respectively.
- Emissions of **fluorinated or industrial gases** are small in absolute terms (14MtCO₂e or 8% of UK total greenhouse gas emissions in 1990), but generally have high global warming potentials, so it is important to control the emissions of these gases. The UK was instrumental in fostering agreements at EU level for a new Regulation on certain fluorinated greenhouse gases and a Directive relating to emissions from Mobile Air Conditioning systems in 2006 which ensure a two-step phase out of Mobile Air Conditioning that use fluorinated -gases with a GWP greater than 150, and the introduction of maximum annual leakage limits to cover the interim period before the phase out; as well as controls on refilling the retrofitting for these systems.

Furthermore the Government is considering new policies to address key sources of non-CO₂ emissions including, for example:

- A market based mechanism to facilitate trading of greenhouse gas reductions from agriculture, forestry and other land management sectors. These sectors accounted for around 8% of greenhouse gas emissions in 2004 (weighted by global warming potential);⁴⁵ and
- A competitive grant scheme, administered by the Coal Authority, to support projects aimed at controlling emissions arising from electricity production from coal mine methane (CMM), exempted from the Climate Change Levy in November 2003.

Issue 5: Emissions from international aviation and shipping

3.2.35 Emissions of greenhouse gases from international aviation and shipping represent an increasing proportion of total global greenhouse gas emissions. Emissions from aviation in particular are increasing at a faster rate than emissions from other sectors

3.2.36 However, emissions from international aviation and shipping are currently excluded from the targets as there is not yet an agreed methodology on how to assign these emissions to the relevant countries. We therefore need to give careful consideration to how it is most appropriate to handle international aviation and shipping in the context of a unilateral UK target. The Bill allows the Secretary of State to amend the targets and bring emissions from international aviation and shipping within them when there is a change in international law or policy. At such a point we may wish to revisit the level of

⁴⁵ Source: UK Climate Change Programme 2006, <http://www.defra.gov.uk/environment/climatechange/uk/ukccp/index.htm>

the targets to ensure they remain both ambitious and achievable, balancing the need to reduce emissions with the need to avoid excessive economic or social cost, and consistent with international progress. Therefore, it is not possible to identify at present what the effect would be of including these emissions on the Bill's targets, without first making an assessment of what appropriate targets would be. The assessment below considers two potential outcomes for illustration, firstly, the inclusion of international aviation and shipping emissions with a proportionate reduction in the level of the target and secondly, inclusion with no changes to the targets.

Benefits:

3.3.37 Including international aviation and shipping in the Bill's targets would ensure all 'UK' emissions are within the targets, thus providing greater environmental certainty over future 'UK' emissions. Not adjusting the target to reflect the inclusion of emissions from aviation and shipping would result in a higher overall level of emission reductions compared to reducing the target. However, because of the relative cost of reducing emissions in these sectors, not adjusting the target would require other sectors of the economy to undertake a greater level of emission reductions, with an associated increase in overall costs (see section on costs below).

Costs:

3.2.38 In order to include international aviation and shipping, one must first create a methodology to define the UK's share of these emissions along with the UK's share of emission credits purchased by these sectors. There is a risk that by unilaterally adopting a particular methodology, the UK could compromise negotiations on developing an internationally agreed methodology and delay international action on tackling these emissions.

3.2.39 It would be possible, when including international aviation and shipping emissions, to reduce the Bill targets proportionally, so as to avoid imposing any additional cost to the economy.

3.2.40 Alternatively, it would be possible to include these emissions and leave the Bill targets unchanged. On that basis, some analysis using the MARKAL-Macro model has been conducted to show the possible impacts of including international aviation emissions in a long-term emissions reduction target. These results suggest that the reduction in GDP related to a 60% reduction in greenhouse gases against a 2000 baseline (including those from aviation) are 50% higher in 2005, or around 1.2% in 2050, compared with 0.8% excluding aviation. Including aviation therefore has a similar economic cost in terms of GDP as setting a 70% reduction target excluding aviation.

3.2.41 The analysis reflects that there are currently assumed to be very limited abatement opportunities in the aviation sector, now and in the future. Including aviation in the target would therefore require other sectors to reduce emissions further in order that the UK as a whole can meet its long-term target (assuming the target remained unchanged).

3.2.42 The above analysis assumed that it will be possible for the UK to take unilateral action to reduce aviation emissions. In reality, due to the international nature of the industry, such 'emission reductions' may simply result in increases elsewhere. Thus global emissions could remain unchanged, although there would be a significant impact on the competitiveness of the UK's aviation industry.

3.2.43 Analysis by Department for Transport (DfT) suggests that against a 1990 baseline the emissions reductions required by other sectors of the economy would be between 69-76% if the 60% emissions target included aviation and shipping, assuming that current

aviation and shipping forecasts are correct. This may overstate the required effort, as it assumes no additional abatement within the aviation and shipping sectors.

3.2.44 The terms of aviation's inclusion in the EU-ETS are still subject to negotiation, but the current proposal is that aviation would be included from 2011 and that aviation would only be allocated allowances equivalent to its emissions at average 2004-6 levels (216 million tonnes CO₂), with any further emissions needing to be met through the purchase of emission reductions elsewhere within the EU-ETS. Thus, in the presence of aviation's inclusion in EU-ETS there will be no growth in *net* aviation emissions from 2004-6 onwards. On this basis, DfT analysis suggests the inclusion of international aviation emissions into the Bill's targets would require the rest of the sectors of the economy to reduce emissions by 64% in order to meet an overall reduction of 60%.

Conclusion:

3.2.45 The Bill retains the flexibility for inclusion of international aviation and shipping at a later stage. In reviewing whether to change the targets as a result - and if so, how to do so – the Government would need to take into account a range of factors, including advice from the Committee, the broader international context and the potential economic cost.

3.3 Provisions to allow flexibility in the Government's response to climate change

Issue 6 : Allowing the use of 'traded effort' to meet UK statutory targets

3.3.1 As greenhouse gas emissions are a global externality; the location of emissions reductions does not change their environmental value. However, it may be cheaper to abate in some sectors than others due to greater availability of mature technological or process substitutes. Alternatively, investment in less developed countries may deliver relatively greater emissions reductions due to the existence of less efficient capital stock. Flexibility to choose where to invest to reduce greenhouse gas emissions is a key pillar of existing multilateral frameworks.

3.3.2 The Kyoto Protocol establishes a system of tradable emissions reductions credits, (the Clean Development Mechanism (CDM) and Joint Implementation mechanisms(JI)), which allow "[Annex 1](#)" countries (developed countries with direct emissions reductions obligations) to invest in mitigation projects in other countries in order to meet their own greenhouse gas reduction targets. This may also be consistent with wider policy objectives on international development, as it can result in the transfer of finance and technology to developing countries. However, the Kyoto Protocol also supports the "principle of complementarity", which asserts that (Annex I) countries should use the project mechanisms in a way which is supplemental to domestic emissions reductions meaning they should therefore achieve a significant part of their emissions reductions obligations through domestic effort.

3.3.3 The Bill proposes that the Government has the power to introduce policies which allow for flexibility in terms of where emissions reductions are realised, across the entire economy (including those sectors not currently covered by the EU-ETS). This might be achieved through the extension of the EU-ETS scheme or through the purchase of EU allowances (EUAs), JI or CDM emissions reductions credits⁴⁶.

⁴⁶ Although it is important to recognise that the existence of project credit markets beyond 2012 is subject to a subsequent international agreement

- 3.3.4 The Committee would advise on the appropriate balance of domestic emissions reductions versus financed emissions reductions overseas. In providing this advice, the Committee would likely consider:
- the marginal and dynamic costs of domestic abatement in sectors outside the EU-ETS in relation to the expected international carbon price. This would need to factor in assessments of potential ancillary effects, such as improved public health, increased energy security, and reduced fuel poverty, which are likely to reduce the net cost of domestic mitigation policies⁴⁷; and,
 - the potential impact of purchasing emissions reductions overseas on the capacity of the UK to demonstrate international leadership (resulting in slower transformation in the carbon intensity of domestic markets).

Benefits:

- 3.3.5 Allowing sufficient purchases of effort to realise emissions savings internationally increases the flexibility of the framework, thereby potentially reducing mitigation costs of reaching a given level of emissions reductions.
- 3.3.6 Table 2 shows indicative analysis, using the results from MARKAL-Macro modelling, which suggests that the costs of meeting the 2050 emissions reduction target could be reduced through the purchase of international emissions reduction credits. An illustrative estimate suggests that purchasing one-third of the effort through international emissions reduction credits, assuming a unitary carbon price of €25/tCO₂e, could reduce total abatement costs by approximately a quarter. Further dynamic analysis has indicated that there is potential to reduce short and medium run transition costs through the purchase of international emissions reduction credits.

Table 2: Analysis of Mitigation Costs in 2050: All Domestic Abatement versus One Third UK-financed International Effort,⁴⁸ £bns (2000 Prices)

Scenarios:	All domestic	2/3 domestic, 1/3 overseas
Annual domestic abatement cost in 2050 (from MARKAL-Macro modelling)	20.3	13.2
Annual cost of buying-in in 2050 (from carbon price assumption of €25/tCO ₂ e)	0	1.8
Total (% of 2050 GDP)	20.3 (0.7%)	15 (0.5%)

- 3.3.7 Failure of the UK to participate in international emissions reduction markets could discourage the level of ambition of other countries who followed suit, and deny the UK potential links to emissions trading schemes being developed and proposed in a number of countries (e.g. Norway, Switzerland, Japan and Australia, New Zealand, and state-level schemes in the US). Furthermore, it would limit ability to transfer finance and technology to developing countries through the use of project credit mechanisms.

Costs:

- 3.3.8 The principal disadvantage of purchasing emissions reductions credits is that it would encourage government and firms to use overseas credits as a cheaper short-term option to reduce emissions. This may restrict the pace of decarbonisation of the UK economy and lead to higher mitigation costs in the long run.

⁴⁷ Section 9.2 of the Synthesis of Analysis of the Energy White Paper 2007
<http://www.berr.gov.uk/files/file39198.pdf>

⁴⁸ Based on scenarios of 60% and 40% reduction by 2050 as estimated by MARKAL-MACRO. Credit prices are assumed to retain the real value of €25/CO₂e.

Issue 7: Provisions for 'banking' and 'borrowing' between carbon budget periods.

- 3.3.9 As outlined in Sections 2.1 and 2.2, the overall cost of reducing the UK's impact on climate change is likely to be affected by the choice of emissions reduction pathway as well other factors such as future technology and fossil fuels costs. As such, a system of five year carbon budgets, established three periods ahead, would require the formation of detailed expectations surrounding these factors over a period of around 15 years. However, factors affecting emissions or the cost of mitigation may be subject to short term shocks or periods of volatility, potentially leading to sharp increases in the costs of meeting budgets.
- 3.3.10 Banking and borrowing allows households and firms to minimise costs or competitiveness risks in response to short run factors, or to smooth incentives across commitment periods when managing the timing of emissions reductions. Banking is the ability to carry over unused quotas from one budget period to a future period and is an accepted principle of the Kyoto Protocol. 'Borrowing' would allow a Government to bring forward emissions allocations from future budget periods.
- 3.3.11 The Bill proposes that the Government would be allowed to bank unused emissions rights for use in a successive period. The Government, under certain circumstances and to a limited extent, would also be allowed to borrow budget allocations from the following period. It is proposed that the maximum permitted level of borrowing would be equivalent to 1% of the following carbon budget. It is envisaged that borrowing might be utilised to dampen the impact of a short run shock.
- 3.3.12 It is envisaged that banking and borrowing provisions would not require Parliamentary approval, but would only be used once the government had first received the advice of the Committee, in order to maximise the transparency of its decision.

Benefits:

- 3.3.13 Banking provides an incentive for 'over-performance' in a given period by allowing additional emissions reductions to count against future targets. Banking can therefore provide for improved environmental outcomes as emissions are reduced sooner. In the case of policies designed to establish a carbon price, banking reduces the risk of price spikes or crashes at the end of budget periods. This may reduce the costs of mitigation, particularly where abatement could become more expensive over time. For example, the heavy use of banking in the US Acid Rain Program has been seen by some as a success in terms of delivering early reductions and improving efficiency⁴⁹. In addition, the potential flexibility of banking to bring forward the profile of emissions reductions may send out important signals surrounding the capacity of the UK to demonstrate leadership in achieving early emissions reductions.
- 3.3.14 The absence of banking might weaken the incentives of policy makers to realise larger-than-needed cost-effective abatement, arising for example from earlier-than-expected availability of new technologies or a change in the underlying preferences of households and firms towards placing greater value on the need for energy conservation. This might result in a missed opportunity for the UK to demonstrate additional leadership in emissions reductions or increased short and medium run mitigation costs, as policy

⁴⁹ Research (*Tietenberg, T. (1998): 'Tradable Permits and the Control of Air Pollution in the United States' Colby College, Department of Economics, Working Paper*) found that 30% of allowances were banked between 1995-99 (Phase One of the programme). Firms made efficient decisions to make earlier reductions and banked allowances forward, due to the expectation of tighter caps in future phases. As a result, in total, emissions reduced in Phase One were twice that required to meet the cap in Phase Two.

makers may need to institute a step change in policy once a new budget period begins (especially if it is perceived to be substantially more constraining).

3.3.15 The capacity to borrow would help to:

- reduce the costs of mitigation arising from the need to manage policy in response to short run shocks or volatility in emissions or the cost of abatement; and deal with “accounting errors” due to time lags in data availability;
- promote credibility in the overall framework by increasing the capacity of the Government to manage the delivery of the budget constraints in the event such events; and,
- do so within a tight limit (1%) which would substantially reduce the risk of undermining the certainty provided by the carbon budgeting framework.

3.3.16 Without the availability of a small borrowing facility to make the necessary accounting adjustment, the Government may be forced to purchase credits on the international markets at short notice in the event of a sudden short run shock in emissions, which may increase the cost of meeting a given target. In addition, the absence of either banking or borrowing may marginally increase the likelihood of needing to review the budget profile.

Costs:

3.3.17 Banking may increase the uncertainty surrounding the precise profile of emissions reductions. Unrestricted, banking could potentially lead to emissions being concentrated in time. Overall the impact on certainty can be limited through the establishment of clear rules surrounding the operations of this element of the framework as well as transparent advice and analysis by and for Government.

3.3.18 Borrowing may impose a cost by reducing predictability surrounding the precise profile of emissions reductions, reducing the certainty provided by the framework. Furthermore, it might limit the potential of Government to deliver the following carbon budget, thereby reducing credibility in the overall framework. Box 4 outlines these indicative impacts in the first two budget periods. As noted, these risks provide a strong argument for limiting the extent of the possible use of this mechanism. There may also be presentational costs associated with allowing borrowing, since this facility is not currently allowed under the Kyoto Protocol or EU-ETS. Under both frameworks, there is a legal obligation to deliver reductions in emissions irrespective of prevailing economic, technology and weather conditions (which the UK has always supported).

3.3.19 However, these costs are likely to be limited due to the fact that:

- the Bill proposes unilateral long term targets, which could put additional risks on UK competitiveness, so additional flexibility is desirable;
- borrowing would not be permitted in relation to emissions reductions obligations under multilateral agreements; and,
- the Bill proposes a series of carbon budgets (agreed unilaterally three periods ahead); as such, unlike in the multilateral context, the level of the subsequent budget from which we would be borrowing is clearly defined.

Box 4: Considering the Impact of Borrowing on Chances of Meeting Carbon Budgets

As outlined in Section 2.2, there are a number of uncertainties that affect the UK’s ability to stay within a given carbon budget. Based on the Government’s own assessment of market uncertainties (although not those affecting the effectiveness of mitigation policies directly), it is useful to consider the potential impact of introducing a borrowing limit of up to 1% of a successive budget period on the likelihood of meeting:

- an illustrative carbon budget in 2008-12 (assuming no additional policy or purchase of overseas emissions reduction credits); and,
- an illustrative carbon budget in 2013-17 (assuming no further borrowing).

Table 3 below shows that introducing a borrowing limit of up to 1% would increase the likelihood of the Government meeting an illustrative carbon budget in 2008-12 (which it currently considers it would have a 75% likelihood chance of meeting, given existing policies and expectations of market uncertainties) by approximately 9%.

Table 3 Impact of Borrowing on Probability of Meeting Illustrative Carbon Budget, '08-12

Borrowing Rate	Probability of meeting 2008-12 budget
None	75%
0.50%	80%
0.75%	82%
1.00%	84%

However, borrowing in one period (particularly higher borrowing limits), reduces the potential of Government to meet subsequent budgets. For example, borrowing 1% in the 2008-12 budget period from the 2013-17 carbon budget (also set so that there is a 75% chance of meeting this budget) might reduce the likelihood of meeting this later budget by 9%, whereas a 2% borrowing limit might reduce this probability by 19% (given existing policies and expectations of market uncertainties). However, the probabilities outlined above do not account for uncertainty around the delivery of policy measures.

Policy uncertainty can vary substantially depending on the particular policy (or mix of policies), with policies designed to influence behaviour at a given carbon price often being subject to more uncertainty than fiscal measures or cap and trade schemes (which fix emissions quantities).⁵⁰ However, the overall level of uncertainty is likely to reduce as a result of, for example: the expected increased importance of the EU-ETS in the overall mix of mitigation policies; and a reduced capacity to fuel-switch between gas and coal in the generation sector, which would lead to higher emissions if coal was chosen over gas.

Issue 8 - Enabling powers to introduce trading schemes through secondary legislation

3.3.20 The Bill includes provisions to introduce new powers to enable a broader range of trading schemes to be implemented through secondary legislation. Once a sector is covered by a trading scheme, the level of its total emissions is guaranteed. The enabling power would not remove the requirements for a full assessment, following the principles of better regulation, of the impacts of any potential scheme.

3.3.21 The Stern Review outlined three broad mechanisms for establishing a carbon price (a key element of the recommended overall mitigation strategy), either: explicitly through direct taxation or the establishment of cap and trade schemes or implicitly, through regulations such as energy performance standards. The choice of intervention is influenced by the particular market which a policy targets: each generic policy instrument (sometimes in combination) is appropriate in certain circumstances. The taking of powers to introduce a particular instrument does not prejudice future policy decisions surrounding the most appropriate instrument in each particular market and time period.

3.3.22 The ease and legal foundations with which these interventions can be made by Government, in seeking to manage carbon emissions, differs for each mechanism. Changes in fiscal policy are already 'enabled' in the sense that they can be made annually as part of the Finance Act. Similarly the Government is enabled to regulate building markets while the EU institutions largely regulate product markets. The Pollution Prevention and Control Act (1999) enables the Government to introduce trading schemes

⁵⁰ Analysis conducted for the National Audit Office (http://www.nao.org.uk/publications/nao_reports/06-07/climate_change_projections.pdf) showed that the Climate Change Programme measures had an uncertainty range roughly equivalent to around 100% of the central expectation of emissions reductions abatement by 2010. This represents 15% of the entire uncertainty surrounding CO2 emissions for this period.

for large industrial sources of emissions within Great Britain.⁵¹ However, it cannot be applied to establish schemes which:

- cover numerous small consumers, for example within heat and transport markets; or
- target sources of emissions at other points in the energy chain (e.g. fuel suppliers, end users of electricity).

Benefits:

3.3.23 Currently to introduce trading schemes in markets not covered by the EU-ETS, the Government would be required to introduce further primary legislation to establish the necessary powers. Failing to take the opportunity to lift constraints to allow for the introduction of trading schemes in secondary legislation could increase:

- the volume of emissions reductions financed internationally (rather than achieved domestically potentially at lower cost); and / or,
- the risk of Government needing to implement more expensive policy options (due to time constraints).

3.3.24 Allowing the introduction of trading schemes across the economy through secondary legislation would reduce the lead-time for implementing these policies, which will add an important element to the policy mix for meeting the targets and budgets in the framework. The provision increases the ability of Government to develop and strengthen the policy framework to better ensure budgets can be met. In the absence of such powers, the Government would be required to introduce further primary legislation to establish the necessary powers requiring Government time and resources to prepare as well as Parliamentary time to approve.

3.3.25 Taking powers now would reduce future pressures on the legislative programme by allowing the core building blocks of any scheme to be developed and scrutinised once rather than repeatedly in primary legislation.

Costs:

3.3.26 As outlined earlier, there are a range of mechanisms with which to establish a carbon price which also include the use of direct taxation and regulations such as energy performance standards. Taking such enabling powers could be perceived as prejudging future policy decisions surrounding the most appropriate instrument in each particular market and time period, although Government could mitigate this risk by clearly outlining its approach to using these powers and the principles it intends to be guided by.

3.3.27 The Bill provides for the introduction of regulations that could create offences relating to trading schemes and to specify the penalties for such offences. The cost of these measures, and the cost of court time will be considered as part of the Impact Assessment of any scheme brought in.

3.4 Provisions to enhance the reporting framework

Issue 9: Reporting of the UK's progress towards its carbon management objectives.

3.4.1 The Bill contains provisions to require the Committee to produce an independent assessment of the UK's progress to achieving its targets and budgets, in an annual

⁵¹The IPPC Act does not extend to Northern Ireland. These powers have not been used for climate change measures to date as the UK emissions trading scheme was introduced as a voluntary mechanism and the EU-ETS was introduced using the European Communities Act. They will however be used in combination with powers in the European Community Act to introduce the proposed SO₂, NO_x and particulate trading scheme.

report to Parliament. The Government should produce a response to the Committee's report each year, also to Parliament. In addition, every five years, following the release of the final, validated data to show emissions in the last year of a budget period,⁵² the Committee report should include a comprehensive assessment report on whether the budget was actually met, and the implications of this for current and future actions to stay on track to meet the legislated targets.

Benefits:

- 3.4.2 Involving the Committee in the annual reporting process would increase the independence and credibility of the reporting framework because:
- the Committee would publish independent advice and analysis on progress towards budgets and targets; and,
 - the Government would be required to respond explaining, where necessary, why the advice of the Committee has not been adopted.
- 3.4.3 This would provide an independent assessment to Parliament of the progress the government has made in meeting the statutory emissions reduction targets. This transparency will give additional credibility to the framework and may therefore help households and firms form expectations regarding future emissions reductions requirements. The reporting requirements will also provide for a consistent approach to reporting of progress against the long run target.

Costs:

- 3.4.4 The Government is already legally required to produce an annual assessment of its progress on greenhouse gas emissions reductions, under Article 2 of the Climate Change and Sustainable Energy Act 2006⁵³. However, the cost of the Committee monitoring the Government's progress would be marginal given that the Committee would necessarily have a Secretariat tasked with doing analysis and assisting the Government in various matters.

Issue 10: Requirement for the Government to report on adaptation.

- 3.4.5 There are currently no legal requirements on the Government to report on or monitor the risks of climate change and the progress the Government is making in adapting to these risks, but there is growing recognition of the need for a more coherent approach⁵⁴. A statutory duty to report on adaptation makes more certain of this and future Government's intentions to acknowledge the risks imposed by climate change for the UK, and address these risks through a coherent strategy.
- 3.4.6 The Bill requires the UK Government to take two main steps in relation to adapting to the impacts of climate change:
- Publication of a UK risk report at least every 5 years; and
 - Publication of an adaptation programme covering England and reserved matters, based on the principles of sustainable development.

Benefits:

⁵² Due to the international reporting framework there is a 15 month time lag on the publication of this final, validated data. Hence for the 2008-12 budget period the comprehensive assessment report final data would be published in spring 2014.

⁵³ Available from: <http://www.opsi.gov.uk/ACTS/acts2006/20060019.htm>

⁵⁴ The overwhelming response to a Government consultation in 2005 on the development of an adaptation policy framework was that this would be useful in helping to coordinate adaptation action, both at local level and across Government. It was also felt that the time was right for a national framework to provide strategic direction, outline priority areas for action and develop methods for trying to avoid cross-sectoral inconsistencies.

3.4.7 The benefits of a risk assessment are wide-ranging, depending on its interpretation and application through work programmes put in place by the UK Government and devolved administrations. Programmes which take the identified risks into account and are then implemented fully could have significant long-term benefits, minimising environmental, social and economic impacts related to climate change.

Costs:

3.4.8 The costs and benefits of these requirements are difficult to quantify. Broadly speaking, there would be a marginal cost to Government of carrying out the risk assessment. The requirement to publish a programme essentially sets in statute work which is already under way, so the additional costs involved would be negligible. There could be costs associated with implementing measures set out in the programme; as with mitigation measures, these would be assessed individually.

3.5 Assessment of measures in the Bill

3.5.1 The Bill proposes a package of measures, which would in summary:

- set statutory targets for 2050 and 2020, and five year carbon budgets;
- establish the Committee on Climate Change (the Committee) to advise the Government on the setting of targets and carbon budgets;
- provide the ability to review budgets and targets as a result of significant developments in relevant circumstances;
- allow for inclusion of non-CO₂ gases in the Bill's targets and budgets at a later stage;
- allow for the UK's share of emissions from international aviation and shipping to be included in the Bill's targets and budgets at a later stage;
- allow emissions reductions overseas to count towards the targets and budgets;
- permit banking and limited borrowing between budget periods;
- include enabling powers to introduce trading schemes through secondary legislation;
- require annual reporting on progress towards targets by the Committee (with Government responses to those reports);
- require the publication of a Government programme on sustainable adaptation.

3.5.2 In addition, the Bill contains provisions to enable:

- reductions in the administrative and compliance costs of the Renewable Transport Fuels Obligation, which aims to reduce the carbon emissions from road transport by obliging fuel suppliers to include 5% biofuels in transport fuels sold; and
- provides a power to pilot local authority incentives for household waste minimisation and recycling, in order to reduce waste to landfill.

3.5.3 The overall package of measures is intended to provide a framework for long term emissions reductions in the UK and to provide certainty around the UK's ambition to tackle climate change. The system of carbon budgets will provide predictability to

households and firms about the short run profile of emissions reductions. Robust and transparent advice from the proposed Committee will be necessary to ensure the credibility of the targets, and to demonstrate commitment to tackling climate change.

- 3.5.4 The measures in the Bill are designed to balance the need for increased predictability with the need to retain some flexibility in order to minimise the potential impacts for the UK. Flexibility will allow the Government to consider any adverse impact on the UK's wider economic, social and policy objectives, which will be particularly important given the unilateral nature of the targets, and the need to be mindful of competitiveness impacts on UK businesses. This flexibility will be provided by:
- allowing emissions targets and budgets to be met by a degree of purchasing emissions reductions credits from overseas, allowing least-cost abatement measures to be utilised regardless of their location (i.e. whether at home or abroad);
 - allowing both the banking and limited borrowing of emissions rights between carbon budget periods, in order to adjust the emissions reduction pathway without affecting total cumulative emissions, and crucially without unduly harming the credibility and predictability of the emissions reduction pathway; and,
 - providing the ability to review the level of statutory carbon targets and budgets if the basis on which the target or budget was initially set has significantly changed, and only following advice from the Committee and with approval from Parliament.
- 3.5.5 The package of measures includes a number of checks and balances surrounding the proposed flexibility mechanisms in the framework, in order to minimise their impacts on uncertainty, in particular:
- amendments to targets and budgets are permitted, but only when significant developments occur, following advice from the Committee and a vote in both Houses;
 - the requirement for Government to seek the advice of the Committee before amending the 2050 target for emissions reductions;
 - non-CO₂ greenhouse gases to be included in the target only at the beginning of a budget period;
 - report annually to Parliament on the level of emissions and credits;
 - increased Parliamentary scrutiny through the greater use of the affirmative procedure in some areas where previously the draft Bill envisaged the negative procedure;
 - the ability to count overseas credit purchases towards the target will be subject to the UK's international legal obligations; and,
 - the use of banking and limited borrowing between budget periods is subject to the advice of the Committee, and a strict limit of 1% on inter-budgetary borrowing.

4. Small Firms Impact Test

- 4.1 The Government recognises that small business account for significant quantities of emissions. For example, the Carbon Trust identified that small and medium-sized enterprises (SMEs) with less than 50 employees in manufacturing sectors or 250 employees in service sectors accounted for approximately 37MtCO₂ of emissions in 2002. In addition, it identified a total cost effective abatement potential of approximately 7.9% (based on a 15% discount rate).⁵⁵
- 4.2 In delivering the proposed statutory objectives, it is likely that SMEs will be affected potentially by both specifically targeted measures as well as wider policies, such as the Renewables Obligation, designed to reduce the carbon intensity of key energy services.

⁵⁵ The Carbon Trust: "The UK Climate Change Programme: Potential evolution for business and the public sector".

These are likely to raise the costs of energy, with subsequent risks to output and employment. However, these risks are likely to be very limited in the case of service sector SMEs, which typically incur a low ratio of energy to total costs, and reduced more generally through the promotion of greater resource efficiency.

- 4.3 The Government recognises that, in designing and implementing policies designed to tackle SME emissions directly (or more general policies affecting this sector), it needs to take account of their often limited capacity to meet detailed or complex compliance requirements. For example, it has taken care to ensure the exemption of small emitters from current emission trading schemes. The development of any future policies will be the subject of detailed impact assessments which will include analysis of impacts on small firms.
- 4.4 The Small Business Service was provided with a copy of these proposals prior to public consultation, and acknowledged our approach and findings.

5. Competition Assessment

- 5.1 This impact assessment does not include a Competition Assessment. This is because the proposals contained within this Bill do not provide for the specific policies and, therefore, the specific impacts on competition within individual markets cannot be considered. However, a discussion of generic distributional issues is included in Section 2.3. Detailed Competition Assessments will be undertaken as part of the Impact Assessment for any policies which are put in place to meet the requirements of the Bill.

6. Administrative Burdens

- 6.1 This Impact Assessment does not include any analysis of the potential additional administration burdens of the policies that may be implemented to reach the objectives of the Bill. Any change in administrative burdens will be considered as part of the Impact Assessments for any proposals brought forward to meet the objectives of the Bill.

7. Enforcement, sanctions and monitoring

- 7.1 The Bill includes a number of checks and balances surrounding the proposed flexibility mechanisms in the framework, in order to ensure transparency and accountability. There is a requirement for the Committee to report annually to Parliament on the level of emissions.
- 7.2 Minor adjustments to the timing of emissions reductions, in the form of banking and limited borrowing proposed under Issue 8 (Section 3.4), would be subject to advice from the proposed Committee. Any use of the wider review clauses enabling the Government of the day to revise the statutory targets or budgets in the event of significant developments in relevant circumstances, would be subject to Parliamentary approval under an affirmative resolution procedure.
- 7.3 Responding to climate change is an increasingly high priority of households, firms and elected representatives. The Bill therefore requires that if emissions exceed the target set, the Government present an explanation to Parliament on the reasons for the deviation. In addition, the Government would be exposed to the possibility of Judicial Review. In such instance, the Government could be required to take remedial action by order of court.

- 7.4 These proposals give the Committee a primary function in reporting on progress towards meeting the budgets and targets, maintaining a consistent approach regardless of the Government of the day. Requiring the Government to respond to the Committee's annual report ensures that Parliament and the public are able to monitor policy in this area and that the Government can be held to account annually in Parliament.

8. Implementation and delivery plan

- 8.1 It is expected that the Climate Change Bill will be enacted in Summer 2008. The following milestones are then envisaged:
- the Committee will lay a report before Parliament, recommending to the Government the level of the first three carbon budgets, for the periods 2008-12, 2013-17 and 2018-22 by 1 September 2008;
 - the Government will set the level of these carbon budgets in secondary legislation, following a Parliamentary process (Order requiring affirmative resolution); it must set these budgets by 28 February 2009 ;
 - the Government will, as soon as reasonably practicable, publish a strategy explaining its policies and proposals for keeping within the budgets that it has set;
 - the Government will be required to set the next budget, for the period 2023-28, in secondary legislation following further advice from the Committee, by 31st December 2010 (at least 11 years before the start of the 2023-28 budget period), again publishing a strategy outlining how it intends to keep within the budget; and,
 - subsequent budgets will be set in the same way, in each case at least 11.5 years before the start of the budget period.

9. Post implementation review

- 9.1 The post-implementation review will focus on the UK's performance towards meeting its legislated carbon budgets and targets, and will be ongoing, as detailed in the reporting requirements of the Bill. Specifically this means that the following reviews will be required:
- an annual report by the Committee, laid before Parliament, assessing the UK's performance and progress towards achieving its legislated targets and budgets. The first report will be due by 30th June 2009;
 - a Government response to the Committee's annual report, laid before Parliament by 15th October 2009;
 - a repetition of this process by the same dates of each subsequent year; and,
 - in the Committee's annual report for 2014 (when all of the relevant data for the first budget period becomes available) a statement of its views on the manner in which the Government carried out its functions in relation to meeting its legislated budget for the period 2008-12; this statement will then be repeated after each budget period, when all data for that budget becomes available – in 2019, 2024, 2029 etc.
- 9.2 The post-implementation review will evaluate performance against a number of key measures of success, in particular focusing on:
- the impact of the framework on emissions of carbon dioxide;
 - the impact of the framework on investment in R&D and diffusion of low-carbon technologies across all sectors of the UK;
 - the costs and benefits of the chosen emissions reduction pathway (in the context of a range of potential alternatives); and,
 - progress towards the achievement of deeper cooperation as part of the UNFCCC and EU-ETS processes.

Specific Impact Tests: Checklist

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

Annex A : Impact Assessment for RTFO Provisions in the Climate Change Bill

- A1.** The Renewable Transport Fuel Obligation (RTFO) will be introduced in April 2008 under the Renewable Transport Fuel Obligations Order 2007 which was made on 25 October to bring the scheme into effect. An Impact Assessment accompanied the Explanatory Memorandum for the order and can be viewed at:
- http://www.opsi.gov.uk/si/em2007/uksiem_20073072_en.pdf
- A2.** Broadly speaking, the implementation of the RTFO provisions in Schedule [5] to the Climate Change Bill would result in a net saving for transport fuel suppliers and for the Administrator of the scheme.
- A3.** Schedule [5] enables the appointment of a new Administrator of the RTFO scheme to replace the Renewable Fuels Agency as appointed under the order. The new Administrator could be the Secretary of State and this would reduce the cost to the Exchequer as the role would be performed by one of the Department for Transport's existing Executive Agencies or a branch within the Department. This means that the Administrator could more easily share the resources of the Agency or Department including HR, finance staff and systems, and IT infrastructure. Also there would not be a requirement for a separate Board. This could result in total cost savings in a range between £100,000 to £300,000 per annum depending on the exact arrangements for the existing Administrator and the new Administrator (and allowance would need to be given for the costs associated with transferring the functions, which again would depend upon the exact arrangements).
- A4.** The provision for an information sharing gateway with Her Majesty's Revenue and Customs (HMRC) would reduce the need for the Administrator to require evidence of fuel sales or for independent auditing and thereby reduce the administrative burden both on transport fuel suppliers and on the Administrator. The provision would also reduce the amount of compliance and inspection work that the Administrator would need to carry out. It is estimated that this might result in an annual saving of around £135,000 per year to transport fuel suppliers (as an industry), and up to £300,000 per annum to the Administrator. Such a provision could also benefit small businesses as the administrative burden of complying with the scheme would reduce. It would have a negligible impact on competition.
- A5.** Under the RTFO an obligated supplier can discharge the obligation by making a buy-out payment instead of producing certificates showing that renewable transport fuel has been supplied. The Energy Act 2004 requires that these buy-out payments are redistributed (or 'recycled') among transport fuel suppliers. Under the order the payments will be recycled to transport fuel suppliers who redeem or surrender certificates. The Bill provides that the RTF order may instead require that the buy-out payments be paid by the Administrator to the Secretary of State (or kept by the Administrator if the Administrator is the Secretary of State) for payment into the consolidated fund. If implemented this could have a positive impact on public finances (up to a theoretical maximum of £170 million per annum if the market was very short on biofuels). However, it is intended that the option for buy-out payments to be paid into the consolidated fund will only be exercised in the unlikely event that recycling proves to have a negative effect on the Government's policy objective of encouraging the supply of renewable fuels. For example, if only a relatively small number

of biofuel producers were able to claim a disproportionately large amount of money through the fund. If this happened the RTFO might provide a lot of support to a small number of companies rather than achieving the policy objective of encouraging all transport fuel suppliers to supply renewable fuel. This overcompensation could also raise state aid issues.

- A6.** It is likely that at least for the first few years of the scheme, the value of the buy-out fund will be very small as there is a strong incentive for obligated suppliers to sell renewable fuel rather than making a buy out payment (given the total package of support measures which comprise the duty incentive for biofuels as well as the buy out payment). This makes it unlikely that the option not to recycle buy-out payments would have to be exercised in the short term and means that, if it were exercised, the positive impact on public finances would be much more limited.
- A7.** The Bill imposes a new duty on the Administrator to promote the supply of renewable transport fuel which reduces carbon emissions and contributes to sustainable development. This might, for example, include publishing information about the environmental effects of biofuels, undertaking research into how to promote good biofuels or providing training or guidance about the benefits or detrimental effects of certain biofuels. It is not expected that this will result in significant cost implications.
- A8.** The Bill contains a new power for the Secretary of State to give written directions to the Administrator concerning the exercise of the Administrator's power to require information from transport fuel suppliers. This power of direction is unlikely to impose additional administrative costs on suppliers or the Administrator. The Administrator will under the order require transport fuel suppliers applying for certificates to provide information about the carbon and sustainability of their biofuels in a certain form or using a particular methodology for measuring carbon savings and assessing sustainability. The power of direction is required to ensure that the Secretary of State could remedy the position in the unlikely event that the requirements imposed by the Administrator did not contribute effectively to government policy or were otherwise unsuitable, for example if they imposed too great a burden on transport fuel suppliers. In exercising the power the Secretary of State would endeavour not to do so in a way which imposed additional administrative costs.
- A9.** The Bill also provides a new power for the Secretary of State to give written directions in relation to how the Administrator counts amounts of biofuel for the purpose of issuing certificates. This power of direction is unlikely to impose additional administrative costs on suppliers or the Administrator. Under the Energy Act it is possible for the RTF order to link the issue of certificates with the carbon savings or sustainability of the biofuels concerned. Because the calculation of carbon saving and sustainability is complex and technical it is likely that the order would require the Administrator to determine and publish the methodology to be applied. The power of direction is required to ensure that the Secretary of State could remedy the position in the unlikely event that the methodology adopted by the Administrator did not contribute effectively to government policy or was otherwise unsuitable, for example if it imposed too great a burden on transport fuel suppliers. In exercising the power the Secretary of State would endeavour not to do so in a way which imposed additional administrative costs.
- A10.** The Bill also allows the RTF order to make references to documents as revised or re-issued from time to time when making provision for counting amounts of biofuel. This will enable the order to refer to international standards relating to carbon saving and sustainability without the need to amend the order every time a change is made to the international standard. It will therefore save the costs of making a new order in these circumstances.

Annex B: Carbon Reduction Commitment Information Gathering Powers in the Climate Change Bill

- B1. The Carbon Reduction Commitment is a new mandatory cap and trade emissions trading scheme covering all energy use emissions from up to 5,000 organisations with electricity consumption in excess of 6,000MWH per year from mandatory half-hourly meters. In the Energy White Paper, Government announced that it would implement the scheme, starting in 2010.
- B2. The information gathering power is necessary to begin identifying organisations covered by the scheme. Government is consulting on an identification process which requires energy suppliers to provide a list of all mandatory half-hourly meters in the UK and their electricity consumption for 2008. The process also requires electricity users to collate their organisation's total electricity consumption from mandatory half-hourly meters and confirm to Government whether it meets the inclusion threshold. This process may take up to 12 months to administer.
- B3. Government is keen to begin the exercise as early as possible in 2009 in order to give potential participants sufficient time to assess whether they are covered by the scheme, and to begin preparing for the new regulation. Without an information gathering power Government will not be able to begin this process until CRC regulations come into force, which depending on parliamentary process may be April or October 2009. Relying on secondary legislation may, therefore, restrict Government's ability to identify participants in time for the scheme to start in 2010, and could place undue administrative burdens on potential participants because of reduced timescales to respond to information requests, as well as reducing the time available for participants to prepare for the scheme.
- B4. The costs associated with the use of these powers has already been included in the updated version of the Partial RIA which was published in June 2007. The costs which were included in this Partial RIA are those identified by Hedra in their 2007 report, "How is the successful qualification of EPC (now CRC) organisations ensured".⁵⁶ Note the figures presented below have been updated since the Partial RIA was published, and will be included in the final Impact Assessment for the policy.
- B5. The total costs relate to those upon Government (producing guidance, building the database and populating the database), electricity suppliers (sending information to customers and producing an electronic file extract)⁵⁷ and the organisations themselves (determining whether or not they are included in the CRC)⁵⁸. The total cost of the above is estimated to total approximately £5.5 million every four years.

⁵⁶ Available online at: <http://www.defra.gov.uk/environment/climatechange/uk/business/crc/pdf/hedra-report.pdf>

⁵⁷ This was not included in the updated version of the CRC Partial RIA.

⁵⁸ This figure has been re-calculated and is now slightly higher than the figures included in the updated version of the CRC Partial RIA.

Annex C: Glossary of Terms and Abbreviations

Annex I Countries	Definition for Kyoto Protocol. Industrialized countries that were members of the OECD (Organisation for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States
BERR	Department for Business, Enterprise & Regulatory Reform (formally the Department of Trade & Industry)
CCPR	UK Climate Change Programme Review
Clean Development Mechanism (CDM)	The project mechanism provided for under Article 12 of the Kyoto Protocol. These are projects in developing countries which reduce emissions of greenhouse gases or enhance sinks.
CO₂	Carbon Dioxide
CO_{2e}	Carbon Dioxide equivalent: an internationally accepted measure of Global Warming Potential (GWP) of greenhouse gases (GHGs). The CO _{2e} represents the amount carbon dioxide with the same global warming potential (GWP), as a single ton of the GHG.
CRC	Carbon Reduction Commitment is a new mandatory cap and trade emissions trading scheme covering all energy use emissions from up to 5,000 organisations with electricity consumption in excess of 6,000MWH per year.
EU	European Union
EU-ETS	European Union Emissions Trading Scheme
EWP	Energy White Paper
G8	Group of 8 of the world's major industrialised economies (Canada, France, Germany, Italy, Japan, Russia, UK, USA), with the European Commission also represented at meetings.
GDP	Gross Domestic Product
Gleneagles Dialogue	Forum for participating countries to work together on the shared challenges of addressing climate change, energy security and access to energy. The Dialogue also oversees implementation of the Gleneagles Plan of Action, which aims to increase the speed with which we reduce greenhouse gas emissions.
Global Warming Potential (GWP)	A measure of how much a given mass of a greenhouse gas is estimated to contribute to global warming. It is a relative scale which compares the gas in question to that of the same mass of carbon dioxide (whose GWP is by definition 1). GWP figures are provided and reviewed by the IPCC.
IEA	International Energy Authority
IPCC	Intergovernmental Panel on Climate Change: A UN body set up to “ <i>assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation.</i> ” For further details please see: http://www.ipcc.ch/
IETA	International Emissions Trading Association
Joint Implementation (JI)	The project mechanism provided for under Article 6 of the Kyoto Protocol. These are projects undertaken in developed countries with targets which reduce emissions of greenhouse gases or enhance sinks.
Kyoto Protocol	The Kyoto Protocol to the UNFCCC. Negotiated in Japan in 1997, it came into force in February 2005. Among other things, the Protocol sets binding targets for the reduction of greenhouse gas emissions by industrialized countries.

MARKAL-Macro	A model of the UK energy system which incorporates a 'top down' macroeconomic component to facilitate the explicit calculation of macroeconomic variables (such as GDP). The model can also capture changes in the demand for energy in response to changes in the price.
Marrakech Accords	Agreements reached in 2001 which set out the detailed provisions building on provisions of the Kyoto Protocol, including those relating to supplementarity, CDM and JI.
ppm	Parts per million: measurement of atmospheric concentration of greenhouse gas.
Stern Review	A recent review lead by Sir Nicholas Stern on the economics of climate change. See the Treasury's website - http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm
Supplementarity	The principle that the use of the project mechanisms should be supplemental to domestic action to reduce greenhouse gas emissions.
UNFCCC	United Nations Framework Convention on Climate Change. 189 countries around the world have joined this international treaty that sets general goals and rules for confronting climate change. The Convention sets an ultimate objective of stabilizing greenhouse gas emissions "at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system." As a "framework" document it is something to be amended or augmented over time. Further information is available from: http://unfccc.int