Ecofys UK
78 Cannon Street
London EC4N 6NQ

tel +44 (0)20 7618 6646
fax +44 (0)20 7618 8001
e-mail info@ecofys.co.uk

DEVELOPING A CARBON BUDGET FOR THE UK

WITH OPPORTUNITIES FOR EU ACTION

- FINAL -

Alyssa Gilbert
Gemma Reece

September 2006
PECSGB062170

Supported by Friends of the Earth

EXECUTIVE SUMMARY

This paper is intended as a discussion paper on the concept of a carbon budget for the UK economy. As such, the paper introduces the concept of a carbon budget and explores different system designs that could be used to put such a budgeting system in place.

The aim in creating a carbon budget is to ensure that the necessary greenhouse gas emissions reductions that the UK is aiming for are genuinely achieved. A well-designed carbon budgeting system should help to achieve this aim by:

1. Raising the profile of greenhouse gas emissions reductions by apportioning ultimate responsibility to the highest levels in government;
2. Embodying a clear, sensibly devised emissions reduction profile for the long-term, which in turn would provide direction and certainty to business and policy makers;
3. Providing a structure for regular monitoring and review of targets; and
4. Providing flexibility for achieving reductions in different sectors of the economy and over time.

A **carbon budget** is a set amount of carbon that can be emitted in a given amount of time, either by the whole economy, or a pre-selected sub-population or set of activities.

The main advantages of a carbon budget approach, when compared to the existing approach where targets are set at 10 or 20 year intervals are:

- The use of stronger terminology in relation to greenhouse gas emissions savings;
- Development of a long-term national emissions profile over time, as opposed to snapshot targets at interim dates which give no indication of the full cumulative environmental impact, or the "area under the curve";
- Providing direction and certainty for businesses and investors in emissions reduction technologies;
- Better information provision allowing for more frequent monitoring and review procedures; and
- Providing opportunities for emissions trading between sectors of the economy within a clear division of effort.

This report explores the potential design features of such a scheme, taking lessons learned from existing budgeting schemes: HM Treasury budget and the EU Emissions Trading Scheme (EU ETS), as well as the proposed scheme for Domestic Tradable Quotas (DTQs).

This document also includes information about the existing processes in the UK that could act as the architecture for a carbon budget scheme – namely, the existing greenhouse gas reporting initiative, the Public Service Agreement (PSA) process and the current system for reviewing climate change policies.

As a result of this information, the report concludes that the carbon budget should be organised in a combination of a top-down and lower-level set of budgets (presented as option six). Under this design the budget is essentially a high-level system divided sectorally and designated to government departments, with the option for departments to use downstream schemes of budgeting to individual organisations as appropriate.

The table-below shows some of the key design elements of the proposed carbon budget scheme.

Design Element	**Preferred Design Option**
Profile and Responsibility	Prime Minister, with roles for government departments
Overall budget setting	Long-term, on the basis of total emissions profiles for sectors to 2050
Scope	Kyoto basket of gases, with aviation and shipping included
Reporting	Annually to Parliament, possibly with division to the policy level
Periods of commitment	Three year cycles (one PSA cycle) OR Five to Six year cycles preferred (in line with two PSA cycles providing better information on past performance at the ends of periods)
Key review process	Comprehensive Spending Review
Structural approach	Option 6 – an integrated approach, mostly high-level target setting with division to Departments and the option for further disaggregation based on their choices
Penalties	Overspending on the budget compromises future allocation to that sector in the next budget period.
Monitoring	Through current GHGI procedures.
Role of trading	Flexibility to allow choice to use trading downstream through individual departmental policies e.g. through the EU ETS in industrial sectors, by individuals etc. At the Government department level no trading will be possible, re-allocation will take place in the six-yearly review cycle
Flexibility/Borrowing	The ability to "borrow" emissions within the budget period such that *total cumulative* emissions remain within the budget over the period. Otherwise penalties will be incurred

In the UK existing processes are sufficiently developed to use for a carbon budgeting scheme as set out above. The carbon budgeting scheme can make use of existing greenhouse gas reporting processes and the Comprehensive Spending Review could provide a useful framework for setting departmental policy objectives. The phases of the carbon budgeting scheme should be either in three, or in five to six-year sections, in order to fit in with these review processes, and enable the desired flexibility within the scheme. The five to six year option provides the ability to collect better information on performance before reviewing the budget, as emissions information is only available after at least a 12 month delay.

Implementation of the carbon budget as set out above could involve the following steps:

- Assess and set the long-term UK carbon budget;
- Assess this budget at a sectoral level;
- Set appropriate policy targets with departments as part of the Comprehensive Spending Review, so that these are in line with financial spending. The overall long-term policy targets for emissions budgets would preferably be set five to six years (to cover one or two cycles). Three year cycles would be an alternative option (to match with financial targets and reduce the opportunity for emissions to increase at a rapid rate uncontrolled);
- The Prime Minister to report emissions annually in relation to the carbon budget in March, alongside announcements of the financial budget both at the high level and sectoral level;
- Review policies annually with the Prime Minister's report and design policy changes;
- Make appropriate changes to PSAs during **alternate**[1] spending review cycles, in line with the carbon budget cycle, on the basis of recommended policy changes in the annual Prime Ministerial reports;
- Allow borrowing of emissions within one carbon budget cycle.

The cost of the carbon budget system as outlined in this report does not represent a very high marginal cost to government. The majority of the processes that are necessary to enable the carbon budget to work are already in place, or have been proposed.

The final section of this study looks at the European context and investigates the feasibility of expanding such a concept more widely in Europe. It is considered possible for the UK to promote a similarly high profile scheme at the EU level. This could be worked towards in steps, perhaps starting with a harmonised, high-profile, EU-wide emissions reporting structure and then gradually move towards the full carbon budget process. The earliest steps would include an assessment of the scale of a budget at the EU level, and a concerted effort to integrate these limits into EU funding processes. At a later stage a long-term carbon budget could be formally set for the EU and the concepts of borrowing within periods etc. incorporated. The budget could then be further disaggregated to individual EU countries.

[1] Or during every spending review cycle if a three year carbon budget cycle is selected.

ECOFYS

Table of contents

1 Introduction

1.1 Introduction

This paper is intended as a discussion paper on the concept of a carbon budget for the UK economy. As such, the paper introduces the concept of a carbon budget and explores different system designs that could be used to put such a carbon budgeting system in place.

A carbon budget is a mechanism for embedding long-term total emissions restrictions into the economy. Carbon targets, as opposed to a budget, are only part of the picture, specifying snapshots of emissions in a given year. A carbon budget, however, seeks to capture the emissions profile of the economy over time.

Although this paper does come to a conclusion about an appropriate design for a carbon budget system, the main purpose of the paper is to illustrate that such a scheme could be possible and that, depending on the end-purpose, a suitable system design can be chosen.

1.2 International Climate Change Agenda

The Kyoto Protocol is the first international step towards reductions in atmospheric greenhouse gas levels. The Protocol has now been ratified and officially entered into force in 2005. The first commitment period runs from 2008-12, during which time signatories must meet internationally agreed target reductions in greenhouse gas emissions.

It is logical that countries, both under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC) and independently, are exploring mechanisms of ensuring that global reductions in greenhouse gases continue well beyond 2012, and in a manner that is in accordance with the appropriate levels of stabilisation of greenhouse gases in the atmosphere.

The UK is one of many countries that is considering appropriate long-term greenhouse gas emissions targets, and approaches to reaching these targets. This report seeks to explore a possible mechanism for keeping the UK on track to adhering to its climate change goals.

1.3 UK Greenhouse Gas Emissions Targets

Under the Kyoto Protocol to the UNFCCC, and within the EU Burden Sharing Agreement, the UK has made a commitment to achieve a 12.5% reduction of its greenhouse gas emissions on 1990 levels on average during the period 2008-2012. This

commitment includes the Kyoto basket of six greenhouse gases (CO_2, CH_4, N_2O, SF_6, HFCs, PFCs)

In addition to this international commitment, the UK has set a domestic goal of reducing CO_2 emissions by 20% (on 1990 levels) by 2010.

As a longer-term commitment, the UK has the goal of achieving a 60% reduction in overall greenhouse gas emissions by 2050, having made "real progress" by 2020. This recommendation was initially proposed by the Royal Committee on Environmental Pollution (RCEP) and later further enshrined in the UK's Energy White Paper published in February 2003.

Although the UK goals focus on CO_2, it is important to note that both the existing Kyoto Protocol and any successors to the Kyoto Protocol are highly likely to include the Kyoto basket of greenhouse gases, not just CO_2.

1.4 Targets versus total emissions

The complete set of UK targets, and the associated policies and measures, are important indicators that the UK is taking the climate change agenda seriously. However, by focusing on targets at set points in time there is a risk that the total volume of emissions released into the environment will be higher than desired. Figure 1 below shows that it is not only the target – but the way in which you reach it and the resulting emissions profile, the total "area under the curve" – that determines the total impact of the UK economy's emissions on the environment.

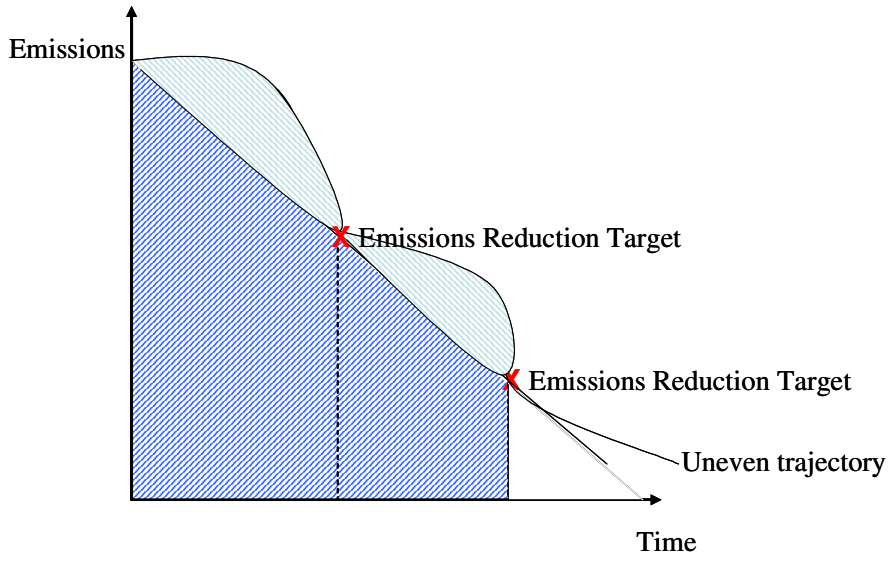

Figure 1 Potential profiles of emissions changes with time

The dark blue shaded area shows the total volume of emissions released into the atmosphere if emissions targets are met along a straight line trajectory. However this is unlikely to occur in a real life situation. If an uneven trajectory is followed, of the sort

shown by the curved lines, an additional volume of greenhouse gas is released (shaded light blue). By the same argument this line could fall below the straight line in places.

As it is the total volume of emissions that is important to the increase in climate change impacts, it is important to monitor a desired path towards a long-term goal, rather than simply setting and meeting medium-, and long-term targets.

This understanding illustrates the importance of setting more frequent targets than ones for e.g. 2010, 2020 and 2050, and monitoring and reviewing these aspirations regularly – even annually.

It is also important to note that due to the lifetime of greenhouse gases in the atmosphere, it is the total cumulative emissions that are important for the climate change impact. Avoided emissions now are in many ways more important than avoided emissions in the future. For example, CO_2 emitted in year one also has effects in years two and three and so on, whereas CO_2 emitted in year three starts acting in year three etc. The longer the time before significant action is taken to reduce emissions, the larger the required action will be.

This report proposes that setting an annual carbon budget for the UK economy that defines the pathway towards a pre-defined long-term goal is an appropriate, practical and effective tool to tackle this concern.

Furthermore, if this approach is structured within budgeting periods, an increased level of flexibility would be possible that could be compensated by inevitable fluctuations between years as a result of e.g. economic cycles.

1.5 What is a carbon budget?

The concept of a carbon budget can be understood in many different ways. Therefore the term carbon budget is more precisely defined here in relation to its use in this report:

> A **carbon budget** is a set amount of carbon that can be emitted in a given amount of time, either by the whole economy, or a pre-selected sub-population or set of activities.

Setting the budget

The budget can be set according to a variety of different approaches. Approaches include estimating the maximum tolerance of the environment to different concentrations of greenhouse gases resulting from emissions, or estimating the technical potential to achieve emissions reductions. In this report the former approach has been chosen and will be discussed in more detail.

Units

This report discusses the concept of a carbon budget measured in terms of the volume of carbon dioxide equivalent (CO_2e) emitted. This is calculated using the global warming potential (GWP) over a defined period for the different greenhouse gases, and expressing their climate change impact relative to the effect of carbon dioxide. Although there are always developments in this field of science and there are certain other important considerations, such as the differential impacts of gases emitted at different altitudes or in different temperatures, the UNFCCC uses a standard set of GWPs and expresses greenhouse gas emissions in terms of carbon dioxide equivalent (over a 100 year time period). It would be logical for the UK to continue to use this internationally agreed standard, and it is considered the most practical option in terms of monitoring emissions, understanding changes and considering the overall environmental impact of all greenhouse gases.

One alternative option would be to monetise the carbon values and therefore express such figures in terms of the financial value of the carbon. However the direct CO_2e reporting approach has been chosen here for two reasons. Firstly to maintain the focus on the actual volume of greenhouse gas emitted to the atmosphere, which is the key environmental parameter. Secondly, at the time of writing this report, a wide range of price reporting mechanisms were under development. Existing carbon markets show extreme price volatility, making monetisation both impractical and confusing. It is conceivable, however, that at some point in the future a carbon budget could successfully be translated into monetary terms for financial reporting purposes, although monitoring of the volume of CO_2e would still be paramount.

Scale

The concept of a carbon budget itself does not automatically relate to a certain scale. In theory a carbon budget could be set on a global, national government, company or individual level. A choice in relation to the appropriate scale of carbon budgeting is a further choice to make once a carbon budget is being used, and relates to the system within which a carbon budget is used.

In this report, the term carbon budget is used in its most general sense, and is initially interpreted at the level of the **UK economy**. The report goes on to consider both the relation to carbon budgets at the smaller scale, and the possible expansion of such a system to the European scale.

Scope

In this report, it is recommended that the carbon budget should cover all UK greenhouse gas emissions within the Kyoto basket, not solely CO_2, as environmentally it is emissions of all greenhouse gases that contribute towards climate change. Near-term UK targets have related to CO_2 emissions as these make up the largest single portion of overall greenhouse gas emissions, but in terms of both impact on the environment and obtaining a true long-term trajectory, it is important to target and reduce emissions of the Kyoto

basket of greenhouse gases (the Kyoto basket). Although a broader list of greenhouse gases than those included in the Kyoto basket of six is available at the UNFCCC level, for policy purposes it is also important that gases are attributable to clear actors, which is not always the case with the UNFCCC's long list.

Control
This report discusses the similarities and differences between a carbon budget for the UK and the current monetary budgeting process in the UK.

The most important similarity that is assumed in the design of a carbon budget is the high profile, and therefore level of control of the budget. It is proposed that the Prime Minister should have overall responsibility for the carbon budget politically, although there is a role to play for Secretary of State for Environment to drive climate change policy. This report proposes different mechanisms for translating the carbon reporting mechanism into further carbon abatement policy decisions.

System Design
Once a carbon budget for the UK government is set, there are various ways in which the responsibility and break down for this budget could be divided in order to manage emissions in the economy. This is an important element of the system design that is investigated further in this report.

Furthermore, the system needs to be:

- *Efficient* in terms of making use of the existing institutional infrastructure; and
- *Effective* in terms of being an actual route to stimulating the necessary emissions reductions to keep within a budget that truly achieves the designated environmental aims.

Trading versus budgets
Carbon budgets have been in the headlines most recently in relation to trading-type mechanisms. It is important to distinguish between budgets and trading at the outset of this report. A budget refers to the actual amount of carbon that is available – be it to a nation, firm or individual. A trading mechanism is a way in which division of this budget can be made more flexible.

This report is primarily concerned with a system in which a carbon budget can be set, managed and reviewed. The relationship of such a budget with trading options is considered as a potential next step, once a budgetary system is established. Trading can be a way to make budgeting at the small-scale (e.g. individual level) more practical and more appealing but having a budget does not necessarily mean having a trading system.

1.6 Coverage of this report

This report begins by outlining the aims and objectives of setting a carbon budget, and then describing the various elements of systems design that are important when devising

such a scheme. The report then continues by comparing and contrasting the proposed carbon budget with two existing systems – the EU Emissions Trading Scheme (EU ETS), and the economic budgetary system for the UK – and proposed scheme to introduce Domestic Tradable Quotas for carbon (or DTQs). This same section will then draw out the important similarities and differences between these schemes and the proposed carbon budget, making conclusions about a possible appropriate system design.

Chapter 4 of this report looks at the efficiency of the proposal – i.e. the ability of a carbon budgeting approach to work within the existing UK infrastructure, and the potential effectiveness of the scheme in terms of its ability to achieve a real improvement in emissions reductions. This same section will investigate the costs of such a proposal. The final section of the report will look at the type of experience that other European countries might be having with similar proposals, and the possible translatability of these scheme to the European level.

2 Carbon budget: Aims and Design

2.1 Why develop a carbon budget?

The aim in creating a carbon budget is to ensure that the necessary greenhouse gas emissions reductions that the UK is aiming for are genuinely achieved. A well-designed carbon budget system should help to achieve this aim by:

1. Raising the profile of greenhouse gas emission reductions by apportioning ultimate responsibility to the highest levels in government;
2. Embodying a clear, sensibly devised, emissions reduction profile for the long-term, which in turn would provide direction and certainty to business and policy makers;
3. Providing a structure for regular monitoring and review of targets; and
4. Providing flexibility to achieve reductions in different sectors of the economy and over time.

At the same time, as with any policy, a carbon budget should:

5. Represent a cost-effective policy option;
6. Avoid duplication with current structures;
7. Maximise synergies with existing processes and systems;
8. Provide as high a degree of certainty as is possible to business.

2.2 Advantages of a carbon budget

In some ways a carbon budget is not extremely different from the existing system of setting and monitoring interim targets, however there are some advantages.

A carbon budget differs in language, and makes it clearer that national emissions of greenhouse gases are strictly limited, and cannot be overshot. The terminology is stronger than that of targets, which can be more acceptably missed.

Secondly, the use of a long-term budget will help to ensure, as explained in section 1.4, that it is the total emissions profile that will be monitored over time, rather than snapshots of emissions reductions at wide intervals.

A corollary of this second point is that the budgeting system will aid policy-makers, rather than put them under pressure. A more regular monitoring and review system will help policy-makers better understand the way in which the UK's emissions profile is changing, and thus amend policies in response.

A long-term carbon budget would also provide direction and certainty for businesses and investors in emissions reduction technologies. A recent survey of FTSE 100 companies quoted in the Financial Times (31/07/06) found that "businesses are confused by the government's policies on climate change and the lack of clarity is hampering investment decisions." The Confederation of British Industry (CBI) have also made official statements stressing "the need for intermediate targets and milestones that take better account of business investment cycles, and for a streamlined policy framework which promotes technology development as well as action by all sectors of the economy."[2] This need to provide certainty and targets for business has been recognised by UK Government.

A carbon budget will effectively put a cap on emissions for the whole economy in a way that the EU ETS currently does for the power and industry sectors. The similarities between a carbon budget and the EU ETS are explored in section 3.4.2. However, the clear advantage of setting out a cap for the whole economy is that it enables new trading opportunities within sectors or between sectors. Although sector-level trading schemes are possible at present, first setting a transparent long-term cap for the whole economy – a "budget" – would be more likely to enshrine a fairer division of emissions rights across the economy.

In summary, the main advantages of a carbon budget are:

- Stronger terminology;
- Development of a long-term profile as opposed to snapshot targets;
- Added certainty for investors in emissions abatement;
- Allowing more frequent monitoring and review procedures; and
- Providing opportunities for emissions trading within a clear division of effort.

2.3 How to develop a carbon budget

The development and implementation of a carbon budgeting scheme will involve several stages – these can all be considered areas where the design of the approach is important.

These are:

a) The scope of the budget;
b) Setting the overall budget at the level of the UK economy;
c) Dividing the budget further;
d) Apportioning responsibility for the budget;
e) The process for monitoring and reviewing progress;
f) Penalties for not adhering to the budget;
g) Flexibility in the budgeting system, including the ability to "borrow"; and
h) The role of trading in relation to the budget.

Issues a-d are explored further in this chapter, whilst Chapter 3 deals with the remaining design issues by comparing the carbon budget model with existing systems. Chapter 4

[2] CBI Weekly Update on Vital Business Issues, Issue 38, Week Ending 7 October 2005

also provides further detail in relation to issues d and e on the basis of the existing infrastructure available.

2.3.1 Scope of the budget

In designing the carbon budget, the scope of coverage has to be considered. The concept of a carbon budget for the UK extended to 2050, and even beyond should not be confined to our current understanding of the international agenda as defined by the Kyoto Protocol and existing emissions reduction initiatives.

The purpose of a carbon budget in this context is to achieve an ultimate environmental aim and, as such, it is important that all greenhouse gas emissions which will affect the global atmosphere are included. Therefore a system will include:

- All six groups of greenhouse gases recognised by the Kyoto Protocol, being CO_2, CH_4, N_2O, SF_6, HFCs and PFCs[3]; and
- All sources that can be attributed to the UK including aviation and maritime emissions;

However, it is proposed that the carbon budget system should not enable leakage in the form of purchase of emission reductions outside of the UK. The main purpose for this stipulation at this stage is practical. The post-2012 global emissions reduction regime may include commitments to reduce emissions by all countries and the structure which currently exists to purchase emissions reductions in different countries (through the Kyoto flexible mechanisms of Joint Implementation, Clean Development Mechanism or International Emissions Trading) may look very different in the future.

Furthermore, purchasing reductions in other countries effectively offsets emissions that are higher than budgeted for in the UK. As a result this so-called leakage means that the initial environmental targets are not actually reached, yet this fact is disguised in the figures reported.

Therefore, because of this uncertainty, and in order to ensure the integrity of making a certain contribution to the environment, mechanisms for such leakage will not be included.

However, any carbon budgeting system should be designed in a flexible manner that would allow for the inclusion of international trading mechanisms at a future date.

2.3.2 Setting the overall budget

The first step in establishing a carbon budget will involve setting out the long-term target and expressing this target in terms of a clear emissions profile. A great deal of work has been done already to demonstrate that the UK can meet its target of a 60% (or more) reduction in greenhouse gas emissions by 2050 domestically through a range of

[3] Although there is a wider range of greenhouse gases recognised at the UNFCCC level, this is the most practically measurable group to choose

measures[4] and through a different combination of scenarios both in terms of economic growth, and the adoption of different low carbon technologies or approaches.

The overall greenhouse gas emissions reduction goal can be set by assessing the maximum acceptable impacts of climate change and therefore the required stabilisation level of greenhouse gases in the atmosphere. Much of this work is already being carried out by the international community within the Intergovernmental Panel on Climate Change (IPCC). It was this environmental-effect-led approach that was behind the RCEP recommended long-term goal, and such an approach has been further enshrined in UK policy since.

This approach will entail a roughly three percent decrease in emissions annually from now until 2050. However, the trajectory towards meeting this emissions profile (i.e. area under the 3% reduction line) could acceptably differ from the linear path, provided the overall emissions from the UK economy over the period from now to 2050 remain the same as if these reductions were achieved in a linear manner.

Alternatively, the carbon budget could be set based on estimates of the technical potential to achieve emissions reductions in a given timeframe. This could be done sector-by-sector in a detailed bottom-up approach, or on the basis of an economy-wide list of policies and measures. Such an approach has the advantages of engaging with the sectors in question directly, and bringing them on board, and ensuring that the goals are truly feasible and not overly-costly.

The first approach has been chosen here for two reasons:

1. The main aim for a carbon budget is to achieve an environmental goal, and therefore it is important that the overall budget is determined by the environmental constraint; and
2. Evidence in accompanying reports has been drawn together to show that the environmental targets being proposed are within technical reach of the UK economy. [4]

It is not intended that a strict environmental goal should be set that puts pressure on the economy, thereby being costly. Reducing the economic impact of the environmental target is one of the main reasons for proposing the development of a budget in the shape of a long-term trajectory. A clear pathway will enable the least-cost long-term options to be found, and should provide certainty across the economy in relation to the support that the government will provide for the establishment of such a low carbon future.

[4] Report by the Tyndall Centre for Friends of the Earth, September 2006, Living within a carbon budget, as well as a range of work carried out by the Tyndall Centre under the title of the project "Decarbonising the UK."

2.3.3 Dividing the National Budget further

Once the overall scale of the national budget has been decided the budget could be disaggregated to a further degree:

- At the highest level, the budget could remain a high-level, whole economy figure;
- It could be further broken down into sectors;
- The budget could be even further divided to the level of certain types of service providers such as companies providing electricity, housing, cars etc.;
- At its most detailed the budget could be divided at the level of the end-user, both individuals and companies or other organisations.

The level at which the budget is divided is an important systems design choice and relates to the overall aims of the system and to issues of practicality and feasibility.

Regardless of the level at which the budget is decided, some level of disaggregation, at least to sector level, is likely to be important in order to enable policy-makers to clearly define the trajectory that the UK will take to reach its long-term goals, and to monitor progress effectively.

Figure 2 shows how the UK budget, under a straight-line trajectory, could theoretically be divided further, in order to provide a clear and transparent understanding of the way in which this budget will be achieved. Each of the coloured sections under the curve represents the total emissions of a sector of the economy. In theory, these sections could be further broken down to represent emissions from sub-sectors of the economy, or even individual companies or citizens.

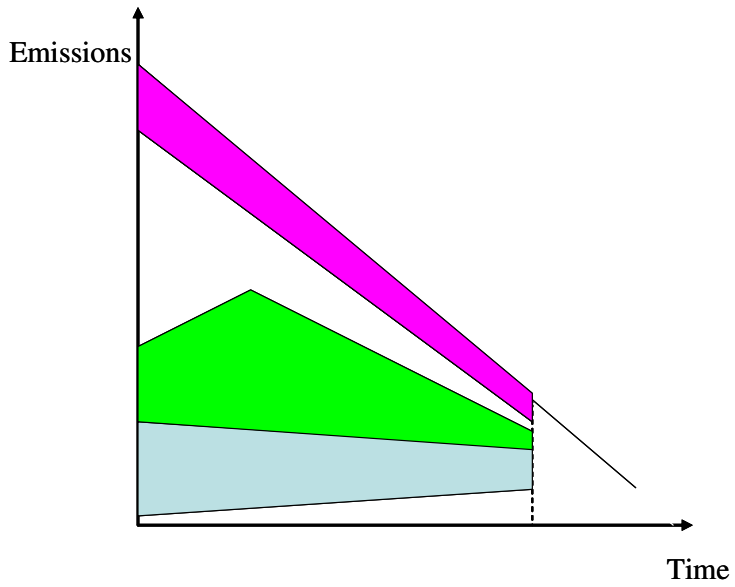

Figure 2 Theoretical long-term division of the overall carbon budget between sectors

In order to provide certainty in relation to the carbon budget, it is proposed that a long-term perspective should be set out at the very beginning of the carbon budgeting system. The areas for each shape should be defined such that, should the budget not be achieved, it will be clear which sectors of the economy need to be "penalised" in the future, or where policies and measures need to be adjusted.

The further the budget is disaggregated, the more complex such a diagram will become, and the more likely it will be that such estimates will be inaccurate. As a result the divisions will no longer be acting as a helpful guide to policy-makers. On the other hand it could be argued that the greater the degree of detailed explanation of how emissions reductions might be achieved, the more likely it will be that goals are met.

It is, of course, possible that a more high-level system could be devised – at the level of the economy and sectors, and then that some sectors could choose to break down their budget further. A good example of this would be in the industry sectors that already fall under the EU Emissions Trading Scheme. Effectively the participating companies already have individual company targets, or budgets, that would fall under the overall UK budget, even though not **every** company in the UK has a carbon budget.

This sector-by-sector approach to disaggregation might prove the most practical, and would enable a step-by-step approach to the implementation of a carbon budgeting scheme in the UK by enabling further disaggregation in some sectors at a later stage.

2.3.4 Responsibility for the Budget

The main purpose of the budget exercise is to raise the profile of the greenhouse gas reduction agenda. In order to do so in a truly effective manner, it is logical that the Prime Minister should be responsible for annual reporting on the carbon budget. The Prime Minister is the preferred option for responsibility in this discussion paper.

Currently, there is a system in place (see Chapter 4) by which Defra has overall responsibility for climate change policy, with CO_2 emission reduction policy as a cross-cutting theme shared, to a certain extent, between departments. Therefore apportioning a carbon budget to Defra, or a similar government department, would not achieve the aim of raising the emissions reduction profile as compared to the present situation. However, there is clearly an important role for the relevant Ministers to play alongside the Prime Minister in taking responsibility for emissions from sectors under their departments' remits, and a particularly important role for the Secretary of State for Environment in driving climate change policy.

HM Treasury could be an alternative choice to Defra - HM Treasury could have responsibility for reporting on the carbon budget alongside the financial budget reports that the department makes. HM Treasury is slightly different from the other government departments in that it does have a cross-government perspective. Furthermore, giving the

Treasury the responsibility for announcing the budget will further emphasise the terminology used, directly linking the financial budget and the carbon budget.

It is also likely that emissions will reflect the economic cycle and so reporting the two in tandem is likely to be instructive. However, this perspective could also be retained if the Prime Minister were given responsibility for the carbon budget and then the Prime Minister and the Chancellor announced their respective headline figures (i.e. carbon and financial figures) at the same time.

Recent Legislation

It is important to note recent legislation. The Climate Change and Sustainable Energy Act received Royal Assent and therefore became law in June 2006[5]. The principle purpose of the Act is to enhance the UK's contribution to combating climate change. The Act places responsibility on the Secretary of State (for Defra) to report annually on steps taken to reduce emissions of greenhouse gases and on the actual level of emissions in the previous year. However no annual emission reduction targets are proposed.

A Climate Change Bill has also been proposed[6]. The aim of this Bill is quoted in Figure 3 below. The Bill places responsibility on the UK Government to set annual greenhouse gas targets out to 2050. Responsibility would be placed on the Prime Minister to report annual progress towards achievement of those targets, at both the national and sectoral level. The Bill has so far been supported by 380 MPs through Early Day Motion 178 [7] presented to Parliament by Michael Meacher, which mentions the need for "a series of more regular milestones" with respect to greenhouse gas emissions "so that annual cuts in carbon dioxide emissions of 3% can be delivered in a framework that includes regular reporting and new scrutiny and corrective processes."

The Bill suggests that responsibility would be placed on the relevant Secretary of State to define the sectors upon which greenhouse gas targets are set, and the Secretary of State could also add to a list of greenhouse gas-related targets listed in the Bill, such as those to promote renewable electricity, heat or transport fuel.

[5] Climate Change and Sustainable Energy Act:
http://www.opsi.gov.uk/acts/acts2006/ukpga_20060019_en.pdf
[6] Proposed Climate Change Bill:
http://www.publications.parliament.uk/pa/cm200506/cmbills/043/2006043.pdf
[7] EDM 178: http://edmi.parliament.uk/EDMi/EDMDetails.aspx?EDMID=28373

"Combat climate change by setting annual targets for the reduction of carbon dioxide emissions until 2050; to place duties on the Prime Minister regarding the reporting on and achievement of those targets; to specify procedures to be followed if the targets are not met; to specify certain functions of and provide certain powers to Members of Parliament with regard to ensuring carbon dioxide emissions are reduced; to set sectoral reduction targets and targets for energy efficiency, the generation of energy from renewable sources, combined heat and power and microgeneration; and for connected purposes."

Source: Climate Change Bill 2006

Figure 3 Aim of Climate Change Bill 2006

The Climate Change and Sustainable Energy Act and the proposed Climate Change Bill could be seen as clear stepping stones towards the development of a carbon budget. Under the Act the responsibilities of the Secretary of State (Defra) has increased, providing important stipulations that could help underpin a carbon budget. The Climate Change Bill would add additional support to the Climate Change Act by placing the responsibility for climate change targets firmly with the Prime Minister – and therefore at the highest possible level.

Under a carbon budget scheme, the Prime Minister could report on the carbon budget annually, effectively achieving the goals of raising the profile of emission reductions, whilst at the same time incorporating the principles of a carbon budget into this high-level reporting mechanism.

2.4 Challenges of developing a Carbon Budget

It is important to note that the UK is likely to encounter some objections to the concept of establishing a carbon budget. Challenges are likely to occur both in relation to the overall concept, and at the level of some of the specific design decisions.

One of the greatest challenges to the concept will be that the UK cannot commit to an absolute limit on greenhouse gas emissions alone. It could be argued that such unilateral action would damage the UK's economy and would lead business to abandon the UK and pollute elsewhere. Therefore it could be argued that any such measures could only be taken under the auspices of an international accord.

This is a valid objection, and certainly one that needs to be carefully considered. However unilateral action is not always appropriate. The UK has committed to taking climate change seriously and has admitted that the environmental challenge is great. Therefore, a serious attempt needs to be made to devise a way to achieve the UK's environmental goals. The UK carbon budget would be just such a holistic approach.

It is also worth noting that the provision of long-term certainty in emissions policy for business would better enable investment in emissions reduction technologies in the UK at an earlier stage and could put UK business at an advantage.

In order to meet this challenge, such a scheme should be devised in a way that:

- Can act as a lead for others to follow;
- Has clear steps by which it could be translated to other EU countries (see Chapter 5);
- Involves setting a budget that is cost-effective and technically possible; and
- Engages with all stakeholders.

Experience with the EU ETS cap-setting exercise has shown that setting an overall budget is a very contentious process, as is the sub-division of this budget further to the sector and company/installation level. The valuable lessons that can be learned from this process are set out further in Chapter 3 below.

3 Choosing an approach

3.1 Introduction

This chapter sets out several different ways in which a carbon budgeting system could be structured in the UK, taking into account the issues explored in Chapter 2. Having considered a few different approaches to this policy mechanism, the suggested scheme will be compared with the EU ETS, the existing UK financial budget, and proposals to set up an individual carbon budgeting scheme (or domestic tradable quotas DTQs).

This chapter argues for a carbon budget which is high-level, broken down into sectors and controlled by government departments, but which has the flexibility to incorporate further disaggregated budgets e.g. at the level of individuals in certain sectors, where deemed relevant.

3.2 Stakeholders

A range of government departments and institutions are already involved at various stages in the work to reduce greenhouse gas emissions. This involvement can be at the level of policy-setting, emissions monitoring, reviewing policies and developing emissions processes.

It is also important to note that, depending on the policy area, the degree to and ease of which different Ministers and Departments have direct influence on those who emit differs. Therefore the potential for highly disaggregated budgets, i.e. at the level of end-user individual or organisation, might be more appropriate and practical in some cases than others. For example, the political acceptability and therefore "ease" of the Department of Trade and Industry directly regulating industrial emitters is higher than that of the Department for Transport directly influencing individual car users.

Some of the key UK government stakeholders identified with relevance to the structures that could be useful in a carbon budget system are listed below:

- Department for the Environment, Food and Rural Affairs (Defra);
- Department of Trade and Industry (DTI);
- Department for Transport (DfT);
- Department for Communities and Local Government (DCLG, formerly ODPM);
- Inter-departmental Analysts Group (IAG);
- Sustainable Energy Policy Network (SEPN);
- The Cabinet Committee on Energy and Environment; and
- The Cabinet Committee on Sustainable Development in Government.

In addition, HM Treasury can have a role through introducing fiscal policies and measures that can support some or all of the emission reduction policies.

This list is not exclusive, many other departments and Parliamentarians have an active interest in climate change policies, however these groups are most closely involved in the processes and policies and measure relating to reducing greenhouse gas emissions.

3.2.1 Division of Emissions

Before investigating potential structures for the carbon budgeting approach, it is useful to understand who the emitters are and how emissions are currently apportioned between sectors and end-users. Figure 4 shows UK greenhouse gas emissions by source and by end-user, historically from 1990 to 2004 and projections for 2010, 2015 and 2020.

Table 2: Greenhouse gas emissions by source, MtC

Sector	Base year	1990	1995	2000	2004	2010	2015	2020
Energy supply	74.4	74.4	63.1	58.2	61.4	56.2	56.0	51.1
Business	58.4	57.5	52.5	43.8	38.7	38.0	39.8	40.4
Transport	34.1	34.1	34.3	36.0	37.4	38.6	40.1	40.7
Domestic	22.3	22.2	22.5	24.6	25.3	21.8	22.0	22.2
Agriculture, forestry and land management	17.0	17.0	15.9	14.7	13.2	11.5	12.1	12.6
Public	3.7	3.7	3.6	3.2	2.9	3.0	3.1	3.2
Total emissions by sources minus total removals by sinks	209.9	209.0	191.9	180.5	178.9	169.2	173.0	170.0

Note: the percentage changes and emission estimates may differ slightly due to rounding

Table 3: Greenhouse gas emissions by end user, MtC

Sector	Base year	1990	1995	2000	2004	2010	2015	2020
Business	97.2	96.4	84.7	74.1	70.3	65.2	66.3	66.0
Transport	40.2	40.2	41.2	42.6	45.0	46.5	47.5	47.2
Domestic	45.9	45.8	41.7	42.1	43.7	38.6	39.9	37.7
Agriculture, forestry and land management	18.0	18.0	16.8	15.4	14.0	12.3	12.8	13.1
Public	8.5	8.5	7.7	6.3	5.9	6.5	6.6	6.0
Total emissions by sources minus total removals by sinks	209.9	209.0	191.9	180.5	178.9	169.2	173.0	170.0

Note: the percentage changes and emission estimates may differ slightly due to rounding

Figure 4 UK Greenhouse gas emissions and projections by UNFCCC source classification and end-user classification[8]

Climate change policy is a cross-departmental area but individual policies and measures can be attributed to particular government departments. For example, transport emissions policy is the remit of the Department for Transport whilst the Department for Communities and Local Government has the responsibility for building sector emissions and buildings policy.

[8] UK Climate Change Programme, March 2006.
http://www.defra.gov.uk/environment/climatechange/uk/ukccp/pdf/ukccp06-all.pdf

3.3 The Structure of a carbon budgeting system

Chapter 2 has explored the value in disaggregating the budget into different levels, and has also noted that the overall responsibility for the budget should lie with the Prime Minister.

In this section of the report, different ways of setting, monitoring and reviewing the budget are suggested in light of those discussions.

The diagram below shows the types of bodies and organisations interacting within the UK government that are considered relevant to the carbon budgeting approach.

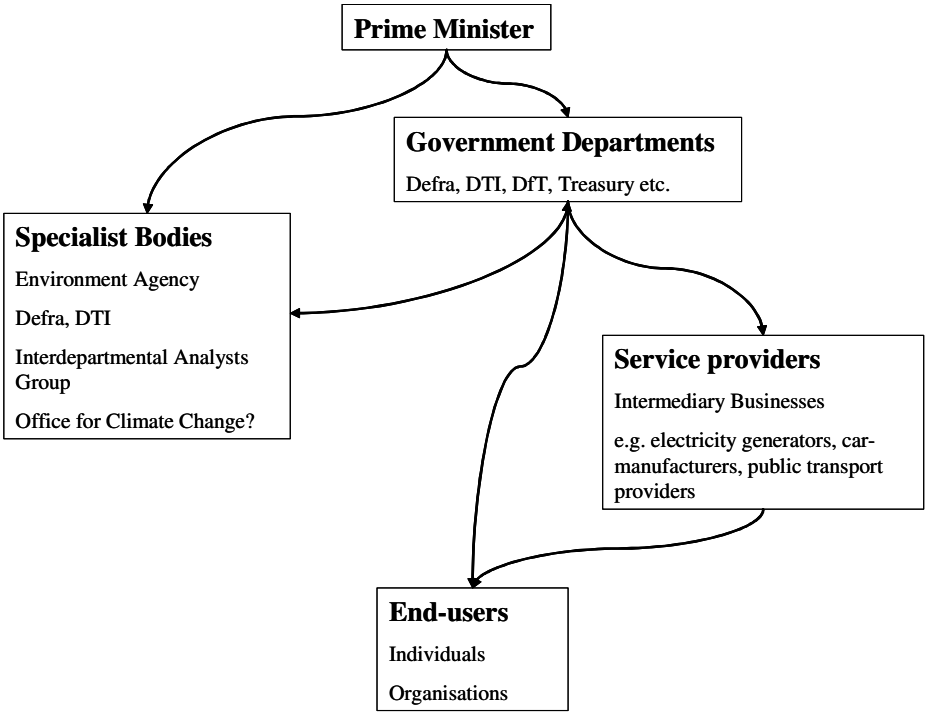

Figure 5 Key bodies and organisations in relation to the carbon budgeting structure

This diagram can be used to understand different levels at which the carbon budgeting scheme can be applied. Different options, with reference to the diagram are outlined below:

Option 1: High-level budget

A high-level budget is set by the Prime Minister. The budget is set annually at the highest level, but apart from this profile-raising role, there is no particular downstream system for breaking this budget down further.

Option 2: High-level budget with high-level divisions and designated agency

A high-level budget is set by the Prime Minister, and the budget is divided into sector-level budgets in a long-term manner (see section 2.3.3). Under this option, either one of the so-called specialist bodies or a new specially-designated body, will be tasked with

carrying out the initial division, and then updating this division where necessary e.g. when a budget is not met and this excess can be attributed to a particular sector. The specialist body will determine which sector should be making further reductions, and potentially, how they will do this.

Option 3: High-level budget, with Departmental responsibility for sectoral emissions
The high-level budget is set by the Prime Minister. As in option 2, the budget is divided further into sector-level budgets in a long-term manner. However, in this case the departments themselves will have a much stronger role in determining their own budgets, rather than in option 2, where an intermediary expert will make this decision externally. This type of model is likely to involve co-operation and negotiation between departments.

Option 4: Middle-level budget setting
The UK-level budget could be divided at the level of those who deliver services, rather than government departments. Under this option, the Prime Minister would still announce a UK budget, but it would be divided into sectors and then apportioned to those who deliver the services related to those sectors, rather than the legislators responsible for the policy framework. These service deliverers would include the private sector (e.g. electricity generators, vehicle manufacturers etc.) but also public agencies (e.g. the Highways Agency).

Option 5: End-user budget
Here, the budget would be set at the level of the UK government and immediately broken down to the level of the end-user (potentially more accurately described as "end-emitter"), both individuals and companies or organisations. Under this option, there is no particular role for legislators, nor service providers and the model is heavily reliant on demand-side pressure to ensure that the appropriate infrastructure is provided. Various such schemes have been proposed and include options such as having individual carbon credit cards etc. Within this design option there is an inherent assumption that the ability to trade within the budgeting system would be allowed.

Option 6: An integrated approach
Although presented as discrete options, there are ways in which the options presented above can, and should, interact with each other in order to ensure that the budget is set at a high-level, achieving the appropriate profile, and that the mechanism for achieving real reductions in emissions is incorporated.

The high-level options 1, 2 and 3 could develop sequentially with time. Options 2 and 3 have a similar level of budgetary division but a different level of responsibility between government departments and specialist government agencies. Therefore a balanced approach or combination of these two approaches could be used.

Options 4 and 5 both relate to apportioning responsibility for the budget to those responsible for delivering or using services whereas options 2 and 3 apportion responsibility for further emissions reductions to the legislators. A combination of these approaches could be achieved whereby either specialist agencies, or government departments are made responsible for their own budgets (options 2 and 3) and then these bodies can choose whether or not further measures should transfer some, or all, of the budgetary responsibility onto service providers or end-users. In effect, options 4 and 5 become policies and measures rather than the overall totality of the scheme.

Therefore, an integrated option – **option six** – could be created which includes a sequentially developed high-level system that combines options 1-3 and the option for departments to use downstream schemes as embodied in options 4 and 5.

This integrated option is likely to be the most promising because it has the following key advantages:

- Development of a high level budget;
- Expert division of budget into long-term sector-level budgets;
- Element of responsibility given to legislators to stimulate the correct infrastructure, research and development etc. to enable budgets to be met; and
- Flexibility for some responsibility to be given to end-emitters, in the sectors where this is most appropriate, through particular policies and measures to enable demand-side pressure, and enact the polluter-pays principle.

Even if an integrated approach is selected, this approach need not be established immediately. Several elements of such an approach could be developed gradually, and in parallel. Some of these elements already exist e.g. the EU ETS is an example of a budget set for a particular sector of end-emitters.

An integrated approach could be established in the following manner:

1. Development of a high-level budget as in Option 1, with a long-term sector-level breakdown developed by specialist agencies;
2. Development of a responsibility structure for legislative bodies, and specialist experts to divide the budget, take responsibility and monitor and review progress;
3. Development of options that further delegate responsibilities to end-emitters, or service providers under the auspices of the relevant legislative body.

3.3.1 Advantages and Disadvantages of certain approaches

It is helpful to look more closely at the options outlined in the section above, in order to understand how they compare against the elements of a well-designed carbon budget that were set out in section 2.1.

Table 1 Carbon budgeting options compared with design elements

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
High profile	Yes	Yes	Yes	Not as evident	Not as evident	Yes
Long-term signals about emissions profile	Not clear	Yes	Yes	Not as evident	Not as evident	Yes
Monitoring and review	Yes, simple	Yes, simple	Yes, simple	Yes, more complex	Yes, could be very complex	Yes, varying complexity
Flexibility between sectors	Yes	Maybe – high-level designations	Maybe – negotiations	Yes, if trading possible	Yes, if trading possible	Yes, combination of trading and high-level decisions
Maximise synergies with existing structures	Yes	Could involve creating new structure e.g. Climate Change Office	Yes, may be a challenge to divide all emissions between government departments	Would need to create further structures	Would need to create further structures	Use of some existing, some new, depending on downstream measures
Certainty for business investment	Low – no information about sectoral breakdown	High – long term sectoral targets	High – long term sectoral targets	Potentially high, with some sectoral division and responsibility closer to businesses	Potentially highest, but dependent on how far into future individual targets would be set	Potential to be high

This table highlights the value in having some level of sectoral division, as under options 2 and 3, but indicates that if the budget was highly disaggregated from the outset there would be a higher degree of complexity in terms of the use of existing structures, and the monitoring and review process. Under option 6 these issues are not as acute because further disaggregation could be developed with time, under the auspices of particular departments.

Flexibility between sectors in achieving reductions to keep within the carbon budget can be achieved in two ways - the first is through a shifting of the original long-term responsibilities through top-down decision-making by legislators, and the second is by converting the budget into emissions allowances and enabling trading by participants at different levels. The first approach is possible under options 2 and 3, whilst options 4 and 5 lend themselves naturally to trading. Of course, it would also be possible to enable trading between government departments, but it is considered more likely that reapportioning of budgets will take place through negotiations at the legislative level. As a result, option 6 offers a mixed type of flexibility

The provision of certainty to business is aided by using sectoral budgets, and it is likely that further disaggregated budgets e.g. to the individual or to intermediate-level organisations such as transport providers would give investors an even clearer idea of how they might be affected by emissions cuts. Choosing a structure that increases flexibility can both help, and hinder, the certainty accorded to businesses. Whilst trading is helpful to investors where they themselves are empowered to take of advantage of it, it can threaten certainty if a market is unstable or if trading takes place at the level of departmental budgets. However, if this second type of trading takes place through negotiations at predefined stock-taking points (the length of the carbon budget cycle is discussed in section 4.3) business would be in a similar position to the current situation in relation to certainty about legislation on greenhouse gas emissions.

Looking across all the options, this assessment seems to support the concept that an integrated option – option 6 – could enable policy-makers to choose the most effective elements of the other options.

3.4 Other systems to learn from

There are various design elements of a carbon budgeting scheme that can be found in existing or proposed schemes. Three systems are looked at in more detail here, and then elements of particular relevance to the carbon budgeting concept are selected and discussed in relation to the carbon budgeting options discussed earlier in the chapter.

3.4.1 HM Treasury Monetary Budget

The financial budget is a useful parallel system to look at in the context of a carbon budget. Not only does it share the same terminology, but some of the concepts are similar. Furthermore, greenhouse gas emissions are likely to be impacted by alter

depending on the economic climate, and therefore there is an inherent link between the financial budget and a proposed carbon budget.

The UK's full monetary budget is announced in April each year. The financial budget for the UK is based on a balance between public spending and government earnings through a combination of publicly-acceptable borrowing and taxation policies.

The monetary budget is continually monitored within HM Treasury and public statements on progress are made in the pre-budget report every autumn. The pre-budget report is essentially a progress report on the ability to reach targets in the previous year, but it also gives an indication of the direction that Government is likely to take in the forthcoming budget.

The budget-setting exercise is an iterative and continuous process and decisions about the budget relate to a concept of the overall envelope of public spending. The level of public spending relates to policy objectives.

In order to establish policy objectives, the Comprehensive Spending Review Process has been established. Every two years government departments enter into Public Service Agreements (PSAs) to determine three-year policy objectives and Departmental Expenditure Limits.

Thus, there is a two-year cycle of review, but in fact a three-year cycle of certainty about policy targets – with one year overlap between review periods. As an example, the Spending Review in 2004 set out PSAs for the years 2006-07 and 2007-08 and confirmed the 2005-06 plans set in the 2002 Spending Review, whilst the review in 2007 will set out plans for 2008-09, 2009-10 and 2010-11 and confirm those already set for 2007-08.

In the financial budget, if the government does not stick to its budgeted spend, it automatically borrows money. The main mechanism for government borrowing is to issue government bonds, however the Private Finance Initiative is another mechanism for central government to borrow funds to enable greater public spending presently.

It is important to note that although theoretically spending could continue uncontrolled, it is not in the interest of a government to do so. The Government must retain a degree of credibility otherwise investors will lose confidence, interest rates will have to increase on government bonds to encourage investment, and therefore inflation will rise.

The economy is expected to cycle between stronger and weaker periods on average about every seven years. The government aims to achieve smooth growth without a boom and bust and therefore stores surplus funds during boom times, for extra government spend when the economy is weak. It should be noted that during these boom periods, when productivity increases, emissions are likely to rise in parallel due to increased manufacturing and activity in all economic sectors.

The current Chancellor of the Exchequer has made an effort to ensure investor confidence in the UK economy by setting two rules:

a) Over the economic cycle the government will borrow only to invest, such that borrowing over the cycle should balance out at zero;
b) The level of government debt should be kept stable.

Within the Eurozone there is a control on the level of debt such that the budget deficit in the Eurozone countries (i.e. annual rate of borrowing) should not be more than 3% of GDP. However, in order to ensure investor confidence in the Euro, lack of adherence to this rule must be strictly penalised, otherwise individual nations could borrow at the expense of investor certainty in the entire region.

The UK economy is designed to be able to buffer against factors that are not under its direct control, such as terror attacks or the "dotcom" bubble burst. The first approach to protecting the economy against these impacts is a defensive one. Attempts are made to avoid becoming too reliant on one or another economic wild card – this is similar to mitigation in the carbon world. The second approach to defending the economy against these impacts is a reactive one. In the event that any type of disaster causes a downturn in the economy, the government may initiate a greater number of public sector projects in order to stimulate the economy again. Along this line of reasoning, if a similar extreme event occurs to cause extreme carbon emissions, thus impacting the carbon budget, the government will have to step in reactively. Government intervention in this case would be an investment in a carbon-reducing scheme, rather than more adding carbon to the budget.

It is important to note that in the most extreme cases the economy may not immediately be able to buffer the impact of a major event, as witnessed by periods of depression or the occasional collapse of economies around the world. In these cases, long term recovery and remediative effort is necessary.

In carbon budget terms the equivalent of a shock to the economy that would cause an unforeseen increase in emissions would be, for example, a very cold winter which causes an increase in heating demand. Cold winters, such as 1996 in the UK, are capable of causing a marked peak in greenhouse gas emissions[9]. Such shocks to the carbon budget could be dealt with by building in, for example, the ability to borrow emissions from future years (see section 3.6). Weather patterns often occur in cycles – or with matching seasons so that e.g. a cold winter will be matched by a cold summer, where less energy is used for air conditioning.

Longer-term trends, such as rising gas prices which could affect the energy supply balance and thus emissions, are equally difficult for Government to predict or control.

[9] See for example Defra UK greenhouse gas emissions 1990 – 2012 available from: http://www.defra.gov.uk/environment/statistics/globatmos/kf/gakf05.htm

However under the right framework and with a guarantee from Government of the long-term carbon budgetary division, the energy sector, should be able to incorporate the carbon limits in the budget into its longer-term planning.

The financial budget has the highest possible profile and the ultimate responsibility for poor budgetary management sits with the Chancellor and Government as a whole.

The impact of the budget on downstream management of finances is clear. Departments are responsible for managing their individual budgets and overspend and will be put under pressure directly if they do not stick within their limits. All government departments have large finance divisions responsible for keeping track of, and accounting for, government spending.

3.4.2 EU Emissions Trading Scheme (EU ETS)

The EU ETS has been in place since January 2005, and is a cap and trade scheme setting a limit on carbon dioxide emissions from installations in the energy sector and particular industry sectors. To a certain extent, this system can be seen as a carbon budget within a section of the economy, along the lines of Option 5 proposed for the carbon budget itself.

As a result, the EU ETS constitutes a carbon budget for the participating sectors, and it is also a carbon budget scheme that integrates trading into the design. The EU ETS aims to incentivise making emissions reductions at the lowest possible cost, by allowing trading of emissions rights between companies. This trading means that participants can choose whether or not it is most cost-effective to make reductions within their installations or, effectively, pay for cheaper cuts elsewhere.

The EU ETS will be run in phases. Phase I runs from 2005 to 2007, Phase II from 2008 to 2012 and the assumption is that future phases will run for five year periods. The idea is that the caps are set for the phases as an average annual cap for installations. The length of the periods enables certainty about the emissions rights available for the installations, and the sectors as a whole. The caps are reviewed during one phase for the following phase, and the intention is to continue to tighten the overall levels of emissions allowed.

Member State governments determine the allocation of emissions rights to installations within their country in a "National Allocation Plan" (NAP) for each phase. NAPs are subject to approval by the European Commission. Allowances can be allocated free of charge or, in the second phase from 2008, up to 10% of the emissions rights could be sold by Member State governments in an auction.

The scheme includes very detailed rules on the monitoring and reporting of emissions in a given year. These reports affect an understanding of adherence to the cap but do not have an influence on the cap itself directly.

The phases of the scheme provide flexibility over the exact timing of emissions reduction delivery because an installation could buy further emissions rights one year, but plan to sell excess in future years, once abatement steps have been put into place. This flexibility is currently possible within a phase. After 2012 this flexibility will be ensured between phases because banking of emissions rights from one phase to the next will be permitted.

The determination of the overall cap in this system is key to its success, and the process for determining this cap has proved very contentious. Caps should be set in line with criteria set by the European Commission. These criteria stipulate that caps must be in line with assessments of emissions developments and that decisions should be made according to the technical potential to reduce emissions in the EU ETS sectors. The European Commission plays an important role in moderating the caps, which are initially determined at national level. There have been concerns in phase I of the EUETS that some Member States inflated emissions projections, in order to provide a greater number of emissions allowances for installations in their countries. It is here where the Commission's role in modulating the caps to an appropriate level has proved very important.

Another key issue is that although EU ETS caps are intended to be set within the framework of national commitments to reduce emissions under the Kyoto Protocol and EU Burden Sharing Agreement, the cap decisions have mostly focused on the EU ETS participating sectors themselves. A full consideration of all of the countries measures to meet Kyoto targets was complex both for countries themselves, and for the European Commission.

The focus given to the EU ETS sectors themselves, and their emissions projections means that decisions on the caps often do not consider the impact that setting a relatively high EU ETS cap would have on the volume of emissions "available" for other sectors within the economy to emit, and hence the increased effort that non-EU ETS sectors would have to make. Setting the EU ETS "budget" within a whole economy budget that had already been agreed would make this process and its consequences for each sector of the economy more transparent.

The EU Linking Directive enables credits earned from emissions reductions from outside the EU ETS sectors through JI and CDM projects to be used within the scheme. As a result, these credits can in effect inflate the cap and allow greater emissions from these sectors than intended through the initial cap-setting exercise.

3.4.3 Domestic Tradable Quotas (DTQs)

The concept of Domestic Tradable Quotas, or Tradable Energy Quotas, has been suggested and explored by various researchers and institutes[10] [11]. Although system

[10] Tradeable Energy Quotas, David Fleming, The Lean Economy October 2005, reprinted January 2006. David Fleming has also done work previously on this topic.

designs vary, the basic concept is to provide the end-users of energy with a limit which they can use. This could take the form of an emissions budget, similar to that proposed in option 5 for the carbon budget, or could relate more directly to energy itself.

The greatest challenge in such a system is the determination of the total budget, as in the carbon budget scheme, and the determination of the appropriate individual quota. Although the concept of equity can be preserved by enabling each individual adult to have the same quota – the size of this budget is likely to be a source of controversy and debate.

Under different systems individuals would be given their quota free of charge and either industry would be treated similarly, or they would buy their emissions rights at an auction. This variety of allocation approaches is similar to that observed in the EU ETS.

DTQ systems include an assumption that these budgets would be traded. This trading would not only put a value on carbon, as in the EU ETS, but would also inherently penalise those who need more than they are allocated.

It is not clear, however, how these systems would be controlled if consumption of individual budgets by end-users and their consequent need for more carbon is vastly out of sink with the budgeted amount. It is for this reason that a DTQ is likely to work best within a top-down system whereby governments also take responsibility for supporting end-users in making low-carbon decisions.

Monitoring of a DTQ system could be straightforward. A presentation given by Tyndall Centre researchers proposed the use of a carbon credit card, to be used in tandem with traditional money when purchasing energy. Most proposed systems include a concept of accounts and suggest that the use of modern technology, similar to that used in banking, would enable simple monitoring of the use of a budget. This system could be relatively straightforward, although setting up the relevant infrastructure would incur a cost.

Interestingly, Defra has expressed public interest in carbon budgeting at the level of individuals and it is likely that the remaining challenges in this approach will be explored further in the near future.

As proposed within option 6 for the carbon budget, the DTQ idea could be used as a particular delivery mechanism for emissions reduction within a wider budgeting approach. It is likely that engaging with individuals at this level will require some time to obtain support and therefore it might be advisable to proceed with an overall carbon budget as DTQs are further developed both technically and in terms of public understanding of the approach.

[11] Domestic Tradeable Quotas: A policy instrument for the reduction of greenhouse gas emissions, Dr. Kevin Anderson, Dr. Richard Starkey, Tyndall Centre for Climate Change Research. Dr Anderson and Dr. Starkey continue to do work on this topic.

3.5 Key Features of the Scheme

The table below summarises some of the important key features of the systems described earlier in this chapter. It is important to note that the entries for the DTQ system are not precise because there are various different proposals for such a scheme at the moment.

	Timing	Division	Borrowing	Review	Penalties	Responsibility	Other sources	Monitoring
HMT financial budget	Annual report. 2 year cycle of Public spending review but with three years of certainty.	Overall budget, divided by governmental department	Overspending causes borrowing, limited by internal rules. Overall redistribution of budget on basis of overspend	Budgetary review is continuous, with six-monthly reporting.	Departments take responsibility and could face budget cuts in the following year.	Chancellor of the Exchequer and Prime Minister	Money can be borrowed through bonds and the private finance initiative	Departmental finance divisions regularly monitor progress towards the budget.
EU ETS	Annual emissions report Cap determined in 3-5 year phases	Sectoral limit, divided by industrial end-user installations	Trading enables borrowing within a phase and between participants	Overall caps reviewed between phases.	Penalties for non-compliance set at €40/tonne for phase I and €100/tonne for phase II, plus need to comply	Operators of installations	International credits through JI and CDM.	Emissions monitored annually.
DTQs	Proposals to be set weekly - annually	Divided by energy end-user	No clear line on approach.	Long-term budget sets limits.	Not clear.	Individuals	Not clear.	Continual monitoring of usage.

3.6 Lessons learnt

These systems can provide valuable lessons for the design of the carbon budgeting scheme.

A long-term perspective

All of the systems have a mechanism for setting out an overall limit to the assets available within the system. This design element matches with the need to set clearly at the outset of the carbon budget (the long-term perspective). This should include a sectoral breakdown of the profiles (as highlighted in section 2.3.3).

Sub-division of the budget

It is clear that all of these systems break down the asset cap further, ranging from government department level to the level of individuals in the case of DTQs. However, it is the Treasury system which might be most sensibly used as a model for the carbon budget because it maintains the whole economy perspective in terms of total assets and THEN provides a breakdown.

Review cycles

Varying review cycles are used, the choice of review cycle in the carbon budget system is investigated in more detail in chapter 4 of this report. However, the concept of overlapping cycles, as used in the Treasury example, as well as overlapping review between phases, as used in the EU ETS, is a helpful model. If the carbon budget is to be allocated to government departments, it would be most logical to align the timing of review cycles with that of the Comprehensive Spending Review which sets out the overall departmental policy objectives.

Credibility

Credibility is an important part of a successful system. The two systems that are already in place (ie. the EU ETS and HMT budget) have clear penalties for non-compliance by those responsible. Under a carbon budget apportioned to government departments penalties that relate to future budgetary allocations are more logically than financial penalties both in terms of the ways in which the institutions operate, and in terms of minimising the real environmental impact of overspend.

Borrowing

The concept of borrowing within phases of the EU ETS, or within economic cycles in the case of HM Treasury's budget, offers a logical model for the carbon budget. As discussed in section 3.4.1, borrowing of emissions from future years may under certain circumstances such as particularly cold winters may be desirable. Borrowing against allowed emissions in the future may be fair, but as with the Chancellor's rules, or the EU ETS phases, *total cumulative emissions* should remain within the budget limit over the cycle. There should also be set limits for borrowing to ensure certainty and confidence in the system.

Therefore, for the carbon budget, it would make sense that review-cycles are determined and that, within these cycles, borrowing phases could be set up. This type of emissions would take place within a government department but in relation to future years' emissions budgets.

As well as borrowing from one's own budget in time, there is the possibility to use trading to enhance the flexibility of the system. Such trading might be enabled between government departments, although this is likely to weaken the certainty at sectoral level that is achieved through the initial high-level division of the budget. Within government departments, departmental budgets could be set, but they could set up policies or measures (such as the EU ETS or DTQs) to cover some or all of the sector's emissions and these end-users could trade, provided the overall emissions for the sector were balanced at the end of the phase.

There are several explicit advantages that enabling a certain degree of flexibility through borrowing and trading would bring:

- Borrowing allows a flexibility in the system that differentiates this approach from annual targets;
- This flexibility allows government and policy-makers to make medium- to long-term investments that aim to cause a significant step change in emissions, but one that is not immediate; therefore balancing out emissions over the borrowing period. This flexibility is important in encouraging longer-term solutions for what is a long-term problem;
- The inherent delay between finalising emissions data and policy-setting means that a longer period of borrowing would allow there to be actual feedback between policy implementation and measured emissions.
- The examples considered in this section show that a trading or borrowing approach can have the added advantage of providing a price signal. Although this is not explicitly a part of the carbon budget scheme, price signals would provide an illustration, in real time, of the cost that the emissions limits are really placing on the economy, or sectors of the economy.

Reporting

The examples used demonstrate that annual, or even six-monthly reporting, is very valuable, and can be carried out regardless of the cycle of decision-making. Therefore, the carbon budget should certainly be subject to annual reporting.

4 Using existing processes

4.1 Introduction

In this section two issues will be explored in relation to the proposed carbon budget:

a) Ensuring that synergies with the existing infrastructure are maximised, and that no duplication is created through additional processes; and
b) Ensuring that a carbon budget system has a clear advantage in terms of achieving additional emissions reductions.

First the existing processes in place will be described, and then their relevance to the design of a carbon budget scheme will be set out in more detail. Finally an estimate of the additional cost of the proposed system will be given in broad terms. Note that the key UK stakeholders and structures are outlined in section 3.2.

4.2 Existing processes

It is important to understand the existing processes that can be used in the implementation of a carbon budget, and could be used to make such a budget more effective and efficient.

4.2.1 Public Service Agreements

Public Service Agreements (PSAs) are departmental targets set with HM Treasury during the Comprehensive Spending Review process (see section 3.4.1). This process takes place in tandem for all government departments and defines their policy priorities, as well as expenditure limits for the following three years.

The reviews are carried out every two years setting plans for three years, such that there is one year overlap in the plans. PSAs are coming up for Review in 2007 and it is possible that climate change will become a more overarching policy during this round of discussions.

Although PSAs are mostly financial, they can set greenhouse gas emissions reductions targets as well. Public Service Agreement 2 (PSA2) is Defra's and is joint with DTI and DfT.

PSA2 for 2005-2008, as set in the 2004 Comprehensive Spending Review is shown below:

PSA 2 *To reduce greenhouse gas emissions to 12.5% below 1990 levels in line with our Kyoto commitment and move towards a 20% reduction in carbon dioxide emissions below 1990 levels by 2010, through measures including energy efficiency and renewables.*[12]

The PSA process is valuable because it provides a high-level mechanism for setting greenhouse gas ambitions, but also considers value for money and cost-effectiveness because the overall agreements are made from a financial perspective.

4.2.2 UK greenhouse gas emissions data

The UK is responsible for reporting greenhouse gas emissions data to various bodies externally, and there are also internal processes and reports set up for reporting this data. In this section the different reports are listed, the infrastructure for collecting the data is described, and the scope of the data explored.

[12] http://www.defra.gov.uk/corporate/busplan/psa2004.htm with Departmental PSA reports available at http://www.hm-treasury.gov.uk/spending_review/spend_sr04/report/spend_sr04_repindex.cfm

Table 2 UK reporting processes in relation to greenhouse gases

Report	To	Lead department	Timing	Details
UK GHG Inventory	UNFCCC and EU	Defra lead, Netcen co-ordinates	Government submits inventory annually to UNFCCC and EU monitoring mechanism. Headline figures released in January for the full calendar year 12 months earlier.	Covers all greenhouse gases. EU Monitoring mechanism report is broken down by sector.
UK National Communication	UNFCCC	DTI lead	Submitted to UNFCCC sporadically. Fourth National Communication sent in April 2006. Fifth not yet planned.	Reports on all national actions to tackle climate change.
Emissions projections	EU	Defra	Currently reported biannually. From 2007 will be annual.	All greenhouse gases.
EU ETS	EU	DTI	Published in the first half of the year for the previous full calendar year of emissions.	Verified emissions data for participants and gases in EU ETS (power and industry, phase I CO_2 only).
New greenhouse gas report	UK	Defra	Proposed annual report likely to be introduced. Should coincide with the report on the monitoring mechanism, which is published in March.	To cover all UK GHG emissions and steps taken to reduce these. Based on data from the other reports plus additional information. Will set out workplan for following year.
Energy sector indicators	UK	DTI	Annual – published every March.	Includes provisional CO_2 emissions data
Emissions reductions	UK	SEPN, operating through a Ministerial committee, an Advisory Board, Strategy Group, working-level group and IAG		Provides information on emissions reductions.

The reports that the UK publishes in relation to greenhouse gas emissions are in Table 2.

In terms of the carbon budget approach several of the existing processes shown in Table 2 are important. Of primary importance is the collection of greenhouse gas emissions data and the certainty and timing of this information.

Figure 6 and Figure 7 show the key organisations involved in collecting this data and the way in which data is compiled in order to report to the UNFCCC and the EU monitoring mechanism.

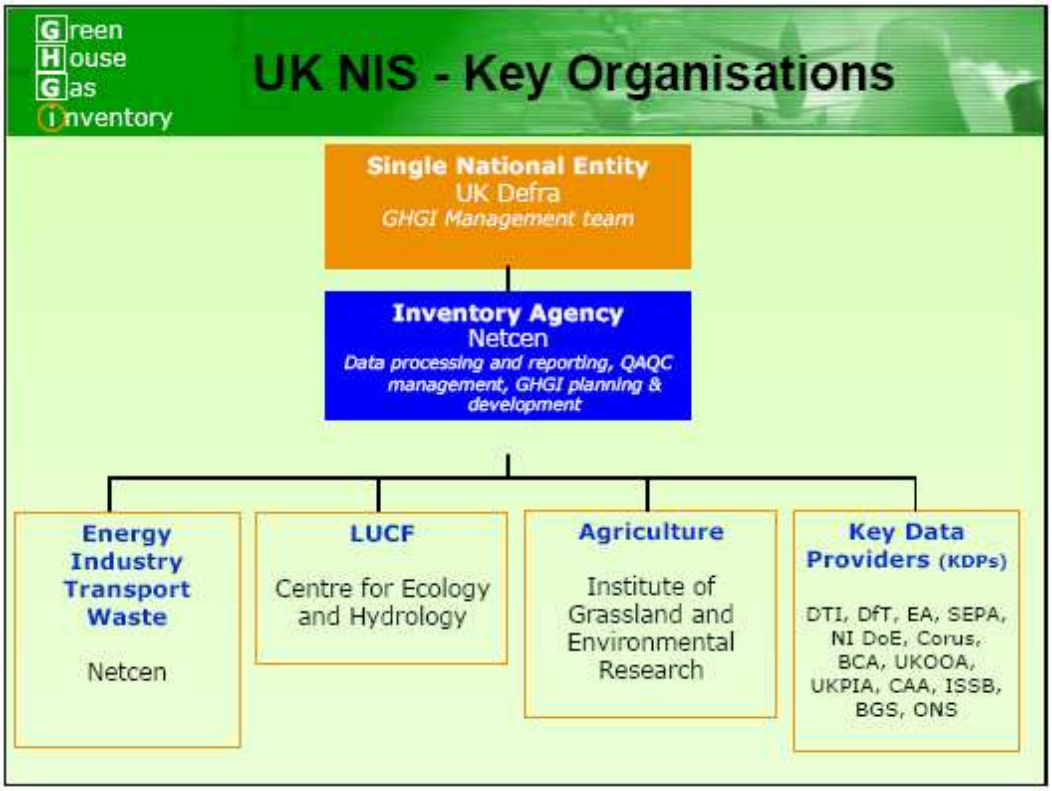

Figure 6 Current organisational infrastructure for inputs to UK National Inventory System[13]

Defra's Global Atmosphere Division has overall responsibility for emissions data compilation and publication. A wide range of organisations provide data to the UK Greenhouse Gas Inventory ranging from government departments to private companies and industrial trade organisations. Data supply agreements exist with several organisations, e.g. National Grid, to supply information in a usable format. DUKES, the UK national energy statistics, is the primary input, covering CO_2 from industry.

NETCEN[14] currently has the contract to compile the data for the whole GHG inventory. The inventory covers emissions data for both CO_2 and all of the Kyoto basket of non-CO_2

[13] Source: DEFRA, Netcen, IGER, CEH (April 2006), UK Greenhouse Gas Inventory 1990 to 2004. p 52
[14] Within AEAT, www.naei.org.uk

gases and includes domestic aviation and shipping, whilst international aviation and shipping are included as a footnote.

The headline data is published on 15 January each year, with a 12-month time lag e.g. 2005 emissions data is published in January 2007. A full detailed inventory is then published on 15 March of the same year. Information is sent to the EU for the Monitoring Mechanism report on 15 March and to the UNFCCC on 15 April.

Although the data is only released after the delay of a full calendar year, it is collected continuously throughout the interim year during which time it undergoes a comprehensive quality assurance process.

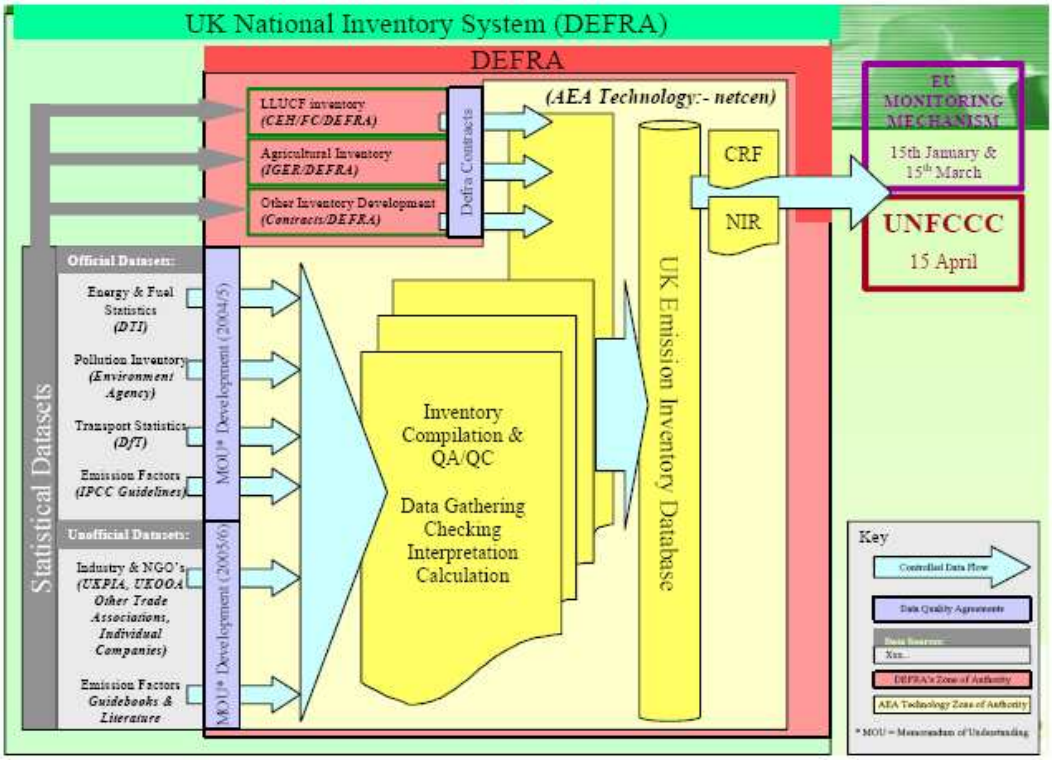

Figure 7 Overview of institutional infrastructure for collation of UK GHG emissions data[15]

Non-CO_2 gases

Data is available for non-CO_2 gases and is reported to the EU under the EU monitoring mechanism through the greenhouse gas inventory process described above.

There is, however, often much higher uncertainty in measuring non-CO_2 greenhouse gas emissions than CO_2 estimates, for example uncertainties for CH_4 emissions lie typically

[15] Source: DEFRA, Netcen, IGER, CEH (April 2006), UK Greenhouse Gas Inventory 1990 to 2004. p 51

in the range +/- 30-50%.[16] The estimates of uncertainties for CO_2 emissions are estimated at 2%[17].

N_2O emissions estimates from agriculture are also very uncertain and there is a lack of data from specific farms. As emissions are heavily dependent on on-farm practices, the use of wider approximations limits the accuracy of the data.[16].

HFC data shows varying levels of uncertainty, depending on the source. PFC and SF_6 data however have low levels of uncertainty.

The uncertainty in the combined GWP weighted emission of all the greenhouse gases in 2004 was estimated at 14%. The report noted that the source making the major contribution to the overall uncertainty is the estimate for Agricultural Soils.[17]

From the perspective of developing and monitoring a carbon budget, it is important that such uncertainties are manageable. It is most important that methodologies remain consistent, and that changes are documented. In this manner changes in greenhouse gas emissions can be accurately followed, and therefore the carbon budget can be accurately monitored.

4.2.3 Reviewing UK Climate Change Policy

The UK Climate Change Programme encompasses all sectors and gases and all policies and measures designed to combat climate change in the UK. Some of the information shown in Table 2 relates to reports on emissions reductions and in the context of the carbon budget, it is important to understand how emissions reductions are measured and policies and measures are reviewed.

The Climate Change Programme was published in 2000 and work on the first review process began in September 2004 continuing through until the new Climate Change Programme was published in March 2006.

The Climate Change Programme is a cross-departmental report led by Defra. However Defra does not have a direct remit to implement change in many of the sectors that cause emissions, and therefore all government departments sit on the Climate Change Programme Review (CCPR) Steering Group (e.g. DTI for industry, DfT for transport, DFES for schools etc).

The recent CCP review was the first thorough review of the approach to greenhouse gas emissions reductions. As a result the proper structures and processes had not to be developed. Having been through this process once, there is now an established cross-

[16] Life Emissions Trading Scheme (LETS) Update: Scoping Phase Report, April 2006 produced for the LETS partners by AEA Technology and Ecofys UK.

[17] UK Greenhouse Gas inventory 1990-2004
http://www.airquality.co.uk/archive/reports/cat07/0605231047_ukghgi_90-04_v1.1.pdf

departmental dialogue and it should be easier to establish more frequent monitoring and review of policies.

The Climate Change Programme review itself suggested a more frequent process than is currently the case:[18]

> Recent experience has proven the need to assess progress towards our medium and long-term goals on a more **frequent and regular** basis. We will therefore in future report **annually** to **Parliament** on our progress at reducing the UK's **greenhouse gas** emissions. Building on this, the Review of the Economics of Climate Change, led by Sir Nick Stern, will consider other aspects of recent proposals for the introduction of "carbon budgeting". This analysis will inform the Energy Review.
>
> **Source: UK Climate Change Programme 2006**

Figure 8 UK Climate Change Programme recommendation about review

This statement has been backed up by the Climate Change and Sustainable Energy Act which received Royal Assent and therefore became law in June 2006.[6] The Act places responsibility on the Secretary of State (for Defra) to report annually on steps taken to reduce emissions of greenhouse gases and on the actual level of emissions in the previous year..

This new greenhouse gas report will fit in with the timing of the UK Greenhouse Gas Inventory and the EU Monitoring Mechanism in March each year, and will therefore announce emissions with a one year time lag (i.e. 2005 emissions to be announced in March 2007). The data reported is likely to be divided to the sector level, and could be broken down even further, for example to the policy level if desired.

As a result, such a report should facilitate more frequent policy review, and therefore enable better delivery of downstream emissions reductions. The report is likely to also include a forward work plan on emissions reduction.

Such a report could remain the remit of Defra, or could be designated to a new specialist agency focusing on climate change, with the endorsement of the various departments currently involved.

4.3 Summary of Timings

Figure 9 shows how the timings of the Greenhouse Gas Inventory reporting, the Comprehensive Spending Review and the PSA-process work. The figure demonstrates how re-assessing long-term carbon budget distribution during **alternate** PSA cycles, makes the best use of the inventory data, and allows for six-year borrowing flexibility within the budget.

[18] Climate Change Programme Review March 2006 (p. 10):
http://www.defra.gov.uk/Environment/climatechange/uk/ukccp/pdf/ukccp06-all.pdf

An alternative option would be to match the carbon budget cycle to single CSR cycles and have a three year period. This would have the advantage of allowing more frequent in-depth monitoring and review; constraining borrowing into a shorter period so that it is less able to get out of control; and increasing the chance of keeping a carbon budget cycle within one reign of Government. However, the existence of annual reporting and review of policies and measures ensures that the detail of the approaches needed to achieve the necessary reductions is constantly updated.

By setting the carbon budget for six-years, the availability of emissions data would also be higher and there would be a chance to see actual feedback between the setting of new policies and measures and the actual impact on greenhouse gas emissions. There would also be longer-term certainty for all parts of the economy about their section of the carbon budget that they are responsible for as they would have a six year vision rather than only three years. Policy changes could still be made with in departments as a result of the annual monitoring and reporting information, but any carbon budget realignment that redistributes the overall emissions up until 2050 will only be made over the longer carbon budget cycles of three six years. It is within these longer cycles that borrowing will be reconciled.

It is also proposed that the Prime Minister's statement on the carbon budget and accompanying report on policies and measures be made in March to coincide with the financial budgetary process and secure the necessary high profile.

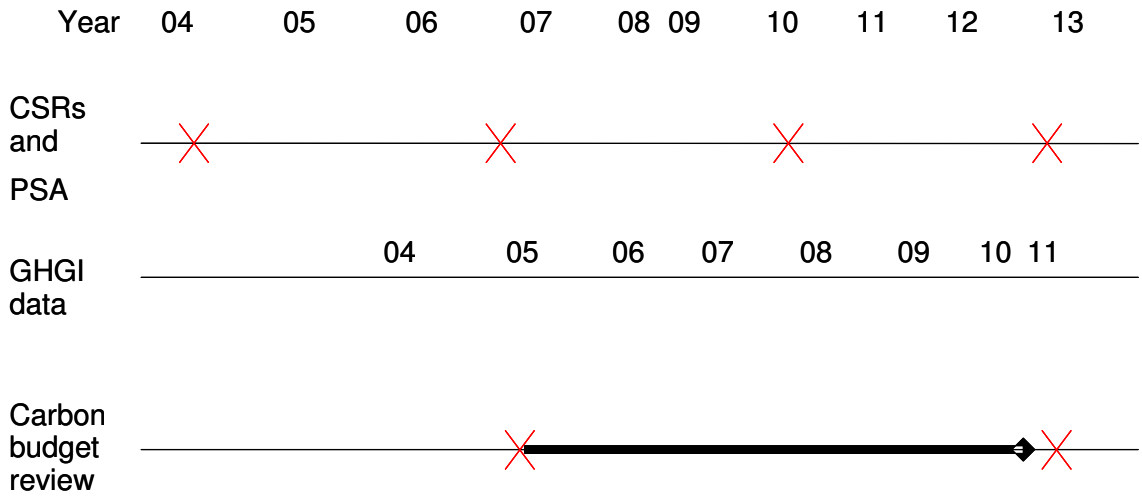

Figure 9 Timing of related processes showing a possible six year carbon budget cycle

4.4 The Carbon Budget and existing processes

This review of existing processes has shown that a great number of systems are already in place that can be used directly for the establishment of a carbon budget system.

The collection of emissions data is thorough, and has full coverage of gases and sectors, as well as a sectoral breakdown. Although there is uncertainty in some of the data, the important factor is that changes in data be accurately measured. Improvements in the approach might be desirable but this should not prevent setting up a carbon budgeting scheme.

Annual reporting to Parliament by Defra of emissions and steps taken to reduce them has already been laid down in law. The process is underway to ensure that this reporting actively leads to a contribution to emissions reductions by stimulating a more frequent review of greenhouse gas reduction policies and measures. There is still scope however for further raising the profile of the new annual greenhouse gas report.

The timing of the various reports that are available is convenient. Although there is a time delay in emissions reporting, the delay is only 15 months, and is therefore not a severe impediment to productive policy review.

Implementation of a UK carbon budget could involve the following steps:

- Assess and set the long-term UK carbon budget;
- Assess this budget at a sectoral level;
- Set appropriate policy targets with departments as part of the Comprehensive Spending Review, so that these are in line with financial spending. The overall long-term policy targets for emissions budgets would preferably be set for five to six years (to cover two cycles). Three year cycles would be an alternative option (to match with financial targets);
- The Prime Minister to report emissions annually in relation to the carbon budget in March, alongside announcements of the financial budget both at the high level and sectoral level;
- Review policies annually with the Prime Minister's report and design policy changes;
- Make appropriate changes to carbon budget limits and policy objectives in PSAs during **alternate**[19] spending review cycles on the basis of recommended policy changes in the annual Prime Ministerial reports;
- Allow borrowing of emissions within one carbon budget cycle.

The carbon budget scheme would add several important benefits to existing process. It would emphasise the clear perspective that emissions should not just be reported on in relation to interim targets but should be limited each year, or within short cycles.

The carbon budget adds the long-term perspective to carbon planning, as well as monitoring policies more frequently. The longer-term perspective provides certainty for industry and investors in emissions abatement technologies. In addition a carbon budget

[19] Under a three year carbon budget cycle these objectives would be reviewed every three years.

could add flexibility to allow borrowing of emissions within certain periods, an advantage of a carbon budget over simple target setting.

It is clear that government departments have an important role in existing processes and policies, which also leads to the conclusion that of the system design options proposed in Chapter 3, the most appropriate ones should certainly include departmental involvement, and potentially the involvement of a new specialist agency. This observation also allows for option 6 which integrates this high-level approach, with the option for downstream disaggregation in some sectors.

4.5 Cost

The cost of the carbon budget system as outlined in this report does not represent a very high marginal cost to government. The majority of the processes that are necessary to enable the carbon budget to work are already in place, or have been proposed.

As an indicative cost, the current contract with Netcen to create a full national emissions inventory for three years, including other work such as website maintenance, is £360,000.

Further work would be required to enable policy review on an annual basis, and could involve a small team of employees across government. This cost could be estimated as the value of four to five full time employees.

Further costs are likely to be associated with the long-term budget setting and division between sectors. As an example, the energy projections team in DTI currently comprises roughly three full time employees, and so this extra work could be estimated as the work of one further full-time individual.

In total, therefore, the carbon budgeting scheme could be set up at the cost of only five to six full time employees, and this would assume that all such posts would be new. Furthermore, as indicated earlier, the government is minded to move in the direction of more frequent reporting and review of policies in any case, and therefore the marginal cost of the carbon budget is minimal.

If the system includes setting up a new agency of some sort to act as a specialist body initial costs could be much higher, although it is likely that such a body would be made up of existing civil servants and so it would only be the additional set up costs of an agency to consider.

In conclusion, the carbon budgeting proposal is unlikely to be costly as it does not represent a great deal of additional work, merely careful thinking about how such work is coordinated and the information used.

5 The European Dimension

One of the greatest challenges to the UK carbon budget approach will be concerns that the UK is taking unilateral action beyond that of the international community and its European neighbours.

As outlined in section 2.4, careful attention to the design of the scheme could help ensure that the carbon budget approach:

- Can act as a lead for others to follow;
- Has clear steps by which it could be translated to other EU countries;
- Involves setting a budget that is cost-effective and technically possible; and
- Engages with all stakeholders.

Furthermore, it could be argued that there is a need for a better way to communicate climate change targets and goals clearly to stakeholders and that a carbon budget meets this need. The EU ETS has already had some success in clearly communicating limits on carbon dioxide to participating sectors. However, there needs to be a clear and consistent approach to doing the same for all relevant gases and sources. Such an integrated and holistic approach is important to making the individual sectoral approaches well-thought through and meaningful.

5.1 Setting the overall budget

It is important that the UK sets a sensible overall budget that is in line with international commitments and ongoing processes in other EU Member States.

The system that has been proposed here is flexible enough to take on board changes in the international carbon agenda, whilst setting long-term certainty in the UK within a six-year cycle.

It is important to note that the suggested approach here to setting the UK target is in line with the approach currently being taken by other EU Member States. France, Germany and the Netherlands, for example, are all looking seriously at making significant reductions in their national emissions in the longer term.

In France there is an active working group on Factor 4 reductions in emissions on 1990 levels by 2050, to include all greenhouse gases. This goal has already been enshrined in law to a certain degree[20]. The French government is looking at different energy scenarios

[20] Article 2 of the French law "establishing the direction of energy policy" 13 July 2005 includes a reference to the need for a factor four reduction of greenhouse gases to be considered as part of the "commen but differentiated responsibilities" of nations to achieve a reduction in global greenhouse gas emissions.

and continues to look at the policies and measures necessary to reach this objective. The Prime Minister has made public statements supporting this direction although there is currently no clear mention of policies such as carbon budgeting

In March 2006 UBA in Germany (Federal Environment Agency) published a report outlining different global greenhouse gas reduction scenarios, as well as an outline of several policies and measures that could be put in place in order to make these greenhouse gas reductions in the future. This report concluded, amongst other things, that it would be technically possible for Germany to reduce its greenhouse gases by 80% on present levels by 2050.

The German Climate Change programme of 2005 aims to put Germany on a path to a medium-term objective of a 40% reduction of greenhouse gases on present day levels by 2020. This goal is contingent on the EU committing to a reduction of 30% across all the member states over the same time frame.

This type of assessment has not been restricted to the Member State level. Some work has also been taken place at the European Environment Agency to look at potential emissions reductions scenarios beyond 2020 (see section 5.2.2). A European Council Resolution in March 2005 has made commitments to a 30% reduction in emissions in 1990 levels by 2020, and makes a general commitment to a 70% reduction but without a clear timeframe. The EU has also stated its goal that temperature increases should be limited to 2˚C, but without clear quantified statements of how this target should be adhered to, and what the implications are for emissions limits.

It is important to note that the type of work going on at the EU level in terms of emissions reductions or limits beyond 2020 is currently limited. There is certainly an opportunity for more detailed discussions to take place at the European level about the precise carbon budget that is appropriate for the EU in the longer term (i.e. 2050, or 2070) in line with the work of the leading Member States. The work that the EEA has done on low emissions scenarios could also be taken forward, stimulating discussions of policy approaches that could deliver the appropriate scenarios.

Looking beyond the EU, several other countries have also explored long-term reductions. Norway is considering scenarios to reduce greenhouse gases by 50-80% by 2050. Japan has also launched research initiatives to look at reductions of 60-80% of greenhouse gases by 2050. The Governor of the state of California in the United States has also set similarly ambitious long-term reduction goals.

These examples indicate that the UK is not alone in setting long-term greenhouse gas goals involving significant reductions in emissions. By adopting a carbon budget approach the UK would be setting a global example of how to put this goal into operation. In particular, the UK could than promote this approach at the European level, perhaps together with some of the other Member States that have been researching long-

term emissions limits and budgets. By providing an example of how such a problem could be approached, the UK could help stimulate the EU to take its research agenda and planning on carbon limits to the next stage – both in terms of timeline, and in terms of depth of analysis.

Any UK scheme would have to be flexible enough to fit with any potential post-Kyoto International emissions agreements that will be made. It might therefore be logical for the first cycle of a UK carbon budget to be chosen in a way that could easily incorporate any developments on the international level (the three year carbon budget cycle should provide this flexibility).

5.2 The EU Structure

The UK could consider promoting the carbon budget as a tool to be used at the European level. Clarity about such an approach would give the EU a leadership role, and also strengthen the argument at home for being the first nation to strictly enforce a carbon budget.

5.2.1 Raising the Profile

A carbon budget could be implemented at the most basic level in Europe, simply to raise the profile of carbon reductions. This aim could be achieved in the UK by giving the Prime Minister responsibility for announcing the overall carbon budget.

The EU governance structure is made up of several organisations, including:

- **The European Council:** made up of the heads of state or government of the European Member States. The Council is made up of Ministers from Member State governments who meet on their relevant policy areas regularly e.g. Environment Council;
- **The European Commission:** the EU's administrative and executive body, which is led by 25 Commissioners, delegated by the Member States, each of whom has a responsibility of furthering an area of EU policy.
- **The European Parliament:** the European democratically elected body.

In order to give a carbon budget a sufficient profile, it would be logical for the European Council to announce the EU's carbon budget and progress towards it at one of its meetings each year. This responsibility would directly parallel the proposed role of the Prime Minister in the UK scheme.

5.2.2 The Carbon Budget and Existing Processes

In discussing the UK carbon budget, it was argued that the EU carbon budget cycle should be linked to the Comprehensive Spending Review cycle both to raise the profile, and to co-ordinate with policy decisions that relate to funding. This same argument could be applied at the EU-level.

Like the individual Member States, the EU has a budget to spend, and policy decisions are made that relate to the way in which these budgets are distributed and the timing of their distribution.

The EU spends money in various ways, including:

- Research and development;
- Structural funds;
- Common Agricultural Policy;
- Through procurement;
- International Aid etc.

There are different structures in place for deciding on these budgets and the ways in which they are distributed. For example the structural funds are divided into different funding streams, and budgets and the conditions of funding are set for a given period of time – currently for 2000-6. Similarly, the Research and Development budgets are distributed through successive Framework Programmes based on agreed policy priorities and outputs. The rules governing the CAP are complex and are undergoing a reform process over the coming years to 2012 such that the basis on which funding is received is gradually changing.

From the examples above, it is clear that the decisions about funding is made through various processes and over different timescales, and therefore funding at the EU-level as a whole does not offer a clear co-ordinated timetable for the carbon budget cycles to adhere to, as in the UK government examples. The connections between climate policy (both mitigation and adaptation) and EU funding streams varies depending on the funding area involved but there are many areas where this co-ordination could be improved and strengthened.

An EU carbon budget could be pro-active in strengthening this connection. By setting a clear long-term budget for the EU the question can then be asked – how can the funding systems in place be used to help adhere to these budgets? In order to influence the policy process appropriately the development of an EU carbon budget should take place in anticipation of the key policy cycles governing these funding systems, in order to give enough to incorporate climate goals into the other goals of the funding policies.

The carbon budget could then be agreed in parallel to decisions about the funding system in order to accord the carbon budget with equally high profile and to ensure that the final agreements are appropriately integrated.

An approach, such as that proposed above, is in line with Article 6 of the EU Treaty of Amsterdam calling for environmental protection requirements to be integrated into the definition and implementation of other policies. This was already contained in Article 174 (ex Article 130r).

5.2.3 Setting and Monitoring the Budget

In practical terms, setting, determining and monitoring whole economy carbon budgets for all European Member States could be contentious. However, it is important to note that much of the infrastructure for doing so is already in place in Member States, even if not at sector level for the whole economy, due to international emissions reporting requirements and the EU ETS.

Setting a long-term budget

As stated earlier, several EU Member States are already investigating potential long-term carbon reduction targets and measures necessary to meet these. Furthermore, at the EU level long-term targets have also been explored.

At the political level Europe's 6th Environmental Action Plan endorses a 70% reduction of greenhouse gases compared to 1990 levels in the long-term. A European Council Resolution from March 2005 recognised that developed countries should aim for a 15-30% reduction of such emissions by 2020.

On the research side, the European Environment Agency published a report in June 2006 looking at long-term greenhouse gas emission reduction scenarios in Europe investigating scenarios of -20% by 2020, -30% by 2030 and -65% by 2050.

This information indicates that if European countries are serious about climate change, then setting an overall EU target for the long-term, and even national targets within that, should be possible.

Monitoring and Reporting on the Budget

As with the UK, much of the greenhouse gas reporting carried out by Member States is reported both to the UNFCCC and to the EU through the monitoring mechanism. Therefore, the structures should be in place to enable a carbon budget report to be made by the Council of Ministers, and mediated through European Environment Agency information, at least annually.

As a result it should be possible for the UK to promote a similarly high profile scheme at the EU level. It would be possible to work towards such an approach in steps, and perhaps start by introducing a system based on a harmonised emissions reporting structure and then gradually moving towards a full carbon budget process. The earliest steps would include an assessment of the scale of a budget at the EU level, and a concerted effort to integrate these limits into EU funding processes. At a later stage a long-term carbon budget could be formally set for the EU and the concepts of borrowing within periods etc. incorporated. The budget could then be further disaggregated to individual EU countries.

In a stepped approach it would be possible initially to announce carbon figures for the EU in total. At the next stage these could then be broken down for sectors across Europe, and gradually this process could include data for individual countries and their sectors. Although it is very possible that this detailed information would be available earlier, the gradual process might lead to a higher level of endorsement from Member States.

5.3 Acceptability

Any European approach would have to be sensitive to the Subsidiarity Principle of the European Union. However, it would be fitting and logical for the EU to stimulate a co-ordinated approach to tackling greenhouse gas emissions, through a common high-level reporting procedure.

A carbon budget should be presented in this manner. It is not intended that the EU would control the allocation of carbon budgets within a country – rather that each country should do so nationally, but with a centralised approach.

It is likely that the reactions of different Member States, however, to such a proposal would be highly dependent on their political approach towards the climate change agenda, and the extent to which a carbon budgeting approach would fit within their existing domestic processes and procedures.

6 Conclusions

This report has argued that setting up a carbon budget scheme is feasible and practical within the UK systems at present. Furthermore, the report has made several recommendations about system design elements that could maximise the effectiveness of a carbon budget scheme.

A carbon budget should be developed using a combination of a top-down and lower-level set of budgets (presented as option six). Under this design the budget is essentially a high-level system divided sectorally and designated to government departments, with the option for departments to use downstream schemes of budgeting to individuals or organisations as appropriate.

This integrated option is likely to be the most promising and has the following key advantages:

- Development of a high level budget;
- Expert division of budget into long-term sectoral budgets;
- Element of responsibility given to legislators to stimulate the correct infrastructure, research and development etc. to enable budgets to be met; and
- Flexibility for some responsibility to be given to end-emitters, in the sectors where this is most appropriate, through particular policies and measures to enable demand-side pressure, and enact the polluter-pays principle.

Even if an integrated approach is selected, this approach need not be established immediately. Several elements of such an approach could be developed gradually, and in parallel. Some of these elements already exist e.g. the EU ETS is an example of a budget set for a particular sector of end-emitters.

Table 3 Preferred Design elements within the carbon budgeting scheme

Design Element	**Preferred Design Option**
Profile and Responsibility	Prime Minister, with government department roles
Overall budget setting	Long-term, on the basis of emissions profiles for sectors to 2050
Scope	Kyoto Basket of gases, with aviation and shipping included
Reporting	Annually to Parliament, possibly with division to policy level
Periods of commitment	Three year cycles (in line with one PSA cycle) OR Five to six year cycles preferred (in line with two PSA cycles,

	enabling more information on emissions to be collected)
Key review process	Comprehensive Spending Review
Structural approach	Option 6 – an integrated approach, mostly high-level target setting with division to Departments and the option for further disaggregation based on their choices
Penalties	Overspending on the budget compromises future allocation to that sector in the next budget period.
Monitoring	Through current GHGI procedures.
Role of trading	Flexibility for choice to use downstream trading through individual departmental policy e.g through the EU ETS for industrial installations. At the departmental level no trading will be possible, re-allocation will take place in the six-yearly review cycle
Flexibility/Borrowing	The ability to borrow within the budget period such that *total cumulative emissions* remain within the budget over that period. Otherwise penalties will be incurred.

Table 3 shows some of the key design elements of the proposed carbon-budget scheme. In the UK existing processes are sufficiently developed to be used for the purposes of a carbon budgeting scheme as set out above. A carbon budgeting scheme could make use of existing greenhouse gas reporting processes and the Comprehensive Spending Review could provide a useful framework for setting departmental policy objectives. The phases of a carbon budgeting scheme should be in five to six-year periods in order to fit in with these review processes, and enable the desired flexibility within the scheme.

The timetable of current emissions reporting is also convenient. Although there is a time delay in emissions reporting, the delay is only 15 months, and is therefore not a severe impediment to productive policy review.

Implementation of a carbon budget as set out above could involve the following steps:

- Assess and set the long-term UK carbon budget;
- Assess this budget at a sectoral level;
- Set appropriate policy targets with departments as part of the Comprehensive Spending Review, so that these are in line with financial spending. The overall long-term policy targets for emissions budgets would preferably be set for five to six years (to cover two cycles). Three year cycles would be an alternative option (to match with financial targets);
- The Prime Minister to report emissions annually in relation to the carbon budget in March, alongside announcements of the financial budget both at the high level and sectoral level;
- Review policies annually with the Prime Minister's report and design policy changes;

- Make appropriate changes to PSAs during **alternate** spending review cycles on the basis of recommended policy changes in the annual Prime Ministerial reports;
- Allow borrowing of emissions within one carbon budget cycle.

In addition to the existing processes a carbon budget approach would add several important benefits. It would emphasise the clear perspective that emissions should not just be reported in relation to interim targets but should be limited each year, or within short cycles.

A carbon budget would add a long-term perspective to carbon planning, whilst potentially giving flexibility to borrow within certain periods. The budget should be set within a strong structure of frequent policy monitoring and review, which is an important step to achieving actual emissions reductions. A long-term carbon budget would also provide direction and certainty for businesses and investors in emissions reduction technologies.

The cost of a carbon budget system as outlined in this report does not represent a high marginal cost to government. The majority of the processes that would be necessary to enable a carbon budget to work are already in place, or have been proposed.

It should be possible for the UK to promote a similarly high profile scheme at the EU level. This could be worked towards in steps, perhaps starting with a harmonised, high-profile, EU-wide emissions reporting structure and then gradually move towards the full carbon budget process. The earliest steps would include an assessment of the scale of a budget at the EU level, and a concerted effort to integrate these limits into EU funding processes. At a later stage a long-term carbon budget could be formally set for the EU and the concepts of borrowing within periods etc. incorporated. The budget could then be further disaggregated to individual EU countries.

It is logical for the EU to stimulate a co-ordinated approach to tackling greenhouse gas emissions. A common high-level reporting procedure such as the carbon budget would be one option to achieve this and this represents a clear area where the UK could act as a leader in the development and implementation of a pioneering scheme.