Tyndall Centre
for Climate Change Research

Making a Climate Commitment: Analysis of the first Report (2008) of the UK Committee on Climate Change

A research report by The Tyndall Centre, University of Manchester

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Report commissioned by Friends of the Earth

March 2009

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The Climate Change Act 2008 represents a significant step in the UK's effort to address climate change and demonstrates that scientific evidence, at least to some extent, is informing policy development.

The Act, amongst other things, establishes the Committee on Climate Change (CCC), an approach to setting five-yearly carbon budgets and a strengthened 2050 target. The budget setting is particularly significant as it provides a valuable mechanism for recognising the importance of cumulative emissions and pathways for addressing climate change. The CCC's inaugural Report sets out a series of recommendations to Government for the first three budget periods up to 2022, along with suggestions for how trading of emissions can be used to help realise them. This research report, prepared for Friends of the Earth, sets out to critically analyse these recommendations and their associated assumptions, particularly with respect to:

- Emissions reductions and pathways required to meet the Government's commitment for keeping temperature rises below 2°C;
- The implications of following the less ambitious pathway described in the CCC's 'interim' budget compared to the 'intended' budget;
- The potential implications of using emissions buy-outs, with a corresponding reduction in domestic abatement, to achieve the proposed budgets; and
- Potential lock-in to infrastructure and behaviour associated with taking particular pathways that makes achievement of the 2050 target increasingly difficult.

The resulting discussion and key conclusions, which strongly challenge the CCC's recommendations, are summarised below:

Key conclusions

2°C target context
The CCC Report is not in line with the level of global emissions cuts required to prevent breaching the 2°C threshold between 'acceptable' and 'dangerous' climate change. With current annual emissions at unprecedented levels and rising each year, maintaining cumulative emissions in line with 2°C requires an almost immediate curtailment and early reversal of emissions growth in industrialised countries.

Implications of choosing the intended pathway
Temperature rise is inextricably linked to the cumulative emissions of greenhouse gases (GHGs) in the atmosphere. Consequently, the first three budget periods, when emissions are at their highest, are the most important in relation to the 2°C temperature threshold. Within the Report, the budgets and 'intended' pathway assume global emissions will peak in 2016. This is highly desirable but extremely unlikely. Using a more realistic 2020 peak would mean a more stringent 'intended' budget in early years. As it stands, even following the 'intended' pathway, the CCC's Report falls short of the Government's commitment to the 2°C.

Implications of choosing the interim pathway
The CCC's 'interim' budget falls even further short of the Government's 2°C commitment, undermining any reasonable claim to international leadership on climate change. If no global deal is reached, the less stringent action to reduce emissions in the UK by following the 'interim' budget in the short to medium-term will compound inaction elsewhere.

Global emission increases
With annual emissions currently at unprecedented levels and rising each year, maintaining cumulative emissions in line with 2°C requires an almost immediate curtailment and early reversal of emissions growth.

Aviation and shipping
The role of aviation and shipping emissions within the pathways is at best unclear. It must be recognised that they are distinct sectors characterised by important differences in relation to accounting and apportionment and their projected growth has significant implications.

Carbon offsets
The Revised EU ETS Directive (adopted 17th December 2008) implicitly weakens the amount of 'effort' required to make cuts in emissions within the UK's own boundaries. The enhanced opportunity to purchase offset credits from un-capped nations through the Clean Development Mechanism (CDM) undermines the UK's climate change objectives, given uncertainties in equivalence between UK emissions reductions and reductions claimed elsewhere.

Carbon lock-in
Adopting the 'interim' rather than 'intended' emission pathway, coupled with opportunities for the significant purchase of offset credits, encourages development of energy infrastructure, habits and preferences that lock the UK into a more carbon intensive future.

Policy recommendations

The following recommendations are based on the analysis presented within this report allied with broader research around the 2°C threshold.

Global framing of the emissions pathways

- The pathways must be informed by the latest understanding of the science of climate change;
- The CCC needs to reconsider the global and EU emission trends underpinning its UK pathways;
- The CCC must revisit its 'intended' emission pathways to consider global emissions peaking later than 2016; and

- There must be a much clearer understanding of the relationship between emission pathways of OECD and non-OECD nations.

The intended pathway

- Regardless of a global agreement, the UK should demonstrate leadership and immediately adopt a stringent 'intended' pathway;
- A revisited 'intended' pathway must reflect the latest science behind the 2°C threshold and should be more demanding than the current pathway recommended by the CCC; and
- As a minimum, the Government should adopt the 'intended' budget with a 42% reduction by 2020 and without a contribution from the CDM. This will still fall short of the 2°C commitment.

Avoiding lock-in

- The UK should commit to achieving reductions from the non-traded sector without offsetting or trading until there is a meaningful global emission cap premised on the 2°C threshold; and
- All UK policy decisions must fit within an 'intended' 2°C-based pathway. Even for the traded sector, the UK must not rely on the EU ETS to exceed the associated cumulative value; i.e. investment in carbon-intensive infrastructure, such as additional airport capacity, new coal stations or major road building, must be considered within the nation's 'intended' budget.

1. Introduction

The Committee on Climate Change (CCC) was established by the Climate Change Act 2008 to provide independent advice to Government on achieving its greenhouse gas (GHG) emissions reductions targets. In its first Report (CCC, 2008), the CCC has provided recommendations for the level of emissions reductions to be achieved during the first three carbon budget periods (see below) and options for achieving these. The findings outlined in this research report explore and challenge whether these recommendations provide a sufficient basis to enable the UK Government to meet its commitment to the 2°C threshold between 'dangerous' and 'acceptable' climate change and its legal duty to reduce emissions by 80% by 2050.

1.1 The UK Climate Change Act 2008

The UK Climate Change Act[1] represents a major step forward in the UK's effort to address climate change and represents the world's first long-term legally binding framework for reducing emissions. In terms of this report, the Act has three key provisions:

- It sets out a legally binding target for 2050 of an 80% reduction in emissions below the 1990 baseline for all targeted GHGs;
- It introduces a five year carbon budgeting approach designed to set the trajectory for reaching the 2020 and 2050 targets; and
- It establishes the CCC as an independent body to advise Government on the levels of targets, carbon budgets, and approaches for achieving them.

During its passage through Parliament, major amendments were made to the initial draft Climate Change Bill. Most crucially the 2050 target was revised upwards, with the Act requiring an 80% reduction of all GHGs by 2050 from the 1990 baseline year[2]. For 2020 the Act sets out a minimum reduction of 26% from the 1990 baseline, however, this is to be reviewed to reflect the move to an 80% target for 2050. The introduction of carbon budgets is crucial as it provides a mechanism for recognising the importance of cumulative emissions and the way that the emissions pathway taken to achieving the final target impacts on them. Five-year 'budgetary periods' are set out in the Act, starting with 2008-2012. At present minimum levels for the budgets are only specified for the period including 2020 and 2050 but under the terms of the Act the actual budgets for 2008-2012, 2013-2017, 2018-2022 must be set by 1st of June 2009. Later budgets need to be set by the 30th June, 12 years before the beginning of the period, ensuring that three budgets are set out at any one time. Final targets and carbon budgets can be amended by the Secretary of State, based on significant developments in either scientific knowledge about climate change or European or international law or policy. While emissions from international aviation and shipping are not currently included in targets within the Act, the Secretary of State has to set out provisions for

[1] The Climate Change Bill was passed into law on the 26th November 2008.
[2] The '1990 baseline' refers to the net emissions of CO_2, methane and nitrous oxide for 1990, but also includes the net emissions of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride for their base year which is 1995.

including emissions from these sectors before the end of the 2012 budgetary period, or has to report to Parliament why this has not been done.

1.2 Setting emissions pathways

EU nation states, amongst other countries, continue to reiterate a commitment to keeping temperature rises below 2°C, yet annual GHG emissions are increasing at rates well above expectations. Given the importance of cumulative emissions, these increases have major implications for emission reduction pathways required if concentrations of GHGs in the atmosphere are to be stabilised at a level that gives a realistic chance of achieving the 2°C threshold.

As argued previously (Anderson and Bows, 2007), if carbon reduction strategies are to be evidence-based then it is important to identify the 'correlation trail' from a global temperature threshold, through to the setting of national emission pathways (Figure 1). Taking this approach has shown that the scale of the challenge, in terms of the urgency and degree of emissions reductions required, is considerable (Anderson et al., 2008; Anderson and Bows, 2008).

The recommendations of the CCC for the first three budget periods set two possible emission pathways up to 2022. Following the European Union (EU) Framework approach, the CCC has proposed an 'intended' budget (42% emission reductions from 1990 baseline), which should apply if a global deal on climate change is reached, and an 'interim' budget (34% emission reductions from 1990 baseline) to apply until that happens. Informed by the correlation trail from temperature to emission pathways, this report examines the implications of both the 'intended' and 'interim' budgets in terms of the subsequent emissions reduction that will be required in the period from 2022 to 2050.

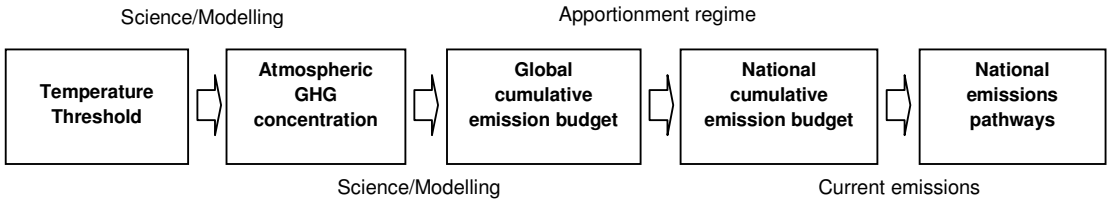

Figure 1: The 'correlation trail' for setting emission pathways (adapted from Anderson and Bows, 2007).

1.3 Achieving emissions reductions

The way emission reductions are achieved in the 2008-2022 period could have significant implications for the UK's ability to achieve what will be major emissions reductions during the period 2022-2050. The CCC Report makes recommendations on the use of offset credits to help the UK reach its targets. This report considers how using such credits, as opposed to domestic emission reductions, could potentially impact on investment and innovation in the low carbon infrastructure requisite for reaching the 2050 target. Moreover, it considers how adopting the lower 'interim' budget investment would be reduced in comparison with the 'intended' budget, with the result that the UK could get 'locked-in' to a more carbon-intensive infrastructure and patterns of behaviour, seriously exacerbating the already challenging 2050 target.

1.4 Report structure

Section 2 challenges the implications of the 2°C target and discusses the global emission pathways that will be required if this target is to be achieved.

Section 3 looks at the CCC's recommendations relating to emissions reductions to be achieved during the first three budgetary periods, and the mechanisms for achieving these reductions.

Section 4 provides an analysis of the CCC Report including: the implication for cumulative emissions of both the 'intended' and 'interim' budgets for the period up to 2022; the emission pathway required for the 2022-2050; the role and implication of offset credits; and the potential for lock-in into more carbon intensive infrastructure

Section 5 discusses the findings, provides a number of conclusions that can be drawn from the research and offers a series of policy recommendations.

2. Climate change: global pathways

Despite the high national and international profile of climate change and the associated development of emissions targets and policies, global GHG emissions continue to rise. Furthermore, the global emission growth rate since 2000 exceeds that of the previous 100-year average (Figure 2). For some sectors and nations, extreme events periodically moderate growth, for example the economic decline following the events of 11th September 2001 and the more prolonged implications of the current and global economic downturn. The challenge is to build on emission reductions, not through ad-hoc recessions but through a deliberate, effective and comprehensive policy framework focussed on climate change mitigation and adaptation. Only with an urgent and stringent framework that addresses cumulative and aggregate emissions from all sectors will the worst excesses of climate change be avoided. The UK Climate Change Act and subsequent report from the CCC are valuable and admirable attempts to address this issue, but nevertheless remain far removed from what is necessary to meet the Government's and EU's commitment to not exceeding the 2°C goal.

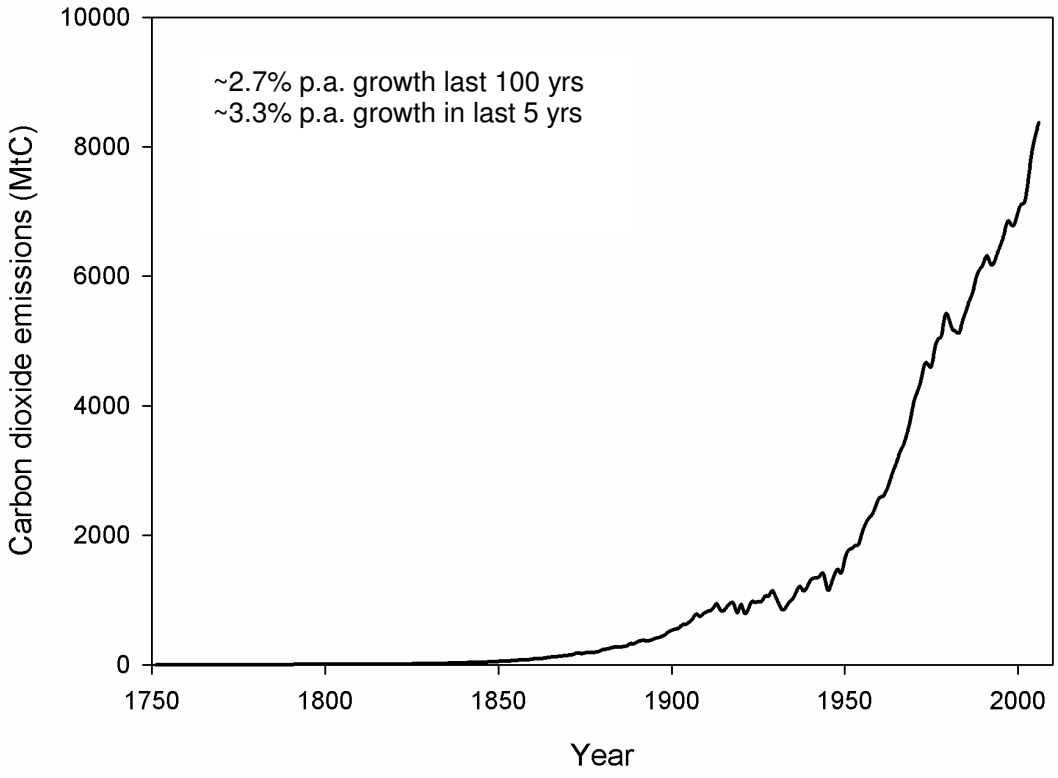

Figure 2: Global emission growth of carbon dioxide from pre-industrial times to the present day.

2.1 The significance of recent emission trends

The portfolio of emissions scenarios informing the international and national climate change agenda typically use modelled as opposed to available empirical data for the post-2000 period; the 2006 Stern Review (Stern, 2006 p.231) and the UK's 2007 Draft Climate Change Bill (Defra, 2007a) demonstrate this trend. However, whilst modelled data essentially extrapolates earlier trends, the empirical emissions data indicates a significant departure from historical growth rates. For example, between 2000 and 2006 global annual emissions grew at 2.4%[3], considerably higher than the 0.95% underpinning Stern's 2006 assessment of the "The Scale of the Challenge". In similar optimistic vein, the 'Partial Regulatory Impact Assessment' within the UK's Draft Climate Change Bill (Defra, 2007a, p.21) assumed UK emissions to fall between 2000 and 2006, whilst in practice they were, at best, stable[4].

The extent of the divergence between empirical and modelled emissions data, particularly when allied with the highly optimistic emission peaking dates[5], has fundamental implications for the scale of both the mitigation and adaptation challenge. In the longer term the implications for cumulative emissions are potentially profound, however, even in the short-term such divergence has serious repercussions. Stern's estimate of global CO_2e emissions increasing by ~5GtCO_2e between 2000 and 2015 is similar to some estimates of total emissions from China alone. In essence, Stern is implying that global emissions (excluding China) will remain virtually unchanged between 2000 and 2015.[6]

In relation to peak annual emission dates, if instead of Stern's 2015 assumption (the CCC use 2016) global peaking did not occur until 2020, with recent trends continuing to 2015 before slowing to an absolute 2020 peak, emissions would be some 15GtCO_2e higher than Stern's 2020 range; equivalent to more than a third of current global annual emissions (Anderson and Bows, 2008, p.3878). The adoption of a 2016 global emission peak within the CCC Report illustrates the tendency of some within the climate community to use highly optimistic assumptions to deliver politically acceptable policy recommendations. In many regards, this 'well meant' framing of the analysis is not serving the policy community well.

[3] CO_2 data from the Carbon Dioxide Information Analysis Centre (CDIAC) including recent data from personal communication with Gregg Marland; non-CO_2 GHG data from the USA Environmental Protection Agency (EPA, 2006) including the projection for 2005, and assuming deforestation emissions in 2005 to be 5.5GtCO_2 (1.5GtC), with a 0.4% growth in the preceding five years in line with data within the Global Forest Resources Assessment (FAO, 2005).

[4] Depending on the assumptions with regards to the inclusion and apportionment of international aviation and shipping emissions.

[5] Ongoing private discussions with academics and decision makers suggests a commonly held view that emissions peaking in 2015 (Stern) or 2016 (CCC) is highly optimistic and very unlikely to be achieved. Reasons for this view include the inertia within existing energy systems reliant on fossil fuels and the increasing proportion of global emissions from India and China, both of whom currently are without emission caps and have no official position on peaking emissions in the coming decade.

[6] Stern envisages a global CO_2e emissions increase of ~5GtCO_2e between 2000 and 2015 compared with provisional estimates for China alone of between 2.7 and 4.8 GtCO_2e, (Wang and Watson, 2008). If the higher estimate for China is correct, Stern's analysis implicitly assumes global emissions (excluding China) remain virtually unchanged between 2000 and 2015.

2.2 2°C and 'dangerous climate change'

In the absence of any globally agreed demarcation between 'acceptable' and 'dangerous climate change', the UK and EU's commitment to 2°C[7] has come to dominate much of the international and national climate change agenda. Moreover, the 2°C threshold has emerged as a reference temperature against which to consider atmospheric concentrations of GHGs and accompanying emission reduction pathways. However, despite the influence of 2°C on the policy process, its ascendancy owes more to evolving politics than to scientifically informed debate. By contrast, the correlation between temperature, atmospheric concentration of GHGs (CO_2e) and cumulative emission budgets arises primarily from a scientific understanding of how the climate functions.

The analysis contained within this report reinforces earlier work (Anderson and Bows, 2007; Anderson and Bows, 2008; Anderson et al., 2008) suggesting the revered status of 2°C continues to stifle more meaningful, open and empirically informed dialogue on climate change. There are certainly strong arguments in support of 2°C (or less) as being an appropriate driver for mitigation policy, however, it increasingly serves only to underplay the potential lock-in implications of inappropriate adaptation. Since the publication of the Intergovernmental Panel on Climate Change's (IPCC) last report, there is evidence from within both the scientific and, to a lesser extent, the policy community, of escalating uneasiness with the rhetoric of 2°C and its subsequent implications for effective policy. Increasingly it is becoming evident that even if all orthodox mitigation measures were implemented as a matter of urgency, it would be difficult to avoid temperatures rising by less than 4°C (~650ppmv). However, even this would require rapid curtailment of deforestation, a radical reversal in emission trends from food production and urgent decarbonisation of the global energy system (Anderson and Bows, 2008) – all issues that are currently undermined by the pre-eminence of 2°C. Notwithstanding this, it is essential that 2°C remains the principal focus of mitigation alongside a clear 4°C driver for adaptation.

2.3 Reframing global emission pathways

To explore the practical climate change challenge at a regional or national level, it is necessary to consider the scale of emission reductions required at the aggregated global scale. Recent Tyndall research (Anderson and Bows, 2008) illustrates the impact of continuing short-term emission growth and a variation in the global peaking date in relation to the 2°C threshold between acceptable and 'dangerous climate change'. In essence the work shows that the later action is taken to mitigate global emissions, the more stringent are the emission reductions required post the peak emission date (Figure 3). Furthermore, if emissions are allowed to peak as late as 2020, GHG emission reductions from all sources of the order of 10% per year would be necessary. According to the Stern Review (Stern, 2006), emissions reductions of greater than 1% have only ever been associated with 'economic recession or

[7] In March 2007, European leaders reaffirmed their commitment to the 2°C threshold (European Commission, 2007).

upheaval'. Consequently, emission reductions necessary to meet the 2°C threshold demand urgent step change mitigation policy and technologies.

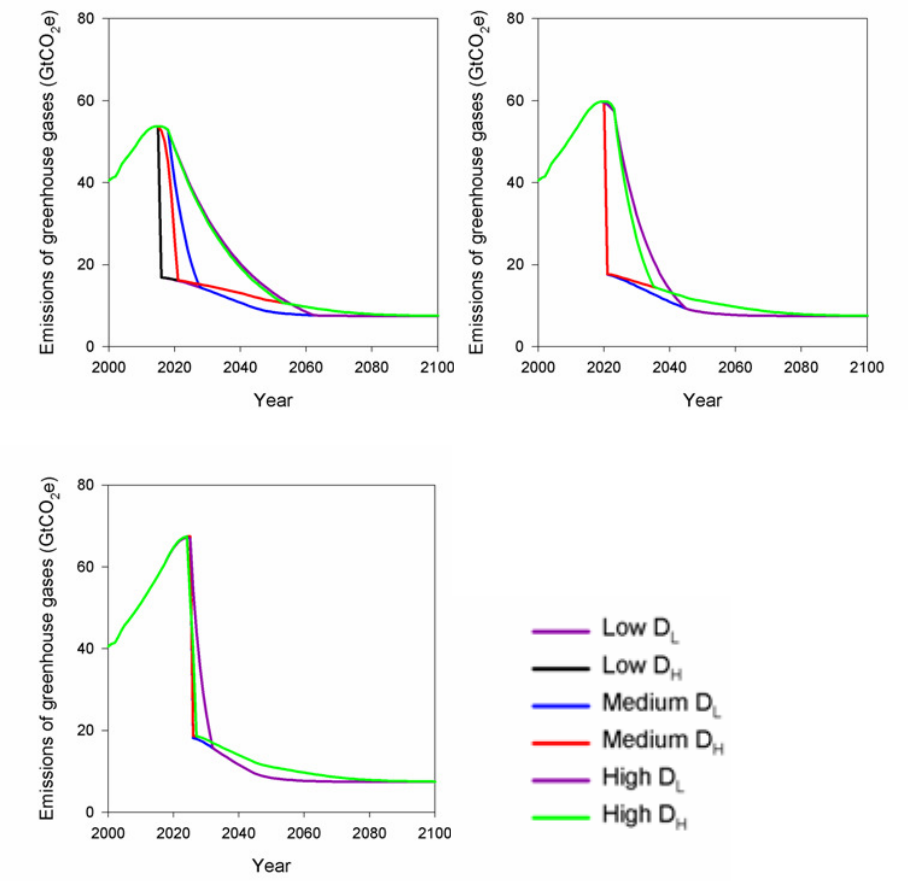

Figure 3: GHG emission pathways commensurate with the 2°C target (Anderson and Bows, 2008). The different scenarios represent the range of cumulative values presented in the IPCC's Fourth Assessment Report in addition to a range of deforestation and non-CO_2 GHG scenarios. DL and DH refer to high and low deforestation scenarios.

An additional and important point is that emissions from GHGs cannot be assumed to decrease to zero (Anderson and Bows, 2008). Any reasonable population size will be associated with ongoing and substantial emissions from agriculture (food production). The consequence of this, allied with optimistic assumptions about emissions from deforestation, suggest that for any reasonable chance of not exceeding the 2°C threshold, CO_2 emissions from energy and industrial processes must be eliminated within two to three decades (Figure 4).

Although this analysis is for the global scale, the implications for OECD nations[8] such as the UK are stark. OECD emissions make up approximately 50% of current global emissions and whilst these are still growing they are doing so at a slower rate than emissions from the non-OECD nations. Assuming the economic growth rates of the non-OECD nations continue to exceed those of the OECD, their emissions will make up a greater and greater portion of the overall emission budget. Consequently, in the short- to medium-term, if the economic development of non-OECD nations is not to be stifled, emissions from OECD nations will need to reduce more radically than the global average – at least until there is wide-spread penetration of low-carbon energy supply.

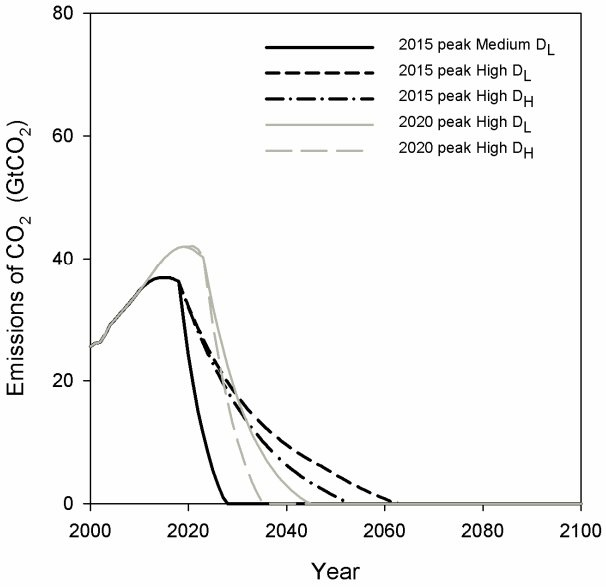

Figure 4: Emission pathways for energy use and industrial processes commensurate with the 2°C threshold (Anderson and Bows, 2008). See Figure 3 for more details.

[8] Organisation for Economic Co-operation and Development

3. Committee on Climate Change (CCC) Recommendations

Fulfilling its remit, the CCC Report provides a series of recommendations on both the level of emissions reductions to be achieved during the first three budgetary periods, and the mechanisms for achieving these reductions. These recommendations are outlined in this section with analysis of their implications following in Section 4.

3.1 Carbon budgets

Within the CCC Report, the first three budgets have been proposed for 2008 until 2022 (Table 1) along with the recommendation that they apply to all Kyoto GHGs, not just CO_2. In line with the EU climate and energy package agreed in December 2008, to which the UK is legally committed, the CCC recommends that the UK Government sets two target budgets – the initial ('interim') budget would apply immediately, the second ('intended') budget, entailing more demanding cuts in emissions, would apply if and when a global agreement is reached.

The **'interim' budget** would require the UK to achieve at least 29% CO_2 reduction (34% GHG) on 1990 levels by 2020[9]. The Report states, "This is below the lowest level likely to be appropriate as a UK contribution to a required global trajectory (in the order of 35%), but it would drive significant progress towards a low carbon economy, given in particular the limitations that we are proposing on the use of offset credits to meet this target. And to aim significantly higher on a unilateral basis (ahead of other EU nations let alone the developing world) would incur increased costs without significant environmental benefit." (CCC, 2008, p.113)

In the event that a 'satisfactory' global deal is agreed at Copenhagen in December 2009 or at subsequent meetings, the CCC proposes adopting the '**intended' budget**, which will require the UK to achieve at least 40% CO_2 reduction (42% GHG) from 1990 levels by 2020. The Report states, "This more ambitious budget would, as envisaged within the EU Framework, involve a greater use of purchased credits with the possibility of increased domestic effort in some areas. A UK contribution of 40%, together with commensurate emission reductions from other Member States, would put the UK and EU on the path to a low-carbon economy and would represent appropriate UK and EU contributions to required global action towards meeting the climate change objective." (CCC, 2008, p.113).

Setting a less stringent 'interim' budget, would lead to additional cumulative emissions released by the UK, and as such contribute to a larger global emission budget. The implications of the UK Government taking this less stringent pathway, from a quantitative perspective and in relation to the potential knock-on consequences, will be considered and presented in Section 4.

[9] The CCC Report notes that this budget is derived from the EU package, which is subject to ongoing negotiation, so could change before the package is finalised. See section 3.2.3.

Table 1: 'Interim' and 'intended' budgets (CCC, 2008).

Budgeting period	'Interim' budget ($MtCO_2e$)	'Intended' budget ($MtCO_2e$)
2008-2012	3018	3081
2013-2017	2819	2679
2018-2022	2570	2245

Figure 5 and Figure 6 present historical emissions data and the 'interim' and 'intended' pathways taken from the CCC report respectively. The historical emissions include the CO_2 emissions released by the international aviation and shipping industries. For international aviation the data are consistent with those gathered by Defra whereas the shipping data are calculated in line with previous Tyndall research using gross domestic product (GDP) to apportion global bunker emissions (Anderson et al., 2008). The shipping emissions are likely to be underestimated due to one of the lower suggested values for global marine bunker emissions used within this method (Bows, 2008) and the considerable uncertainty in total global CO_2 emissions from marine bunkers (Endresen et al., 2004).

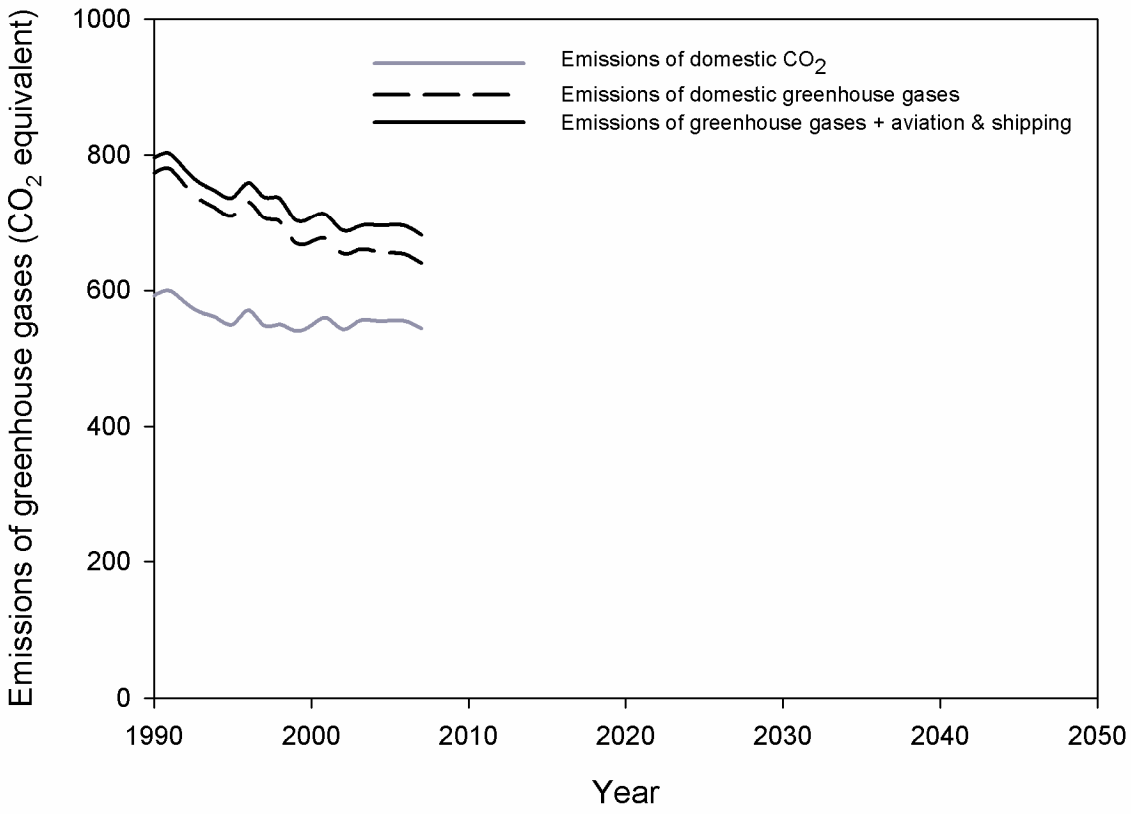

Figure 5: Emissions of domestic CO_2, domestic GHG emissions and the CO_2 emissions from international aviation and shipping.

Although it could be inferred from Figure 5 that emissions have reduced in response to climate change policies, in practice CO_2 emission reductions have largely been in response to a move from coal to gas fired power stations and a significant shift of carbon intensive manufacturing overseas. In addition, substantial reductions in non-CO_2 GHGs have been due to abatement at industrial point sources. In many respects, these are one-off opportunities.

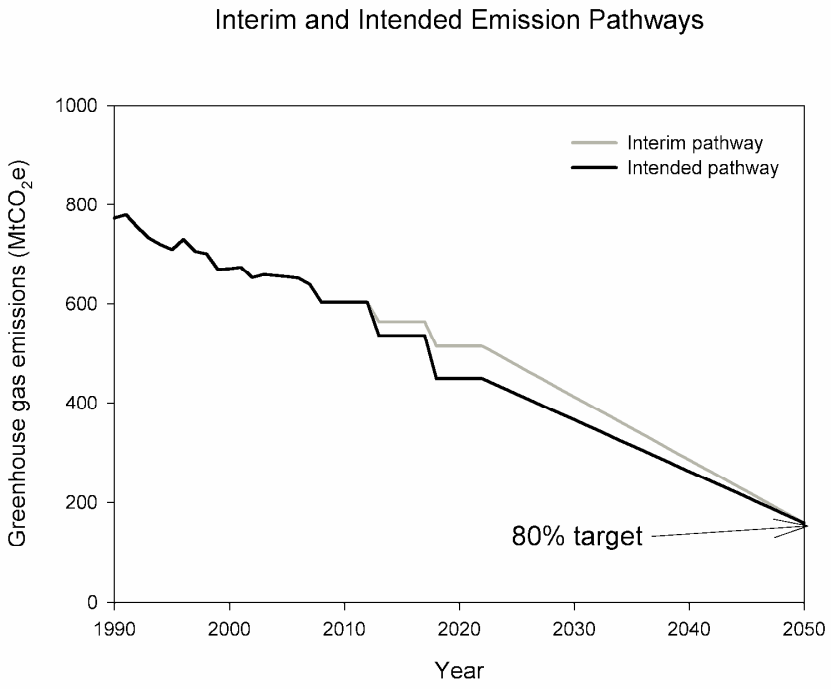

Figure 6: Historical emissions of domestic GHGs (excluding aviation and shipping) prior to 2007, with three emission budgets from 2008 to 2022 and an emission pathway towards an 80% target based on 1990 levels by 2050.

The pathways presented within the CCC Report, whilst not in keeping with the UK's fair contribution to the Government's 2°C commitment[10], nonetheless are challenging and if adopted would represent a significant step forward by the UK Government. In addition to the three budget periods to 2022, it also presents an 80% emission reduction target by 2050. Therefore, from around 2022, annual emissions reductions are required to be 2 - 3% rising after the 2040s. However, although both 'interim' and 'intended' pathways are aiming for the 80% reduction in 2050, they have different cumulative emission values and hence climate change impacts (see Section 4).

[10] The Government is committed to playing its fair role in maintaining global mean surface temperatures at or below the 2°C threshold; this can not be reconciled with the 500-550ppmv focus of the CCC Report.

3.2 European Union Carbon Allowances (EUAs) and offset credits

Carbon trading has come to be a central policy tool for climate change mitigation on an international scale. The EU Emissions Trading Scheme (EU ETS) and the Kyoto Protocol flexibility mechanisms are based on the assumption that the geographic location of emissions is not significant to climate change mitigation for long-lived and well mixed GHGs. They incorporate a group of financial instruments for the exchange of mitigation effort. Governments and private sector organisations can use these instruments to purchase emissions reductions from overseas to enable them to stay within their emission budgets (referred to as **buy-out**), rather than directly reducing their emissions (**abatement**). This means that the **domestic effort** – the amount of emission reductions for a given period of time that is attributable to abatement activities within the UK relative to a base year (2007) level of emissions – required to meet a given budget, is reduced. The rationale for this approach is that it helps bring about emission reductions at least total cost, it acts as a spur to low carbon innovation in regulated industries and gives greater confidence in the environmental outcomes than does a carbon tax. However, as the CCC Report and the Stern Review recognise, these financial instruments are not a panacea.

3.2.1 The EU ETS

The EU ETS is a cap and trade scheme that has operated in the EU since 2005. Installations covered by the scheme are those which carry out activities listed in Schedule 1 of the UK Regulations and include (Defra, 2008):

- energy activities (e.g. boilers, electricity generators, CHP);
- production and processing of ferrous metals;
- mineral industries; and
- pulp and paper industries.

These industries covered by the scheme are referred to as the **traded sector** within the CCC Report. Industries that are not covered by the EU ETS, principally residential, services, transport and certain other industries, are referred to as the **non-traded sector**. The traded sector accounts for approximately 45% of UK's CO_2 emissions when aviation and shipping are taken into account[11]. In Phase II of the scheme, European Union Allowances (EUAs), tradable permits each equal to a tonne of CO_2, have been distributed amongst operators within the traded sector to reflect the projected emissions of each industry (CCC, 2008, p.149). One exception to this is the large electricity producers (LEPs), which received a lower allocation in the UK's Phase II National Allocation Plan (NAP). The UK determined that this sector should be responsible for delivering the additional savings the UK expects the EU ETS to achieve, as it is partially insulated from international competition and has lower cost

[11] The CCC (CCC, 2008,p.149) puts the traded sector at 50%, but does not include aviation and shipping in the national total emissions.

abatement opportunities than other sectors (Defra, 2008). Under the scheme emissions reductions are supposed to follow from simple economic choices, with - businesses decide whether to abate and sell their excess allowances, or emit and purchase allowances, based on the price of EUAs relative to the cost of abatement options available. Since the total amount of EUAs is strictly limited by the terms of the EU ETS, any purchases of EUA by businesses in the UK ought to result in emission reductions elsewhere in Europe.[12] This issue is further discussed in Section 4.3.

3.2.2 Financial mechanisms of the Kyoto Protocol

The Kyoto Protocol has two mechanisms for trading emissions: Joint Implementation (JI); and the Clean Development Mechanism (CDM). JI projects are established in countries that have an emissions cap under the Kyoto agreement, i.e. other Annex 1 countries. The associated unit of exchange is the Emission Reduction Unit (ERU). CDM projects, on the other hand, are based in countries *without a cap*, i.e. developing countries, and generate Certified Emissions Reduction (CER) credits. Emissions from projects covered by CDM schemes are not capped, rather projects must reduce emissions relative to a notional baseline. Any reductions relative to this baseline generate credits (each credit is deemed equivalent to a tonne of CO_2) that can be sold in the carbon markets.

The use of JI and CDM can be problematic resulting in **leakage**, that is "the indirect effect of emission reduction policies or activities that lead to a rise in emissions elsewhere (e.g. fossil fuel substitution leads to a decline in fuel prices and a rise in fuel use elsewhere). For CDM/JI projects, leakage can be a result of unforeseen circumstances, improperly defined baseline, improperly defined project lifetime or project boundaries, and inappropriate project design" (BERR, 2009).

3.2.3 Interaction between the EU ETS and Kyoto Protocol

The policy landscape is dynamic and, as a policy tool, the EU ETS is evolving as lessons are learned from earlier phases of the scheme. During 2008 the European Parliament negotiated a new package of EU climate and energy policy measures, which includes a Revised EU ETS Directive. The EU negotiations were ongoing as the UK's Climate Change Bill was passing through parliament and, significantly, the subsequent CCC Report was produced before the European Parliament adopted the Revised ETS Directive in December 2008. The CCC Report acknowledges that the outcome of the EU negotiations will have a bearing on its recommendations. The following overview of the relationship between the EU ETS and other trading schemes is based on the newly adopted climate and energy package (European Commission, 2008b).

CDM and JI credits can be used in the EU ETS subject to certain criteria. Without a strict numeric interpretation of "supplementarity" of mitigation in the Kyoto Protocol, Marrakech Accords or initial EU ETS Directive, the quantity of offset credits allowed into the EU ETS Phase II was limited by each of the National Allocation Plans developed under guidance from the European Commission. Currently this allows an

[12] The EU Climate and Energy Package, agreed in December 2008, makes a number of significant changes to the structure of the ETS for Phase III (2013-2020), as described in Section 3.2.

EU-wide proportion of 13% volume of EUAs. The Linking Directive (adopted in 2004) also specifies that credits generated from nuclear power projects or biological sinks (forestry and land use change) cannot be used in the EU ETS and that large hydroelectricity projects (20MW) must comply with international guidance on local impacts "including those contained in the World Commission on Dams year 2000 Final Report" (European Commission, 2004).

The December 2008 climate and energy package substantially increases the potential for using CDM/JI offset credits, or similar in a successor agreement to the Kyoto Protocol, in Phase III of the EU ETS. The key provisions of the Revised ETS Directive Article 11A are summarised in the box below (European Commission 2008c, Q20):

"The revised Directive extends the rights to use these credits for the third trading period and allows a limited additional quantity to be used in such a way that the overall use of credits is limited to *50% of the EU-wide reductions over the period 2008-2020*…In practice, this means that existing operators will be able to use credits up to a minimum of 11% of their allocation during the period 2008-2012, while a top-up is foreseen for operators with the lowest sum of free allocation and allowed use of credits in the 2008-2012 period…Based on a stricter emissions reduction in the context of a satisfactory international agreement, additional access to credits could be allowed, as well as the use of additional types of project credits or other mechanisms created under the international agreement."

3.2.4 Recommendations and assumptions of the CCC

The CCC makes a number of recommendations with respect to the role of purchased credits (CCC, 2008, p.125), which are summarised below:

- There should be no limit to the extent that EUAs are allowed to count towards the UK budget.

  This is based on the assumption that effective reductions will originate in a developed economy and hence contribute to a rising price for carbon and spur technological development. This is intended to increase the economic efficiency of regulation, over and above that created by national policy.[13]

- There should be no planned use of offset credits to meet the non-traded sector 'interim' budget.

  Under the assumptions of the 'interim' scenario, the non-traded budgets are based on the official Government central case projections with no additional policies other than those already in place (CCC, 2008, p131).

[13] As such, emissions from installations within the UK, including potential new build coal fired power stations, could continue to rise if their operators were prepared to purchase the necessary permits. This could lead to a substantial economic transfer to other nations and industries within the EU. This scenario has the precedent that in Phase I of the EU ETS, the UK power sector was a substantial net purchaser of permits, buying 124.3Mt, or 31%, over their 407.3Mt allocation.

- Use of offset credits to meet the incremental effort in moving to the 'intended' budget would be acceptable, although further consideration should first be given to intensifying domestic policy.

  It is recognised that the effort needed to move to the 'intended' budget may require up to 140MtCO_2 of offset credits may be purchased to meet the non-traded sector emissions reduction objectives (CCC, 2008, p.132).

- Use of offset credits to meet the traded sector budget **up to the limit allowed in the EU ETS** is acceptable.

  The traded sector can use the CDM allowance for Phase II of the EU ETS into Phase III by converting CERs to EUAs subject to administrative criteria. The EU ETS Phase II National Allocation Plan for the UK sets a maximum limit of CDM credits at 8% of allocated EUAs. For the purpose of reconciling the budgetary period 2017-2022 with Phase III ending in 2020, the CCC assumed that a similar annual allowance for credits would be continued (7.5Mt p.a.). However, given that the Revised EU ETS Directive allows up to 50% of emission reductions to be purchased through offset credits, the allowance for credits will be higher than assumed by the CCC. The implications of this will be explored in Section 4.

4. Analysis of the CCC Report

In this Section, the implications of following the 'interim' rather than the 'intended' emission pathway as discussed within the CCC Report (CCC, 2008) are analysed. In addition to quantitative assessment, issues of emission buy-out, rebound and lock-in are considered. It should be borne in mind that this analysis assumes that global emissions peak in 2016 as presented in the CCC Report.

4.1 'Interim' vs 'intended' pathways and their implications

The temperature implications of climate change are essentially dependent on the cumulative emissions released into the atmosphere. Therefore, a delay in action to mitigate emissions, or indeed a less stringent emission pathway, will need to be made up for in later years to maintain a given concentration and hence global mean temperature. In particular, if global emissions were to peak in 2020 rather than the 2016 date assumed within the CCC Report, this would have significant ramifications for the UK's own emission pathway. The implications of an alternative peaking date is not explored quantitatively here, however it should be borne in mind that if global emissions do not peak by 2016, the UK's emission pathway would need to be significantly modified.

To explore the difference in assuming the 'interim' rather than the 'intended' emission pathway, the cumulative emissions that would be released under the 'intended' pathway are compared with those under the 'interim' pathway. If, by 2050, cumulative emissions are to remain the same, the 2050 target requires adjustment. In addition, the emission pathway followed from 2022 to 2050 will also need to be modified.

Figure 7 illustrates graphically the difference in cumulative emissions between the 'interim' and 'intended' pathway within the first three budgeting periods. Building on this, Figure 8 presents the 'intended' pathway and the adjusted 'interim' pathway out to 2050 to maintain the same cumulative emissions.

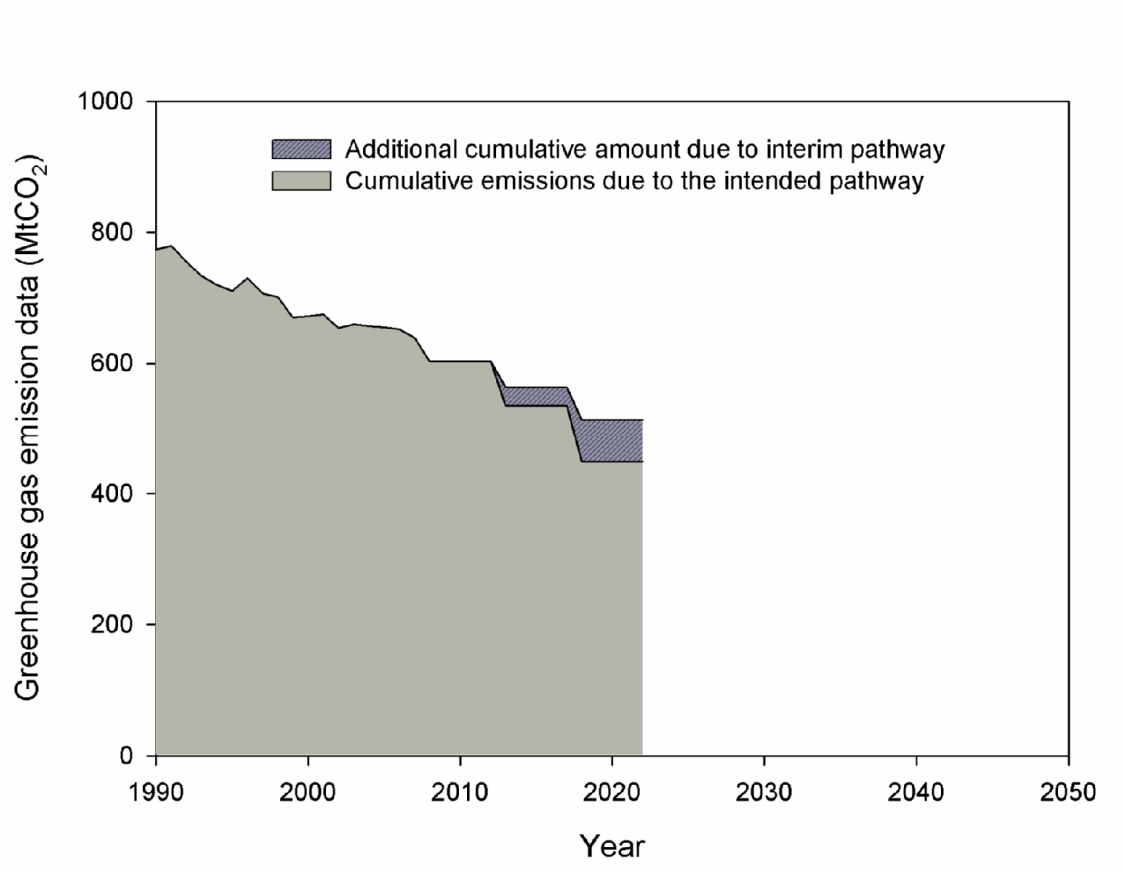

Figure 7: The cumulative emissions associated with the 'intended' and the 'interim' emission pathways for GHGs. The lighter shaded area shows the cumulative emissions due to the 'intended' pathway, and the darker shaded area the additional cumulative emissions released into the atmosphere by following the 'interim' target.

According to this analysis, emissions in 2050 need to be reduced by a further 5% to ensure that the cumulative budget remains the same. Furthermore, the annual emission reductions of 2-3% originally depicted between 2022 and the 2040s are increased by 1% in each year to 3-4%. The implications of an additional 1% emissions reduction are significant. Such rates of reduction are extremely challenging, even within a scheme allowing for emissions trading. This issue of buy-out will be discussed subsequently.

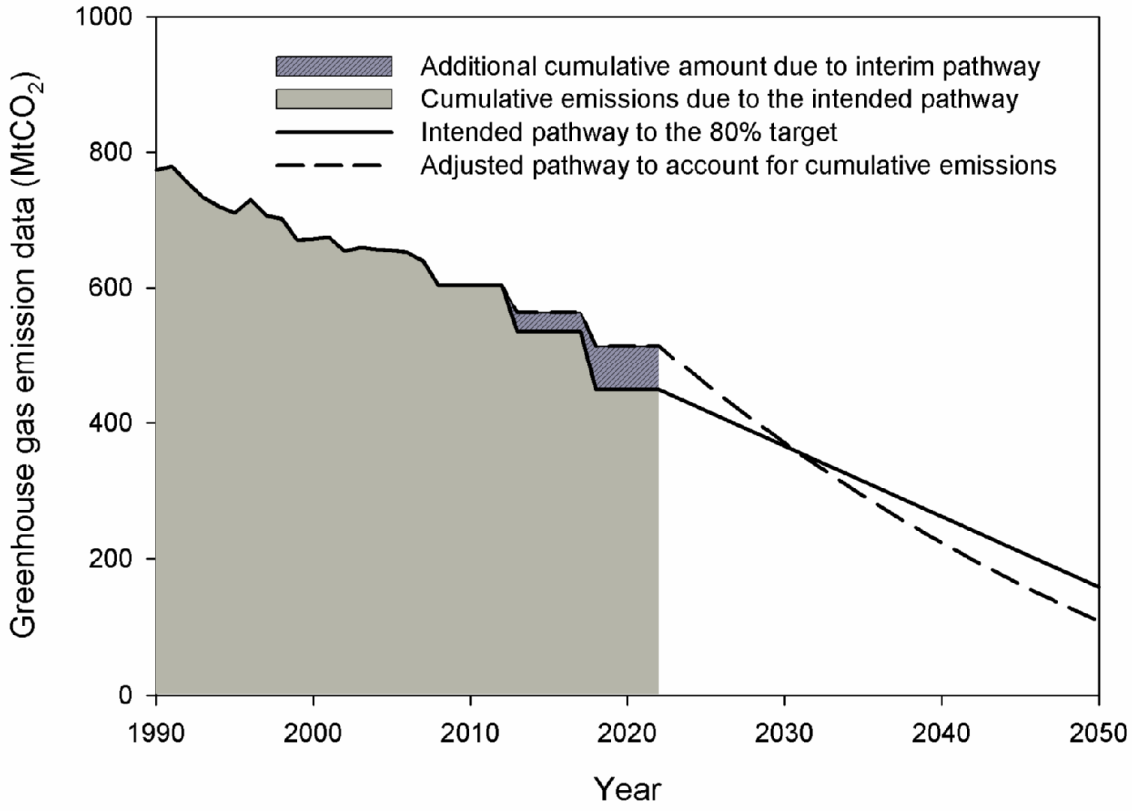

Figure 8: The emission pathway for the original 80% target and 'intended' pathway is presented as the solid black line. The dashed line shows the emission pathway necessary under the 'interim' budget if the cumulative emissions are to remain the same as if the 'intended' pathway had been taken.

4.2 Implications of emission buy-out

"The extent to which the UK should be willing to rely on the purchase of credits from overseas, is a complex and contentious issue and one on which the CCC has been explicitly asked to make a recommendation (CCC, 2008, p.159)."

The Report presents the quantities of emissions that may be traded but still counted towards the carbon budgets in a variety of ways. Here, absolute amounts in the context of long-term cumulative budgets are addressed. For the traded sector, the Report recommends no restriction on the quantity of EU ETS permits that may be counted in the UK budget in both 'interim' and 'intended' budget proposals. Data are not presented, but there remains the possibility that the traded sectors of the UK economy may not reduce emissions at all but purchase permits from around Europe[12]. The December 2008 EU climate and energy package (specifically the Revised EU ETS

Directive (European Commission, 2008b)) allows for a greater proportion of offset credits than considered by the CCC. The implications of this new package are considered within this section.

In the 'interim' scenario of no global deal, the limit of offset credits allowed in the EU ETS 2008-2020 would be fixed at the total amount in the Phase II NAPs with transfer allowed to Phase III. This implies a maximum quantity of 1400MtCO_2e with a UK installation limit of 98.5MtCO_2e, 8% of its EUAs allocation. Extending this proportion out to 2022[14] the CCC Report states that 13% of reduction effort from equivalent 2007 emissions output is met by offsets in this period.

These quantities should be reconsidered in light of the increased quantity of offsets permitted in the Revised EU ETS Directive: approximately 1600MtCO_2e (excluding any further amount for new sectors such as aviation to be included, (European Commission, 2008c, Q20)[12]. Further, because there is the possibility of installations in other nations buying CERs up to their respective limits and selling on the subsequent surplus of EUAs, the proportion of UK effort that will be met by offsets should be considered at the aggregate mean. With similar pro rata allowance for 2021-2022, we anticipate that offsets will be allowed to meet 26% of traded sector effort in the first three budgetary periods. Even with no offset of the non-traded sector this implies that 17% of UK economy wide effort is undertaken outside of the EU.

Table 2: The cumulative emissions associated with the effort required from the traded and non-traded sectors for the UK's 'interim' and 'intended' budgets

		Traded Sector	Non-traded Sector	Whole Economy
Interim Budget (2008-2022)	**Cumulative Effort (MtCO_2e)**	867	469	1336
	Quantity Offset (MtCO_2e)	222	0	222
	Offset (%)	26	0	17
Intended Budget (2008-2022)	**Cumulative Effort (MtCO_2e)**	1184	617	1801
	Quantity Offset (MtCO_2e)	353	140	493
	Offset (%)	30	23	27

[14] Taking the annual proportion of the 98.5Mt allowance 2008-2020 (EU ETS Phase II) and multiplying to 2008-2022 (CCA first three budgets).

If there is a successor agreement to the Kyoto protocol, the CCC expects a substantial expansion in the demand and allowance for offset credits (CCC, 2008, p.148). The EU climate and energy package (European Commission, 2008a) proposed in January 2008 allows for half of the additional abatement effort, in moving to a 30% GHG abatement target to be met by offset credits. The CCC Report anticipates that this would mean, approximately, an additional 950Mt of credits. There are no quantitative estimates of allowable offsets in the adopted December 2008 EU package under these circumstances: "access to credits from projects in third countries should be increased simultaneously with the increase in the level of emission reductions to be achieved through the Community scheme" (European Commission, 2008b, note 28). If similar calculations are made for the implications for UK carbon budgets, 30% of effort in the traded sector could then be met with offsets. Further, the CCC Report 'intended' budget allows for purchase of 140MtCO_2e of credits in lieu of reductions in the non-traded sector, hence 27% of the whole economy reduction effort could be met outside of the EU.

4.3 Alternative buy-out options

The CCC Report recommends that the UK Government should count offset credits in the traded sector - up to the limit allowed in the EU ETS - towards the UK carbon budget, and allow use of offset credits in the non-traded sector once the 'intended' budget is adopted. In essence, this position can be characterised as the 'multilateral with offsets' strategy.

Alternative arrangements on buy-out and offsets would have different implications for the overall cumulative emissions and hence their link to the Government's 2°C commitment. Table 3 summarises a range of such alternatives (Option 5 represents the CCC strategy).

Table 3: Comparing emissions reduction strategies for the UK[15]

Option	Action	Description and assumptions* **NB**: global emissions must **peak by 2016** in each case	Use EU ETS EUAs?	Allow buy-out of CDM offsets?	Chance of ≤ 2°C increase
1	Unilateral	– UK adopts 'intended' budget immediately but makes all emissions reductions domestically.	No	No	Low → Very low (Decreasing)
2	Unilateral with EUAs	– UK adopts 'intended' budget immediately, using EU ETS allowances and domestic reduction. – No use of non-EUA offsets. †	Yes	No	
3	Unilateral with offsets	– UK adopts 'intended' budget immediately, using EU ETS and CDM offset credits within the scope of EU ETS, and makes domestic emissions cuts. † ‡	Yes	Yes	
4	Multilateral with offsets	– UK adopts 'interim' budget until a global deal is agreed, then switches to 'intended' budget. † ‡	Yes	Yes	
5	Multilateral with offsets	– UK adopts 'interim' budget until a global deal is agreed, then switches to 'intended' budget. † §	Yes	Yes	

* Underlying assumptions regarding permissible use of CDM offsets are derived from the new EU energy and climate package, adopted in December 2008

† Strict and reducing cap within EU ETS.

‡ No unintended emissions increases (leakage) from CDM projects *(idealistic*)

§ Assumes possible leakage from JI / CDM projects (*realistic*)

The degree to which Options 1 to 5 may be considered compatible with the 2°C threshold depends on a range of factors. In relation to the strategy recommended by the CCC (Option 5) the 'very low' rating is consistent with a high probability of exceeding 2°C (although the terms 'low' and 'very low' may appear harsh, they are intended to reflect the fact that all pathways represent much lower than a 50% chance of 2°C, as discussed in Section 3.2.). The principal reasons for this are:

1. Waiting for an international deal before embarking on the 'intended' pathway will increase cumulative emissions unless subsequent pathways are able to absorb the early excess of cumulative emissions, as discussed in Section 4.1 above.

[15] Because the EU ETS cap is not based on the UK intended budget, it is not reasonable to assume that 1tCO_2 abated in the UK is equivalent to 1tCO_2 traded in the EU ETS, or to 1tCO_2 'saved' under CDM.

2. The extent to which the UK relies on offset credits to meet its targets. The more abatement the UK undertakes domestically, the less it needs to rely on offset credits. The more the UK 'buys out', the more its overall path to decarbonisation will be compromised. As the CCC points out, "A policy of relying too much on purchased credits in the initial years could make a stretching 2050 domestic target unachievable and could cost the UK dearly by mid century given the likely high and rising cost of purchased credits." (CCC, 2008, p160). Further concerns relate to:

   i. The extent to which reliance on EUAs and offset credits causes **lock-in** to energy intensive infrastructure with a long operational lifetime.

      If it is cheaper to buy-out than to invest in long-term low carbon technology improvements, then industry will, in theory, buy-out, effectively continuing 'business as usual' with only marginal domestic emissions reduction. By offsetting emissions and continuing with traditional patterns of investment, rather than implementing national low carbon infrastructure projects (e.g. renewables, improvements to the energy distribution grid, transport infrastructure improvements, vehicle and fuel efficiency), the UK commits to a high carbon future for the economic operational lifetime of its infrastructure. Hence, the more emissions trading is preferred to decarbonising, the more the UK diverges from a meaningful pathway and the further it departs from anything even approaching 2°C.

   ii. The **stringency of the overall emission cap** on EU ETS and the consistency of that cap with a 450ppmv CO_2e pathway.

      Despite permits notionally representing the same physical entity, a tonne of CO_2 equivalent emissions reductions made under different cap and trade systems are not necessarily equivalent. If the UK allows unrestricted exchange of permits, its budgets are only as meaningful as the combined UK plus EU ETS cap, which must therefore be judged against a similar 'correlation trail' logic (Figure 1).

iii. The extent to which carbon **leakage** is eliminated.

This depends on the mix of JI/CDM offsets used; the introduction of well-monitored and enforceable emission **caps** in regions where CDM projects occur; and the stringency of emissions reduction verification of those projects.

The CCC Report recognises this issue:

> "…there remain concerns as to whether offset credits can ever be as certain a form of emission reduction as domestic reductions. While the procedures for the approval and monitoring of CDM projects are being continually improved, any system of credits for reduction against a hypothetical business-as-usual scenario, is inherently less robust than a cap and trade system where reductions are required in the certifiable total of all emissions" (CCC, 2008, p.160).

Despite improvements, verifying the amount of actual emissions reduction that occurs as a result of CDM projects is still problematic when projects are located in industrialising countries where there is no cap on emissions. Verification of emission reductions claims generated under CDM relies on a great deal of subjective judgement. Unanticipated consequences of CDM projects, for example the stimulation of local economies, also complicate emissions accounting. For example, CDM projects may provide investment for infrastructure or plant which is subsequently utilised more intensively than predicted, particularly if that country is rapidly industrialising. As a result, the project may end up contributing a net increase in emissions.

The problem of potential leakage in the geographical dimension of policy is also acknowledged in the CCC Report in its discussion of 'competitiveness challenges and opportunities' (CCC, 2008, p.367). Carbon leakage could occur if EU production capacity relocates to regions with no overall emissions cap, and where use of the most efficient technology is not presumed. Hence a net increase in global emissions may result. In summary the CCC states,

> "we conclude that a small number of industries may be at risk of "carbon leakage" (i.e. the danger that production and/or new investment is relocated to other countries with less stringent carbon controls). There are, however, policies available to mitigate this risk: one of these policies should be adopted in the new framework for EU ETS" (CCC, 2008, p.365).

The Revised EU ETS Directive does indeed make provision for granting 100% free allowances (still subject to a declining cap on total emissions) for "installations in all exposed industries" (European Commission, 2008b) once a global deal is agreed. This is intended to prevent carbon leakage by ensuring that internationally competitive industries are not displaced from the EU ETS into uncapped economies by the costs of buying allowances.

4.4 Implications for lock-in

Lock-in describes the circumstances whereby society becomes committed to a particular future emissions pathway through the investment choices made by governments and industry. Developed from evolutionary economics, lock-in takes account of how technologies become intertwined with institutional and social processes, making it difficult to shift to alternative 'ways of doing' things. As such, technological systems must be considered in conjunction with how they are used, how they contribute to expectations and preferences and how, over time, we become locked into particular practices – regardless of whether the are 'objectively' efficient or not. Early investments, positive feedbacks and economies of scale can substantially shape the innovation of new technologies, their diffusion and the society that uses them. For example, the gauge of railways, early support for light water nuclear reactor designs, the neglect of canals, 'just in time' delivery and a centralised alternating current (AC) grid have all locked modern society into particular pathways that make it very difficult to now move to alternative, more efficient or more sustainable ways of living.

In relation to climate change, lock-in is often used in conjunction with terms like 'energy intensive' or 'high carbon' to indicate present day investments in capitally expensive high-emitting infrastructure and processes. In the case of major public infrastructure such as power plants, transport networks and the energy distribution grid, the lock-in effect is likely to endure for several decades, thus frustrating subsequent efforts to mitigate emissions. In its first Report, the CCC only discusses the issue of lock-in in the sense of having to scrap assets in the period 2020-2035 (CCC, 2008, p.106). It does not go so far as to discuss the implications for social norms and preferences and technological development trajectories influenced by substantial buy-out rather than domestic effort.

4.5 Implications for the treatment of aviation and shipping

Much discussion has surrounded the inclusion of emissions generated by international aviation and shipping within the UK Climate Change Act. Difficulties arise from how to apportion 'international' emissions to nation states. Furthermore, the emission apportionment issues differ between aviation and shipping. Aviation is primarily passenger-focused with clear arrival and departure points, whereas shipping is freight-focussed with complicating routing arrangements. The CCC therefore recommends that emissions from international aviation and shipping are omitted from the first three

budgets but included in the 2050 target. The implications of this are not analysed in detail within this report. The UK Government has, however, recently published updated CO_2 emission forecasts for aviation, indicating that decreases in emissions below 2005 levels will not be possible through emissions trading. Therefore, the cumulative budget for the UK would have to be further adjusted to allow for the additional aviation emissions to be accounted for within the 2050 target. Similarly, it is likely that the international shipping sector will also see its emissions increase.

Accommodation for both sectors to increase within the bounds of the emissions trading scheme are not viable without significant buy-out external to the EU. However, without a global cap, and assuming emissions in non-OECD nations continue to grow, buying permits in this way will likely render the goal of the UK playing its fair role in avoiding 'dangerous climate change' obsolete.

5. Discussions and conclusions

The cumulative emission approach to addressing global, regional and national emission pathways has gained significant ground in recent years. Recognition of a need for early action to mitigate emissions is widespread throughout UK climate policymaking. However, the consequence of taking this approach is that it leads to ramifications when calculating the impact of choosing an 'interim' over an 'intended' emission pathway. If a global deal is not reached in Copenhagen, less stringent action to reduce emissions in the short to medium-term in the UK will compound inaction elsewhere. The additional cumulative emissions released would ensure that the subsequent emission reductions required to avoid 'dangerous climate change' will be more severe. Going beyond this, the emission reductions required to remain in line with the 2°C goal, as illustrated in Figure 1 and discussed below, point to the necessity for an even more stringent emission pathway. It is imperative therefore that the emission pathway followed in the UK is at the more challenging end of the spectrum.

5.1 Implications of the global context for the UK

The analysis presented here has not quantified the emission pathway required to be consistent with the global analysis conducted by Anderson and Bows (2008). However, the scale of the emission pathway challenge allows broad conclusions for the UK to be inferred from a global perspective.

5.1.1 Compatibility with the 2°C threshold

The rhetoric of meeting the 2°C threshold between 'acceptable' and 'dangerous climate change' continues to subvert meaningful scientific and policy dialogue on mitigation and as a consequence, adaptation. Whilst the CCC Report demonstrates significant independence from the political process, it is nevertheless constrained by the analytical limitations imposed by the Government's repeated commitment to 2°C. The report certainly makes challenging demands of policy makers, however, in order to reconcile 'politically acceptable' emission reduction rates with the 2°C threshold it is premised on several highly optimistic and sometimes unclear assumptions, not least that global emissions of GHGs peak as early as 2016.

The CCC's first Report is therefore inevitably and significantly compromised by its implicit need to deliver demanding but nonetheless politically palatable conclusions in line with the 2°C threshold.

5.1.2 Politically-expedient global emission peak year

Averting the worst excesses of climate change depends on constraining the cumulative emissions of GHGs over the 21st century generally, and particularly over the next 40 years or so. However, as current annual emission levels are unprecedented and rising each year, maintaining cumulative emissions in line with 2°C requires an almost immediate curtailment and early reversal of emissions growth; global emissions must peak in the next few years.

The CCC Report follows the precedent established by Stern by adopting a similarly early global emissions peak; 2016 for the CCC compared with 2015 for Stern. The choice of peaking date is central to any subsequent analysis of carbon budgets and pathways, yet neither the CCC nor Stern gives sufficient justification for their choices, despite little evidence that such early dates are in any way viable at the global scale. Consequently, whilst theoretically a peak in 2016 does permit much lower and more politically acceptable annual emission reduction rates, it is at best highly optimistic and at worst dangerously misleading.

If instead of a 2016 peak an arguably more appropriate date of 2020 had been adopted, the scale of reductions necessary would fundamentally have changed the complexion of the report (assuming the CCC's approach to apportionment remains the same). Currently, policy makers are left with the impression that, applied stringently, established suites of policies and approaches can deliver reductions in line with the 2°C threshold. By contrast, peaking in 2020 or later would recast the agenda as much more radical and urgent, and well beyond the ability, even if applied stringently, of orthodox policies to deliver the necessary mitigation and adaptation. In other words, peaking in 2020 would require an even more stringent 'intended' pathway and significantly reduce the scope for emissions trading as other nations would also be subject to extremely challenging emissions reduction rates. In this important regard the CCC Report does not serve the policy makers well.

5.1.3 Challenges associated with non-OECD emission growth

The CCC pathways, as well as being dependent on the peaking year, are also dependent on assumptions about how global cumulative budgets are divided amongst nations and how emissions from deforestation are considered. Whilst the CCC Report discusses alternative apportionment regimes, there is insufficient detail to understand fully the assumptions about cumulative emissions splits between nations. Also, no reference is made to how the significant portion of global emissions associated with deforestation should be apportioned.

Given the early peak date, it is also important to have a clear view as to how much the non-OECD nations can continue to grow emissions beyond 2016 – this potentially has fundamental implications for the rate of reductions necessary in typical OECD countries. Recent research, using a 2015 peak year, had global emissions from energy reducing at between 6% and 15% per annum, whilst a related analysis specifically focussing on the UK suggested 6% to 9% would be necessary (Anderson and Bows, 2008; Anderson et al., 2008). Clearly, even for a 2015 peak year, there is a substantial discrepancy[16] between the results of these analyses and those presented in the CCC's Report.

[16] For example, the CCC's Report presents a pathway with 2 - 3% per annum emission reductions as opposed to 6% to 9% within Anderson et al (2008).

5.1.4 Aviation and shipping

Aviation and shipping emissions receive scant regard and their role within the pathways is at best unclear, with emissions excluded from the initial budgeting periods, yet included in the 80% 2050 target. Whilst this in itself needs to be remedied in future reports, aviation and shipping are distinct sectors characterised by important differences in relation to accounting and apportionment. Furthermore, their projected growth both globally and at a UK level has implications to the extent of the UK's climate change impact.

5.2 The CCC Report and the role of trading

The pathways and budgets presented within the Report allow for varying amounts of offsetting depending on the pathway taken and the sector being considered. Such offsetting may be through the EU ETS or the conventional instruments provided within the Kyoto Protocol. The extent to which offsetting can occur, and the quality of the offsetting in relation to equivalent emission credits to achieve aggregated emission reduction, has significant implications for the UK's climate commitment.

5.2.1 Implications of the revised EU ETS Directive

Since the CCC published its Report the EU has revised the EU ETS Directive as part of the EU's new climate and energy package. Allying the revised December 2008 Directive with the CCC's trading assumptions provides significant opportunities for the UK to avoid the emission-reduction 'effort' necessary to meet the pathways.[17]

i. Effort transferred to less-industrialised nations (CDM)

The UK's combined traded and non-traded sectors could buy out approximately 17% and 27% of the reductions necessary under the 'interim' and 'intended' pathways respectively (see Table 2). In other words, the UK could reduce the 'effort' necessary to meet the 'interim' pathway by 17% and the 'intended' pathway by 27%, with the effort essentially transferred to less-industrialised nations outside of the EU (via the CDM/JI and their successor mechanisms).

ii. Effort transferred to EU and less-industrialised nations (EUAs and CDM)

Taken to its limit, the UK could purchase all the traded sector emission reductions from the EU and 23% (see Table 2) of the non-traded sector reductions from outside the EU. In theory at least almost three quarters of all the UK's emission-reduction effort to meet the CCC's 'intended' pathway could be undertaken outside of the UK. The figure is 65% for the 'interim' pathway.

[17] The revised package does allow for more CERs (1600Mt vs 1400Mt – 2008 to 2020), however these conclusions are also a result of using a more realistic calculation based on the average import of CERs to the EU ETS (1600Mt divided by the UK proportion of the sum of Phase II NAPs, 11.8%) rather than the restriction on UK installations (8% CERs per installation specified in the UK Phase II NAP). This is justified on the basis that there will be a price discrepancy between EUAs and CERs and that other EU installation will hence use the maximum proportion of CERs and sell on the excess EUAs. UK installations would be buying EUAs, but they will in effect only be available because of import of CERs elsewhere.

5.2.2 Global equivalence of carbon permits

Central to the concept of carbon trading is the assumption that the climate impact associated with $1tCO_2$ abated in the UK is equivalent to $1tCO_2$ cancelled in the EU ETS permits, or to $1tCO_2$ 'saved' under CDM. Whilst this simple equivalence is attractive from a carbon trading perspective, until such time that a similar premise informs the cumulative values of the CCC's pathways, the total quantity of EU allowances and any future global caps, the assumption behind carbon trading that the climate impact of a tonne saved in one place is equivalent to one saved in another does not necessarily hold. This is particularly the case when a tonne is transferred from a nation with an explicit emissions cap to a nation with no such cap, and is even more problematic if the CDM recipient nation's economy is growing rapidly. Even under 'cap and trade', the emissions saving represented by cancelling a permit in one system is not necessarily the same as cancelling a permit within another[18].

5.2.3 Unequal treatment of time

The structure of carbon credit trading is reliant on the fact that a tonne of emissions reductions transferred between nations, companies, sectors, etc, does genuinely result in a 'real' tonne saved. There can be no certainty that this is the case as emissions reduction credits are always created from a counterfactual 'business as usual' case. Subjective decisions must be made as to the extent of the projects' boundaries, as currently defined in the CDM methodologies. Whilst within the literature on carbon capture and storage there is significant focus on century-level leakage, within CDM the temporal project boundaries and market leakage effects are invariably omitted from methodologies. For nations with similar emission caps the issue of time is not directly relevant; however, for CDM and offset arrangements with un-capped nations the issue of time is central. Any particular CDM investment must have a low probability of initiating carbon releases within decadal timeframes; however, the rate of economic growth of many nations in receipt of CDM renders decadal assessments almost valueless, and certainly robust calculations over 20 to 30 years are not possible.

5.2.4 Promoting carbon lock-in

A significant weakness of the CCC's Report arises from a combination of its support for relatively high levels of buy-out and trading allied with its failure to adequately address lock-in associated with early policy decisions, particularly on infrastructure and accompanying social practices. The implications of this are difficult to exaggerate and have the potential to inadvertently lend credibility to Government decisions that cannot be reconciled with the CCC's own carbon pathways. Certainly the findings of the CCC's Report could be used to justify a programme of new coal-fired power stations provided they were constructed as 'capture ready'. Nevertheless, this would lock the UK into high levels of cumulative emissions regardless of whether capture technologies were retrofitted or not. However, whilst the electricity from coal-fired stations does not necessarily lock-in end-user practices (alternative low-carbon electricity is available), this is not the case for some other lock-in policies.

[18] For example, if one nation with a cumulative budget based on a 'fair' apportionment of global cumulative emissions associated with a 2°C threshold purchases from another nation whose values are premised on 4°C, the assumption of equivalence may not hold.

Announcing the go-ahead for the third runway the Government claimed that UK aviation emissions in 2050 would be no more than they were in 2005 – in stark contrast to the Department for Transport's report published on the same day and in which aviation emissions are predicted to increase by 60% by 2050. This 'apparent' contradiction however was possible as the Government were relying on purchasing the necessary emissions from outside of the UK – an approach broadly supported by the CCC's Report, both explicitly in terms of buy-out and trading and implicitly through its neglect of 'social practice' lock-in. Once the new runway is constructed there will be increased pressure for additional terminals, the provision of new capacity will lead to additional demand, new routes, increased frequency, new aircraft – all contributing to new and reinforced practices for which few alternatives exist. Once holiday homes are bought, families and friends spread out geographically, businesses develop overseas markets and international conferences become the norm so new practices will embed within society with, in contrast to electricity generation, little opportunity for alternative low carbon solutions to replace them.

5.2.5 Clarity of the Report and associated analysis

The Report does not give sufficient information to fully understand the reasoning behind the 'intended' and 'interim' pathways. Future reports should be clear and explicit about all assumptions and provide full data behind the choice of values (including the cumulative values to 2050 and preferably to 2100). In addition, the global context should accompany discussion on the UK pathways, for example, when are the non-OECD emissions to peak, and what is the growth rate and/or absolute emissions for a given period (preferably the same as the periods important within the pathways)?

5.3 Policy recommendations

The following policy recommendations are based on the analysis presented within this report allied with broader research around the 2°C threshold.

5.3.1 Global framing of the emissions pathways

- The pathways must be informed by the latest understanding of the science of climate change;
- The CCC needs to reconsider the global and EU emission trends underpinning its UK pathways;
- The CCC must revisit its 'intended' emission pathways to consider global emissions peaking later than 2016; and
- There must be a much clearer understanding of the relationship between emission pathways of OECD and non-OECD nations.

5.3.2 The intended pathway

- Regardless of a global agreement, the UK should demonstrate leadership and immediately adopt a stringent 'intended' pathway;

- A revisited 'intended' pathway must reflect the latest science behind the 2°C threshold and should be more demanding than the current pathway recommended by the CCC; and
- As a minimum the Government should adopt the 'intended' budget with a 42% reduction by 2020 and without a contribution from the CDM. This will still fall short of their 2°C commitment.

5.3.3 Avoiding lock-in

- The UK should commit to achieving reductions from the non-traded sector without offsetting or trading until there is a meaningful global emission cap premised on the 2°C threshold; and
- All UK policy decisions must fit within an 'intended' 2°C-based pathway. Even for the traded sector, the UK must not rely on the EU ETS to exceed the associated cumulative value; i.e. investment in carbon-intensive infrastructure, such as additional airport capacity, new coal stations or major road building, must be considered within the nation's 'intended' budget.

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