

CCC Insights Briefing 4

Advising on the level of the UK's carbon budgets

The Climate Change Committee (CCC) provides evidence-based advice on the level of the UK's carbon budgets.

A central element of the UK Climate Change Act (2008) is a series of legally-binding five-year 'carbon budgets' for allowable levels of economy-wide GHG emissions, which act as stepping stones towards the UK's 2050 obligation to reduce emissions to Net Zero.

The Climate Change Committee (CCC – the UK's independent expert adviser on climate change) recommends carbon budgets based on detailed scenarios for reducing emissions from each sector of the UK economy. These scenarios are designed to identify a cost-effective path to the 2050 target, including both near-term emissions reductions and the development of options for the longer term. Alongside this analytical work, the CCC undertakes extensive stakeholder engagement to ensure access to the best available evidence and to uncover potential objections before making its recommendations.

This briefing discusses the role of carbon budgets within the UK Climate Change Act and the approach used by the CCC to advise the UK Government on the appropriate level for UK carbon budgets.

This briefing is structured in four sections:

- The role of carbon budgets in the UK Climate Change Act
- Considerations in setting a carbon budget
- Determining a credible path for a low-carbon transition
- Evidence gathering and transparency in advising on the level of carbon budgets

This briefing is one of a series on the workings of the UK Climate Change Act and the Climate Change Committee.

Box 1: CCC 'Insights' Briefings

This briefing is part of a series of eight that document the work of the UK Climate Change Committee (CCC) under the Climate Change Act. The CCC is the UK's independent advisory body on climate change mitigation and adaptation tasked with providing regular advice to Government on emissions targets and adapting to a changing climate. The CCC publishes annual assessments of progress towards meeting these targets, biennial assessments of progress in adapting to climate change, and supporting analyses on key emerging issues. These briefings are intended as a practical guide to give insights on the CCC's work and learning over the twelve years since its foundation in 2008.

The briefings in this series are:

- UK Climate Change Act
- The Climate Change Committee
- The UK's Net Zero target
- Advising on the level of the UK's carbon budgets
- Monitoring progress in reducing the UK's greenhouse gas emissions
- Conducting a climate change risk assessment
- Monitoring progress on adapting to climate change in the UK
- Past Climate Change Committee reports

1. The role of carbon budgets in the UK Climate Change Act

Carbon budgets are allowable levels of UK emissions over a five-year period, required under the UK Climate Change Act.

Under the UK Climate Change Act (2008), carbon budgets are the maximum allowable levels for total UK greenhouse gas (GHG) emissions over a defined five-year period. These are legally binding on the UK Government. They form the required path of UK emissions reductions towards the legally-binding target level for UK emissions in 2050, set in 2019 to be 100% reduction in GHG emissions relative to 1990 levels (the Net Zero target), and are part of the UK's contribution to meeting the global goals of the Paris Agreement.

UK carbon budgets have several important features:

Five-year durations make the carbon budgets targets more resilient to unexpected events.

- **Five-year duration:** UK carbon budgets are defined for total emissions over a five-year period. This means that they are less sensitive to higher or lower energy usage due to a particularly warm or cold year or the impacts of unexpected high or low economic growth than targets defined for a single year.
- **Set based on the UK 'net carbon account':** The 'net carbon account' is the formal definition of UK emissions used under the UK Climate Change Act. It includes GHGs aggregated into a carbon dioxide equivalent total using standard international emissions reporting practice.* Historically, the net carbon account has used the UK's share of the emissions cap for sectors included in the European Union's Emissions Trading System (EU-ETS). In the future this may change to absolute emissions as the UK leaves the EU-ETS.
- **Legislated twelve years in advance:** The UK Climate Change Act requires the level of each carbon budget to be legislated at the latest 12 years in advance of the beginning of the five-year budget period. This helps provide certainty for business and industry regarding the trajectory of UK emissions and allows enough time for a policy programme to be put in place to achieve the level of the budget, without stretching so far out that very speculative technology assumptions are required to set the target.
- **Set after consultation with the CCC:** The UK Government proposes the level of the carbon budgets for approval by Parliament. In advance of this, the CCC is required to give its advice on the level of the budget. The Government must take account of the CCC's advice: it may choose to diverge from the CCC's advice, but if so, it must provide a statement of the reasons why it has not followed the advice. To date, the Government has accepted the CCC's advice on the level of all five carbon budgets legislated.
- **High bar for alteration:** Once the level of the carbon budget is legislated it can only be altered if there have been significant changes to the basis on which it was set (Box 2). Any proposed changes must be approved by Parliament. The Government is also required to take advice from the CCC in advance of proposing to Parliament any changes to legislated carbon budgets.

Budgets are set twelve years in advance and must consider the advice of the CCC.

* Specifically CO₂, CH₄, N₂O, HFCs, PFCs, SF₆.

Budgets are binding at the economy-wide level, rather than for specific sectors, to allow flexibility regarding how they can be met.

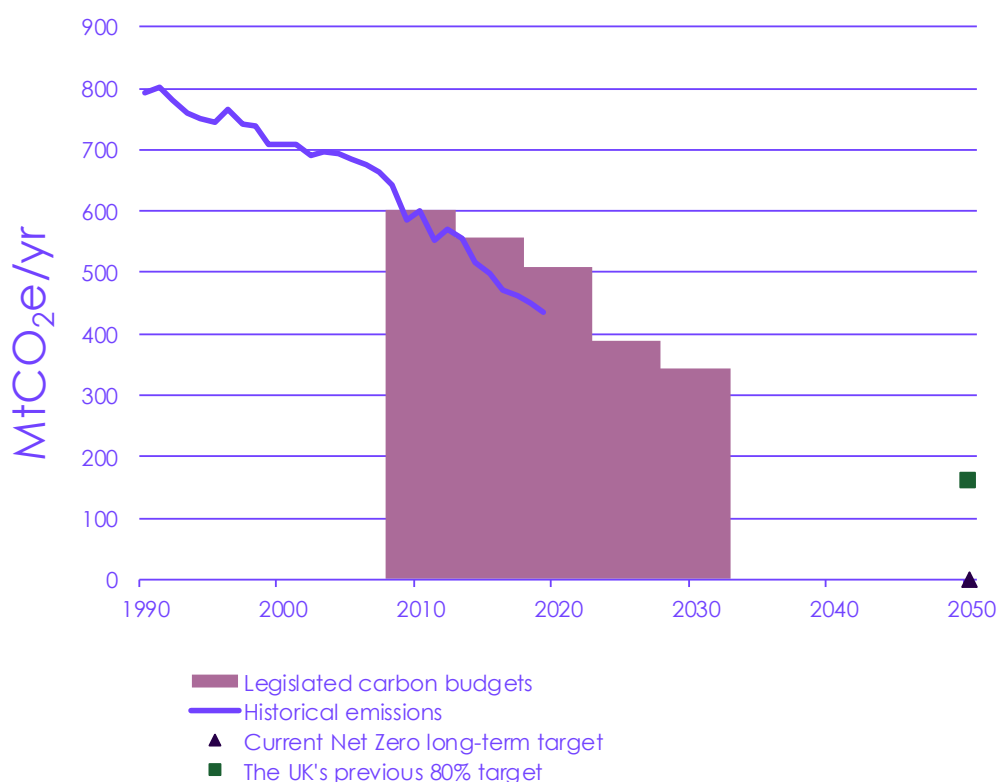
Five carbon budgets have been legislated in the UK to date – extending to 2032.

- **Flexibility in the means to achieve budgets:** Only the economy-wide level of emissions (measured according to the UK carbon account) is binding under the Climate Change Act. Sectors are not formally allocated shares of this total within the law. This allows for flexibility in the balance of actions across the economy to achieve the budgets, while providing certainty over the broad direction.

Five UK carbon budgets have been legislated to date, extending to the end of 2032 (Fig. 1). These budgets were all legislated as part of the pathway to the UK's previous long-term target of an 80% reduction in emissions by 2050. The first two carbon budgets were outperformed, and emissions are below the current (third) carbon budget for 2018-2022.

The Sixth Carbon Budget for the period 2033-2037 will be set on the path to the UK's new long-term target to reach net-zero GHG emissions by 2050. It needs to be legislated by June 2021, following advice from the CCC in December 2020.

Fig. 1 Emissions pathways to carbon budgets and the Net Zero target



Source: CCC (2020) Reducing UK emissions: 2020 Progress Report to Parliament

Box 2: Revising carbon budgets

The Climate Change Act specifies a strict set of criteria under which a legislated carbon budget can be altered. These are:

- Significant developments in the scientific knowledge about climate change.
- Significant developments in European or international law or policy.
- Inclusion of additional GHGs within the carbon budget emissions accounting system or the formal inclusion of GHG emissions from international aviation and shipping.

The Government must consult the CCC for its advice before it can amend any carbon budget. To date, the only time a revision to a UK carbon budget has been formally considered was for the Fourth Carbon Budget (2023-2027). When it initially accepted the CCC's advice on the level of the budget in 2011, the Government commissioned a review (to be completed in 2013) on whether the UK's Fourth Carbon Budget remained the right target, specifically regarding whether the UK's trajectory was significantly more ambitious than the EU-wide one due to concerns that this could place the UK at a competitive disadvantage.

The CCC completed its review and found no changes in the evidence base that supported a change to the level of the Fourth Carbon Budget. The Government accepted this advice and the budget level remained unchanged.

2. Considerations in setting a carbon budget

The Government and the CCC are required to consider a range of factors when setting the level of a UK carbon budget. These range from science and technology through to the impacts of meeting the budget on UK society and international action.

The CCC presents its statutory advice on the level of a carbon budget to the Government in the form of a report and associated supporting outputs (Section 4). This report is issued publicly at the same time to aid transparency.

The UK Climate Change Act specifies several criteria that must be considered by Government when setting a carbon budget and by the CCC when providing its advice:

- **Scientific knowledge about climate change:** The CCC draws primarily on the work of the Intergovernmental Panel on Climate Change, supplemented by surveys of the latest scientific evidence.
- **Technology relevant to climate change:** The CCC builds bottom-up scenarios for each sector of the economy based on the latest engineering estimates and market evidence of low-carbon technology's performance, costs and expected development.
- **Impacts on economic circumstances, including competitiveness:** The CCC calculates the resource cost associated with its carbon budget pathways, highlights the co-benefits from emissions reductions (Section 3), and occasionally commissions further economic modelling. The CCC also identifies potential opportunities in low carbon sectors and considers policy options to mitigate potential adverse impacts on competitiveness for trade-exposed sectors.
- **Impacts on fiscal and social circumstances:** Fiscal impacts include the impact on taxation revenue, public investment and borrowing – generally the CCC has considered that these can be managed through policy adjustments.

Social impacts are those such as fuel poverty, jobs and the security of energy supply – the CCC calculate current and potential impacts on energy bills and model scenarios that maintain energy security while reducing emissions.

- **Differences for the devolved administrations:** The CCC also provides advice under separate climate legislation in Wales and Scotland (Box 3). These assessments help the CCC to understand what is feasible and where the different levers to achieve the carbon budgets lie, given the mix of centralised and devolved responsibilities for climate policy in the UK.
- **Circumstances at a European and international level:** The CCC considers the UK's obligations internationally under the Paris Agreement and the United Nations Framework Convention on Climate Change. It also considers the actions being taken internationally and the impacts that the UK target could have on the wider global efforts to address climate change. During its membership of the EU, the UK had obligations to contribute to EU emissions reduction targets and other goals such as for renewable energy.

The CCC is required to make judgements and assess trade-offs across these factors to come to its final recommendation.

The budget recommendation represents the CCC's judgement across these different considerations. It is informed through the CCC's techno-economic assessment (Section 3) and through a programme of evidence gathering and stakeholder engagement to help understand the relevant constraints on delivery in the real economy (Section 4). The CCC's budget advice reports aim to make transparent the judgements that the Committee made and lay out the evidence base that was used to inform them.

Box 3:

Setting emissions targets for the UK's devolved administrations

The CCC also serves as the independent advisory body to the Scottish and Welsh Governments in their respective national climate change legislation. Like the UK Climate Change Act, the CCC has a responsibility to advise these Governments on their emissions targets prior to their legislation.

Advising on targets for the devolved administrations entails several additional challenges:

- **Smaller geographical scales:** The smaller size of annual emissions in the UK's devolved administrations means that specific sectors (or individual installations) can be relatively more important than at UK level due to the geographical distribution of emitting activities around the UK. Where emissions are heavily influenced by large heavy-industry point sources (e.g. Wales) this can make future emissions pathways sensitive to the timing of decarbonisation options at these sites. Additionally, not all mitigation options may be available within a devolved administration due to geography (e.g. more limited potential for geological CO₂ storage in Wales than in Scotland).
- **Additional data challenges:** Some important datasets may not have enough granularity to be used for analysis at the level of the UK's devolved administrations. This can mean that additional work or new data collection is needed to provide the relevant information to base recommendations on.
- **Dependences between devolved and UK targets:** Some aspects of energy and climate policy in the UK are devolved. Whether a target in a devolved administration can be achieved will depend in part on the policies in place at a UK-wide level and coordination across multiple levels of Government.

These factors can mean that a similar level of policy ambition would result in different rates of emissions reduction across the parts of the UK. For example, the CCC previously concluded that applying a similar level of ambition to that needed for the whole UK to get to Net Zero by 2050 would mean that Scotland could reach Net Zero by 2045 while Wales could reach a 95% reduction in GHG emissions by 2050.

3. Determining a credible path for a low-carbon transition

Principles for identifying a credible path for the low-carbon transition

The CCC builds scenarios to inform its recommendations. These are developed in accordance to several principles to help meet the criteria in the UK Climate Change Act.

For the first five UK carbon budgets, the CCC has based its advice around detailed techno-economic scenarios for the UK transition towards a low-carbon economy. A set of principles are used to guide the CCC's development of these scenarios:

- **Alignment to the long-term target:** The UK carbon budgets represent the pathway to achieving the long-term (2050) obligation, which is now to reduce UK emissions to Net Zero. Nearer-term carbon budgets have been set to balance the effort needed to reduce emissions through to the carbon budget period with the need for further reductions beyond them to meet the 2050 target. For example, as cars typically have lifetimes of around 15 years, the CCC pathways require that markets for electric vehicles scale up to 100% of sales by the first half of the 2030s.
- **International significance:** Global climate change largely depends on the global cumulative emissions of (long-lived) GHGs over time and not just the level of emissions in 2050. The UK emissions pathway implied by the near-term carbon budgets therefore needs to be grounded in the context of what is necessary to help the world achieve the goals of the Paris Agreement. This includes understanding how the national commitments made in the UK's carbon budgets can support decisions to increase ambition in other countries, as well as developing technologies in the UK which could subsequently be deployed elsewhere.
- **Cost-effectiveness:** Where possible, measures to reduce emissions should be 'cost-effective'. In scenario building we use an implicit shadow carbon price pathway to determine the relative timing of different emissions reduction measures to keep the overall costs of the transition as low as possible. Aiming to avoid the unnecessary scrapping of existing or new capital stock, where possible, also helps to ensure that the pathway to the 2050 target can be delivered at lowest overall cost.
- **Keeping options open and avoiding lock-in:** The precise path to Net Zero remains uncertain. For example, the extent to which people will be willing and able to change their behaviour and the costs of low-carbon technologies. Dealing with these uncertainties requires actions to develop options – not a wait and see approach. As well as deploying established and 'no-regrets' low-carbon technologies, the CCC scenarios include actions to develop emerging technologies that may be needed to meet the long-term goal and could plausibly scale-up in time from pilot projects today. For example, in the past that has included offshore wind in the UK, in the future it includes carbon capture and storage and hydrogen in various applications and sources. Similarly, long-lived high-carbon technologies that could be locked in for the long term are excluded (e.g. coal-fired power plants).
- **Real-world credibility:** In developing scenarios, the CCC attempt to characterise barriers to the adoption of low-carbon technologies and behaviours (e.g. the need to scale up supply chains and the willingness of the public to purchase electric cars), then consider how these can be overcome, including the availability of policy options.

The scenarios are built to begin with the current state of the world and are constrained to realistically achievable rates of change into the future.

- **Avoiding 'off-shoring':** Emissions of GHGs contribute to climate change wherever in the world they are emitted. The CCC's scenarios for setting national carbon budgets (which only cover territorial emissions) are designed to avoid actions that would reduce emissions in the UK but increase them elsewhere through 'off-shoring' resulting in no overall reduction in global emissions.

Some flexibility is needed when applying these principles to ensure specific circumstances and non-climate benefits can be incorporated.

These principles form the core methodology for how the CCC creates techno-economic transition pathways, but it is not applied rigidly. For instance, some emissions reduction measures can have significant wider benefits (e.g. improved home insulation that helps to reduce fuel poverty) and may therefore be included within the CCC's carbon budget scenarios even when they are narrowly not yet cost-effective. CCC also include options to reduce emissions that Government has already committed to even if not strictly cost-effective in all cases.

Modelling the low-carbon transition

Quantitative sectoral-based modelling is at the core of the CCC's scenarios.

Cautious assumptions regarding uncertainties (e.g. future tech costs) are used to help ensure carbon budgets are deliverable.

The CCC build scenarios using a range of detailed sectoral models, which capture specific constraints and challenges, alongside insights from economy-wide system models, which provide sense-checks and inform where scarce resources like bioenergy are best used. In using these models the CCC typically err towards more conservative assumptions (e.g. for cost reductions or changes in behaviours), so that more speculative developments are not necessary to meet the recommended carbon budgets.

Modelled pathways are not intended to be prescriptive, but useful guides to the expected changes that will need to be delivered to achieve the budget.

The scenarios are intended to represent transitions that could deliver the carbon budget but are not prescriptive paths that must be followed – they demonstrate that the budgets can be delivered and in a cost-effective way, rather than dictating exactly what should be done. More broadly, the CCC explore uncertainties by developing multiple scenarios (e.g. with alternative technology choices or with different rates of delivery), running sensitivities (e.g. for high and low economic growth) and by including near-term options that keep in play multiple ways to reduce emissions in the longer-term.

The CCC's modelling typically creates a *baseline* (or business-as-usual) projection of emissions without further climate policies and subtracts the emissions reductions (or *abatement*) resulting from the roll-out of low-carbon technologies and behaviours. Comparing the relative costs of the baseline and the abatement scenario gives an indication of the potential costs of meeting the carbon budgets, though macro-economic modelling that allows for the dynamics in the economy (e.g. the benefits of shifting costs from imports of fossil fuels to domestic investment) is ideally needed to identify the impact on GDP.

Modelled pathways are also used to inform the CCC's progress-monitoring role.

The techno-economic scenarios are also useful for the CCC's progress monitoring and for identifying where climate policy needs to be strengthened.

4. Evidence-gathering and transparency

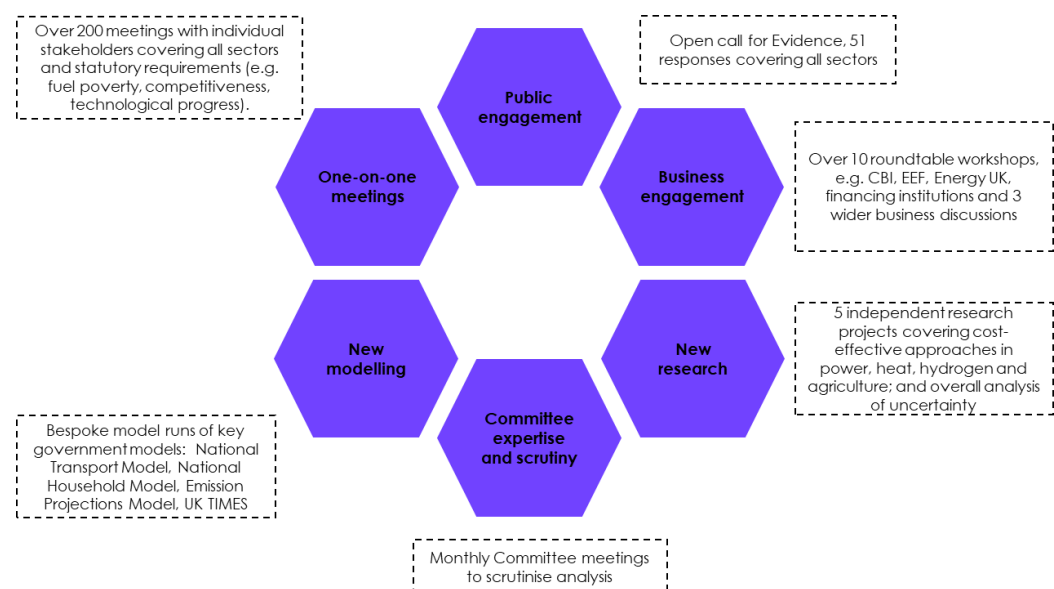
Extensive evidence-gathering is used to support the CCC's in-house analysis and ensure its recommendations are supported by as wide an evidence base as possible.

In producing its advice on the level of the carbon budgets the CCC relies on a range of evidence sources including expert and stakeholder input (e.g. Fig. 2):

- **In-house analysis:** The sectoral pathways underlying each budget recommendation are produced by the CCC Secretariat and refined through an iterative process with Committee members. This process can include commissioned research, modelling conducted within the secretariat and analysis building upon previous work, for example dedicated reports undertaken by the CCC into specific aspects of decarbonisation.
- **Call for evidence:** The CCC conducts an open call-for-evidence in advance of producing its advice on a budget level. Responses, from external individuals and organisations including academia, industry and NGOs, highlight pieces of evidence that the CCC should consider when setting the carbon budget. A summary of the responses and the responses themselves are published alongside the advice on the level of the budget (unless explicitly submitted in confidence).
- **Stakeholder engagement:** The CCC uses dedicated workshops and roundtables on topics of relevance to aspects of the carbon budget to engage in depth with a range of experts. This helps to identify opportunities for emissions reduction across the economy, the barriers to action and the potential impacts of carbon budgets - and policies to meet them, on business and wider society. Engagement is used both to gather further evidence and to test emerging findings.
- **Expert advisory groups:** The CCC has commissioned independent expert advisory groups to provide external input on specific aspects of decarbonisation. These appointed expert participants serve in a personal capacity according to defined terms of reference. The group's chair is contracted to provide a *Chairs Report* to the CCC detailing the group's findings. These reports are published as supplementary evidence alongside the CCC's main advice.
- **Commissioned research:** The CCC uses its research budget to complement in-house work by commissioning research from consultants or academia to build its evidence base. Analytical output from these projects can either directly or indirectly feed into the sectoral pathways underlying the budget recommendation. The projects will normally produce a report to the CCC which is published as supporting evidence alongside the CCC's advice on the level of the carbon budget.
- **Government modelling/data:** The CCC has a memorandum of understanding with the UK Government to share relevant data and modelling. Where relevant the CCC will use these resources as part of the evidence base underpinning the advice on the budget level.

The collaborative approach ensures the CCC has access to the best available evidence. It also helps to test emerging findings and uncover potential disagreements and alternative perspectives in advance of final decisions on the carbon budgets. Publishing the various inputs to the CCC advice alongside the advice itself ensures transparency, helping to bolster the CCC's credibility and to support strengthening of the wider evidence base over time.

Fig. 2:
Evidence and engagement for the CCC's advice on the level of the Fifth Carbon Budget



Source: CCC (2015) *The Fifth Carbon Budget – The next-steps towards a low-carbon economy*.



Climate Change Committee
151 Buckingham Palace
Road, London SW1W 9SZ

www.theccc.org.uk

[@theCCCuk](https://twitter.com/theCCCuk)