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Energy Demand Research Centre

Response to the Climate Change Committee consultation for the 7th Carbon Budget

January 2024

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UK Research and Innovation
Economic and Social Research Council
Engineering and Physical Sciences Research Council

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Summary

The Climate Change Committee (CCC) in the UK was established under the Climate Change Act (2008) to provide independent advice to the UK Government on how to achieve the goal of net zero Greenhouse Gas emissions by 2050. The CCC recognise the need for the UK to achieve this goal by gradually reducing GHG emissions overtime to ensure an orderly path for the UK to net zero. This has resulted in the CCC proposing "Carbon Budgets" that outline the total GHG emissions that can be emitted by the UK over five-year periods. This is also consistent with the science of climate change where it is the total cumulative GHG emissions that determines the climate impact as opposed to the level of emissions in a specific year. This report outlines the response from the Energy Demand Research Centre (EDRC)[3] to the CCC's consultation on how they should go about establishing their advice on the total GHG emissions within the 7th Carbon Budget (2037 to 2042). This time period represents a late stage of the UK's climate journey with the ambition of being net zero by 2050. It is envisaged that most of GHG emission reductions will have been achieved by this date. The balanced pathway to net zero produced by the CCC as part of their 6th Carbon Budget assessment suggests that GHG emissions in 2037 will be 152MtCO_2e and that the total GHG emissions of the 7th Carbon Budget will be around 605MtCO_2e. This means that average annual GHG emissions will need to be 121MtCO_2e over the 7th Carbon Budget time period, a 71% reduction from GHG emissions in 2022. With little room for manoeuvre, there is little work to be done on what the carbon budget will be between 2037 and 2042 and more to be said about the strategies and policies that will deliver this.

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Our response focuses primarily on the role of energy demand reduction in achieving the 7th Carbon Budget as this is the core area of research for the centre. We rely on the best available evidence produced over the past five years by researchers within EDRC and research external to the centre. We are looking forward to engaging more with the CCC as they move forward with their essential assessment.

Response to the individual questions

Question 1. Pathway constraints

"Have we captured the main technological, social, economic and commercial factors we should be considering in our pathways? Do you have any evidence for barriers in specific sectors and technologies?"

The methodology captures many of the most significant factors but either fails to give adequate attention to some key factors or proposes an approach that provides a limited assessment. First, the assessment of economic factors relates to a narrow economic framing of "cost-effectiveness". This is a rather traditional and outdated approach to assess the economic implications of net zero futures. It fails to consider the economic implications of thermodynamic efficiency gains, for example, meaning that any Government financial intervention is seen as a cost as opposed to a key driver of economic growth (Sakai et al, 2018). There is also the question of the cost of a specific policy pathway compared to what? If there is no assessment of a future that fails to address GHG emission reduction, then a cost effectiveness approach simply looks like a cost which is simply not true.

Second, the approach contains a presumption against demand side measures relative to technological solutions and it also takes a very conservative view as to what is possible on the demand side (Barrett et al, 2022). It is essential that an unbiased assessment is undertaken. The statement in the document, "We look to reasonable demand reduction options where a key technology cannot be relied upon in the future" and "what is considered a feasible reduction will be based on observed societal change elsewhere and historically, behavioural and social science research, data on public attitudes as well as wider societal impacts", suggests that demand reduction is considered only in sequence after technology. It also locks in an assumption that demand changes which can be considered are only those which we can already see, at least somewhere in the world. It is unreasonable to place such a condition on demand reduction measures when it is not applied to technological change. This is not to suggest that demand side measures should not be subject to robust analysis; simply that the case for inclusion and the ambition that can be included should not be limited in ways which are not applied to the technology pathways.

Third, there is growing evidence that 'Sustainable Aviation Fuels' may contribute proportionally more to the global warming potential of aviation through greater contrail production, and this should be factored into any assumptions about technology shift in this sector (Cairns, 2023).

Barrett, J., Pye, S., Betts-Davies, S. et al. Energy demand reduction options for meeting national zero-emission targets in the United Kingdom. Nat Energy 7, 726–735 (2022). https://doi.org/10.1038/s41560-022-01057-y

Cairns, S. 2023. The non-CO2 impacts of planes are a key reason to reduce aviation demand. CREDS Policy brief 030. Oxford, UK: Centre for Research into Energy Demand Solutions.

Sakai, M.; Brockway, P.E.; Barrett, J.R.; Taylor, P.G. Thermodynamic Efficiency Gains and their Role as a Key 'Engine of Economic Growth'. Energies 2019, 12, 110. https://doi.org/10.3390/en12010110

Question 2. Additional Action Pathway and contingency plans

"What types of government measures do you think should be included in the Additional Action Pathway and/or as contingency options rather than in the Balanced Pathway? Please explain why."

Measures that have significant co-benefits beyond a narrow economic framing of cost reduction should be given priority when considering additional action. Many of the measures to deliver emission reduction sit outside what could be described as energy policy and relate to health, improvements in quality of life through better work-life balance and social cohesion. For example, the Positive Low Energy Futures pathways considered the implications of introducing a four-day working week and the implications this had on energy demand and GHG emission reduction (Barrett et al, 2022). There is a tension in the "Additional Action Pathway" related to what is seen as acceptable now while recognising that what is acceptable in the future could be entirely different. For example, attitudes towards meat consumption have changed substantially in the last decade and an assessment undertaken 10 years ago could have been sceptical of substantial change (Garvey et al, 2021).

Second, it is essential that the Additional Action Pathway does not simply include the demand side measures that were rejected as part of the balanced pathway. There is a danger that demand side measures are portrayed as secondary or more challenging to implement if the balanced scenario is not balanced and favours technological interventions.

There are also some specific areas that could be given further attention. In particular, a major focus on the potential for downsizing electric vehicles and shifting from cars to other forms of powered light electric mobility. The International Transport Forum estimates that if the

transition to electrification focuses on smaller EVs and other forms of e-mobility, the vehicles will "require one-third less street space, one-third less battery capacity (and battery materials) and one-third fewer charging points compared to the like-for-like pathway. Electricity use would be 15% lower (ITF, 2023). 96% of all journeys are under 35 miles in length and the continued push by vehicle manufacturers to service these journeys with ever larger and heavier vehicles will have huge additional social, economic and environmental costs as well as putting unnecessary pressure on grid upgrades and charging provision.

Garvey, A., Norman, J., Owen, A., and Barrett, J. 2021. Towards net zero nutrition: The contribution of demand-side change to mitigating UK food emissions. Journal of Cleaner Production. Doi: https://doi.org/10.1016/j.jclepro.2020.125672.

International Transport Forum (2023) Shifting the focus: smaller electric vehicles for sustainable cities, https://www.itf-oecd.org/sites/default/files/docs/shifting-the-focus-smaller-electric-vehicles-sustainable-cities_0.pdf

Question 3. Uncertainty

"Are there any major sources of uncertainty that should be considered in our uncertainty analysis? For example, for which technologies are costs or performance likely to be particularly uncertain?"

The balanced pathway implies that a single assessment is possible to determine the most economically efficient pathway. Clearly, this is not the case whether considering technologies or broader societal changes. Historically, predictions of costs have been poor and estimated costs of low carbon technologies have often been inflated. This is particularly true of solar power for example. Economic models do not have perfect foresight, and this should be reflected in the pathways. The idea that there can be a balanced pathway that provides a rational assessment based on cost does not hold. Instead, we would propose an approach where all options are considered, and an appraisal of these options is provided considering the associated barriers and opportunities.

There is also uncertainty about the delivery of previous carbon budgets and the implications for the assessment of the 7th CB. For example, Section 2.2.3 states that the main questions for surface transport are about "how fast the tail-end of emissions are reduced" as emissions will have reduced by between around 80% and 90% by 2037 relative to 2022. This analysis appears to assume that the 6th CB is adhered to in transport when the Carbon Budget Delivery Plan clearly downgrades ambition for transport. The analysis in the CREDS report, "Reverse Gear", showed that surface transport emissions are currently projected to exceed the 6th CB by at least 180 MtC – if all policies are delivered. It seems far from clear how this overshoot will be corrected for in the approach being adopted. It is non-marginal as the difference in

emissions between 2019 and 2020 (first year of pandemic) was 24 MtC and the overshoot is harder to correct as the degree of electrification of vehicles increases.

Marsden, G. 2023. Reverse gear: The reality and implications of national transport emission reduction policies. Centre for Research into Energy Demand Solutions. Oxford, UK. ISBN: 978-1-913299-17-0

Question 5. Reduction in high-carbon activities and choices

"What are the main factors we should consider when assessing a potential shift in patterns of travel and diet in our Balanced Pathway and our Additional Action Pathway?"

Reducing meat consumption is the most effective way of mitigating food system emissions from a consumption perspective (see Garvey et al., 2021), more so than changes to food waste, or consuming local or organic food. In evaluating the future potential for dietary transitions, a key factor should be exploring the trajectory of recent dietary trends. UK meat consumption is at its lowest recorded level and 14% of UK adults are considered 'flexitarian', that is, following a reduced meat diet (Goodier and Sunnemark, 2023). This trend is often attributed to preferences for plant-based diets in younger demographics, with people under age 35 twice as likely to be vegetarian than those over it.

There have therefore been significant shifts in diet to date. Further exploration of the drivers of these shifts, including demographic factors, would be valuable in projecting future changes and determining realistic policy interventions to promote more plant-based consumption. This would help align policy interventions with real diets and lifestyles, by firstly aiming to drive reductions to the overall frequency and quantity of meat consumption. The role of incorporating plant-based food in public sector environments could be further explored as a means to reach groups that have not changed their dietary behaviour to date. This clearly links health benefits with GHG emission reduction. The analysis with CREDS and the Government Office for Science provides further insights into this issue (see Net Zero Society Report).

The document states that aviation is one of the sectors with no credible way to completely decarbonise by 2050 and, together with agriculture, waste and land-use sources, will be starting to dominate the Seventh Carbon Budget Period. Greenhouse gas removals will be "increasingly important" to ensure a sufficient reduction in net emissions (Figure 2.1 and 2.2). However, emissions from aviation are dominated by wealthy individuals. Research by Buchs and Mattioli found that "the top 5% of flight GHG emitters are responsible for 40.2% of flight emissions and the top 10% for 60.8% of flight emissions, while the bottom 80% of flight GHG emitters only generate 16.1% of all flight emissions". It is difficult to understand how the costs

of negative emissions technologies could be accommodated whilst also adhering to the fairness and social distribution lens identified throughout the methodology. It seems important that clear mechanisms for ensuring the polluter pays in this sector, which is very much more of a choice than waste for example, are established and that this feeds back to (reduced) demand.

Büchs, M. and Mattioli, G. 2022. How socially just are taxes on air travel and 'frequent flyer levies'? Journal of Sustainable Tourism. doi: 10.1080/09669582.2022.2115050

Garvey, A., Norman, J., Owen, A., and Barrett, J. 2021. Towards net zero nutrition: The contribution of demand-side change to mitigating UK food emissions. Journal of Cleaner Production. Doi: https://doi.org/10.1016/j.jclepro.2020.125672.

Goodier and Sunnemark. 2023. UK meat consumption at lowest level since records began, data reveals. Guardian. Available from: https://www.theguardian.com/environment/2023/oct/24/uk-meat-consumption-lowest-level-since-record-began-data-reveal.

Question 6. Considerations for Scotland

"What are the distinctive characteristics that should be considered when developing pathways and costs for Scotland?"

It is important to acknowledge that Scotland has set out a target of reducing road traffic kilometres by 20% by 2030. There is, at least in policy formulation terms, a commitment to a different approach to road traffic growth to that seen in England. Applying a universal set of considerations on future travel demand and policy blends is not going to work.

Question 7. Considerations for Wales

"What are the distinctive characteristics that should be considered when developing pathways and costs for Wales?"

Wales has already committed to, effectively, a moratorium on major road building in Wales in response to the climate emergency. It also has a target to reduce road traffic by 10% per capita and, therefore has a divergent policy picture from England and Scotland. This complicates baselining. Whilst not primarily a climate change policy, there has also been a significant divergence in speed management policy with the 20mph limit as standard for local roads in built up areas. This may have implications for the relative attractiveness of cycling and walking. In the short-run, its impacts on emissions from fossil fuelled cars might need to be tracked as these could (but not necessarily will) be increased if engines are not well calibrated or driven appropriately to operate efficiently at lower speeds.

Question 8. Considerations for Northern Ireland

"What are the distinctive characteristics that should be considered when developing pathways and costs for Northern Ireland?"

From April 2022 to March 2023, 48.5% of Northern Ireland's total electricity consumption was generated by renewable sources based in Northern Ireland, mainly from wind energy. Northern Ireland has important infrastructural issues which can potentially affect its decarbonisation pathways in terms of speed and delivery. Approximately 68% of Northern Ireland's households rely on oil as their main heating source, which has both cost and emissions implications. The Northern Ireland Housing Executive has estimated that, based on modelling which builds on a 2016 Housing Condition Survey, 24% of all households in Northern Ireland were in fuel poverty in 2019 (under the 10% fuel poverty indicator). However, National Energy Action (NEA) commissioned a survey in 2022 which showed that 45% of households were in fuel poverty. Given the high reliance on expensive oil-based heating, decarbonising heating in Northern Ireland is a key consideration for addressing both emissions and fuel poverty alleviation. While agriculture remains the largest emitting sector, decarbonising Northern Ireland's transport sector (second largest emitter in Northern Ireland) needs to consider decarbonising the transport sector in a way that takes into consideration the country's limited public transport network which lack a sufficient electrified train network and buses are infrequent, in rural areas in particular. This leaves people with no other option than having to rely on expensive and polluting personal cars, or taxis, which can be an issue particularly for those who are on a low income and/or have accessibility or mobility needs (Martiskainen et al. 2023). The combination of high reliance on oil-based heating and limited public transport options raises joint issues to consider across housing and transport decarbonisation in the Northern Ireland context.

Martiskainen, M., Hopkins, D., Torres Contreras, G.A., Jenkins, K.E.H., Mattioli, G., Simcock, N., Lacey-Barnacle, M. 2023. Eating, heating or taking the bus? Lived experiences at the intersection of energy and transport poverty, Global Environmental Change, Volume 82, 2023, 102728, https://doi.org/10.1016/j.gloenvcha.2023.102728.

Question 9. Whole-economy costs and benefits

"What are the most important elements of impacts on the economy and competitiveness that should be considered in our assessment?"

The methodology document states that the baseline will not include the costs associated with inaction, i.e. reduced productivity due to climate change. This is an issue that needs resolving

that does not necessarily need a detailed analysis, but a section of the final report should provide a summary of the latest evidence that indicates the scale of these costs in terms of overall impact on GDP to provide valuable context.

The whole-economy costs must consider the contribution of energy efficiency as a driver of economic growth. Past modelling approaches undertaken using either GCE or econometric models have failed to include this in the analysis and thus provide an underestimate of the benefits of the transition. New evidence has shown that improvements in thermodynamic energy efficiency can explain the unassigned / unexplained economic growth when calculating total factor productivity (Santos et al, 2021). The analysis of the UK estimates that thermodynamic energy efficiency contributes contributing 25% of the increases to gross domestic product (GDP) in the UK over the period of 1971–2013 (Sakai et al, 2018). This is a greater contribution to GDP than labour productivity gains over the same period. The process of increased electrification for mobility, homes and industry processes will result in thermodynamic energy efficiency improvements (Eyre, 2021) that could lead to significant economic growth. If this is excluded from the economy wide analysis, a more complete picture of the economic outcomes of the net zero transition will not be presented.

The planned methodology as states that, “We will seek to quantify, where possible, the co-impacts (non-monetary costs and savings) associated with the transition.” This is essential, but this needs to be very clearly thought through. At the moment, the transport strategy is to decarbonise through electrification with travel demand growth. That strategy delivers (albeit too slowly) on CO2 emission reduction but not the other benefits of demand reduction on congestion, safety or health. Not only that, but without a commitment to pricing changes it will add to traffic growth, delay and congestion as set out in the 2022 DfT National Road Traffic Projections. This is where the assumptions about baseline matter. The baseline is in fact critical in defining when items appear as co-benefits or costs.

The planned methodology also states, “As in the Sixth Carbon Budget advice, we will calculate the abatement cost (i.e. cost per tonne of abatement) of each abatement measure to identify its cost-effectiveness and compare this to other measures”. This single measure by measure approach does not work for much of transport because the collective outcome from packages is greater than the potential of individual measures. Going down the “measure by measure” route will almost certainly reduce the relative attractiveness of demand reduction or shifting options.

Finally, in relation to co-benefits, clearly not all of these can be monetised. Evidence from Finn and Brockway (2023) show that omission of mitigation co-benefits may inhibit many energy demand reduction policies, that there are over 86 individual co-benefits that need to be

considered and that less than 25% of policy assessments quantify or discuss these broader energy demand reduction co-benefits (Finn and Brockway, 2023).

Finn, O. and Brockway, P. E. (2023) Much broader than health: Surveying the diverse co-benefits of energy demand reduction in Europe', Energy Research & Social Science. Elsevier Ltd, 95(December 2022), p. 102890. doi: 10.1016/j.erss.2022.102890.

Sakai, M. et al. (2019) 'Thermodynamic Efficiency Gains and their Role as a Key "Engine of Economic Growth"', Energies, 12(110), pp. 1–14. doi: 10.3390/en12010110.

Santos, J., Borges, A. S. and Domingos, T. (2021) 'Exploring the links between total factor productivity and energy efficiency: Portugal, 1960–2014', Energy Economics, 101(June). doi: 10.1016/j.eneco.2021.105407.

Question 10. Social impacts and distributional analysis

"What are the most important elements of social impacts and the distribution of costs and benefits society that should be considered in our analysis?"

It is essential that the analysis considers how those who are in fuel poverty and transport poverty factors in that people can be affected by overlapping, intersectional, vulnerabilities. Previous research by Cambridge Econometrics with CREDS has shown that vulnerable households can be disproportionally affected in Net Zero transition: "When considering equity-weighted energy bills (as recommended by Green Book guidelines on distributional analysis (HM Treasury, 2022b), the analysis undertaken by CREDS applies 'equity weights' to estimate household bills. Equity-weighting places a higher social value on costs or benefits for lower income households than the equivalent costs or benefits for higher income households. The rationale behind this is the economic principle of the diminishing marginal utility of income which says that the value of an additional £1 of income is greater for low-income households than for high-income groups. The highest household bills are paid by low-income households, particularly from ethnic minorities, living in social housing predominantly in urban areas. Similarly, pensioners with disabilities and long-term health conditions, with either average or low-incomes, are also expected to pay high energy bills in all the modelled scenarios." (Dellaccio et al. 2022). Dellaccio et al (2022) showed that in 2035, "As a proportion of income, the archetype spending the most on energy bills is mainly composed of ethnic minority households on a low income and living in social housing", also young (i.e. 16-34), low-income renters, and pensioners typically on disability benefits, pay proportionally higher energy bills. Pathways should use best available evidence and enhanced data on household composition to target specific vulnerable groups and consider potential intersectional vulnerabilities.

An example of the problems of failing to properly embrace distributional impacts in policy analysis was shown in the decision to push back the phase out of the sale of petrol and diesel

vehicles to 2035. Those running EVs are subject only to electricity at domestic energy VAT rates if they can home charge, whereas those consumers left with older fossil fuel vehicles pay 60 to 70 pence per litre on fuel duty. It is far from clear that pushing back the phase out date was progressive (as poorer groups do not generally buy new cars) – it could well be regressive, but it is not commonplace to foreground such analysis. The CCC's own balanced pathway implies the creation of this substantial inequity during the period of transition to an all EV fleet but it is not clear how this should influence the pathway decisions. Whilst CCC does not have the power to set the corrective taxes necessary to balance this out, it should be highlighting the issues.

Finally, we would recommend exploring the method proposed by Owen and Barrett (2020) that was also used by the Cabinet Office in their Net Zero Review. This approach takes account of the full supply chain of all goods and services allowing a more comprehensive assessment of the distributional implications (Owen and Barrett, 2020).

Dellaccio, O., Dicks, J., McGovern, M. and Stenning, J. 2022. The distributional effects of pathways to net-zero and the implications for fuel and transport poverty. Centre for Research into Energy Demand Solutions. Oxford, UK. ISBN: 978-1-913299-16-3. https://www.creds.ac.uk/wp-content/uploads/CREDS-pathways-zero-fuel-poverty.pdf

Owen A., Barrett J. (2020) Reducing inequality resulting from UK low-carbon policy, Climate Policy 20(10) 1193-1208, https://doi.org/10.1080/14693062.2020.1773754

Question 11. Methodology

"Are there any key methodological issues we have missed or, in your view, are mistaken for our Seventh Carbon Budget advice?"

We have commented on two issues related to the overall methodological approach; the reduction in the number of pathways and calculating the baseline.

While I appreciate the considerable effort to generate additional pathways, the decision to include only two is problematic. First, particularly with the balanced pathway, it implies that it is possible to truly assess the most economically efficient and socially acceptable pathway up to 2050. One element scenario modellers would all agree on is that it is impossible to predict the future however good the models. It is very difficult to predict technology costs, public perceptions and policy responses. It is essential that the UK Government is presented with all the mitigation options to make an informed decision on the net zero pathway for the UK and this is difficult to achieve with one balanced pathway. We recognise that there is an additional pathway but again there is a concern that this pathway will include all the measures that are seen as socially unacceptable now and could include more energy demand measures than the balanced pathway. Second, as points out in an earlier question, the criteria for assessing

technological options does not appear to be consistent when appraising energy demand options. A comparable analysis of all options is essential. Please refer to Barrett et al (2022a) for further insights. Third, the UK is currently behind on many of the policy areas needed to deliver net zero, as acknowledged by the CCC. The assumption that the 5th and 6th Carbon Budget will be meet is problematic and this needs to be recognised in the analysis.

The consultation states that “The baselines for each sector in our analysis will be a projection of emissions representing a hypothetical world without further decarbonisation in the UK. This means that low-carbon technologies would remain at today’s stock levels and today’s efficiencies.”

This approach is inconsistent with the practice of DfT for example which take forward committed and funded policies in the baseline (which the CCC acknowledges in the consultation). So, for example, there would be an acceptance that the Zero Emission Vehicle Mandate is now in law and so we know what % of vehicles sold will be electric – even if we don't know how many vehicles will be sold. It makes the baseline look worse than it actually is and therefore inflates progress. More importantly, it makes much more problematic the task of scrutiny when different baselines propagate.

Question 12. Engagement

“How best can we engage with experts and stakeholders to build our evidence base and test our emerging thinking?”

We would establish an “oversight” advisory group that could present reports to the secretariat and the Committee challenging them on the issues that arise from the consultation process. It seems very difficult for the Committee itself to have the time to fully scrutinise the approach and this approach would allow valuable input on a regular basis throughout the process.

The Energy Demand Research Centre (EDRC) would be very happy to be involved and bring together a strong group of academics with considerable experience in the field of energy demand reduction. We already have many connections across the CCC and would be delighted to support you during this challenging project.

About EDRC

The Energy Demand Research Centre (EDRC) undertakes research for an affordable and secure low energy future. Our interdisciplinary research programme identifies evidence-based energy demand reductions for a sustainable and more equitable future. We work closely with partners from policy, industry, civil society and academia.

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