February 2020

Centre for Alternative Technology (CAT)

A response to the call for evidence: The Sixth Carbon Budget and Welsh emissions targets

1. Introduction to the Centre for Alternative Technology (CAT)

The Centre for Alternative Technology (CAT) is a world-leading charity promoting solutions for sustainability. CAT covers all aspects of green living: environmental building, renewable energy, energy efficiency, eco-sanitation, woodland management and organic growing.

From its base in Wales, CAT undertakes a range of education and research activities, all aimed at raising environmental awareness and facilitating effective action.

These include:

- A visitor centre that provides information, advice and inspiration to visitors from all over the world.
- The Graduate School of the Environment, with a range of postgraduate degrees in environmental architecture, renewable energy, sustainable food and natural resource management.
- Residential and one-day courses for the general public, as well as more in-depth skills training for builders, engineers, electricians and plumbers wishing to specialise in sustainable technologies.
- Curriculum-based education to visiting schools, colleges and universities, as well as educational outreach, including teacher training and school visits.
- A free information service answering enquiries on all aspects of sustainable living.
- A successful volunteer programme for those that want to gain hands-on experience.
- CAT's flagship research project, Zero Carbon Britain, looks at how we can get to net zero greenhouse gas emissions using technology available today.

This year sees the development of a new Zero Carbon Britain Hub and Innovation Lab at CAT, which will provide information, advice, training and support for local authorities and communities in responding to the climate challenge.

www.cat.org.uk

A. Climate science and international circumstances

Question 1: The climate science considered in the CCC's 2019 Net Zero report, based on the IPCC Special Report on Global Warming of 1.5°C, will form the basis of this advice. What additional evidence on climate science, aside from the most recent IPCC Special Reports on Land and the Oceans and Cryosphere, should the CCC consider in setting the level of the sixth carbon budget?

ANSWER:

Since the launch 20 years ago of the Royal Commission on Environmental Pollution report: 'Energy – The Changing Climate', which offered scenarios that explored a 60% reduction in UK carbon emissions by 2050 (RCEP, 2000), the degree of urgency in the decarbonisation timeline has continually increased.

Policymakers must be confident that the current target is ambitious enough to meet the demands of the evidence base. It would therefore be productive to build in an ongoing process to regularly compare the predicted level of extreme weather events in the models being used with the actual real-life data from the scale and number of extreme events being experienced in relation to the measured levels of global temperature rise.

Several leading scientists have spoken out on this. In an interview with the BBC former UK Govt. Chief Scientific Advisor, Professor Sir David King said the situation was so grave that the UK should bring forward the date for cutting emissions of greenhouse gases to almost zero from 2050 to 2040. Prof King told the BBC: "It's appropriate to be scared. We predicted temperatures would rise, but we didn't foresee these sorts of extreme events we're getting so soon." (Harrabin, 2019)

References:

Harrabin, R. 2019. (19 Sept) 'Faster pace of climate change is 'scary', former chief scientist says', BBC, https://www.bbc.co.uk/news/science-environment-49689018

RCEP, 2000. 'Energy – The Changing Climate'. London, TSO.

Question 2: How relevant are estimates of the remaining global cumulative CO_2 budgets (consistent with the Paris Agreement long-term temperature goal) for constraining UK cumulative emissions on the pathway to reaching net-zero GHGs by 2050?

ANSWER:

The key factor in preventing very serious climate impacts is the total emissions released during the pathway to net-zero, rather than any particular long-term target, so global cumulative emissions must be central to zero carbon planning.

Pathways to net zero must take into account both the remaining global carbon budget and considerations of climate justice.

Calculations of the UK's 'fair share' should take several factors into account alongside the

Question 2: How relevant are estimates of the remaining global cumulative CO_2 budgets (consistent with the Paris Agreement long-term temperature goal) for constraining UK cumulative emissions on the pathway to reaching net-zero GHGs by 2050?

total global carbon budget: 1) moral responsibility for historic carbon emissions; 2) relative wealth of the UK (and the extent to which this is based on activities that contributed to historic emissions); 3) the share of the remaining carbon budget that will be required to allow less industrialised nations to develop and adapt to climate impacts.

Question 3: How should emerging updated international commitments to reduce emissions by 2030 impact on the level of the sixth carbon budget for the UK? Are there other actions the UK should be taking alongside setting the sixth carbon budget, and taking the actions necessary to meet it, to support the global effort to implement the Paris Agreement?

ANSWER:

As many leading climate scientists point out, the key factor in preventing very serious climate impacts is the total emissions budget released during the pathway to net-zero, rather than any particular long-term end date.

There is an emerging international recognition that significant action by 2030 is the only viable option; the earlier the large-scale reductions occur, the better the chance of avoiding dangerous climate change.

This must impact on the ambition level of the sixth carbon budget as rising to the climate challenge as early as possible also offers the UK both the technical and cultural leadership opportunities in delivering rapid emissions reduction.

Question 4: What is the international signalling value of a revised and strengthened UK NDC (for the period around 2030) as part of a package of action which includes setting the level of the sixth carbon budget?

ANSWER:

As the UK is hosting COP26, the signalling value of a strengthened UK NDC is clearly going to be high.

One of the key required outcomes for COP25 in Madrid was to settle the remaining details of the ‘Paris Accord’, so the UNFCCC process can focus on the vital ratchet-mechanism process of raising ambition for NDCs at COP26 in Glasgow. Clarity and resolution to ‘Article 6’ of the Paris rulebook is needed to ensure there is no double counting of emissions reduction, and to build in global equity. Despite exceeding their schedule by a record 44 hours, COP25 failed to reach a deal on this.

However, led by Costa Rica, a growing coalition of countries offered the Chilean COP Presidency a set of 11 benchmarks which represent the “minimum” standard to ensure

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integrity of the global carbon trading system. Known as the Unconventional Group, these countries have been working since the pre-COP25 meeting in San José, Costa Rica, to increase the level of ambition in talks dealing with carbon markets (DCC, 2019).

The UK is to be congratulated for supporting this coalition.

If the UK were to offer a strengthened NDC, backed by a revision of existing budgets and an ambitious sixth budget in line with the UK's increase from 80% to net-zero goal, this could help offer momentum to resolve Article 6 and help ensure COP26 is a success in deploying the Paris ratchet-mechanism process for raising ambition globally.

References:

DCC, 2019. '32 leading countries set benchmark for carbon markets with San Jose Principles'. [Press release, available from https://cambioclimatico.go.cr/press-release-leading-countries-set-benchmark-for-carbon-markets-with-san-jose-principles/, accessed 29/01/20]

B. The path to the 2050 target

Question 5: How big a role can consumer, individual or household behaviour play in delivering emissions reductions? How can this be credibly assessed and incentivised?

ANSWER:

Time is tight. There now needs to be an urgent and systemic shift in policy to drive change both for business and for individuals and households. CAT's *Zero Carbon Britain: Rising to the Climate Emergency* (2019) explores and compares a range of potential policy mechanisms.

Cap schemes can be implemented either 'upstream', focusing on suppliers of fossil fuels and energy services directly, or 'downstream', seeking to change individual behaviours, such as home energy use, driving and flying. Companies or individuals who emit less than their share (as defined in various ways) can sell their surplus to those who have emitted more than their share.

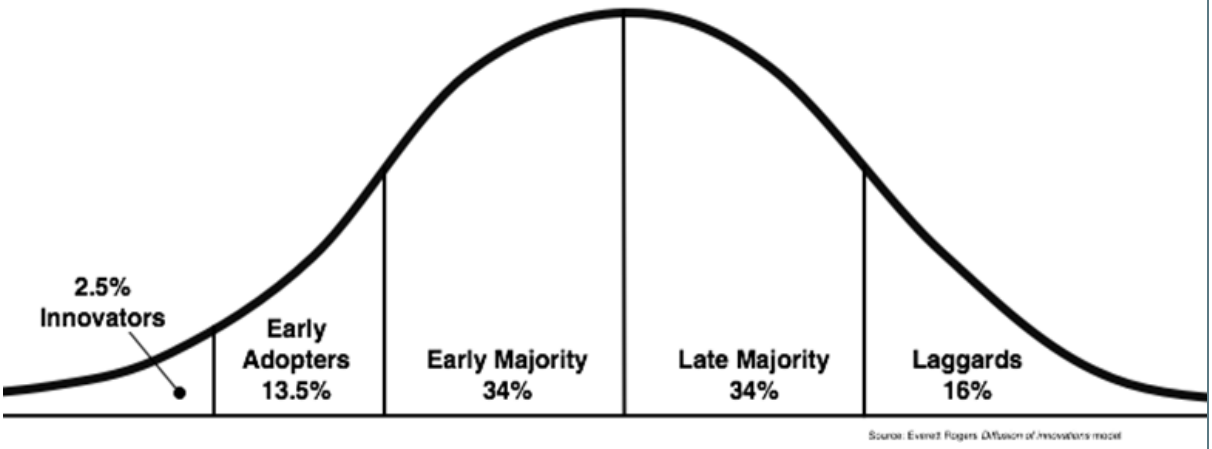
It is unlikely that any one single policy mechanism can deliver the radical emissions reductions we now require. We will need a policy framework combining effective upstream and downstream mechanisms designed to work well with a range of sectors, including energy production, industry, housing, business, transport, land use and agriculture.

Policy change, whilst important, is not enough on its own to bring about the required systemic shifts in behaviour. There needs to be capacity building support for Local Authorities to enable them to deliver on targets. A new Zero Carbon Britain Hub at CAT will help build the capacity of Local Authorities and communities to turn climate emergency declarations into action.

Question 5: How big a role can consumer, individual or household behaviour play in delivering emissions reductions? How can this be credibly assessed and incentivised?

Influencing individual attitudes and behaviour is also important so that we don't see the rise of movements such as the *Gilets Jaunes* in response to Macron's carbon tax. According to the Rogers 'Diffusion of Innovation Theory' (2003), over time an idea or product gains momentum and diffuses (or spreads) through a specific population or social system.

Fig. 1 Diffusion of Innovation Theory adoption profile or 'adoption curve'



The Centre for Alternative Technology has a long history of innovation and of inspiring, informing and enabling Innovators and Early Adopters to take action on sustainability and climate change.

Closing the gap between what is physically necessary to address climate change and what current UK emissions reduction targets are projected to achieve will require high-level all-party political commitment, cross-sectoral collaboration and public engagement at every level.

References:

Rogers, E., 2003. *Diffusion of Innovations, 5th Edition*. Simon and Schuster.

Question 6: What are the most important uncertainties that policy needs to take into account in thinking about achieving Net Zero? How can government develop a strategy that helps to retain robustness to those uncertainties, for example low-regrets options and approaches that maintain optionality?

ANSWER:

One of the most important uncertainties is the viability of delivery-at-scale and the resulting

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cost of the deployment of the levels of CCS and BECCS in many mitigation scenarios to remove hundreds of billions of tonnes of carbon dioxide from the atmosphere later this century, as a result of less ambitious action in the near future.

An increase in the number of early-ambition fully integrated hourly modelled scenarios that do not depend heavily on these as yet unproven-at-scale technologies would enhance the robustness of the information underpinning policy development options.

Since 2007, the Centre for Alternative Technology's Zero Carbon Britain research has been exploring these options, using hourly modelling, based on a ten-year data-set.

CAT's latest report *Zero Carbon Britain: Rising to the Climate Emergency* (CAT, 2019) demonstrates that by using energy more efficiently we can power down demand by 60%. At the same time, we can power up the UK's renewable energy resources to replace fossil fuels. And by making changes to our agricultural systems we could then balance out the remaining residual emissions from non-energy processes (for example from cement production or livestock) by removing greenhouse gases from the atmosphere through natural carbon capture from forests and restored peatlands. This would take us to net zero emissions overall without depending on the uncertainties of massive future deployment of CCS and BECCS.

References:

CAT, 2019. *Zero Carbon Britain: Rising to the Climate Emergency*. Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/

Question 7: The fourth and fifth carbon budgets (covering the periods of 2023-27 and 2028-32 respectively) have been set on the basis of the previous long-term target (at least 80% reduction in GHGs by 2050, relative to 1990 levels). Should the CCC revisit the level of these budgets in light of the net-zero target?

ANSWER:

This is perhaps the CCC's most important and most urgent task.

The revised net-zero end point marks a significant change in the relevant circumstances set out in the Climate Change Act, so revised more ambitious budgets must be embedded in all interim targets.

In addition, it is important to recognise that many, such as Sir David King, would now argue that the 2050 date for net-zero is too slow (Harrabin, 2019).

The key factor in preventing very serious climate impacts is the total emissions budget released during the pathway to net-zero, rather than any particular long-term target, therefore the earlier the large-scale budget reductions occur, the better the chance of

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References:

Harrabin, R. 2019. (19 Sept) 'Faster pace of climate change is 'scary', former chief scientist says', BBC, https://www.bbc.co.uk/news/science-environment-49689018

Question 8: What evidence do you have of the co-benefits of acting on climate change compatible with achieving Net Zero by 2050? What do these co-benefits mean for which emissions abatement should be prioritised and why?

ANSWER:

CAT's *Zero Carbon Britain: Rising to the Climate Emergency* report brings together a range of evidence around co-benefits and multi-solving opportunities (CAT, 2019).

Examples include employment opportunities, improvements in public health and wellbeing (with concomitant reduction in NHS costs), enhanced energy security and a reduction in poverty and inequality (Jennings, Fecht and de Matteis, 2019).

Employment

CAT's *Zero Carbon Britain: Rethinking the Future* scenario (2013) was used in research published by the Green European Foundation (Chapman, Essex and Sims, 2018), which estimates that there is the potential for the creation of 980,000 transition jobs and 710,000 long term jobs across the UK, with the additional advantage that many of these jobs could be created in economically deprived areas.

Health and wellbeing

Diet: CAT's *Zero Carbon Britain: Rising to the Climate Emergency* report (2019) includes a food and diets model that shows how the UK's agricultural GHG emissions can be dramatically reduced by changing the mix of foods in our diet: less meat, more fruit and vegetables, pulses and starchy foods (such as pasta, bread and potatoes). The nutritional model shows that these dietary changes, which are largely in line with those of the 2019 EAT-Lancet 'Food in the Anthropocene' report (Willett *et al*, 2019), would have positive health outcomes, including reducing levels of obesity and diet-related diseases.

Exercise: Decarbonising the transport sector should be approached with public health co-benefits in mind. Rather than focus mainly on the switch to electric vehicles, investment in public transport and infrastructure for walking and cycling presents the opportunity to tackle the problems associated with sedentary lifestyles (CAT, 2017).

Wellbeing: Wellbeing can be understood as a measure of how people feel, how they function on a personal and a social level, and how they evaluate their lives as a whole (New Economics Foundation, 2012). It is closely associated with 'quality of life' and is

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influenced by personal and external conditions. For example, physical health (Edmunds, 2013), social connection (House, 1988), satisfying employment (Bryson, 2014), levels of equality/inequality.

As we explore scenarios for moving away from fossil fuel dependency whilst also preparing for the climate impacts already in the system, we must adopt these new indicators to help monitor how these influence our wellbeing – both in our personal lives and collectively as a society.

Opportunities for multi-solving

CAT's *Zero Carbon Britain: Rising to the Climate Emergency* (2019, P120) highlights the shifts in policy approach needed to optimise multi-solving co-benefits, including:

- A national, cross-sector climate emergency action plan to link it all up.
- Interdisciplinary skills, so experts in one field can access the knowledge to optimise additional gains across a range of different fields.
- Break through the budgetary silos to reveal all the benefits – for example, if a clean air investment comes from the Department of Transport, the benefits may appear mostly in NHS savings.
- Link up the different levels of authority, so collaboration happens between different organisations operating at different scales or sectors.
- Long-term thinking, because significant benefits may be realised over much longer periods.

References:

Bryson, A., 2014. Does Worker Wellbeing affect Workplace performance? Department of Business Innovation and Skills www.gov.uk

CAT, 2013. *Zero Carbon Britain: Rethinking the Future.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-rethinking-the-future/

CAT, 2017. *Zero Carbon Britain: Making it Happen.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-making-it-happen/

CAT, 2019. *Zero Carbon Britain: Rising to the Climate Emergency.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-rising-to-the-climate-emergency/

Chapman, Essex and Sims, 2018. 'Unlocking the Job Potential of Zero Carbon'. Green European Foundation and the Greens/EFA Group in the European Parliament. Available from: https://gef.eu/wp-content/uploads/2018/12/GEF_ClimateJobs-brochure-main.pdf

Edmunds, S., 2013. Let's Get Physical, the impact of physical activity on wellbeing. Mental

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Health foundation.

House, J S, 1988. Social Relationships and Health Science 241, Issue 4865: 540-545. DOI: 10.1126/science.3399889

Jennings, Fecht and de Matteis, 2019. Briefing Paper: 'Co-benefits of climate change mitigation in the UK'. The Grantham Institute. Available from: https://www.imperial.ac.uk/grantham/publications/2019/co-benefits-of-climate-change-mitigation-in-the-uk-what-issues-are-the-uk-public-concerned-about-and-how-can-action-on-climate-change-help-to-address-them.php

New Economics Foundation (2012) https://neweconomics. org/2012/06/happy-planet-index-2012-report

Willett, W. et al., 2019. 'Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems'. Lancet, v. 393, n. 10170.

C. Delivering carbon budgets

Question 9: Carbon targets are only credible if they are accompanied by policy action. We set out a range of delivery challenges/priorities for the 2050 net-zero target in our Net Zero advice. What else is important for the period out to 2030/2035?

ANSWER:

Time is tight. The 2030/35 period must be built upon a much earlier urgent and systemic policy shift, increasing the budgets created for an 80% target to those compliant with a net-zero target.

Closing the gap between what is physically necessary to address climate change and what current UK emissions reduction targets are projected to achieve will require high-level all-party political commitment, cross-sectoral collaboration and public engagement at every level.

CAT's report *Zero Carbon Britain: Rising to the Climate Emergency* (2019, P114) explores and compares a range of leading potential policy mechanisms, including upstream and downstream approaches.

It is unlikely that any one single policy mechanism can deliver the radical emissions reductions we now require. We will need a policy framework combining effective mechanisms designed to work well with a range of sectors, including energy production, industry, housing, business, transport, land use and agriculture.

Working national and local policies together in this way has been shown to be effective in reducing emissions (UNEP, 2012).

Some of the mechanisms that operate on an international level are subject to 'carbon leakage' – moving production abroad to areas where carbon trading has not yet been

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implemented, or where carbon taxes are lower. Some mechanisms can even provide a disincentive to decarbonise, especially in the short-term, delaying decisions and leading to infrastructure 'lock-in' that commits to higher energy use or emissions over the following decades. If policy mechanisms are to be effective on a global level, they must be designed to avoid or manage these issues (CAT, 2019, P118).

References:

CAT, 2019. *Zero Carbon Britain: Rising to the Climate Emergency.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-rising-to-the-climate-emergency/

UNEP, 2012. The Emissions Gap Report 2012. United Nations Environment Programme (UNEP), Nairobi.

Question 10: How should the Committee take into account targets/ambitions of UK local areas, cities, etc. in its advice on the sixth carbon budget?

ANSWER:

As of 28th January, climateemergency.uk estimate that in Britain over 85 per cent of the population lives in areas that have declared a climate emergency, with over 400 councils all together declaring (climateemergency.uk, 2020).

Local councils, cities and regions are now exploring ambitious plans for areas within their own jurisdiction and calling for ambitious national and regional action plans. A new Zero Carbon Britain Hub and Innovation Lab being developed by the Centre for Alternative Technology will provide support, training and resources to help turn local ambitions into zero carbon action plans (CAT, 2019a). It is vital that the CCC advice supports and builds on this momentum and that existing budgets are upgraded to reflect both the urgency of the challenge and the appetite for tackling it that exists at a local level.

References:

CAT, 2019a. 'New hub and innovation lab to share zero carbon solutions'. [Press release]. Available at: https://www.cat.org.uk/new-hub-and-innovation-lab-to-share-zero-carbon-solutions/

climateemergency.uk (2020). 'Climate emergency declarations in 1,341 jurisdictions and local governments cover 803 million citizens.' (28th January, 2020). Available from: https://climateemergencydeclaration.org/climate-emergency-declarations-cover-15-million-citizens/

Question 11: Can impacts on competitiveness, the fiscal balance, fuel poverty and security of supply be managed regardless of the level of a budget, depending on how policy is designed and funded? What are the critical elements of policy design (including funding and delivery) which can help to manage these impacts?

ANSWER:

The world is going to have to move rapidly to net-zero, therefore if the UK is a policy leader in this transition, there will be benefits in competitiveness, exports and economic transition.

In terms of the critical elements of policy, the Green New Deal offers the potential for an interlinked package of measures, including an investment in green infrastructure of at least £50 billion a year, which will benefit every community and constituency in Britain, providing skilled jobs, eradicating fuel poverty, making homes comfortable in summer and winter, and keeping energy costs down. (The Green New Deal Group, 2013)

Multiple groups in the UK and Europe are now promoting policies that prioritise decarbonisation, community and employee-led transition from high-carbon to low and zero-carbon industry.

A co-creative, co-production, multi-solving approach to policy design, with input from a broad range of disciplines, is needed if we are to make the most of the opportunities presented by the transition to net-zero, to mitigate potential risks. It is vital that policymakers don't work in silos. CAT's Zero Carbon Britain Hub and Innovation Lab will be taking this approach to help policymakers with planning and prioritisation.

References:

The Green New Deal Group, 2013. 'A National Plan for the UK: From Austerity to the Age of the Green New Deal'. New Weather Institute.

Question 12: How can a just transition to Net Zero be delivered that fairly shares the costs and benefits between different income groups, industries and parts of the UK, and protects vulnerable workers and consumers?

ANSWER:

To illustrate what a just transition to net zero could look like, CAT's *Zero Carbon Britain: Rising to the Climate Emergency* report (2019, P127) explores evidence from a number of useful sources:

'Unlocking the Job Potential of Zero Carbon' (Chapman, Essex and Sims, 2018).

This report, which draws on CAT's research into net zero scenarios, explores the potential for employment in the transition to net zero in the UK, Hungary and Republic of Ireland, including looking at opportunities across the UK.

The authors conclude that, "A transition economy would divert investment from long-distance transport, fracking for shale gas and speculative housing developments into local rail, bus and active transport to localise the economy, alongside massive planned renewables and energy efficient investment, and a new vision for farming and land-use to

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revitalise rural areas."

'Sea Change: Climate emergency, jobs and managing the phase-out of UK oil and gas extraction' (Muttitt, Makova and Crighton, 2019)

This report underlines that the UK and Scottish Governments face a choice between two pathways that stay within the Paris climate limits:

1. Deferred collapse: continue to pursue maximum extraction by subsidising companies and encouraging them to shed workers until worsening climate impacts force rapid action to cut emissions globally; the UK oil industry collapses, pushing many workers out of work in a short space of time.

2. Managed transition: stop approving and licensing new oil and gas projects, and begin a phase-out of extraction and a just transition for workers and communities, negotiated with trade unions and local leaders, and in line with climate change goals, while building quality jobs in a clean energy economy.

Given the tightness of remaining carbon budgets, each new license, permit or tax break for oil and gas pushes the UK further towards the deferred collapse path. The Sea Change report instead recommends the second course; it shows that energy transformation can meet UK climate commitments while protecting livelihoods and economic wellbeing, if the right policies are adopted. Local manufacturing and workforce participation therefore need to guide new approaches to economic development, industrial policy and ownership, together with stronger trade union rights for workers affected by energy transitions.

This report makes a case that with the right policies, job creation in clean energy industries will exceed affected oil and gas jobs by more than threefold.

References:

CAT, 2019. *Zero Carbon Britain: Rising to the Climate Emergency.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-rising-to-the-climate-emergency/

Chapman, Essex and Sims, 2018. 'Unlocking the Job Potential of Zero Carbon'. Green European Foundation and the Greens/EFA Group in the European Parliament. Available from: https://gef.eu/wp-content/uploads/2018/12/GEF_ClimateJobs-brochure-main.pdf

Muttitt, G., Markova, A., and Crighton, M., 2019. 'Sea Change: Climate emergency, jobs and managing the phase-out of UK oil and gas extraction'. Platform, Oil Change International and Friends of the Earth Scotland.

D. Scotland, Wales and Northern Ireland

Question 13: What specific circumstances need to be considered when recommending an emissions pathway or emissions reduction targets for Scotland, Wales and/or Northern Ireland, and how could these be reflected in our advice on the UK-wide sixth carbon budget?

ANSWER:

Land use is too often seen as hard to decarbonise in Wales, even though the National Farmers Union has set the ambitious goal of reaching net zero greenhouse gas emissions across the whole of agriculture in England and Wales by 2040. However, to reach this goal, the NFU estimate displacement of fossil fuel use by land-based renewables will only deliver GHG savings of up to 3 MtCO2e/year, whilst they rely on bioenergy with carbon capture and storage (BECCS) to deliver the vast majority savings of up to 22 MtCO2e/year – this is as yet unproven at scale.

CAT's *Zero Carbon Britain: Rising to the Climate Emergency* report (CAT, 2019) shows how more ambitious emissions pathway actions, such as much larger renewable deployment and shifting to a healthier lower impact diet, could allow the rural areas of the UK to contribute to a net-zero target without dependency on BECCS, whilst also reducing food imports from around 42% to 17%. This could also free up more land to support carbon sequestration and provide space for nature to thrive.

The new Zero Carbon Britain Hub at the Centre for Alternative Technology plans to work with farmers, farmer's unions, local authorities and communities in Wales in order to achieve 100% net zero carbon emissions by 2050 or earlier.

References:

CAT, 2019. *Zero Carbon Britain: Rising to the Climate Emergency.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-rising-to-the-climate-emergency/

Question 14: The Environment (Wales) Act 2016 includes a requirement that its targets and carbon budgets are set with regard to:

- The most recent report under section 8 on the State of Natural Resources in relation to Wales;
- The most recent Future Trends report under section 11 of the Well-Being of Future Generations (Wales) Act 2015;
- The most recent report (if any) under section 23 of that Act (Future Generations report).

a) What evidence should the Committee draw on in assessing impacts on sustainable management of natural resources, as assessed in the state of natural resources report?

b) What evidence do you have of the impact of acting on climate change on well-being? What are the opportunities to improve people's well-being, or potential risks, associated with activities to reduce emissions in Wales?

c) What evidence regarding future trends as identified and analysed in the future trends report should the Committee draw on in assessing the impacts of the targets?

d) Question 12 asks how a just transition to Net Zero can be achieved across the UK. Do you have any evidence on how delivery mechanisms to help meet the UK and Welsh targets may affect workers and consumers in Wales, and how to ensure the costs and benefits of this transition are fairly distributed?

ANSWER:

The Wellbeing of Future Generations (Wales) Act was developed on the basis of a comprehensive evidence review, not just of the outcomes that matter for wellbeing but also of the processes – the ways of working – that make us better off.

The resultant framework identified five processes - 'Sustainable Development Principles' - for delivering wellbeing goals, namely: Long-term, Prevention, Integration, Collaboration and Involvement.

Acting on climate change clearly meets the Long-Term principle. But the other four principles may or may not be met depending on the particular policies involved. Abiding by all five principles provides the opportunity to act on climate change in ways that also improve people's wellbeing.

The principle of Prevention requires acting on climate change immediately, not waiting for things to get worse.

Specific opportunities related to wellbeing include providing people with stable employment in green industries and localised efforts to conserve and restore natural ecosystems.

The principle of Integration requires pursuing all of the seven Wellbeing Goals together - not sacrificing any particular goal for the purposes of efficiency. This requires joined-up, evidence-based policy. In particular, it requires that action on climate change also helps

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create greater equality (one of the seven wellbeing goals). In other words, reduction in consumption must be coupled with forms of redistribution.

Lastly, the principles of Collaboration and Involvement require that action on climate change occurs across all sectors and levels of society - national/local, public/private, top-down and bottom-up.

Question 15: Do you have any further evidence on the appropriate level of Wales' third carbon budget (2026-30) and interim targets for 2030 and 2040, on the path to a reduction of at least 95% by 2050?

ANSWER:

Question 16: Do you have any evidence on the appropriate level of Scotland's interim emissions reduction targets in 2030 and 2040?

ANSWER:

Question 17: In what particular respects do devolved and UK decision making need to be coordinated? How can devolved and UK decision making be coordinated effectively to achieve the best outcomes for the UK as a whole?

ANSWER:

E. Sector-specific questions

Question 18 (Surface transport): As laid out in Chapter 5 of the Net Zero Technical Report (see page 149), the CCC's Further Ambition scenario for transport assumed 10% of car miles could be shifted to walking, cycling and public transport by 2050 (corresponding to over 30% of trips in total):

a) What percentage of trips nationwide could be avoided (e.g. through car sharing, working from home etc.) or shifted to walking, cycling (including e-bikes) and public transport by 2030/35 and by 2050? What proportion of total UK car mileage does this correspond to?

b) What policies, measures or investment could incentivise this transition?

ANSWER:

Question 19 (Surface transport): What could the potential impact of autonomous vehicles be on transport demand?

ANSWER:

Question 20 (Surface transport): The CCC recommended in our Net Zero advice that the phase out of conventional car sales should occur by 2035 at the latest. What are the barriers to phasing out sales of conventional vehicles by 2030? How could these be addressed? Are the supply chains well placed to scale up? What might be the adverse consequences of a phase-out of conventional vehicles by 2030 and how could these be mitigated?

ANSWER:

Question 21 (Surface transport): In our Net Zero advice, the CCC identified three potential options to switch to zero emission HGVs – hydrogen, electrification with very fast chargers and electrification with overhead wires on motorways. What evidence and steps would be required to enable an operator to switch their fleets to one of these options? How could this transition be facilitated?

ANSWER:

Question 22 (Industry): What policy mechanisms should be implemented to support decarbonisation of the sectors below? Please provide evidence to support this over alternative mechanisms.

a) Manufacturing sectors at risk of carbon leakage

b) Manufacturing sectors not at risk of carbon leakage

c) Fossil fuel production sectors

d) Off-road mobile machinery

ANSWER:

Question 23 (Industry): What would you highlight as international examples of good policy/practice on decarbonisation of manufacturing and fossil fuel supply emissions? Is there evidence to suggest that these policies or practices created economic opportunities (e.g. increased market shares, job creation) for the manufacturing and fossil fuel supply sectors?

ANSWER:

Question 24 (Industry): How can the UK achieve a just transition in the fossil fuel supply sectors?

ANSWER:

A useful just transition pathway is explored in the report 'Sea Change: Climate emergency, jobs and managing the phase-out of UK oil and gas extraction.' (Muttitt, Markova and Crighton, 2019).

This report underlines that the UK and Scottish Governments face a choice between two pathways that stay within the Paris climate limits:

1. Deferred collapse: continue to pursue maximum extraction by subsidising companies and encouraging them to shed workers until worsening climate impacts force rapid action to cut emissions globally; the UK oil industry collapses, pushing

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many workers out of work in a short space of time.

2. Managed transition: stop approving and licensing new oil and gas projects, and begin a phase-out of extraction and a just transition for workers and communities, negotiated with trade unions and local leaders, and in line with climate change goals, while building quality jobs in a clean energy economy.

This report make the case that with the right policies, job creation in clean energy industries will exceed affected oil and gas jobs by more than threefold. Such an energy transformation can meet UK climate commitments while protecting livelihoods and economic wellbeing, if suitable policies are adopted, guided by affected workers, trade unions and local communities.

Further useful analysis is offered in the report 'Unlocking the Job Potential of Zero Carbon' (Chapman, Essex and Sims, 2018). In 2018, the Green House think tank led a project which estimated the number of jobs that would be created by a transition to a zero carbon economy where we reduce emissions of GHG in line with the aspiration to limit global warming to 1.5°C.

Using a detailed methodology, and building on aspects of CAT's research into net zero scenarios, this work embraces a local jobs-rich green investment strategy in local authority areas in the UK. It also offers parallel analysis for each region of Hungary and the Republic of Ireland.

References:

Chapman, Essex and Sims, 2018. 'Unlocking the Job Potential of Zero Carbon'. Green European Foundation and the Greens/EFA Group in the European Parliament. Available from: https://gef.eu/wp-content/uploads/2018/12/GEF_ClimateJobs-brochure-main.pdf

Muttitt, G., Markova, A., and Crighton, M., 2019. 'Sea Change: Climate emergency, jobs and managing the phase-out of UK oil and gas extraction'. Platform, Oil Change International and Friends of the Earth Scotland.

Question 25 (Industry): In our Net Zero advice, the CCC identified a range of resource efficiency measures that can reduce emissions (see Chapter 4 of the Net Zero Technical Report, page 115), but found little evidence relating to the costs/savings of these measures. What evidence is there on the costs/savings of these and other resource efficiency measures (ideally on a £/tCO2e basis)?

ANSWER:

Question 26 (Buildings): For the majority of the housing stock in the CCC's Net Zero Further Ambition scenario, 2050 is assumed to be a realistic timeframe for full roll-out of energy efficiency and low-carbon heating.

a) What evidence can you point to about the potential for decarbonising heat in buildings more quickly?

b) What evidence do you have about the role behaviour change could play in driving forward more extensive decarbonisation of the building stock more quickly? What are the costs/levels of abatement that might be associated with a behaviour-led transition?

ANSWER:

Question 27 (Buildings): Do we currently have the right skills in place to enable widespread retrofit and build of low-carbon buildings? If not, where are skills lacking and what are the gaps in the current training framework? To what extent are existing skill sets readily transferable to low-carbon skills requirements?

ANSWER:

The Committee on Climate Change (2019) has already identified two clear areas where we will need a large well trained workforce: retrofitting insulation and heat pumps.

CAT has experience in delivering skills training and academic courses in renewable energy and sustainable building, amongst other areas. We have ambitious plans to develop a new Renewable Energy and Construction Skills Centre to rapidly develop a wider range of training programmes to allow more people to gain the skills needed for the zero carbon transition.

References:

Committee on Climate Change, 2019. *Net Zero: The UK's contribution to stopping global warming.* London, CCC.

Question 28 (Buildings): How can local/regional and national decision making be coordinated effectively to achieve the best outcomes for the UK as a whole? Can you point to any case studies which illustrate successful local or regional governance models for decision making in heat decarbonisation?

ANSWER:

Question 29 (Power): Think of a possible future power system without Government backed Contracts-for-Difference. What business models and/or policy instruments could be used to continue to decarbonise UK power emissions to close to zero by 2050, whilst minimising costs?

ANSWER:

Question 30 (Power): In Chapter 2 of the Net Zero Technical Report we presented an illustrative power scenario for 2050 (see pages 40-41 in particular):

a) Which low-carbon technologies could play a greater/lesser role in the 2050 generation mix? What about in a generation mix in 2030/35?

b) Power from weather-dependent renewables is highly variable on both daily and seasonal scales. Modelling by Imperial College which informed the illustrative 2050 scenario suggested an important role for interconnection, battery storage and flexible demand in a future low-carbon power system:

i. What other technologies could play a role here?

ii. What evidence do you have for how much demand side flexibility might be realised?

ANSWER:

b) i. Carbon neutral synthetic gas can play a more important role than is currently recognised. Hourly modelling of the renewables mix in the CAT's *Zero Carbon Britain* scenario (CAT, 2019) shows a surplus of energy 74% of the time. We ensure there is enough energy at other times by:

- Shifting energy demand using 'smart' appliances and using batteries, pumped storage, heat storage and hydrogen for short-term energy storage over hours or days.
- Using carbon neutral synthetic gas (which can be dispatched quickly into the electricity grid when we need it) for long-term energy storage over weeks or months.

This research suggests conventional 'baseload' power that provides a continuous supply of electricity but can only respond slowly (nuclear, for example) doesn't work well with a highly variable renewable energy system, as it leads to further overproduction when renewables already exceed demand.

CAT's report explores the role for carbon neutral synthetic gas (power to gas) - a growing technology that creates a market for the substantial amounts of surplus renewable electricity to produce hydrogen and, in a subsequent step using the Sabatier reaction, methane gas, or liquid fuels using the Fischer-Tropsch process.

For real life power to gas projects see https://www.storeandgo.info

b) ii. CAT's latest *Zero Carbon Britain* report (CAT, 2019) is based on a scenario using real

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b) Power from weather-dependent renewables is highly variable on both daily and seasonal scales. Modelling by Imperial College which informed the illustrative 2050 scenario suggested an important role for interconnection, battery storage and flexible demand in a future low-carbon power system:

   i. What other technologies could play a role here?

   ii. What evidence do you have for how much demand side flexibility might be realised?

hourly weather data (solar radiation, wind speeds, temperatures, etc.) for the last ten years – a total of 87,648 hours – to simulate patterns of supply and demand.

In our scenario:

- 74% of the time, supply of renewable electricity exceeds direct demand for electricity (including electricity for heating and transport) required at any one moment. Due to the very large number of wind turbines and other renewable electricity producers, over a third of the total electricity produced (about 300 TWh per year) is surplus to what is directly required at the time of production. However, 26% of the time, electricity supply does not fully meet demand.
- Short-term storage mechanisms, such as pumped storage and battery storage (200 GWh storage capacity), 'shiftable' demand from smart appliances and electric car charging (over 500 GWh storage capacity in total but only part of this capacity is ever available), and heat storage (200 GWh heat) reduce the proportion of time during which electricity supply does not meet demand from 26% to 11%. This reduces the amount of surplus electricity to about 270 TWh per year.

References:

CAT, 2019. *Zero Carbon Britain: Rising to the Climate Emergency.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-rising-to-the-climate-emergency/

Question 31 (Hydrogen): The Committee has recommended the Government support the delivery of at least one large-scale low-carbon hydrogen production facility in the 2020s. Beyond this initial facility, what mechanisms can be used to efficiently incentivise the production and use of low-carbon hydrogen? What are the most likely early applications for hydrogen?

ANSWER:

Surplus renewables can be used to produce hydrogen. However, compared to natural gas (primarily methane), hydrogen is difficult to store and transport and there is almost no

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existing infrastructure suitable for it.

Carbon neutral synthetic gas is made via the Sabatier process which can be seen as 'upgrading' hydrogen to a gas that is easier to use with our existing infrastructure. This can offer a powerful mechanism to incentivise the production of hydrogen, as CAT's 2019 scenario explores using real hourly weather data (solar radiation, wind speeds, temperatures, etc.) for the last ten years – a total of 87,648 hours – to simulate patterns of supply and demand.

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To store enough biogas and synthetic gas for these periods, our scenario includes 80,000 GWh of methane gas storage (CAT, 2019, PP68-70).

References:

CAT, 2019. *Zero Carbon Britain: Rising to the Climate Emergency.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-rising-to-the-climate-emergency/

Question 32 (Aviation and Shipping): In September 2019 the Committee published advice to Government on international aviation and shipping and Net Zero. The Committee recognises that the primary policy approach for reducing emissions in these sectors should be set at the international level (e.g. through the International Civil Aviation Organisation and International Maritime Organisation). However, there is still a role for supplementary domestic policies to complement the international approach, provided these do not lead to concerns about competitiveness or carbon leakage. What are the domestic measures the UK could take to reduce aviation and shipping emissions over the period to 2030/35 and longer-term to 2050, which would not create significant competitiveness or carbon leakage risks? How much could these reduce emissions?

ANSWER:

Question 33 (Agriculture and Land use): In Chapter 7 of the Net Zero Technical Report we presented our Further Ambition scenario for agriculture and land use (see page 199). The scenario requires measures to release land currently used for food production for other uses, whilst maintaining current per-capita food production. This is achieved through:

- A 20% reduction in consumption of red meat and dairy
- A 20% reduction in food waste by 2025
- Moving 10% of horticulture indoors
- An increase in agriculture productivity:
  - Crop yields rising from the current average of 8 tonnes/hectare for wheat (and equivalent rates for other crops) to 10 tonnes/hectare
  - Livestock stocking density increasing from just over 1 livestock unit (LU)/hectare to 1.5 LU/hectare

Can this increase in productivity be delivered in a sustainable manner?

Do you agree that these are the right measures and with the broad level of ambition indicated? Are there additional measures you would suggest?

ANSWER:

The proposed reductions in meat consumption and food waste are achievable, and we would push for more ambition in reduction of meat and dairy. However, these changes to diet and lifestyles are dependent on understanding the behaviour change programmes necessary to bring this about.

Increasing productivity will be less achievable in Wales. For example, wheat is very sensitive to extreme weather and temperature patterns, which are more changeable due to climate change (Asseng et al, 2019). Farmers could adapt to unseasonable weather by growing mixes of different varieties with a lower yield, however to expect higher yields with increasingly poor soils, less stable seasons, whilst reducing the use of pesticides,

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fungicides and herbicides is unlikely.

Transitioning from conventional agricultural methods to more sustainable ones might also initially see a reduction of yields (offset for the farmer by lower cost inputs) until pest and predator populations have established a balance or more suitable varieties of the crop are used.

A more transformative approach would be to increase 'yield' rather than productivity, with yield including increased biodiversity, rain infiltration and thus flood prevention, soil carbon sequestration, human culture, language etc. This yield could well be increased over the coming years with proper management.

Moving 10% of horticulture under cover: when taken out of the ecosystem, crops will no longer be providing ecosystems services e.g. flood alleviation, carbon sequestration, etc. and will require inputs of e.g. fertilizer, pest control, ventilation. This will increase costs and more research is required to establish these before taking this approach in policy.

Reducing livestock by 20%: We would argue that a reduction of 50% is a more realistic assessment of what's needed, with silvopasture systems most recommended. We would not recommend increasing stocking densities but rather increasing tree and hedge cover (CAT, 2019).

References:

Asseng , S, Martre, P, Maiorano, A, et al., 2019. Climate change impact and adaptation for wheat protein. *Glob Change Biol*. 2019; 25: 155-173. https://doi.org/10.1111/gcb.14481

CAT, 2019. *Zero Carbon Britain: Rising to the Climate Emergency.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-rising-to-the-climate-emergency/

Question 34 (Agriculture and Land use): Land spared through the measures set out in question 33 is used in our Further Ambition scenario for: afforestation (30,000 hectares/year), bioenergy crops (23,000 hectares/year), agro-forestry and hedgerows (~10% of agricultural land) and peatland restoration (50% of upland peat, 25% lowland peat). We also assume the take-up of low-carbon farming practices for soils and livestock. Do you agree that these are the key measures and with the broad level of ambition of each? Are there additional measures you would suggest?

ANSWER:

Question 35 (Greenhouse gas removals): What relevant evidence exists regarding constraints on the rate at which the deployment of engineered GHG removals in the UK (such as bioenergy with carbon capture and storage or direct air capture) could scale-up by 2035?

ANSWER:

Question 36 (Greenhouse gas removals): Is there evidence regarding near-term expected learning curves for the cost of engineered GHG removal through technologies such as bioenergy with carbon capture and storage or direct air capture of CO_2?

ANSWER:

Question 37 (Infrastructure): What will be the key factors that will determine whether decarbonisation of heat in a particular area will require investment in the electricity distribution network, the gas distribution network or a heat network?

ANSWER:

Policies that support longer term thinking will be a key factor. It is important to recognise that any current new-build or building eco-retrofits must focus on the long-term infrastructure needed for a net-zero goal.

For example, continuing to fit gas boilers as part of a retrofit programme is short term thinking, as they will need to be removed before the end of their design life, whereas installing heat pumps now in parallel with the transition to a 100% renewable energy grid will help enable the transition to low carbon heating systems. (CAT, 2019, P46)

References:

CAT, 2019. *Zero Carbon Britain: Rising to the Climate Emergency.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-

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britain-rising-to-the-climate-emergency/

Question 38 (Infrastructure): What scale of carbon capture and storage development is needed and what does that mean for development of CO_2 transport and storage infrastructure over the period to 2030?

ANSWER:

Zero Carbon Britain: Rising to the Climate Emergency (CAT, 2019) shows a path which removes dependence on mass deployment artificial CCS, by taking ambitious action to power down demand, power up 100% renewables and improve diets and land-use practice - so natural carbon capture systems such as doubling forest cover and re-vitalising peat bogs are sufficient to balance the residual emissions.

Whilst carbon capture technologies should continue to be explored and invested in, no net zero scenario or decarbonisation plan should be dependent on unproven technologies for its success.

References:

CAT, 2019. *Zero Carbon Britain: Rising to the Climate Emergency.* Available from: https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-rising-to-the-climate-emergency/