



## Friends of the Earth (England, Wales & Northern Ireland) response to the Committee on Climate Change call for evidence on the sixth carbon budget

### Question and answer form

When responding, please provide answers that are as specific and evidence-based as possible, providing data and references to the extent possible.

***Please limit your answers to 400 words per question and provide supporting evidence (e.g. academic literature, market assessments, policy reports, etc.) along with your responses.***

#### 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:

The research on climate tipping points by Lenton et al, published in nature (<https://www.nature.com/articles/d41586-019-03595-0>), suggests that the prudent course of action globally, and by implication by nations, is to reduce greenhouse gas emissions as deep and fast as possible. This is a different approach than trying to identify what a UK fair share of a remaining carbon budget for a given temperature target is. It reinforces the idea that we are already in a climate emergency situation.

The emerging evidence on climate sensitivity, covered in this recent Carbon Brief report (<https://www.carbonbrief.org/cmip6-the-next-generation-of-climate-models-explained>), is that the climate might be more sensitive to greenhouse gases than previously thought (which would drastically reduce the carbon budget for delivering on the Paris Agreement). If these findings were to be confirmed as more model runs are undertaken, this would again point towards reducing emissions as fast and deep as possible.

The precautionary approach to meeting the Paris Agreement obligations is, therefore, we believe, to cut emissions as deep and fast as possible.

**Question 2:** How relevant are estimates of the remaining global cumulative CO<sub>2</sub> 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:**

Notwithstanding our answer to question 1, the scientific estimates of carbon budgets are clearly material to the discussion. An equity-based interpretation of the global budgets would identify the upper limits of what the UK carbon budget could be (but we should aim to minimise UK emissions as much and as fast as possible). But as our answer to Q1 also identifies, this is an area with uncertainties (e.g. of climate sensitivity), and therefore a precautionary approach is needed.

The equity-based interpretation of global carbon budgets is important. There are a range of approaches. The 'fairest' approach would include significant consideration of UK historical emissions (after all the science of climate change is not new) and would lead to a need for almost immediate cessation of UK emissions. While this isn't practical it does reinforce the need for the UK to reduce emissions as fast as possible (including its consumption-based emissions), and in addition support countries overseas to reduce their emissions in recognition that we have over-consumed our fair share of the global carbon budget. Given the UK's long history of greenhouse gas emissions, our international obligation is very large indeed. Friends of the Earth and others will soon publish research on this which we will share with the Committee.

**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:**

The sixth carbon budget will necessarily be extremely small (see our answers to Q1 and Q2) and fourth and fifth budgets significantly reducing. The reduction of these earlier budgets would send a strong international signal. But it is also well known that much of the UK's emissions reductions are as a result of offshoring manufacturing and that our consumption-based emissions are much less reduced than our territorial emissions. Therefore, to show genuine global leadership the UK needs to:

- Declare an immediate moratorium on new Overseas Development Assistance (ODA) investments in oil and gas projects, including indirect investments by the Commonwealth Development Corporation (CDC).
- Commit to end UK Export Finance (UKEF) investments supporting oil and gas projects by 2021 (in line with EAC inquiry recommendation) and review current UKEF energy investments with consideration for a just transition for workers and communities impacted by the phase out of fossil fuel support.
- Adopt mechanisms to review the climate impacts of proposed projects supported by ODA or UKEF and only invest in (near) zero emissions projects.
- Commit to no international offsetting in the UK pathway.
- Ensure outcomes of carbon market (Article 6) negotiations at COP26 achieve an overall mitigation in global emissions.

**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?

- Increase financial/technological support for climate finance (across mitigation, adaptation and Loss and Damage) in line with developing country needs.
- Commit to not only a significantly enhanced NDC for territorial emissions but also to significantly reduce consumption-based emissions.

**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:

It is important, but it has to be properly raised ambition, not just the existing domestic UK target or a target slightly adjusted, because that will be seen as a paper exercise and PR stunt rather than actually raised ambition. Done well, with the right diplomatic clout behind it, it could encourage other countries to set ambitious, revised NDCs. Alongside the NDC the UK should also commit to reduce consumption-based emissions (e.g. a greater domestic production of animal feed to reduce or eliminate imports of animal feed from nations allowing deforestation for soya plantations).

But it also must be believable. The UK is already way off-track for meeting existing carbon budgets, and the Committee's evidence continues to rightfully draw attention to this failing. The Budget on March 11<sup>th</sup> is an important opportunity to demonstrate that the UK is upping its game and getting back on track.

## 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:

Household consumption accounts for almost three quarters of global GHG emissions <https://pubs.acs.org/doi/10.1021/es803496a#>. And as sectors like electricity generation decarbonise, there's an urgent need for the public to play a much greater role, particularly in terms of their diets, home heating and transport.

The CCC already has the excellent report by Dr Richard Carmichael setting out the role of behaviour change in relation to meeting net zero ambitions <https://www.theccc.org.uk/publication/behaviour-change-public-engagement-and-net-zero-imperial-college-london/>. This helpfully sets out the urgent need for bold action by government to help people make the necessary shift to low impact lifestyles.

**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?

There is much uncertainty about the degree of behaviour change that can be delivered by any particular policy, but we don't have the luxury of waiting until the research is entirely clear. The government must begin now and learn by doing.

To encourage the public to change, government needs to walk the talk, including putting in place policies that are in line with a net zero ambition e.g. rejecting the third runway at Heathrow, funding a modal shift to public transport, walking and cycling rather than new road projects and embedding net zero and sustainability in all procurement arrangements.

The Better by Half roadmap <https://www.eating-better.org/betterbyhalf#4-2> sets out the actions needed by government to support a reduction in meat and dairy consumption, e.g. by normalising sustainable diets through public procurement, and proper integration of sustainability into national dietary guidelines (currently the Eatwell Guide focuses mainly on health), which should then underpin policy development at all levels of government.

Fiscal levers should be explored as subsidies and taxes could play an important role, particularly in reducing air travel (a frequent flier levy), grants to help with upfront costs of installing eco-heating like heat pumps and ways to help with upfront and running costs of Electric Vehicles.

Taxes and subsidies work in the case of shifting diets. A growing body of research is finding that measures to make unhealthy foods more expensive and healthy foods less expensive are among the most effective interventions for changing eating habits, see <https://onlinelibrary.wiley.com/doi/abs/10.1111/nure.12123>

The government should also actively champion co-benefits, because people will feel them more quickly and tangibly than the longer-term benefit of reducing emissions. E.g. Healthier, sustainable diets have huge knock-on benefits for our health. Research for Friends of the Earth found that lower meat diets could prevent 45,000 early deaths from heart disease, cancer and strokes, and save the NHS around £1.2bn a year [https://cdn.friendsoftheearth.uk/sites/default/files/downloads/healthy\\_planet\\_eating.pdf](https://cdn.friendsoftheearth.uk/sites/default/files/downloads/healthy_planet_eating.pdf).

**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:

There are uncertainties everywhere (technology, social-acceptance, costs, practical limits). Actions that are no-regrets and/or have significant co-benefits should be pursued without delay (e.g. housing insulation, heat pumps, active travel, healthier diets, faster roll out of renewables, faster transition to electric vehicles) while uncertainties are explored.

Large-scale choices that are based on significant assumptions (e.g. the availability and sustainability of feedstocks for BECCS, hydrogen from gas being low carbon in practice) that stifle action on more sustainable actions (e.g. development of electrolysis, deeper cuts earlier) need to stop being positioned as a given. For example:

**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?

- The promotion of greenhouse gas reduction via BECCS by the CCC and some modellers has been shown to have a mitigation deterrent effect (e.g. enables decision-makers to avoid or put off difficult decisions or seek to avoid the need for current government spending) according to forthcoming research by McLaren et al at Lancaster University.
- The CCC has not got a perfect track-record in forecasting future prices of emerging technologies (e.g. solar or off-shore wind) but in backing hydrogen from SMR with CCS it is likely to lock-in future emissions from natural gas leakage and imperfect carbon capture and freeze out the development of electrolysis. The promise of hydrogen from SMR also is inhibiting early action on the no-regrets policy of a rapid roll-out of heat pumps.
- There is uncertainty about the efficacy and longevity of negative emissions and offsets, which is often over-looked in scientific and governmental carbon reduction pathways. Assumptions around efficacy and longevity are also made in corporate, institutionally and individual decision-making. Instead we need to develop pathways on the assumption that negative emissions will fail (e.g. carbon sinks turning to sources) and that credible governance of offsets will not emerge (because they haven't for the last 20+ years). Doing so would give a much stronger focus on mitigation, including for innovation in hard to treat sectors.

**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:

Absolutely, both to get on the right pathway but also because the carbon budget for 1.5 degrees is much smaller and, in any case, we need to cut emissions as fast and deep as possible due to emerging science on tipping points and climate sensitivity (see our answer to Q1). It would be very difficult for the CCC to justify with any credibility either scientifically or economically a decision not to recommend revision of the fourth and fifth budgets and it would raise concerns that the CCC was tailoring its advice to accommodate the wishes of the current government instead of carrying out its duties impartially.

**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:

The Grantham Institute has carried out research into co-benefits:

<https://www.imperial.ac.uk/media/imperial-college/grantham-institute/public/publications/briefing-papers/Co-benefits-of-climate-change-mitigation-in-the->

**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?

[UK.pdf](#). Areas that have strong co-benefits are issues that improve health (e.g. less meat and dairy consumption, active travel, restrictions on cars in urban areas and switching to electric vehicles, home insulation) and/or bring economic advantage to the UK (e.g. offshore wind development, exploitation of our large renewable potential for development of electrolysis).

Co-benefits are important to recognise both because co-benefits often bring economic advantages (e.g. reduced costs to the NHS) and can also bring people along on the journey who are sceptical of climate change or just resistant to change. However, they should not be used as a filter or prioritisation tool because the scale of impacts of climate change and the speed of action needed does not allow for actions without co-benefits to be side-lined or ignored. An example of this is the roll out of heat pumps. This area does not bring any obvious co-benefits, yet it is critical that progress in rolling out heat pumps is made as a matter of urgency.

### 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:

There are significant barriers to action on climate change at a local level. Friends of the Earth is working with the Local Government Association and others to identify these and the policy changes needed to allow for local delivery. We will happily share this work with the CCC as it develops. Without local participation in delivery, national targets will not be met.

One significant barrier that remains is a belief by some within government and the media that meeting the UK's obligations can be met through slow, steady progress and that technology and/or nature will save the day (e.g. electric cars, hydrogen from SMR with CCS, greenhouse gas removals, peat restoration and tree planting paid for from offsets). And, that new high-carbon infrastructure is compatible with carbon reduction goals (e.g. airports, roads) because one-day we'll have electric cars and electric planes. It is therefore critical that the CCC injects some realism itself into this debate, and that it itself refrains from using potential greenhouse gas removals to avoid making challenging recommendations in areas such as livestock and flying (the recent Australian fires offer a clear illustration that natural climate sinks aren't always permanent and can themselves be degraded by the climate-related effects).

Fundamentally the transition to a low carbon future will necessarily involve citizen involvement, participation and pressure. The urgency given to the issue over the past 12 months is in large-part due to the action of the school-strikers and XR, as well as established environmental groups. Public participation needs to be supported and encouraged to inform good decisions and to secure societal and democratic buy-in.

**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:**

The Committee needs to recognise the extremely strong desire for speedy action from local government and the citizens within these areas. The take-home message from all the 240+ climate emergency declarations to date is to cut emissions as fast as possible. It would be wrong to critique some of these motions because they were uninformed by research on local decarbonisation pathways because what they reflect is instead a realisation that already climate change is creating harm and future harm needs to be minimised. It should also be noted that many have also responded to scientific concerns raised by bodies such as IPBES as well as luminaries such as Sir David Attenborough by declaring ecological emergencies not just a climate emergency (this has relevance in areas such as importation of animal feed and restoration of natural climate sinks and ecosystems needed for resilience).

Greenhouse gas reductions and nature restoration cannot be delivered without the active participation of local government. The CCC needs to recognise this and identify what powers, responsibilities and finance is needed to enable local government to deliver to its full potential, and thereby capitalise on the enthusiasm for local action and the unique role local government can play. In doing so it is necessary to reinforce the need for mechanisms for active participation by those most impacted by climate change (often economically or otherwise marginalised) and particularly young people.

**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:**

Firstly, climate change is a multigeneration international issue the consequences of which are, if unchecked, immeasurably large. It cannot simply be given equal footing alongside shorter-term domestic considerations. There is historic precedence for prioritising long-term considerations over short-term considerations, e.g. the UK's response to the rise of fascism in the 1930s and 1940s was a recognition that short-term and significant sacrifices were necessary for long-term benefit.

That said, a rapid response to climate change managed well could also bring significant economic and social co-benefits (see Q8), although done badly could bring short-term harm. But the pathway the CCC recommends should not need significant sacrifice from the majority of the population (although high-consuming sections of society, e.g. frequent fliers, drivers of large cars, people living in large houses, will need to constrain emissions more significantly than others).

The climate pathway identified needs to identify what mitigation necessities are necessary to achieve social acceptability, ensure a just transition, and ensure marginalised communities are not disproportionately impacted. This may often be through other non-climate related policy mechanisms such as state aid or border taxes to maintain competitiveness and protect jobs, or reduced costs or free public transport to aid the shift from cars.

**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?

**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:

It is important to map jobs, industries and locations that are potential 'losers' in the rapid transition to net zero and put in place appropriate strategies of diversification, training, etc. to mitigate these. Our sister group Friends of the Earth Scotland is working with the Unions and others to map a just transition pathway for the large oil and gas industry in Scotland (see: <https://foe.scot/campaign/just-transition/>). This is a good model to follow.

Just Transition is often perceived as being solely about energy intensive industries, but it's also important to note that in some areas the transition from livestock farming is needed (and Friends of the Earth recommends a deeper reduction in meat and dairy consumption than the CCC, with the accompanying reduction in livestock production that this implies); the potential for afforestation provides transition opportunities if accompanied by necessary funding and skills development. For example, lower density systems can allow for agroecological approaches in line with eating much less meat and dairy overall. E.g. a sheep farmer in Wales has reduced sheep numbers by 60%, cut inputs, and increased both profitability and biodiversity on farm. See <https://www.eating-better.org/betterbyhalf#2-3>

In addressing how to ensure future climate related changes do not disproportionately harm particular groupings it is also important to recognise that the world is changing in multiple ways which means the choice is not between a) doing nothing and b) acting on climate change. Robotics, artificial intelligence, etc are all disruptions and all areas of the economy and society need to adapt and evolve in any case.

The transition needs an active central government and active local government. While some people of particular political persuasions have a natural inclination for a small government, in the areas of climate change communities can't be left simply to suffer the consequences of market choices and doing so would lead to a political backlash and socio-economic costs.

#### 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:



**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?

In Wales there are particular circumstances that need to be recognised, these are:

- The Context of Wellbeing of Future Generations Act sets a clear path for Wales to achieve sustainable development and act in the interest of the long term and future generations, taking preventative action. This means that there is a political context for bold action and for that to be across public bodies in Wales. As with our answer to Q11, in Wales short-term economic interests do not trump action on climate change, which is still sadly the context for too much decision-making in England and at a UK level. This Act also works against the siloed action that bedevils decision-making in the UK government and elsewhere.
- There is also a strong political and public appetite for innovation and doing things differently in Wales, and a strong recognition of the need to develop low carbon industries across Wales. Again, this creates a potential that is not necessarily replicated across the UK.
- Wales also still has strong communities and networks that can support and facilitate behaviour change for the common-good. The expertise such as the CAST Centre based at Cardiff University, which is looking at behaviour change and emission reduction in more difficult areas, is easier to deploy in a smaller country with close connections across civil society and to all levels of government.
- Wales has already committed to end fossil-fuel extraction and the last remaining coal-fired power station is about to close (Wales' largest single emitter).

All these factors can contribute to a faster carbon reduction in Wales compared to the UK as a whole.

In terms of Northern Ireland, the Assembly has just reformed and there is a hope that the transition to a low carbon economy will be a priority. Northern Ireland is part of the whole of Ireland electricity grid, so grid decarbonisation rates are also influenced by decisions made in Ireland. However, there is a significant potential for rapid decarbonisation of electricity north and south of the border. With a large number of off-grid homes Northern Ireland would also be a sensible location to prioritise the rapid roll-out of heat-pumps, which would enable Northern Ireland to be ahead of the rest of the UK in this transition.

**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:

For b, see our answer to Q8, and for d) please see our answer to Q12

**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:

See our answer to Q13, we are of the view that to date the Committee has taken too negative a view of the possible emissions trajectory and that for Wales a steeper reduction trajectory than for the UK as a whole is possible.

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

ANSWER:

This is a response from Friends of the Earth England, Wales and Northern Ireland. Our sister group Friends of the Earth Scotland may respond to this question.

**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:

Friends of the Earth has worked closely with Transport for Quality of Life on analysing the scale of mileage reduction needed and the degree of modal shift necessary to deliver on climate change goals, which if delivered will also bring significant benefits in terms of air pollution. The research outputs are at:

<https://www.transportforqualityoflife.com/policyresearch/transportandclimatechange/> and the summary is at <https://policy.friendsoftheearth.uk/insight/radical-transport-response-climate-emergency>

The research shows that at least a 20% reduction in car mileage is necessary, and much higher if a ban on the sale of ICE cars, vans and motorbikes isn't in place by 2030. Drawing on research from overseas, where a much greater share of journeys is by cycling or public transport, we estimate that if comparable levels of public transport use can be achieved in English Combined Authorities as those in Munich, Vienna and Zurich city-regions car mileage in these areas will be cut by over 9% (so clearly achieving these increases is a significant but not sufficient step in the right direction). We make the following recommendations:

- **Make carbon reduction the Department for Transport's top priority;** adopt a whole transport sector carbon budget (including international aviation and shipping); and translate the national target into subsidiary targets for government departments, Highways England, and regional and local bodies.
- **Transfer the money currently and due to be spent on roadbuilding in its entirety to invest in sustainable local transport.** Bring in other national and local sources of funding for sustainable transport, including a public transport payroll levy.
- **Bring in an Eco Levy for driving and balance this by making local public transport fare-free.**
- **Ensure all new development is in locations that are served by excellent public transport.**

**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?

- **Redeploy Highways England engineers to build a strategic cycleway network** alongside all single-carriageway main roads, for 15 km either side of every settlement.
- **Change the structure of the railway so that it is a single entity operating under public control, in the public interest, and bring all local public transport under local authority control**, so that we can set standards for public transport frequencies according to settlement size and adopt a Swiss-style integrated national and local public transport timetable.

**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:

It is disappointing that the framing of this question is skewed to the negative rather than exploring what the positive potentials could be (while not ignoring the risks and challenges). However, as with our response to Q11, climate change is a multigenerational and international issue that requires action. Any negative impacts on car companies and workers in these companies need to be mitigated (see Q12 on just transition) and not used as a reason for delaying this shift. In addition, a rapid transition to electric vehicles will help mitigate (but not eliminate) levels of air pollution that are illegally high in many locations and the UK is legally obliged to remedy in the shortest possible time. The transition to electric vehicles is now unstoppable in any case (cost reductions, better driving experiences) and the greater threat to industries and jobs is from being behind the pack in this global transition rather than leading it.

**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:

Friends of the Earth has not looked at this issue in depth, but note that it is an area of significant research and innovation (e.g. see Scania at <https://www.scania.com/group/en/electrification/>). It maybe that 100% electrification is the route taken or that hydrogen has a role. In energy terms hydrogen is less efficient but more flexible. But as it is necessary to reduce emissions as deep and as fast as possible it is necessary to produce the hydrogen through electrolysis and not SMR.

**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:

See our answer to Q12 (just transition and Friends of the Earth Scotland's work with unions in the oil and gas sector) and our answer to Q11 (use of measures such as border taxes, state aid, etc).

**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:

See Q12 and Friends of the Earth Scotland's work on just transition with unions in the oil and gas sectors in Scotland (<https://foe.scot/campaign/just-transition/>)

**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 £/tCO<sub>2</sub>e 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:

Energy efficiency and heating are related but can go at different speeds, although should be coordinated. Already the government has a statutory target to ensure all fuel poor homes are EPC C by 2030 and social housing and the private-rented sector could easily be required to achieve this.

Friends of the Earth has not seen any evidence that says all homes could not reach EPC C by 2030 (e.g. on skills gaps or manufacturing capacity) if the right carrots and sticks are deployed to encourage and support privately-owned homes to reach this target. E3G have done extensive work in this area and call for all homes to be EPC C by 2030. They say that "...zero or low interest loans, repayment holidays, grants, tax credits, price signals and other incentives .... have been successfully deployed in best practice energy efficiency programmes, including in Scotland, France and Germany. Additional rewards should be provided for those who invest more to bring their homes up to EPC A or B.". The proposal by the Scottish government for a minimum energy efficiency standard before sale of properties should also be considered in other nations.

The roll out of eco-heating needs substantially speeding-up but a skills gap and requirements for changes to the grid and the scale of growth in low carbon energy is likely to mean this transition cannot be completed by 2030. But with 1.6 million gas boilers installed every year there is no reason why a fast transition to air-source heat pumps, hybrid heat-pumps, and heat batteries cannot be delivered by 2040 at the latest. A cut-off date for replacement of gas boilers in homes where alternatives are possible is needed together with a guarantee that the cost of installation and running the system will be no higher than their existing system (funded by the government). 10 million heat pumps should be fitted by 2030. Local authorities should play a central role in coordinating the roll out of energy efficiency programmes and eco-heating (working with energy companies and network providers).

**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?

There is also good evidence that smart controls can minimise energy wastage - for example, <https://www.behaviouralinsights.co.uk/trial-results/the-nest-learning-thermostat-making-energy-savings-easy/>. There is no reason why energy companies shouldn't be obliged to offer these free of charge to house-holders (obviously these need to be models of smart controllers that are future-proofed to work well with heat pumps / heat batteries).

**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:

**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:

Friends of the Earth is of the view that local authorities should coordinate area wide energy efficiency and heating transformation programmes. We know that is a view shared by many in local government and this may emerge as a joint policy recommendation from the work we are doing with the Local Government Association and others. It is however important that local strategies are informed by an understanding of the speed and depth of carbon reductions required, ideally through a statutory duty on local authorities and an allocation of carbon budgets. This will mitigate the risk that the siren calls from the gas industry that the transition to zero carbon heating can magically be delivered through natural gas SMR do not seduce local authorities to inaction (there is some anecdotal evidence of this in parts of the north of England).

**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:**

Contracts-for-Difference are working and there needs to be a strong rationale for adopting a different approach, together with high-confidence that any replacement scheme delivers similar or greater confidence in the investment community and a clear route to market for the electricity produced. This is particularly important for very capital-intensive projects (such as off-shore wind).

**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:**

Friends of the Earth does not think the CCC should assume any biomass with CCS in its pathway, because it is not clear that any biomass will be available for this (see answer to Q35).

We have previously criticised the CCC indicative scenario for the low level of renewables, the use of natural gas with CCS for routine electricity production and back-up. A much higher level of renewables with clean hydrogen (i.e. not via SMR with CCS) used as a back-up is an alternative to natural gas with CCS and does not suffer fugitive methane emissions or carbon loss at capture stage. The use of hydrogen also can eliminate curtailment of renewables at times of high renewable energy production.

A much greater and faster roll out of renewables will require policy action by the government which is currently hindering the development of on-shore renewables (particularly on-shore wind).

As with Q26, we also believe a much faster role out of heat pumps (ideally coupled with heat batteries to smooth the demand for electricity).

The strategic role for hydrogen as an energy store to be built-up in times of excess renewable energy production (particularly during the summer) is not sufficiently accounted for in the CCC indicative mix.



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  - i. What other technologies could play a role here?
  - ii. What evidence do you have for how much demand side flexibility might be realised?

Work by Octopus Energy as part of their Agile tariff, including using IFTT controls demonstrates a significant potential for demand-side response to energy costs and carbon intensity of the grid. See <https://octopus.energy/ifttt/>

**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:**

Friends of the Earth opposes the development of hydrogen from fossil fuel because it is not low carbon due to CCS not being 100% effective plus fugitive emissions from extraction and transmission. The promise of this is also seducing some local authorities, and potentially the government to believe they do not need to worry about heating. The development of SMR + CCS should not be supported or subsidised (which may make it more costly than hydrogen from electrolysis).

The development of hydrogen should be supported. Both through removing blockages to low cost renewable energy (e.g. onshore wind) and through innovation funding for electrolyser development. This industry holds an economic potential for the future whereas SMR is an outdated and mature technology.

The early likely applications for hydrogen are garbage trucks, buses, and trains. There is scope for some mixing with natural gas during the transition to mostly electric heating (with gas in hybrid heat pumps).

**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:

Emissions from international aviation are already a significant source of UK greenhouse emissions. Aviation also produces emissions such as nitric oxide and nitrogen dioxide (nitrogen oxides - NO<sub>x</sub>) that indirectly contribute to global warming. The science is uncertain, but it is estimated that this roughly doubles the harm caused by flying. It is not credible to continue to ignore non-CO<sub>2</sub> emissions in carbon budgets, as the CCC and government has (with the implication that much deeper emissions cuts in aviation are necessary).

Friends of the Earth also disagrees that the main responsibility for governing aviation emissions should fall to the ICAO. The offsetting proposals by the ICAO (CORSIA) are shockingly poor. While in theory, carbon offsetting enables individuals and institutions to pay for environmental projects that reduce carbon emissions with the aim of balancing out their own carbon footprints, but in practice, the vast majority of these projects will have happened or needed to happen anyway. In 2016, a report for the European Commission found that only 2% of projects under the CDM had a high likelihood of being effective. (see references at <https://policy.friendsoftheearth.uk/policy-positions/aviation-and-climate-change-our-position>). A better response to the environment and climate emergency is not to fly. The promotion of offsetting is both misleading and is a deterrent to mitigation and behaviour change, and needs addressing through policy and fiscal change.

In addition, there is scope to reduce flying. 72% of passengers to/from UK airports were traveling for leisure (2016 figures) and the majority of plane trips are made by relatively few people. UK government statistics from a survey in 2014 showed that just 15% of passengers made 70% of all plane trips. The proportion of business travel from the UK's main airports has declined over the past 10 years. The idea that constraining aviation raises competitiveness concerns does not bear examination.

A Frequent Fliers Levy or Air Miles Levy could be a powerful tool to reduce aviation use, without harming the family holiday (although 50% of the public do not fly each year, so the idea that all families fly abroad on holiday is a myth). Subsidies should also be eliminated (e.g. public funding for road, rail and trams to airports).

Alternatives to flying can also be promoted and financially supported (e.g. cheaper long-distance train travel). Note also that greater awareness of climate change may lead to reduced flying, for example Sweden has seen a decrease in flights (<https://www.bbc.co.uk/news/world-europe-51067440>).

In short, the UK should take a policy lead in significantly reducing the quantity of flights as well as policy measures to improve the efficiency of aircraft.

**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 narrow focus on increasing productivity is problematic. Intensification of farming techniques, including increased livestock stocking rates, monocropping, farm specialisation and increase in farm size have contributed to the decline of UK biodiversity (State of Nature Report 2019 <https://nbn.org.uk/wp-content/uploads/2019/09/State-of-Nature-2019-UK-full-report.pdf>).

Future productivity requires healthy soils, pollinator populations and natural predators – all undermined by high input farming (<http://www.fao.org/state-of-biodiversity-for-food-agriculture/en/>)

The recent fall in productivity in the UK comes despite an increase in recent decades of chemical inputs, intensive cultivation, monoculture cropping and raising stocking rates above the carrying capacity of land, showing that further intensification will not help productivity.

A 20% reduction in consumption of red meat and dairy is not ambitious enough. We support a 50% reduction in consumption and production of **all** meat and dairy by 2030, as supported by over 60 organisations of Eating Better. A roadmap of actions needed: <https://www.eating-better.org/betterbyhalf>

The Eat-Lancet Commission looked at how to achieve healthy diets within planetary boundaries by 2050. It found that consumption of fruits, vegetables, nuts and legumes will have to double, and consumption of foods like red meat and sugar will have to be reduced by more than 50%. Although this takes a global view, in the UK we eat twice as much meat as the global average, so a 50% reduction is broadly in line with recommendations. [https://eatforum.org/content/uploads/2019/07/EAT-Lancet Commission Summary Report.pdf](https://eatforum.org/content/uploads/2019/07/EAT-Lancet_Commission_Summary_Report.pdf)

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Cutting Europe's meat and dairy consumption by half reduces GHGs by 25-40%, along with other co-benefits for health and the environment. <https://www.sciencedirect.com/science/article/pii/S0959378014000338>

We are concerned about the CCC's recommendation that the 20% reduction in ruminant meat should be substituted with chicken. This may help with the UK's direct emissions but will increase our footprint (and indirect emissions) in relation to deforestation and land use change in South America (Amazon and Cerrado) for soy feed production.

We also do not support increasing livestock density. Lower density systems can allow for agroecological approaches in line with eating much less meat and dairy overall. E.g. a sheep farmer in Wales has reduced sheep numbers by 60%, cut inputs, and increased both profitability and biodiversity on farm. See <https://www.eating-better.org/betterbyhalf#2-3>

A 20% reduction in food waste by 2025 is unambitious. 50% by 2030 should be set as a legally binding target, which is in line with an ambitious interpretation of the Sustainable Development Goal 12.3.

Some of the additional measures needed include:

- Strong support for agroecological farming solutions – which benefit both climate and nature
- More trees within farming systems – agroforestry and silvopasture systems should be supported as a means of building up carbon stores.
- Although this is a focus on GHG emissions, CCC needs to recognise impacts in other areas – particularly as we are facing a nature crisis. There should be a strong bringing together of action to address these twin and interlinked crises as siloed action to address one could impact negatively on the other.

**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:**

In developing recommendations for the pathway towards net zero and the sixth carbon budget the Committee will need to at the same time be cognisant of:

- a) The UK's global agricultural carbon footprint, particularly livestock feed, and the need to reduce this alongside reducing territorial emissions, and;
- b) the likely need for the UK to be significantly net negative in the second half of the century. Most pathways identified by the IPCC result in an over-shoot of 1.5 degrees and require significant net negative global emissions to return global temperatures to 1.5 degrees. In addition, 1.5 degrees is not a 'safe' level of climate change and globally we should be aiming to reduce temperatures as much as possible.

Within this context this deployment of natural climate solution is too low. In 1972 approximately 70,000 hectares of woodland were planted. With a necessary shift to a much lower meat and dairy consumption (at least 50%, for climate and health reasons) such levels should become the norm increased upon as rapidly as possible which maintain biosecurity measures to prevent the import of tree diseases. Friends of the Earth is calling for the UK to double tree cover by around mid-century.

The take up of low carbon farming practises, and agroforestry will need sufficient financial support via the new post Brexit payment system, independent advisory services to all farmers, as well as a strong regulatory baseline for all farmers and landowners – the required level of ambition will not be met by a minority of farmers being rewarded for low carbon practices whilst the majority continue with business as usual or taking up more carbon intensive practices.

Regarding peat and peatlands, the Committee has rightly called for an immediate end to peatland (blanket bog) burning and an end to the retailing of bagged peat by 2023. Cessation of both are required if peatlands are to be play their part in carbon sequestration, and in supporting biodiversity, water retention and flood prevention, within 2023-25 period.

The scope to restore the condition of peatlands is considerable. The Committee's proposal that regulating against bare peat is important in that regard although the Committee's overall peatland restoration targets under its Further Ambition scenario are surprisingly unambitious. Friends of the Earth wish to see the delayed England peat strategy set an ambitious target for most if not all of England's upland peatlands to be restored to the natural wet condition in which they can help restore biodiversity and play their part in storing carbon, and for a high proportion of lowland peat on farmland to be wetted for similar function.

In addition, there should be a target and policy measures for the restoration and extension of saltmarshes and seagrass meadows, both of which are important carbon stores and bring adaptation benefits.

**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?

In terms of bioenergy crops, Friends of the Earth recommends a prioritisation of land-use for domestic food production, including livestock feedstock to replace imports. The UK also has very low levels of tree cover which needs to be improved on both as a carbon store and for nature restoration.

It is possible that alongside a 50% reduction in meat and dairy consumption this still allows for some limited sustainable production of biofuels, in which case these need to be manufactured using CCS (as the CCC recommends) and targeted to uses to where other alternatives don't exist. It is worth noting that current production of gas from anaerobic digestion is already displacing food production and in the case of maize also having negative soil health and biodiversity impacts. There needs to be much stronger regulation of biofuel production.

In practice, it is mainly aviation where alternatives don't readily exist that a very limited supply of biofuels can best be used (electricity production can readily be produced from wind and solar sources, and heat can be provided by heat pumps, electricity, and hydrogen produced from electrolysis). The production of biofuels for mitigation cannot be an excuse to dial back mitigation actions in aviation, as the industry is promoting. A frequent flier levy or air miles levy, etc. need to be pursued with vigour to reduce the number of flights taken and reduce the number of long-haul flights).

In other words, the UK needs to use its land area to reduce our global carbon footprint not just territorial emissions, and where spare biomass is sustainably available it should be prioritised for uses other than electricity production.

**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:

The Committee should recommend separate targets for climate mitigation and greenhouse gas removals, with mitigation targets aiming to get to as close to zero as possible. Some GGR approaches, for example afforestation and peat restoration, can not be assumed to be permanent (e.g. due to fires, etc) and therefore are wholly inappropriate to 'offset' against emissions. That said GGR are necessary in addition to maximum mitigation, and the UK will need to pursue with vigour net negative emissions once net zero has been achieved.

**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?

Bioenergy done badly can negatively impact on mitigation both through displacement of lower carbon energy such as wind, solar or heat-pumps and through carbon losses in forested areas.

Forest Research has identified a number of recommendations for sustainable sources of biomass for energy (cited in the CCC Bioenergy Report), which would significantly limit the amount of biomass available for energy use. It recommends that any biomass should be locally produced and not imported to the UK. Friends of the Earth supports this.

Theoretically the use of CCS changes the maths on carbon impacts of imports but in order to minimise carbon emissions and maximise carbon removal it still makes sense to only use domestic production of biomass (and in practice, the scale of imports currently to Drax cannot be sustainably produced in the UK currently or in the near future).

In addition, the IPBES clearly demonstrates that the world is facing a biodiversity emergency alongside a climate emergency. Afforestation and agroforestry is needed to both for climate mitigation reasons and biodiversity recovery (as well as climate adaptation, soil protection, etc). And, the UK is a large importer of biomaterials (timber, feedstock) and reducing this carbon footprint should be a priority.

These constraints (no imports of bioenergy, Forest Research recommendations on types of biomass to use, biodiversity restoration, replacement of livestock feed as a higher priority) imply low availability for biomass with CCS in the UK for a substantial period (in all likelihood decades). If biomass is used with CCS in the future it should be used in small-scale highly efficient units and not in large-scale inefficient plants such as Drax, and only when full lifecycle carbon impacts are identified (including any losses of carbon from the sources of biomass via soil or standing forests).

Regarding DAC – the limit to deployment so far is the low price on carbon. Across the world most DAC, if not all, is capturing CO<sub>2</sub> for use (for example in Enhanced Oil Recovery). DAC will be necessary, particularly in countries such as the UK which are historically major contributors to climate change. But it must be used to maximise negative emissions and not to delay mitigation action in areas such as livestock or aviation and shouldn't be used to enhance oil recovery. The economics needs to work if DAC is to take off, which in practice in the near-term means it will need to be funded by the government (ideally though a polluter pays tax on the fossil fuel industry).

In other words, the UK will need to significantly drawdown carbon pollution and by more than is possible than through natural carbon sinks alone (although these should be the priority). Domestic biomass availability for BECCS will be low for a number of decades in the UK and the priority should be to develop and deploy DACs (most sensibly funded by a polluter pays tax on the oil and gas companies).

**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<sub>2</sub>?

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:

The limited size of the UK's remaining carbon, which will require significant levels of decarbonisation by 2030, requires a focus on electrification (e.g. heat pumps, heat batteries). Alongside the rapid transition to electric vehicles this will require significant investment in renewable energy, storage and distribution.

Heat networks will have a limited role, but these also need to be powered by electricity not natural gas or biomass due to high associated GHG.

Given the much higher energy demands in winter there is a need for either supplementing electric heating with clean hydrogen from electrolysis (not dirty hydrogen from SMR with CCS) via the use of hybrid heat pumps or alternatively providing the additional electricity needed via stored gas turbines powered by hydrogen (manufacturing throughout the year from excess renewables and/or dedicated renewables). The former is more energy efficient due to reduced energy losses but may be more economically efficient through allowing the gas grid to be phased out.

**Question 38 (Infrastructure):** What scale of carbon capture and storage development is needed and what does that mean for development of CO<sub>2</sub> transport and storage infrastructure over the period to 2030?

ANSWER:

In the near-term CCS is needed in some industry, although maximum electrification (e.g. steel) or use of sustainably produced hydrogen should be the priority. CCS is needed for greenhouse gas removals which for the next few decades in the UK will need to focus on Direct Air Capture.

But it is critical that the promise of CCS does not delay mitigation in areas such as heating (through a promise of heating via dirty hydrogen produced by SMR with CCS) or the development of cleaner industry (e.g. electric-arc steel to recycle waste steel). Already the government is dragging its feet on the roll-out of heat pumps as it explores a hydrogen-based option for heating (which as stated earlier is incompatible with the significant reduction needed to carbon emissions by 2030).