

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: **N/A**

Question 2: How relevant are estimates of the remaining global cumulative CO₂ 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: **N/A**

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: For the aerospace sector to play its part towards 2030 targets, the Government needs to continue to support the sector through funding for research and development. **The Aerospace Technology Institute (ATI) funding should be extended beyond 2030.** The ATI has funded several successful projects that aim to improve the aerospace sector's impact on the environment.

The ATI's current £150m per year budget requires an annual uplift of £30m to £180m per year in order to sustain core technologies. Alongside an uplift, accelerating progress in sustainable technology to move towards net zero requires an additional ATI budget allocation of £150m per year to 2036 to deliver third-generation, technologies through a UK aerospace electrification research programme. These additional amounts will be matched by industry. This would stimulate the development of hybrid and electric flight demonstrators, provide a basis for exploring alternative propulsion systems such as hydrogen, support air transport system optimisation and enable market pull measures to drive uptake of new technology.

The Government should deliver policies that encourage and reward industry investment in research and development. It is also vital that the Government creates an environment that continues to improve aerospace competitiveness and therefore the viability of green

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?

innovation. This should be done in close partnership with European partners given the highly integrated way the aerospace industry operates across the UK and EU.

The global nature of aviation means that as far as possible, policy should be set at an international level. The UK should then introduce domestic policies to support these international commitments in a way that won't lead to carbon leakage and impact the competitiveness of UK industry. By 2030 the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) will be well established, and the sector expects this to work well. It's important that the UK do not introduce additional taxes or other schemes, as this could lead to competitive distortions and carbon leakage. Other industries and countries can decarbonise at different rates, but for aviation it is important that there is one global approach. **The UK should seek an extension to CORSIA beyond 2035 given the longer lead times for technology in the aerospace sector.**

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 set out in the CCC Net-Zero report, reducing emissions from aviation will require a combination of international and domestic policies. If the UK makes significantly stronger commitments than the EU and other international partners, it could create a less competitive business environment for the sector in the UK, thus increasing the risk of carbon leakage.

The UK Government should engage with industry and international partners ahead of COP26 in order to agree a realistic but strong approach for the aerospace and aviation sectors on climate change at an international level.

The UK should be considerate when setting bold targets domestically. It is important that industry is supported by Government towards making the necessary improvements. For example, the UK Government should continue to invest in and fund research and development in technological solutions for aviation.

The UK Government should also work closely with the aerospace, aviation and oil & gas industries to increase the commercial viability of Sustainable Aviation Fuels (SAF). The UK aviation sector has identified that £100m per year of investment is required to establish a pilot for UK infrastructure. Shorter term, SAF is the most realistic way to significantly reduce carbon emissions from aviation. **The Government should incentivise increased production of SAF and support any required changes in infrastructure to decrease the cost of production and other barriers to SAF becoming a more prominent way of fuelling flights.**

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: **N/A**

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 two main areas of focus for the aerospace industry as they look to meet the challenge of climate change. Electrification and hybrid technology, and SAF.

Electrification is also where some of the key uncertainties lie. As the CCC Net-Zero report highlights, it is highly unlikely that a fully electric passenger aircraft will be operational by 2030 or even 2050. It is important that this does not deter the Government from investing in this area as it is one of the only long-term solutions for removing emissions from aerospace. The ATI has funded some of the most promising projects in this area with over 50% of the ATI Programme investment directly concerned with the environment.

Example: E-Fan X¹ is an ATI-funded project which is developing a pioneering 2MW hybrid-electric propulsion system demonstrator via the modification of a regional airliner. Led by Airbus and Rolls-Royce, the E-Fan X is an important next step to make electric flight for larger aircraft technologically feasible and the project will pave the way to a hybrid single-aisle commercial aircraft that is safe, efficient, and cost-effective.

There is also a significant role for SAF to play in the decarbonisation of aviation. SAF is the near-term opportunity to decarbonise aviation. It requires long term policy stability and financial support for the scaling-up and rollout of sustainable fuel capacity. As set out in the Sustainable Aviation Fuels Roadmap (attached), **SAF incentives need to be competitive with the incentives provided to road fuels. This means applying a 1.2x multiplier for developmental sustainable aviation fuels, establishing a dedicated Office for Sustainable Aviation Fuel and £500m of matched public/private funding over five years.**

CORSIA is the best option globally to deliver reductions in emissions from aviation, while technologies are developed for the long term. A separate domestic approach would not be advantageous for the industry and, as set out throughout this response, could lead to carbon leakage and a negative impact on competitiveness.

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: **Not to include aviation emissions.** As the CCC net-zero report points out, it is unrealistic for new aircraft to be zero-carbon by even 2050. The only zero-carbon propulsion system is fully battery electric and the technology is very unlikely to have been

¹ <https://www.airbus.com/innovation/future-technology/electric-flight/e-fan-x.html>

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?

developed by 2050. The aviation and aerospace sectors rely on stable policy and have been working towards the existing targets, both in the UK and globally.

UK targets already go beyond global commitments, so it is important that any adjustments to UK emissions targets that include international aviation emissions take this into account.

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: As set out throughout this response, **investment in R&D and SAF will deliver benefits beyond just a reduction in CO₂ emissions.** By supporting these industries, the aerospace and aviation industries will reduce their impact on the environment, while new, high skilled jobs will be created across the UK. The UK can become a leader in green technology and SAF for aviation. This will help secure the long-term strength and security of the sector.

Investment in these areas will also allow society to continue benefiting from aviation. It brings families, communities and economies together, which is vital in supporting a global effort to combat climate change.

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: The Government needs to continue to support the sector through funding for research and development. **The ATI funding should be extended beyond 2030.** The ATI has funded several promising projects that aim to improve the aerospace sector's impact on the environment.

Example: Project Fresson² led by Cranfield Aerospace solutions, will modify a 9-seat Britten Norman aircraft with a hybrid electric propulsion system suitable for short flight routes such as those operated in Scotland by Loganair. Project Fresson brings together a great partnership to develop innovative technology for a sustainable all-electric air transport solution for isolated islands. The partners' ultimate goal of delivering the first commercial passenger-carrying all-electric aircraft service in the UK will mark a significant breakthrough for all-electric propulsion.

The Government should continue to deliver policies that encourage industry investment in research and development. It is also vital that the Government creates an environment that continues to improve aerospace competitiveness and therefore the viability of green

² <https://www.cranfield.ac.uk/press/news-2019/cranfield-announces-uk-government-grant-for-the-development-of-electric-flight>

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?

innovation. This should be done in close partnership with European partners given the highly integrated way the aerospace industry operates across the UK and EU.

When projects such as Project Fresson are delivered successfully, it is important that Government continues to support businesses as they work to take these from being conceptual ideas demonstrating operational capability, to commercially deliverable.

The UK Government should also take a leading role in developing the regulatory arrangements for the production and utilisation of SAF. Details of this are set out in the Sustainable Aviation Fuels Roadmap (attached). We should be looking to SAF for short haul flights in the short term, and in the medium to longer term SAF should be used for long haul flights.

The UK should also work with international partners to ensure CORSIA is extended past 2030 and not take action to undermine this through disruptive domestic policies.

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: **N/A**

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: Within the budget, special consideration should be shown for aviation emissions given the unique challenges of decarbonising the sector. There is an opportunity for the UK to become a leader in green technologies for the aerospace/aviation sector, and the Government should support this.

The competitiveness of UK industry is at risk without adequate funding and support in place. There is increasing work going on globally to develop the technologies required to decarbonise aviation. If the UK Government does not provide the necessary support for this work, it increases the likeliness of other countries taking the lead and gaining the competitive advantage in the area of green technology for aviation.

The Government can help manage this by continuing to work with industry to fund research and development in green technology. As set out throughout this response, the priority for the aerospace sector is extension of ATI funding. Additionally, it is important that support exists, not only throughout the research and development phase, but also into commercialisation of these technologies. We should be seeking to develop our low carbon solutions in all sectors and then export them. This will provide long term economic strength for the UK and create skilled jobs across the UK.

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: 90% of aerospace jobs are located outside of London and the South East. Continued support for the aerospace sector through favourable policies from Government will ensure the sector remains at the forefront of researching and developing green technologies, thus offering high skilled jobs outside of London.

ATI portfolio projects on contract have the potential to create and sustain up to 66,000 UK jobs³. Through continued investment in ATI projects, high value jobs in the regions will continue to be created and sustained as these technologies develop and work their way towards the commercial mainstream.

By investing in green technologies for aerospace, the need for the introduction of market-based measures is reduced. Market-based measures that increase the cost of flying for consumers is likely to negatively impact those on low incomes. It is widely recognised that aviation has a positive effect on the social and economic wellbeing of a country. Removing the ability for those on low incomes to fly risks creating a social divide between those who can, and those who can't afford to fly. Any measures taken to increase the cost of flying should take this into account and ensure that individuals from across the socio-economic spectrum are able to fly.

In summary – **any focus on aviation and aerospace should be on technological solutions to aviation emissions, not on controlling demand by increasing the cost of flying.** Attached is the Sustainable Aviation Carbon Roadmap, which highlights what has already been achieved as well as what steps should be taken to reduce aviation emissions to net-zero by 2050.

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: **N/A**

³ <https://www.ati.org.uk/projects/monthly-stats/> (January 2020 stats)

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 aerospace sector has significant operations in Wales e.g Airbus in Chester and Newport. Investment in aerospace technology to reduce carbon is likely to have a positive impact on jobs in these areas.

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: N/A

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

ANSWER: N/A

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: N/A

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: **N/A**

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

ANSWER: **N/A**

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: **N/A**

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: **N/A**

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: Aerospace falls into the first category. As set out throughout this response, the UK Government's focus should be on investment in green technology and better support

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

for sustainable fuels. Alongside airspace modernisation, these are the two key areas for the decarbonisation of aviation.

Providing funding and grants, through organisations like the ATI will help the UK become a leader in green technology and encourage sustained industry investment. As referenced in previous answers, it is also important for the Government to take steps to ensure successful breakthroughs in green technology can be commercialised within the UK. This will secure high value jobs for the long term, reduce emissions from aviation, and mitigate the risk of carbon leakage.

As set out throughout this response, supporting the development of SAF is also crucial. The recommendations set out in the Sustainable Aviation Fuels Roadmap and Sustainable Aviation Carbon Roadmap (both attached) should be implemented. SAF has the potential to replace fossil fuels for aviation and therefore also decarbonising the fossil fuel production sectors alongside the aerospace and aviation sectors.

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: The recommendations set out in the Sustainable Aviation Fuels Roadmap (attached) would create around 5,200 jobs by 2035, and as set out in our answer to question 12, ATI portfolio projects on contract have the potential to create and sustain up to 66,000 UK jobs.

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

ANSWER: The Sustainable Aviation Fuels Roadmap (attached) sets out how we can realistically achieve a transition from fossil fuels to sustainable fuels in aviation. **This includes setting up an Office for Sustainable Aviation Fuels, to improve cross-Government coordination and industry engagement.** This will help progress the development and commercial deployment of SAF and help the UK to become a leader in this growing market.

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: **N/A**

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: **N/A**

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: **N/A**

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: **N/A**

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: **N/A**

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: **N/A**

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: **N/A**

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: The details of the domestic measures the UK could take to reduce aviation emissions can be found in the Sustainable Aviation Carbon Roadmap (attached).

By 2050, the UK aviation industry can achieve net zero carbon emissions through the following initiatives compared with a scenario of growth at today's efficiency:

- 4.3 Million Tonnes of carbon dioxide (MtCO₂) saving due to carbon pricing impact on demand.
- 3.1 MtCO₂ saving from better air traffic management and operating procedures
- 23.5 MtCO₂ saving from introduction of known and new, more efficient aircraft
- 14.4 MtCO₂ saving from sustainable aviation fuels
- 25.8 MtCO₂ saving from effective Market Based Measures

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: **N/A**

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: **N/A**

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 use of robust carbon offsets and investment in innovative carbon removal solutions will be vital to address residual UK aviation emissions by 2050. We ask the government to:

- **Raise ambition on carbon capture, utilisation and storage (CCUS) deployment and commit to supporting at least two clusters to be operational by 2025.**
- **Work with industry to ensure UK carbon removal solutions are eligible for airline investment through CORSIA.**

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 CO₂?

ANSWER: **N/A**

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: **N/A**

Question 38 (Infrastructure): What scale of carbon capture and storage development is needed and what does that mean for development of CO₂ transport and storage infrastructure over the period to 2030?

ANSWER: **N/A**