

Building a zero-carbon economy – Call for Evidence

Background

On 15 October 2018 the governments of the UK, Scotland and Wales [asked](#) the Committee on Climate Change (CCC) to provide advice on the UK and Devolved Administrations' long-term targets for greenhouse gas emissions and the UK's transition to a net zero-carbon economy. Specifically: when the UK should reach net zero emissions of carbon dioxide and/or greenhouse gases as a contribution to global ambition under the Paris Agreement; if that target should be set now; the implications for emissions in 2050; how such reductions can be achieved; and the costs and benefits involved in comparison to existing targets.

The advice has been requested by the end of March 2019.

The UK's long-term emissions target is currently for at least an 80% reduction in greenhouse gas emissions from 1990 to 2050. It covers all sectors, including international aviation and shipping and is measured on a 'territorial' basis (i.e. based on emissions arising in the UK). On a comparable basis, emissions in 2017 were estimated to be 38% below 1990 levels.

The current target was set in 2008 based on [advice](#) from the Committee. That advice considered that to avoid the worst impacts of climate change, the central expectation of global temperature rise should be limited "to, or close to, 2°C", while the probability of crossing "the extreme danger threshold of 4°C" should be reduced to an extremely low level. That meant global emissions would roughly have to halve by 2050. The 2008 advice made the assumption that the UK should not plan to have a higher level of per capita emissions in 2050 than the global average.

The long-term target guides the setting of carbon budgets (sequential five-year caps on emissions that currently extend to 2032 and require a reduction in emissions of 57% from 1990 to 2030). Both the 2050 target and the carbon budgets guide the setting of policies to cut emissions across the economy (for example as set out most recently in the 2017 [Clean Growth Strategy](#)).

Any change to the long-term targets would therefore be expected to have significant implications, not just in the long-term but on current policies to drive the transition.

The CCC will advise based on a thorough consideration of the relevant evidence. We expect that to cover:

- The latest climate science, including as contained in the [IPCC Special Report on 1.5°C](#).
- The terms of the [Paris Agreement](#).
- Global pathways (including those reported by the IPCC) consistent with limiting global average temperature rise in line with the goals of the Paris Agreement.

- International circumstances, including existing plans and commitments to cut emissions in other countries, actions to deliver on those plans and opportunities for going further.
- An updated assessment of the current and potential options for deep emissions reductions in the UK and emissions removals from the atmosphere, including options for going beyond the current 80% target towards net zero.
- An appraisal of the costs, risks and opportunities from setting a tighter long-term target.
- The actions needed in the near term that would be consistent with achieving the long-term targets.

This Call for Evidence will contribute to that advice.

Responding to the Call for Evidence

We encourage responses that are brief and to the point (i.e. a maximum of 400 words per question, plus links to supporting evidence, answering only those questions where you have particular expertise), and may follow up for more detail where appropriate.

You do not need to answer all the questions, please answer only those questions where you have specific expertise and evidence to share. It would be useful if you could use the question and response form below and then e-mail your response to: communications@theccc.gsi.gov.uk using the subject line: 'Zero carbon economy – Call for evidence'. Alternatively, you can complete the question and answer form on the CCC website, available [here](#).

If you would prefer to post your response, please send it to:

The Committee on Climate Change – Call for Evidence
7 Holbein Place
London
SW1W 8NR

The deadline for responses is 12 noon on Friday 7 December 2018.

Confidentiality and data protection

Responses will be published on our website after the response deadline, along with a list of names or organisations that responded to the Call for Evidence.

If you want information that you provide to be treated as confidential (and not automatically published) please say so clearly in writing when you send your response to the consultation. It would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded by us as a confidentiality request.

All information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the access to information legislation (primarily the Freedom of Information Act 2000, the Data Protection Act 1998 and the Environmental Information Regulations 2004).

Question and response 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 response to a maximum of 400 words per question.

Part 1: Climate Science

Question 1 (Climate Science): The IPCC's Fifth Assessment Report and the Special Report on 1.5°C will form an important part of the Committee's assessment of climate risks and global emissions pathways consistent with climate objectives. What further evidence should the Committee consider in this area?

ANSWER: UK HFCA has no comment on this.

Question 2 (CO₂ and GHGs): Carbon dioxide and other greenhouse gas gases have different effects and lifetimes in the atmosphere, which may become more important as emissions approach net-zero. In setting a net-zero target, how should the different gases be treated?

ANSWER: UK HFCA has no comment on this.

Part 2: International Action

Question 3 (Effort share): What evidence should be considered in assessing the UK's appropriate contribution to global temperature goals? Within this, how should this contribution reflect the UK's broader carbon footprint (i.e. 'consumption' emissions accounting, including emissions embodied in imports to the UK) alongside 'territorial' emissions arising in the UK?

ANSWER: UK HFCA has no comment on this.

Question 4 (International collaboration): Beyond setting and meeting its own targets, how can the UK best support efforts to cut emissions elsewhere in the world through international collaboration (e.g. emissions trading schemes and other initiatives with partner countries, technology transfer, capacity building, climate finance)? What efforts are effective currently?

ANSWER: UK HFCA has no comment on this.

Question 5 (Carbon credits): Is an effective global market in carbon credits likely to develop that can support action in developing countries? Subject to these developments, should credit purchase be required/expected/allowed in the UK's long-term targets?

ANSWER: UK HFCA has no comment on this.

Part 3: Reducing emissions

Question 6 (Hard-to-reduce sectors): Previous CCC analysis has identified aviation, agriculture and industry as sectors where it will be particularly hard to reduce emissions to close to zero, potentially alongside some hard-to-treat buildings. Through both low-carbon technologies and behaviour change, how can emissions be reduced to close to zero in these sectors? What risks are there that broader technological developments or social trends act to increase emissions that are hard to eliminate?

ANSWER:

Despite industry reducing emissions by 49% from 1990-2017, there has been a stall in reductions over the last five years, and in 2017 emissions rose by 1%. In the UK, final energy consumption in the industrial sector is dominated by electricity and natural gas, which account for 34% and 36% respectively. Switching these fuels to cleaner alternatives such as hydrogen could help to decarbonise industrial sectors. In 2016, emissions from natural gas used in industry amounted to just over 25 million tonnes. Analysis by Policy Exchange found that if natural gas was completely replaced by hydrogen, the emissions would drop by 71% if the hydrogen was produced by SMR with CCS or 91% if produced by wind power electrolysis¹.

Hydrogen is uniquely placed to help heavy industry decarbonise industrial processes. Companies such as voestalpine in Austria² and HYBRIT³ (comprised of SSAB, LKAB and Vattenfall) are currently looking at making this a reality for steel productions. This will allow them to become leaders in the production of zero emission building materials, and secure a value-added future for their steelmakers. With the right support, the UK steel industry could – and should – follow.

There are further options to decarbonise existing industrial processes via hydrogen, including the use of low-carbon hydrogen in novel synthetic pathways, storing hydrogen from renewables to generate zero carbon electricity at a later date and the use of hydrogen as a heat source. For example, on Teesside ethylene production is being effectively decarbonised by the use of ethane as a feedstock. This process generates hydrogen as a by-product, which is then used as an energy source, displacing natural gas and reducing carbon emissions.

The figure below, from the Royal Society's Report 'Options for producing low-carbon hydrogen at scale' shows the role of hydrogen in a low carbon energy system, including for the hard-to-reduce sectors (industry, transport and agriculture)⁴. More specifically, the figure highlights the range of sources of low carbon hydrogen generation - from renewables and nuclear through to fossil fuels with carbon capture and storage. Production processes and the range of applications are also shown, illustrating the breadth and flexibility of the opportunity.

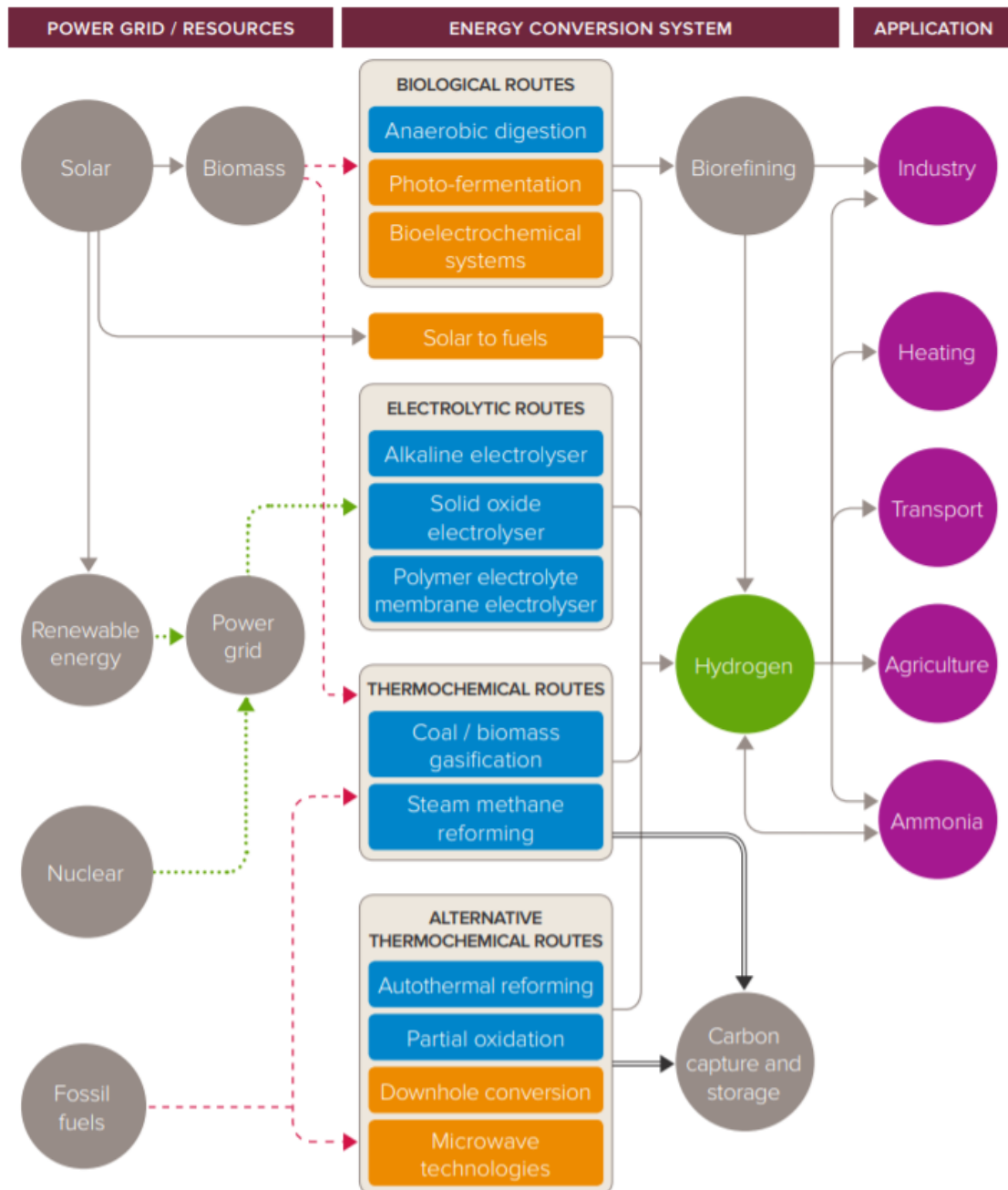
¹ <https://policyexchange.org.uk/wp-content/uploads/2018/09/Fuelling-the-Future.pdf>

² <https://www.h2future-project.eu/>

³ <https://www.ssab.com/company/sustainability/sustainable-operations/hybrit>

⁴ <https://royalsociety.org/~media/policy/projects/hydrogen-production/energy-briefing-green-hydrogen.pdf>

Question 6 (Hard-to-reduce sectors): Previous CCC analysis has identified aviation, agriculture and industry as sectors where it will be particularly hard to reduce emissions to close to zero, potentially alongside some hard-to-treat buildings. Through both low-carbon technologies and behaviour change, how can emissions be reduced to close to zero in these sectors? What risks are there that broader technological developments or social trends act to increase emissions that are hard to eliminate?



Question 6 (Hard-to-reduce sectors): Previous CCC analysis has identified aviation, agriculture and industry as sectors where it will be particularly hard to reduce emissions to close to zero, potentially alongside some hard-to-treat buildings. Through both low-carbon technologies and behaviour change, how can emissions be reduced to close to zero in these sectors? What risks are there that broader technological developments or social trends act to increase emissions that are hard to eliminate?

In other areas, hydrogen is being explored as an option to decarbonise aviation – for example, Singapore based aviation company HES Energy Systems is developing a passenger aircraft powered by hydrogen to be trialled by 2025⁵ and Easyjet has announced its plans to trial hybrid hydrogen planes⁶.

Question 7 (Greenhouse gas removals): Not all sources of emissions can be reduced to zero. How far can greenhouse gas removal from the atmosphere, in the UK or internationally, be used to offset any remaining emissions, both prior to 2050 and beyond?

ANSWER: UK HFCA has no comment on this.

Question 8 (Technology and Innovation): How will global deployment of low-carbon technologies drive innovation and cost reduction? Could a tighter long-term emissions target for the UK, supported by targeted innovation policies, drive significantly increased innovation in technologies to reduce or remove emissions?

ANSWER:

The UK cannot rely on low carbon, clean energy innovation technologies being invented and deployed elsewhere. Not only will our future productivity rely on having a cost-effective, clean energy system, home-grown innovative solutions such as hydrogen and fuel cells (H&FCs) will also be the source of the UK's competitive advantage and will provide significant economic export value and trade globally. Hydrogen is the only energy vector that is able to link a diverse range of energy generation sources with the various components of energy demand. Low carbon hydrogen can be produced in various ways ranging from electrolysis to steam methane reforming with CCS. Hydrogen will provide the flexibility, connections and networks to make the new energy system work cleanly and cost effectively, through short term and long term (seasonal) renewable energy storage, clean fuel for transport, decarbonised heat and beyond. Fuel cells are the most efficient and clean solution to generate electricity, and heat in CHP systems, in a decentralised energy system. Fuel cells can be used in stationary and mobile applications, either directly fuelled by renewable hydrogen derived from biomass, electrolysis or other means, or - in the short-term - hydrogen from industrial waste streams or derived from natural gas or other fossil fuel sources.

⁵ <https://eandt.theiet.org/content/articles/2018/10/hydrogen-powered-aircraft-proposes-carbon-free-future-for-aviation/>

⁶ <https://www.telegraph.co.uk/finance/newsbysector/transport/12134814/EasyJet-to-trial-worlds-first-hydrogen-hybrid-plane.html>

Question 8 (Technology and Innovation): How will global deployment of low-carbon technologies drive innovation and cost reduction? Could a tighter long-term emissions target for the UK, supported by targeted innovation policies, drive significantly increased innovation in technologies to reduce or remove emissions?

The ubiquity of the opportunity and future role for hydrogen – both address global policy challenges, and to enhance UK competitiveness has been highlighted in a range of recent reports, including the latest from the CCC^{7 8 9 10 11}.

Many other countries, such as Japan, China, South Korea, California and Germany, have committed to ensuring that H&FCs will play a key role in their decarbonisation strategies, to the benefit of their indigenous industries and export markets. These countries offer important lessons for the UK. By way of example, in Germany the Government has established the National Innovation Programme Hydrogen and Fuel Cells (NIP) in 2006. The programme, which successfully established 50 hydrogen refuelling stations by 2016, is now in its second phase (2016 – 2026) and has a budget of €2bn from industry combined with €1.4bn from Federal Government¹².

In South Korea, as a result of strong governmental supporting policies and substantial investment by South Korean companies, the country now has the world's largest fleet (by MW) of stationary fuel cell systems, including the 59MW Gyeonggi Green Energy park in Hwasung City, South Korea¹³. The Government provides subsidies for the installation of new and renewable facilities in residential buildings, which include fuel cell systems¹⁴.

The graph below shows how policy Incentives such as Japan's Ene-farm program and South Korea's 'New and Renewable' (N&R) energy support mechanism can stimulate manufacturing and thus help reduce costs dramatically. This provides a valuable lesson for the UK regarding the importance of investment and support for technology demonstration and scale-up.

⁷ <https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf>

⁸ <http://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-scaling-up-Hydrogen-Council.pdf>

⁹ <https://northerngasnetworks.co.uk/h21-noe/H21-NoE-23Nov18-v1.0.pdf>

¹⁰ <https://policyexchange.org.uk/wp-content/uploads/2018/09/Fuelling-the-Future.pdf>

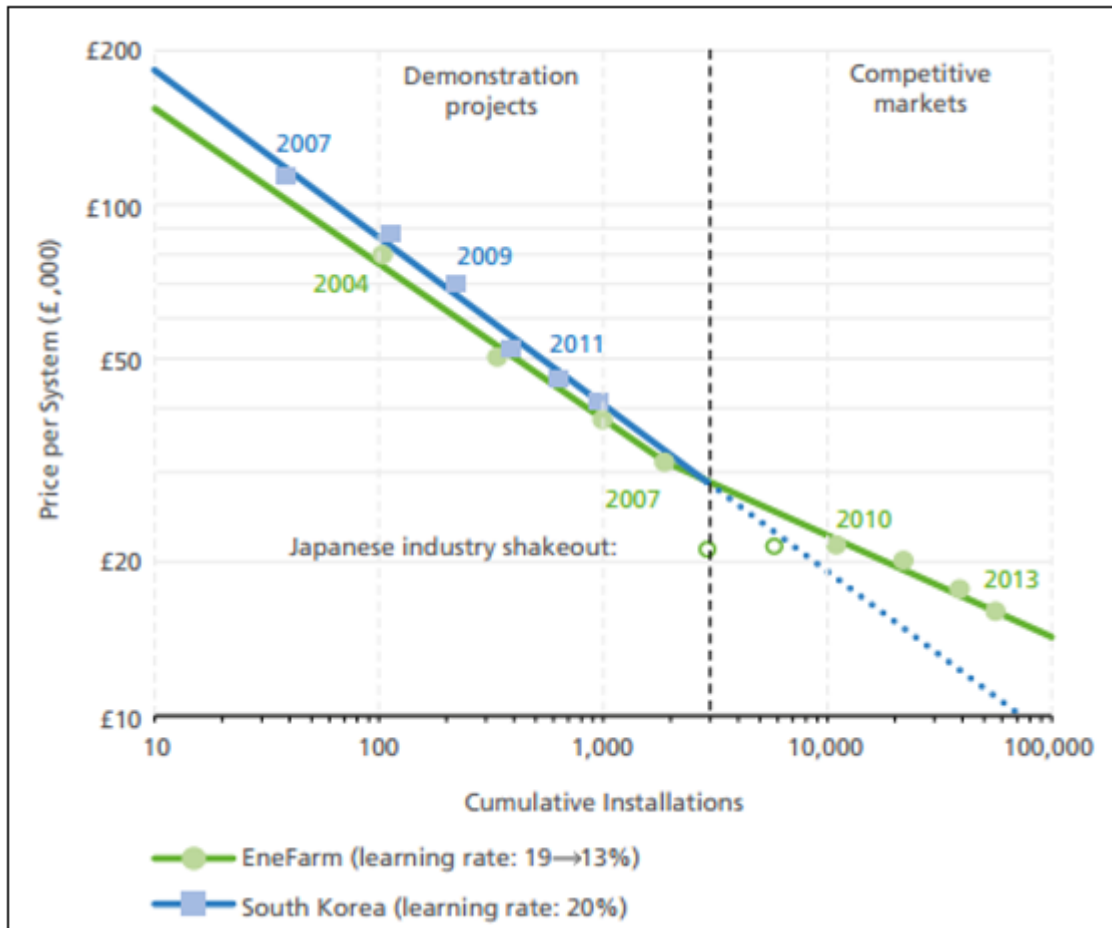
¹¹ <https://royalsociety.org/~media/policy/projects/hydrogen-production/energy-briefing-green-hydrogen.pdf>

¹² http://ieahydrogen.org/pdfs/WHEC-2018_Bonhoff_20180621.aspx

¹³ <https://academic.oup.com/ce/article/2/2/126/5055431>

¹⁴ http://www.energy.or.kr/renew_eng/new/subsidy.aspx

Question 8 (Technology and Innovation): How will global deployment of low-carbon technologies drive innovation and cost reduction? Could a tighter long-term emissions target for the UK, supported by targeted innovation policies, drive significantly increased innovation in technologies to reduce or remove emissions?



The UK has a mix of innovative fuel cell and hydrogen companies, as well as active multi-nationals, such as Air Products, BOC and Johnson Matthey with interests and investments in the space. Having been the second most successful recipient of EU funds for the development and trialling of hydrogen and fuel cells for a number of years, and one of the most active players in Europe, the sector is at a critical point. Earlier gains and current successes, such as the UK lead in hydrogen for heat / decarbonisation of the gas grid, are at risk of being overtaken by the actions and investments of other nations. Without a firm commitment from Government to continue to nurture UK innovation, the country is at risk of outsourcing these technologies, with associated negative impacts on competitiveness and growth. An appropriate policy framework, including tighter emission standards, will help stimulate the UK industry to deliver both carbon reduction in the UK, and clean industrial growth for the wider economy, including through rapidly developing global markets.

There are three key areas that need to grow in tandem to unlock hydrogen and fuel cell growth:

- 1) The deployment of hydrogen supply facilities – including through CCS.
- 2) The build out of hydrogen infrastructure – including vehicle refuelling.
- 3) Deployment of hydrogen and fuel cell transport, heating, power and industrial

Question 8 (Technology and Innovation): How will global deployment of low-carbon technologies drive innovation and cost reduction? Could a tighter long-term emissions target for the UK, supported by targeted innovation policies, drive significantly increased innovation in technologies to reduce or remove emissions?

applications.

As other countries are demonstrating, clear targets, combined with time / scale limited and focused support will provide certainty and a framework for industry to operate in and grow.

The Government could pro-actively encourage the selection of a domestic suppliers where capability exists to provide the product or service. Several other countries directly encourage and support the growth of home-grown small companies in key areas and the UK should do this too.

Government procurement agencies, e.g. from different regions, could jointly procure to obtain volume discounts and give suppliers the volumes they need in order to raise the expansion capital they require. Equally, Government agencies could develop schemes that look to the private sector where possible to add to the procured volumes.

With the deployment of hydrogen refuelling infrastructure, we recommend the Government set a target for full national coverage by 2040. A recommitment to the first phase of 65 refuelling stations as soon as possible, as per the recommendations of the H2Mobility report¹⁵, should kick-start progress towards this longer term target.

See also Question 10.

Question 9 (Behaviour change): How far can people's behaviours and decisions change over time in a way that will reduce emissions, within a supportive policy environment and sustained global effort to tackle climate change?

ANSWER: UK HFCA has no comment on this.

Question 10 (Policy): Including the role for government policy, how can the required changes be delivered to meet a net-zero target (or tightened 2050 targets) in the UK?

ANSWER:

The future energy system and, particularly, the interconnection between heat, power and transport is a nationally significant issue of increasing resonance. Failure to carefully plan the development of the whole energy system will result, at best, in huge increases in delivery cost of, at worst, complete failure to deliver¹⁶.

Clear understanding of game changing solutions, such as H&FCs, will help to optimise outcomes. For example, fuel cells as stationary power or CHP are delivering substantial benefits to the energy system - better grid resilience, increased use of renewables,

¹⁵ <http://www.ukh2mobility.co.uk/wp-content/uploads/2013/08/UKH2-Mobility-Phase-1-Results-April-2013.pdf>

¹⁶ <http://www.raeng.org.uk/publications/reports/a-critical-time-for-uk-energy-policy>

Question 10 (Policy): Including the role for government policy, how can the required changes be delivered to meet a net-zero target (or tightened 2050 targets) in the UK?

localised carbon reduction, air quality benefits etc. Similarly, hydrogen is an excellent energy storage medium - avoiding the cost of renewables curtailment¹⁷ and simultaneously decarbonising heat, power and transport. We believe that the Government needs to take a whole energy system approach and urgently put in place a detailed strategic plan to optimize hydrogen and fuel cells' role in the energy transition.

To unlock private investment, and help maintain and grow the UK's position in this space, the Government must show its commitment to H&FC solutions in the medium to long term. It should do this by committing itself to rollout targets and publicly to supporting and investing in these low carbon solutions alongside the private sector. Currently investor confidence has been shaken by mixed signals from Government and its more visible support for battery technology, where there is little UK developmental leadership.

In particular, UK HFCAs make the following recommendations for Government action:

1. **Ensure that investment in hydrogen refuelling infrastructure is at equal levels with other technologies**
2. **Enable hydrogen energy storage & power-to-gas solutions** to unlock and support the further shift to renewable generation through implementation of the necessary regulatory and procurement processes
3. **Launch a fuel cell deployment programme for stationary CHP and power applications** - recognising the efficiency, environmental benefits and grid balancing potential that they offer
4. **Position the UK at the forefront of hydrogen fuelled heavy transport** (heavy good vehicles (HGVs), trains, ships etc.) - through provision of innovation support and vehicle deployment support structures, incentives for the use of hydrogen fuel, Industrial R&D and clean vehicle funds specifically targeting hydrogen and fuel cell deployment in long range and heavy-duty applications
5. **Commit to the continuation of the hydrogen for heat programme** for the UK to retain its global leading position in this space and decarbonise its heating sector through hydrogen - used in fuel cells, boilers and other appliances.

In addition, we agree with the recommendations from the latest CCC report¹⁸ around the strategy for decarbonising heavy goods vehicles (HGVs), energy efficiency improvements, hydrogen deployment, identification of low-regret hydrogen deployment opportunities, public engagement and demonstrations.

See also Question 8 for further comments on the role of Government policy.

Part 4: Costs, risks and opportunities

Question 11 (Costs, risks and opportunities): How would the costs, risks and economic opportunities associated with cutting emissions change should tighter UK targets be set, especially where these are set at the limits of known technological achievability?

¹⁷ http://www.fch.europa.eu/sites/default/files/CommercializationofEnergyStorageFinal_3.pdf

¹⁸ <https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf>

Question 11 (Costs, risks and opportunities): How would the costs, risks and economic opportunities associated with cutting emissions change should tighter UK targets be set, especially where these are set at the limits of known technological achievability?

ANSWER: UK HFCA has no comment on this.

Question 12 (Avoided climate costs): What evidence is there of differences in climate impacts in the UK from holding the increase in global average temperature to well below 2°C or to 1.5°C?

ANSWER: UK HFCA has no comment on this.

Part 5: Devolved Administrations

Question 13 (Devolved Administrations): What differences in circumstances between England, Wales, Scotland and Northern Ireland should be reflected in the Committee's advice on long-term targets for the Devolved Administrations?

ANSWER: UK HFCA has no comment on this.

Part 6: CCC Work Plan

Question 14 (Work plan): The areas of evidence the Committee intend to cover are included in the 'Background' section. Are there any other important aspects that should be covered in the Committee's work plan?

ANSWER: UK HFCA has no comment on this.