Committee on Climate Change

Independent advice to government on building a low-carbon economy and preparing for climate change

The Sixth Carbon Budget and Welsh emissions targets – Call for Evidence

Background to the UK's sixth carbon budget

The UK Government and Parliament have adopted the Committee on Climate Change's (CCC) recommendation to target net-zero emissions of greenhouse gases (GHGs) in the UK by 2050 (i.e. at least a 100% reduction in emissions from 1990).

The Climate Change Act (2008, 'the Act') requires the Committee to provide advice to the Government about the appropriate level for each carbon budget (sequential five-year caps on GHGs) on the path to the long-term target. To date, in line with advice from the Committee, five carbon budgets have been legislated covering the period out to 2032.

The Committee must provide advice on the level of the sixth carbon budget (covering the period from 2033-37) before the end of 2020. The Committee intends to publish its advice early, in September 2020. This advice will set the path to net-zero GHG emissions for the UK, as the first time a carbon budget is set in law following that commitment.

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).

The Act also specifies other factors the Committee must consider in our advice on carbon budgets – the advice should be based on the path to the UK's long-term target objective, consistent with international commitments and take into account considerations such as social circumstances (including fuel poverty), competitiveness, energy security and the Government's fiscal position.

The CCC will advise based on these considerations and a thorough assessment of the relevant evidence. This Call for Evidence will contribute to that advice.

Background to the Welsh third carbon budget and interim targets

Under the Environment (Wales) Act 2016, there is a duty on Welsh Ministers to set a maximum total amount for net Welsh greenhouse gas emissions (Welsh carbon budgets). The first budgetary period is 2016-20, and the remaining budgetary periods are each succeeding period of five years, ending with 2046-50.

The Committee is due to provide advice to the Welsh Government on the level of the third Welsh carbon budget (covering 2026-30) in 2020, and to provide updated advice on the levels of the second carbon budget (2021-25) and the interim targets for 2030 and 2040. Section D of this Call for Evidence (covering questions on Scotland, Wales and Northern Ireland) includes a set of questions to inform the Committee's advice to the Welsh Government.

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 <u>400 words</u> 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 UK HFCA has no response to this question.

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

ANSWER: The UK HFCA has no response to this question.

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 UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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 UK HFCA has no response to this question.

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 three key messages in the Net Zero advice which are particularly pertinent to the role of hydrogen:

1. "There needs to be a greater sense of urgency surrounding progress" – a number of initiatives are exploring the role for hydrogen across the energy system. In line with the net zero advice sentiment, there is a need to shift from analysis to action. Initial deployments should be accompanied by clear scale-up plans. Unless there is a kick start to progress, there is a strong risk that necessary levels of scale-up will not be achieved and targets will not be met.

2. "Challenges previously not addressed must now be faced head on by government" – these include the decarbonisation of industry, heavy transport and heat. Hydrogen is uniquely positioned to deliver effective decarbonisation across these 'hard to abate' sectors. Furthermore, with a 'whole systems approach', the reach and benefits of hydrogen can be both optimised for these sectors and extended into aspects of light transport, energy storage, distributed power and more.

3. "Clear leadership is needed, right across Government, with delivery in partnership with businesses and communities" – a good starting point would be a clear statement of intent from Government. A lack of transparency on Government's interest in hydrogen could be initially addressed through such a statement – to include a clearly defined pathway to deliver the envisaged role for hydrogen. This will encourage public and investor engagement, and help to enhance wider awareness. Lessons can be learnt from the offshore wind sector in this regard.

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?

More specifically, we would support a clearly defined low carbon hydrogen production target for the period to 2030 / 2035. This would form part of a pathway to deliver a longer-term target of 300–400TWh by 2050. In the short term, hydrogen production via SMR+CCS offers an opportunity for rapid scale-up in low-carbon hydrogen, with the trajectory being towards zero-carbon hydrogen, via electrolysis. Note that the Hydrogen Council recently concluded that, with appropriate investment, the cost of hydrogen could fall by 50% by 2030[6].

A production target should be augmented by policies to stimulate supply and demand in tandem, as well as progressive carbon reduction. Early stage demand focused mechanisms could include tax incentives and other mechanisms to reduce the cost of the user through the transition. In particular cases, mandating could work well – for example, requiring all new boilers to be hydrogen ready.

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 UK HFCA has no response to this question.

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: With careful policy, we can achieve the optimal balance between carbon reduction and these other policy pressures on the road to net zero. This includes supporting UK companies who can contribute to the transition, and, in the global marketplace, deliver UK economic growth.

The UK is increasingly seen as a leader in hydrogen and fuel cells, providing the potential for early wins. Economies of scale, as deployment grows, will also play an important role (see Q9 for key policy elements to support this and minimise risk). Underlying principles for policy design include stimulating cost reduction, applying a whole systems approach (at both the sector and project level) and recognising wider benefits, such as air quality improvement.

More broadly, the transition to net zero will include the need for short term support from Government policy combined with longer term policies around carbon. For example, it is possible that, in the longer term, UK goods and services will face issues in matching the costs of higher carbon imports, or be export constrained by carbon mitigation in the UK. This will require Border Carbon Adjustments, which increase over time to match changes in UK and global markets.

[6] https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf

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: The UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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 UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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

ANSWER: The UK HFCA has no response 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: The UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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

ANSWER: The UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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: Whilst current policies across transport are heavily weighted towards EVs, there's growing recognition of their limitations. These include range, re-charging times, the commercial case for public chargers, pressure on / cost implications for the distribution grid, the overall cost of infrastructure, the availability of rare earth materials etc. In heavy transport particularly, there's an increasing consensus on the role for hydrogen, because significantly less compromise is involved around payload, vehicle uptime and change to duty cycle/business model than across all of the alternatives. Similar considerations apply to fleets for commercial users (for example, police vehicles).

With respect to hydrogen in these applications, the benefit case urgently needs to be demonstrated and communicated in practical applications, over an appropriate length of time to impart confidence that costs for both the vehicle and the fuel will enable them to compete operationally. A proper national strategy for sourcing and managing hydrogen and developing the supporting infrastructure is an important element of this. Scale up can be facilitated through proactive intervention to support the availability of vehicles and the growth of infrastructure, including fuel purchase. The latter encompasses extending the RTFO to cover all types of low carbon hydrogen production.

The IEA's 2019 report[7] notes that *BEVs and FCEVs could complement each… with FCEVs offering the best opportunities for vehicles driven at long ranges, with fast refuelling requirements and in regions with …cheap hydrogen".* Furthermore, it suggests that once a hydrogen refuelling infrastructure has been built, light-duty FCEVs could take advantage of cost and performance improvements in both fuel cells and batteries. It also comments that *"Despite higher initial costs than BEV charging infrastructure, hydrogen refuelling stations can offer significant advantages when deployed at scale…. In the longer term, over 400 refuelling stations would be needed to service a fleet of 1 million hydrogen FCEVs if the ratio of refuelling stations to cars were similar to that for today's oil-powered car fleet. This compares to almost 1 million private charging stations and at least 10 000 fast-charging public stations that would be needed for a fleet of 1 million BEVs".*

As the heavier elements of hydrogen transport develop, it will be important to review wider transport policies. Support and frameworks are currently strongly balanced in favour of electric vehicles and, as hydrogen becomes more widely available, it may become the more logical solution for an increasing range of transport and vehicle types.

[7] https://www.iea.org/reports/the-future-of-hydrogen

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: Our answer will only be referring to parts c) and d).

In terms of broad policy mechanisms, there should clearly be a focus on the level of carbon abatement achieved.

Place-based clusters, such as those being facilitated by the ISCF and IETF (and articulated across a number of regional projects), will be an important and cost-effective deployment route for hydrogen. To maximise impact, such clusters should include consideration of the full range of hydrogen and fuel cell solutions, including off-road mobile machinery of various types.

Fuel cell powered industrial forklift trucks, as an example of off-road mobile machinery have been successfully operating commercially in a number of applications around the world[8]. There are also a range of connected opportunities for hydrogen on construction sites – both for off-road transport and temporary power.

The decarbonisation of off-road machinery could be incentivised in part by the availability of appropriately priced hydrogen, and in part through other incentives similar to those applied to electric vehicles.

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 UK HFCA has no response to this question.

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

ANSWER: The UK HFCA has no response to this question.

[8] https://www.h2-international.com/2019/11/17/new-call-for-fc-forklifts/

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: The UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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

ANSWER: The UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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: As mentioned in the Net Zero Technical Report, hydrogen will be an important resource for back-up when renewable variable generation is low, but it will be equally (if not more) important for when renewable variable generation is high. Hydrogen is the only solution that can effectively provide inter-seasonal energy storage. This is going to be critical as renewable energy penetration increases. The intermittent nature of renewables means that electrolytic hydrogen specifically is of increasing relevance.

Despite this, the coverage of electrolysis isn't fully consistent or transparent, with the exception of the strong message around high costs. On this latter point, the Hydrogen Council's latest report states that *"Since 2010, the cost of electrolysis has fallen by 60 per cent, from between USD 10 to 15 per kg hydrogen to as low as USD 4 to 6 today. The analysis shows that they will continue to fall: offshore wind-based electrolysis shows another 60 per cent cost reduction from now until 2030"*[9]. Exhibit 14 of this report - see below - breaks the analysis down between capex, efficiency, O&M and energy costs.

Exhibit 14 | Renewable hydrogen from electrolysis production cost scenarios[5], USD/kg hydrogen

Cost of renewable hydrogen with varying LCOE and load factors
USD/kg H_2

< USD 2/kg | USD 2-3/kg | USD 3-4/kg | > USD 4/kg | Viable medium-term (<2030)

LCOE	Capex electrolyser	USD 750/kW					USD 500/kW					USD 250/kW				
UDD 0/MWh	5.7	2.8	1.9	1.4	1.1	4.2	2.1	1.4	1.1	0.9	2.8	1.4	0.9	0.7	0.6
USD 10/MWh	6.1	3.3	2.4	1.9	1.6	4.7	2.6	1.9	1.5	1.3	3.2	1.9	1.4	1.2	1.0
USD 20/MWh	6.6	3.8	2.8	2.4	2.1	5.2	3.0	2.3	2.0	1.8	3.7	2.3	1.9	1.6	1.5
USD 30/MWh	7.1	4.2	3.3	2.8	2.5	5.6	3.5	2.8	2.5	2.2	4.2	2.8	2.3	2.1	2.0
USD 40/MWh	7.5	4.7	3.8	3.3	3.0	6.1	4.0	3.3	2.9	2.7	4.6	3.2	2.8	2.6	2.4
USD 50/MWh	8.0	5.2	4.2	3.7	3.5	6.5	4.4	3.7	3.4	3.2	5.1	3.7	3.2	3.0	2.9
USD 100/MWh	10.3	7.5	6.5	6.1	5.8	8.9	6.7	6.0	5.7	5.5	7.4	6.0	5.6	5.3	5.2
Load factor		10%	20%	30%	40%	50%	10%	20%	30%	40%	50%	10%	20%	30%	40%	50%

SOURCE: McKinsey

[9] https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf

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?

The range of benefits of electrolysis – providing interseason storage, adding value to renewables and delivering system balancing – will be best realised through policy which supports these benefits. For example, the Electric Vehicle Energy Taskforce recommends incentives for energy storage via electric vehicles. A similar approach could be taken with hydrogen.

The IEA[10] hydrogen report discusses the effect of scale on hydrogen-related technologies. The cost of fuel cells, refuelling equipment and electrolysers will all benefit from the scaling up of hydrogen infrastructure, and facilitate the use of hydrogen across a wide range of applications. The impacts of this span beyond just decarbonisation and extend into grid resilience, energy efficiency and air quality, to name a few.

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: Hydrogen production facilities can only be considered a success if there is a demand for the hydrogen produced. Thus, the policy framework and business models for hydrogen should encompass both demand and supply side, and stimulate both simultaneously. Encouraging large users to pick hydrogen will be key - mechanisms that ensure a rational economic case and establish a virtuous circle are needed (e.g. tax incentives). And, as discussed above, a clear Government commitment to hydrogen, combined with targets and a mandated pathway to their delivery, will help to provide long term confidence and reduce risk.

The latest Hydrogen Council report mentioned earlier identifies 22 applications where hydrogen can become a cost-competitive low-carbon solution before 2030 under the right conditions (see Exhibit 5 reproduced below).

[10] https://www.iea.org/reports/the-future-of-hydrogen

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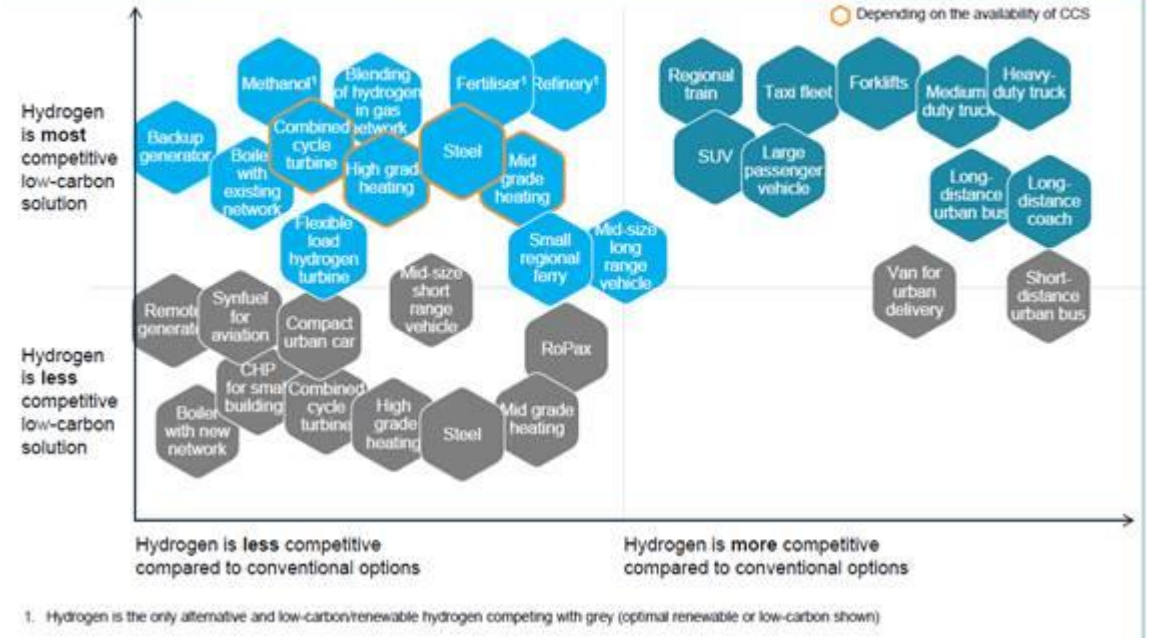
Exhibit 5 | Competitiveness of hydrogen applications versus low-carbon and conventional alternatives



See Q21 for comments on HGVs. Other transport applications, such as trains and shipping (with the sector heavily invested in exploring the decarbonisation opportunities hydrogen offers[11]) are also evolving rapidly, and there is a window of opportunity for the UK to take a leading role aligned with the wider system developments discussed elsewhere

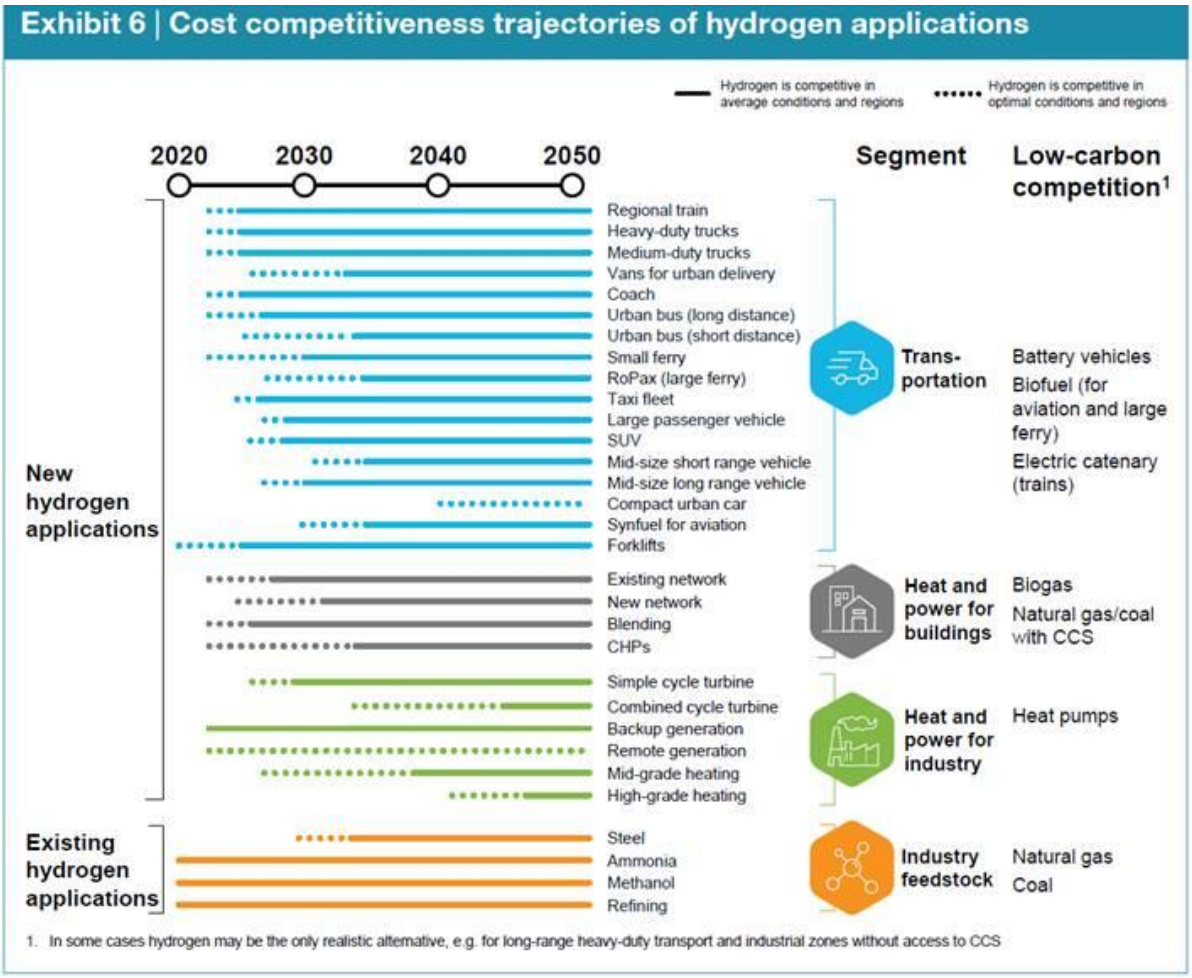
There is considerable recent and ongoing work in the UK to evaluate and clarify the feasibility of hydrogen for heat through repurposing of the gas grid. Building on initial studies, current activities are focused in areas such as exploring what levels of hydrogen will be possible and developing, testing and demonstrating hydrogen ready boilers. With the latter expected to be commercially available during the second half of the 2020's[12], and other work due to report over that time-frame, we are moving rapidly towards the transition from 'thinking' to 'doing'. Through this, it will be important that time-frames and activities across various parts of the 'hydrogen for heat' solution are fully aligned. This should include and extend to opportunities for meeting other demands for hydrogen via the gas grid. Incentive mechanisms could include mandating that all new boilers are hydrogen ready. See also Q37.

[11] https://www.globalmaritimeforum.org/getting-to-zero-coalition

[12] https://www.theccc.org.uk/publication/net-zero-technical-report/

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?

The latest Hydrogen Council[13] report also includes timelines for competitiveness (see Exhibit 6 reproduced below, and concludes that from 2020-2025 hydrogen could become competitive in transportation, particularly for large vehicles with long ranges (i.e. trains, trucks, coaches, and taxi fleets) and forklifts, alongside greater prevalence of hydrogen for heat (via the gas grid).



[13] https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf

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 UK HFCA has no response to this question.

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 UK HFCA has no response to this question.

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: The UK HFCA has no response to this question.

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 UK HFCA has no response to this question.

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

ANSWER: The UK HFCA has no response to this question.

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 necessary groundwork for this is nearly complete. There are a number of projects such as HyDeploy showing that we can start to decarbonise the gas grid with hydrogen now[14]. H21 Leeds City Gate showed the feasibility of decarbonising heat through hydrogen with minimal disruption to customers, and minimal investment in existing infrastructure[15] and H21 North of England provides a detailed pathway to a 100% hydrogen route for decarbonisation[16]. There are some locations where blending / injection will be initially useful. Overall, hydrogen for heat is a practical and achievable solution. See also our answer to Q31.

In average conditions and regions, scale-up could result hydrogen being cost competitive in new and the existing heat network as well as blended between the mid 2020's and mid 2030's[17].

In the context of this question, there is a need for clarity and consensus on the role of the gas grid. Not allowing gas connections to some housing is profoundly wrong. In seeking to correct poor building regulations and compliance through this route, the UK would limiting low cost and low carbon energy supplies. For new build, conversions and existing buildings – as well as existing CHP systems, boilers and heat networks - the options of both low carbon electricity and hydrogen, and hydrogen CHP units, needs to be available. See the latest Hydrogen Council Report[18] and other studies for consideration of aspects such as housing stock and density.

[14] https://hydeploy.co.uk/app/uploads/2018/12/15055_HD_PH2_PROJECT_REPORT_v2.pdf

[15] https://www.northerngasnetworks.co.uk/wp-content/uploads/2017/04/H21-Report-Interactive-PDF-July-2016.compressed.pdf

[16] https://www.northerngasnetworks.co.uk/event/h21-launches-national/

[17] https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf

[18] https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf

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

ANSWER: The UK HFCA has no response to this question.