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

## Question and answer form

SGN manage the network that distributes natural and green gas to 5.9 million homes and businesses in Scotland and the south of England. We welcome the opportunity to respond to this consultation.

### 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:

**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:

We support the targets of net zero emissions in the UK/Scotland in 2050/45. Ensuring the sixth carbon budget is compatible with a cost effective and deliverable pathway to net zero is essential. Given that key policy decisions around heat decarbonisation are not expected until around 2024, the level of emissions reductions implied by the sixth carbon budget needs to take into account that the current policy trajectory will only see significant conversion to low carbon heating from the late 2020s or early 2030s.

**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:

**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:

## 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:

It is clear that further research is needed to better understand the extent to which consumers will change their behaviour to deliver net zero. Evidence suggests concern about climate change has risen, but only 38% are aware that reaching net zero will require a change to the way homes are heated.[1] Customers could be a significant barrier to net zero if the solution to decarbonise heating is reliant on significant behaviour change. The solution(s) should ultimately be driven by what offers the best customer value proposition.

Our view based on our engagement with our customers to date is that they are very price sensitive and unable to pay much more for decarbonised heat. We have also seen that they favour solutions to decarbonise heat where behaviour change and in home disruption is minimised. This is why we believe solutions such as a switch to hydrogen heating are likely to be more successful.

A regulation requiring all new boilers to be hydrogen ready would see rapid uptake given last year 1.67 million gas boilers were sold in the UK.[2] This would make a future hydrogen switchover – with or without hybrid heat pumps – far easier. Hydrogen ready boilers are also set to add only about £50 to the cost of a boiler and will mean a household could be converted to hydrogen after a single visit from an engineer.

Crucial evidence on customer attitudes towards clean heating solutions will come from pilot projects like our H100 project which is looking to construct and demonstrate the UK's first 100% hydrogen network in Scotland. Ensuring there is sufficient funding for such projects is therefore crucial in the coming years to enable subsequent heat policy decisions. Ultimately if these projects can deliver a solution that customers want it will be key to going greener faster.

[1] https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/Energy%20Consultation%20responses/Zero%20sum%20(2).pdf

[2] https://www.eua.org.uk/record-boiler-sales-show-how-decarbonisation-will-work/

**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?

**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:

We believe there are a number of key uncertainties including:

- **The solution to decarbonise heat at scale** which will need to be informed by evidence from pilot projects for hydrogen like H100 in the coming years. The Pathways to Net-Zero report by Navigant highlights how a balanced pathway where we use more decarbonised gases could save £13bn a year compared to an electric only Pathway[3].
- **The level of disruption customers will tolerate from the decarbonisation of heat**. If they will not tolerate a high level of disruption, policy will need to take this into account. Research by Citizens Advice said only 38% people realise they'll need to change the way they heat their home to meet net-zero.[4]
- **The timescales for the development of CCUS** which the CCC highlight as crucial net-zero and to deliver hydrogen at scale.
- **The level of progress on energy efficiency**. The current lack of policy raises questions around the government's appetite to improve the efficiency of existing owner occupied houses. Without it, heat policy will have to be designed to produce clean heating for less efficient buildings that still require high temperature heating.
- **How low carbon gasses like biomethane will be supported from April 2021** is uncertain despite the 2019 Spring Statement pledge the UK Government will look to 'accelerate the decarbonisation of gas supplies'. The consultation due by the end of 2019 has not emerged.[5]

To tackle these uncertainties:

- **Funding is urgently needed for research and demonstrations** into solutions like hydrogen that could be key to decarbonise heat. This could be direct UK/Scottish government funding, included as part of the RIIO-2 price control or a combination.
- **Introducing a regulation requiring all new boilers are hydrogen ready** will add only around £50 to the cost of a boiler, maintain optionality for conversion to hydrogen and reduce the costs and disruption of conversion by avoiding the need to replace boilers before the end of their lifetimes.[6]
- **A successor scheme to the Renewable Heat Incentive (RHI)** which will close in March 2021 is now an urgent priority to incentivise the delivery of biomethane. The

[3] http://www.energynetworks.org/assets/files/gas/Navigant%20Pathways%20to%20Net-Zero.pdf

[4] https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/Energy%20Consultation%20responses/Zero%20sum%20(2).pdf

[5] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/785618/WMS_final_Commons.pdf

[6] https://www.bbc.co.uk/news/science-environment-50873047

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CCC has called biomethane a low regrets option to reduce emissions now which also maintains optionality while awaiting heat policy decisions.

- Rapid progress is needed to meet the ambition to have a CCUS cluster running by the mid-2020s. CCUS will be key to produce the clean hydrogen needed for net zero.

**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:

Whatever the level of the fourth and fifth carbon budgets, the key thing is to put the UK on a cost-effective trajectory to 2050. While short term progress is important, there is still a lot of groundwork to be done to lay the foundations for deep emissions reductions from heat and industry that could come from the commercialisation of technologies including CCS and hydrogen. Given the UK is currently off track to meet the existing fourth and fifth carbon budgets, the most important action is to put policies in place to meet those targets.

Having said that, we can understand the optimum pathway and go greener faster if research, development, pilot demonstrations and rollout mechanisms are supported with the necessary funding in the next year or two. Areas where we see this as lacking and urgently needed is for hydrogen and CCS pilot projects.

**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 has a major opportunity to be a global leader in terms of delivering a decarbonised gas network, provided that further innovation and demonstration projects are approved and funded in this country to develop that potential. Along with our view that a decarbonised gas solution will have a higher customer value proposition than electric solutions for most customers, the potential post-Brexit export benefits are another reason we think it should be prioritised.

The Hydrogen Council roadmap presents a 2050 vision where the global annual sales of hydrogen technology and services reach £2.5 trillion and create jobs for 30 million people.

**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?

The roadmap estimates that global demand for hydrogen could increase tenfold between 2015 and 2050.[7]

The UK has important strengths, which mean it stands to benefit from exports and tax revenues. Firstly, it has one of the most extensive gas networks in the world, which supplies around 300TWh of gas each year to business and industry, alongside that around 300TWh for domestic consumers and 300TWh to power stations, and which is already being upgraded through the Iron Mains Replacement Programme to make it suitable for transporting hydrogen. The gas network industry has developed a detailed pathway to decarbonise to net-zero.[8] A key project along this pathway is our H100 project which is looking to build a 'world first' of its kind 100% hydrogen network.[9]

The UK will have an opportunity to earn export revenue from manufacturing hydrogen technologies, including appliances, electrolysers and gas reformers; storing CO2 on behalf of other countries and/or through capturing and storing CO2 from industrial processes and then exporting the low carbon products; and exporting renewable hydrogen. Secondly, many of the jobs in these sectors would be in less affluent regions, including in Scotland.

## 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:

**Large scale trials of low carbon heating:** BEIS and Ofgem need to ensure that UK/Scottish government policy and the upcoming RIIO-2 price control provide the funding to allow large scale trials of technologies like hydrogen for heating to provide the evidence that will need to underpin key government heat policy decisions around 2024. If we want to go greener faster then research, development and pilot demonstrations need to be supported with more urgency than they are currently.

**A successor scheme to the Renewable Heat Incentive:** The RHI has been key to connect over 100 biomethane plants to the gas network since 2012 and further deployment is recognised as a low regret action to reduce emissions in the short term to meet carbon budgets.[10] Despite the Chancellor's 2019 Spring Statement commitment to advance the decarbonisation of gas supplies and consult on it in 2019, the mechanism to deliver this is yet to be consulted on. This means there is likely to be no immediate follow on stimulus for new biomethane plants when the RHI closes at the end of March 2021.

[7] https://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-Scaling-up_Hydrogen-Council_2017.compressed.pdf

[8] http://www.energynetworks.org/assets/files/gas/Navigant%20Pathways%20to%20Net-Zero.pdf

[9] https://sgn.co.uk/about-us/future-of-gas/hydrogen/hydrogen-100

[10] https://www.theccc.org.uk/wp-content/uploads/2016/10/Next-steps-for-UK-heat-policy-Committee-on-Climate-Change-October-2016.pdf

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**Net zero ready appliances:** the net-zero report highlights the need for almost all heating systems for existing homes to be low carbon or ready for hydrogen. Given the average lifespan of a gas boiler is 10-15 years we believe that mandating all new and replacement gas boilers are hydrogen ready from the mid-2020s is a no regrets step that will overcome a potential future delivery challenge if all boilers had to be replaced upon hydrogen conversion. Manufacturers are also suggesting it would only increase the cost of a boiler by around £50.

**CCUS:** As mentioned previously, CCUS projects need to be supported urgently if we are serious about net zero. This is particularly important given its key role to produce clean hydrogen to reduce emissions across a number of sectors.

**Gas quality changes:** Crucial short term changes are required to bring the gas quality requirements for GB out of the Gas Safety Management Regulations (GSMR) legislation into a new more flexible industry standard to be managed by IGEM. This will be much more agile and enable changes to things like the level of hydrogen allowed much more quickly once the safety case has been proven. This change has been due to happen shortly for a while but delayed by other legislative priorities.

**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:

Local targets/ambitions and climate emergency declarations should not distract from the need for a national approach to deliver net-zero. This is particularly important when we consider solutions to deliver decarbonised heat. Locally driven action should be seen as complementary to action at a regional and national level as net zero will require infrastructure to share energy between areas and cities.

We have been heavily engaged in the development of local energy plans in our network areas in southern England and Scotland. From this it is clear that areas and cities may achieve the rapid decarbonisation of the buildings and transport that they have direct control over but convincing many thousands of citizens to make the changes to the way they travel and heat their homes in line with timescales like 2030 may be more difficult.

There is a need to develop a stronger understanding among local actors of the need for a balance between local and national initiatives to tackle the decarbonisation challenge. Something we have noticed in our engagement with local stakeholders is they can feel driven by the likes of local climate emergencies to feel like the decarbonisation challenge needs to be tackled through local initiatives alone. Greater understanding is needed that local initiatives will complement rather than replace the need for national networks.

We believe there is a risk that different local areas develop different decarbonisation plans which do not align with the national strategy - which is yet to be finalised - particularly around the decarbonisation of heat. We believe a lack of coordination could increase the

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cost and difficulty of delivering a clean, secure and affordable net-zero energy system across the UK.

Finally, there will be a need to take into account differences across regions that could occur due to local characteristics. An example being the potential for North East Scotland to take advantage of the local characteristics that makes it a prime targets to be the first area of the UK to convert to hydrogen.[11] This is explored in more detail in the Navigant pathways to net-zero report.[12]

**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:

It needs to be recognised that there are trade offs between these areas and in particular where decarbonising costs more than not decarbonising. There are also only a limited number of ways to pay: taxation, consumer bills (households or businesses) or government borrowing (future consumers).

Whatever solutions are prioritised to deliver net zero there is a need for long term support to provide certainty and deliver cost reductions as has been seen through the recent CfD auctions for offshore wind. The same level of stability is urgently needed for the successor scheme to the Renewable Heat Incentive from April 2021. Technologies like biomethane that can make key contributions towards forthcoming carbon budgets are approaching a hiatus in support unless policy is rapidly developed.

One of the ways of mitigating the impact of the transition on household budgets and fuel poverty is to decarbonise heat while minimising the upfront costs to customers. A way of doing this is to utilise the price control regime for energy networks to spread costs over several decades. If a switch to hydrogen is pursued, the costs of conversion could be added to the network element of gas bills in a similar way to the Iron Mains Replacement Programme which is due to end in its current form in 2032. The potential to do this is explored in the H21 Leeds City Gate report.[13]

Another low regret policy is to mandate that new boilers installed are 'hydrogen-ready' from the mid-2020s. The success of the mandation of condensing boilers in 2005 shows how successful such a change can be. This will take advantage of the natural boiler replacement cycle (12-15 years) and mean that the disruption to transition to clean heating could be limited to a single engineer visit of less than an hour to change out around three components so the boiler can run on hydrogen rather than natural gas.

[11] https://investaberdeen.co.uk/images/uploads/Hydrogen%20leaflet.pdf

[12] http://www.energynetworks.org/assets/files/gas/Navigant%20Pathways%20to%20Net-Zero.pdf

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

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Ensuring funding streams are not siloed is also important. At scale trials of low carbon heating in the coming years are crucial if we are to proceed to on time policy decisions around 2024 but they will not be possible without the right funding mechanisms (whether funded by Government through taxation or bills via the network price control). At the moment we also see situations where several necessary projects have to compete for funding pots where only one can be successful.

**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 key objective has to be to minimise costs and disruption to households. Many households are severely capital-constrained, and therefore solutions with a high upfront cost, even if cheaper over a 20-year lifetime, are simply out of reach for many people – 18.9 million households (69% of the total) have less than £10,000 in savings, and of these, 12.6 million have no or less than £1,500 of savings.[14]

We believe a transition to hydrogen has the ability to be the means to deliver a just transition. This needs to consider the annual heating bill, the upfront cost of low carbon heating equipment, how these will be paid for, and the associated disruption. The Iron Mains Replacement Programme demonstrates how the conversion could be paid for through the network price control settlements in order to minimise upfront costs to customers. The H21 Leeds City Gate report explores this in more detail.[15]

The introduction of a requirements that all new boilers installed are hydrogen-ready will avoid the need for households to pay for a new appliance upon conversion and would initially only cost around £50 more than a regular gas boiler. We are not aware of an example of how this upfront cost to customers could be minimised for electrification without locking customers into a financing agreement to pay off the cost of a heat pump over time.

## 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:

[14] https://themoneycharity.org.uk/media/December-2019-Money-Statistics.pdf

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

**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?

Scottish Government decisions on how to decarbonise heat at scale to meet their target of net-zero for 2045 can only take place after the UK Government's enabling decisions expected around 2024 on the long term role of the gas network.[16] The forthcoming carbon budgets need to take this decision timeline into account even if the earlier net zero target than the rest of the UK could drive quicker decarbonisation from the late 2020s.

The recent pathways to net zero report by Navigant highlights the potential rollout of clean gasses like hydrogen and biomethane in different regions.[17] It foresees the rollout of hydrogen to decarbonise heating starting in clusters like the North East of Scotland and spreading out across the nearby regions. The potential for Scotland to be one of the first regions to convert to hydrogen is something that needs to be considered when recommending the pathway for Scotland.

[16] https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2017/12/scottish-energy-strategy-future-energy-scotland-9781788515276/documents/00529523-pdf/00529523-pdf/govscot%3Adocument/00529523.pdf?forceDownload=true

[17] http://www.energynetworks.org/assets/files/gas/Navigant%20Pathways%20to%20Net-Zero.pdf

**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:

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

ANSWER:

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

ANSWER:

These targets must take into account the expected timeline for key decisions on how heat will be decarbonised. Decisions on the future of the gas network are reserved to the UK Government and its decisions on the balance between hydrogen and electrification to decarbonise heating are not expected until around 2024. Decisions on how to decarbonise the 80% of Scottish homes that are on the gas network will have to follow which means that serious progress outside the new build, social housing and off gas grid sectors will not take place until the late 2020s.

However, with a positive enabling decision we believe that rapid progress could be made to convert Scotland to hydrogen from the late-2020s starting in areas like Aberdeen where our Aberdeen Vision project is looking to build a 100% hydrogen pipeline from the St

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

Fergus Gas Terminal to provide clean energy for heat and transport in a city where hydrogen transport is the most advanced in the UK.

**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:

An area decision making needs to be coordinated is on the approach or approaches to decarbonise heat. While regional solutions may emerge as a result of the characteristics of a particular area, an uncoordinated approach to the decarbonisation of heat risks putting the net-zero target in doubt if the different infrastructures aren't in place to support the different solutions that neighbouring towns could want to adopt. A piecemeal approach could also increase costs by reducing economies of scale and resulting in the need to invest in multiple infrastructure networks.

## E. Sector-specific questions

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

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

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

ANSWER:

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

ANSWER:

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

ANSWER:

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

ANSWER:

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

a) Manufacturing sectors at risk of carbon leakage

b) Manufacturing sectors not at risk of carbon leakage

c) Fossil fuel production sectors

d) Off-road mobile machinery

ANSWER:

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

ANSWER:

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

ANSWER:

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

ANSWER:

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

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

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

ANSWER:

a) Net zero requires the heating systems to be changed in almost 28 million UK households. This breaks down to around 1 million existing homes a year and 20,000 per week if the work was to start in the mid 2020s. However, as we have pointed out in our answers to earlier questions, as key decisions on the preferred approach are not due until around 2024, the transition will not begin in earnest until later in the 2020s.

Getting to evidence based policy decisions more quickly would require funding streams that enable projects like our H100 100% hydrogen demonstration to move forward more quickly. A current constraint is the Network Innovation Competition as part of RIIO-GD1 only awards funding once a year and all the gas network projects have to compete for a share of £18m. The mechanism for RIIO-GD2 will need to be designed with the level of investment required in the coming years to produce the evidence base required for informed heat policy decisions.

Given that a record 1.67 million gas boilers were sold last year, mandating that new and replacement boilers were hydrogen ready would enable more than the required number of homes to be made net-zero ready, ahead of a hydrogen supply becoming available. It is worth noting the town gas to natural gas conversion at its peak around 1972 was converting 2.3 million homes a year.

Another crucial enabling element to speed up the programme for decarbonising heat would be to speed up the programme to futureproof the gas network with hydrogen-ready polyethelene pipes in the RIIO-2 price control from 2021. This can both reduce the amount of methane escaping and the level of work to make the network hydrogen ready in subsequent price controls from 2026. We have proposed accelerating the delivery of this programme in our RIIO-GD2 business plan following strong support from our stakeholders due to the clear environmental benefits of saving an additional 3.6 $ktCO_2e$.[18]

[18] https://www.sgnfuture.co.uk/wp-content/uploads/2019/12/SGN-RIIO-GD2-Business-Plan.pdf

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b) Our experience tells us that energy consumers are not willing to undergo disruption for purely environmental benefits. As stated above, mandating hydrogen-ready boilers would enable over 1 million homes a year to be ready for decarbonisation, without requiring any behavioural change at all. We are not aware of any evidence that suggests the public would favour approaches to decarbonising heat that require significant behaviour change over ones that do not require any like hydrogen.

**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:

A report for BEIS on the logistics of hydrogen conversion highlighted that the existing base of around 130,000 gas safe engineers could deliver the downstream conversion of the UK's 23 million homes with a gas connection in 16 years. The report also said if a designated conversion workforce was developed, then all UK homes could be converted much more quickly.

The H21 North of England report showed that a widespread conversion of homes to hydrogen would require over 3,000 gas engineers for a number of years. The workforce would require hydrogen training, but the overall size of the workforce for a domestic hydrogen conversion would be manageable when compared to the current number of gas safe engineers.

It is worth noting the gas workforce is ageing, and so recruitment, training and retention of younger gas engineers is critical. In our experience, decarbonisation is a strong motivator for young people, who value work that contributes positively to the environment. A hydrogen heating roll out would, we believe, prove to be a strong motivator for young engineers.

**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:

A hydrogen conversion requires a definite decision to be made for a switchover to hydrogen. This may be a phased process across regions and will need to consider where the hydrogen is being produced and how it is being transported to the area to be converted. A conversion is likely to be needed on an inter-regional or national basis given the benefits of economies of scale as hydrogen production is increased.

We see a need for a national framework to guide local/regional decision making to ensure any local plans do not hamper the ability to deliver the least cost transition across the UK. An example we are seeing is local authorities and cities setting and trying to meet local climate emergency targets for 2030 but many strategies we have seen to try and meet those targets would be inconsistent with a future UK Government policy decision to decarbonise heat through hydrogen.

The best case study of a widespread conversion to a different form of heating has to be the town gas to natural gas conversion in the 1960s and 70s. While it was carried out in a different era and by a nationalised industry it is a fantastic example of a national policy implemented regionally and locally. A recent study for BEIS looked at the logistics of domestic hydrogen conversion with reference to the previous conversion from town gas.[19]

**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:

[19] Frazer-Nash Consultancy, Logistics of Domestic Hydrogen Conversion, October 2018 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/760508/hydrogen-logistics.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?

ANSWER:

**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:

While the recognition that hydrogen production will be needed is welcomed, more than one large scale low carbon hydrogen production facility will be needed by 2030. All of the major industrial clusters need to decarbonise, and indeed a number of cluster projects, including in Scotland, the North West and Humberside, envisage a major role for hydrogen. Therefore if only one production facility is up and running by 2030, the net zero target is likely to be at risk given the need to roll hydrogen out at scale if the key challenges of decarbonising heating, industry, heavy transport, shipping are to be met.

Possible mechanisms to support hydrogen production were discussed in the BEIS CCUS business models consultation. A CfD type mechanism may be the most straightforward incentive to support 100% hydrogen for heating. The reference price could be the natural gas price. The RTFO could be extended to support hydrogen for transport. We are aware that BEIS are also looking at how hydrogen that is blended into the gas network in the shorter term could be supported by the mechanism that replaces the RHI from 2021.

It will be important to avoid double-subsidies, and this could be achieved, for example, by only allowing one mechanism to be used for each unit of hydrogen produced. A recent report by the Hydrogen Council concluded that the cost of hydrogen could fall by 50% by 2030 with the right investments.[20]

For transport of hydrogen, an extension to the existing RAB-based network charging regime is most appropriate, ensuring a low cost of capital and using an existing well-understood and successful mechanism.

[20] Hydrogen Council, Path to hydrogen competitiveness: A cost perspective, January 2020 https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf

**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?

We envisage early applications for hydrogen to be focused on HGVs, Buses, Shipping, Rail, industrial use, and blending in gas networks.

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

ANSWER:

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

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

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

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

ANSWER:

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

ANSWER:

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

ANSWER:

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

ANSWER:

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

ANSWER:

One of the key factors to consider for all areas of GB where there is a gas network is the investment that has taken place through the Iron Mains Replacement Programme. 83% homes in GB currently use mains gas for heating. In our Scotland and southern gas networks, our low and medium pressure systems are over 75% and 70% hydrogen ready respectively with the iron pipes having been replaced with polyethelene (PE). By 2032, the expected end of the current programme over 90% of our networks will be hydrogen-ready, which the H21 project is looking to prove with the testing that is underway.

Key factors determining whether heat decarbonisation will need gas or electricity distribution network investment include:

- Hydrogen supply, and for hydrogen produced from methane, CCS availability, storage for hydrogen
- Biomethane supply, for regions where biomethane could be rolled out with hybrid heating systems
- The availability of clean electricity when heat is needed in winter when the wind isn't blowing, the sun isn't shining over periods when batteries cannot bridge the gap
- How energy will be stored to ensure demands can be met even on the coldest periods when intermittent sources may not be available
- Whether the cost and associated disruption to reinforce the energy networks for a particular solution is economical and acceptable to customers

**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?

- National or regional policies to support the required network investment for clean heating
- Customer acceptance of the different solutions

**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:

We agree with the scale of CCS needed to meet net zero set out in the Committee's net zero report – of 75-175 million tonnes captured and stored per annum by 2050. We also agree that CCS will be needed across sectors – including for hydrogen production, power generation, BECCS and industry.

In order to achieve this, CCS infrastructure will be required in all major clusters and as set out previously we believe that hydrogen production will be needed at these clusters (not just one) by 2030.