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.

The ADE is the UK's leading decentralised energy advocate, focused on creating a more cost effective, efficient and user-orientated energy system. The ADE has over 150 members active across a range of technologies, including both the providers and the users of energy. Our members have particular expertise in combined heat and power, heat networks, demand side energy services and energy efficiency.

A. Climate science and international circumstances

Question 1: The climate science considered in the CCC's 2019 Net Zero report, based on the IPCC Special Report on Global Warming of 1.5°C, will form the basis of this advice. What additional evidence on climate science, aside from the most recent IPCC Special Reports on Land and the Oceans and Cryosphere, should the CCC consider in setting the level of the sixth carbon budget?

ANSWER: n/a

Question 2: How relevant are estimates of the remaining global cumulative 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: n/a

Question 3: How should emerging updated international commitments to reduce emissions by 2030 impact on the level of the sixth carbon budget for the UK? Are there other actions the UK should be taking alongside setting the sixth carbon budget, and taking the actions necessary to meet it, to support the global effort to implement the Paris Agreement?

ANSWER: n/a

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: n/a

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:
Within the energy sector, the current system does not currently rely upon individuals and businesses playing a strong role and instead, has a much stronger focus on supply-side interventions; such as encouraging investment in large-scale renewable plant. However, going forward, individuals and companies will need to be more strongly incentivised to reduce their emissions – for example, through retrofitting their homes with energy efficiency measures, replacing their gas boiler with low carbon heat options such as connecting to low carbon heat networks or heat pumps or through installing smart systems that can make use of their energy flexibility to support the electricity system's operability.

Trials have started to demonstrate that this role can be relatively significant – including, for example, the Energy System Catapult's work on heat as a service models and newer supplier products offering Time of Use tariffs. Ofgem's work through the Access and forward-looking charges reforms to review the literature on consumer response to flexibility signals should also be useful in setting out current understanding across countries.

It is important to note that good quality data regarding individual and business energy use is currently lacking in some areas which makes it difficult to properly assess and incentivise the role users can play. The most significant areas include: domestic heat consumption data, actual (rather than theoretical) energy performance by both domestic and non-domestic buildings and domestic electricity consumption and flexibility data (although this is improving).

The ADE's recent report, '**Laying the foundations for net zero**' sets out, with supporting evidence, how improved household energy data, a rising trajectory of minimum energy standards and stronger guarantees against operational performance of interventions, such as pay for performance models, could create stronger consumer demand and investment into retrofitting homes for net zero.

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: It is still not clear how the UK will decarbonise its heating demand. As the CCC's work has shown, this is increasingly likely to create a patchwork of different areas – for example, a hydrogen cluster near CCUS opportunities in the North East, electrification through, for example, heat pumps and the development of strategic heat networks in many cities.

Firstly, and as has been clearly stated previously by the CCC, reducing energy demand is critical to all heat decarbonisation pathways. The current Government target of EPC C by 2035 was developed before the net zero target became law and should be reviewed to make sure that it remains compliant. Even if EPC C is still sufficient to reach net zero by 2050, the UK is very unlikely to hit it. Much stronger Government action to support individuals and businesses to invest in energy efficiency retrofit is needed now. Whilst ECO remains important, the Government should use any future incentives to decarbonise heat to encourage households and businesses to invest in energy efficiency measures at the same time. This could include, for example, including energy efficiency criteria as part of the eligibility criteria for any future renewable heat subsidies.

Secondly, flexibility is also a low regrets option. Achieving very significant levels of domestic and non-domestic demand-side response will significantly reduce the cost of the transition. The main priorities must be –

- Removing barriers to accessing existing flexibility markets: Ensuring distribution-connected flexibility is dispatched in the Balancing Mechanism when it is unconstrained and cheaper than Transmission assets and reforming balancing services
- Developing flexibility markets on the Distribution networks: Developing liquid, pay as clear markets for intra-day network management to minimise renewable energy constraints as well as longer-term markets as an alternative to network reinforcement
- Supporting greater sector coupling between the gas, electricity and heat network sectors and making use of technologies such as thermal storage and CHP to provide relatively cheap sources of balancing

Thirdly, some heat decarbonisation technologies are at a more mature stage than others. Rather than waiting until the entire picture is known, the UK Government should introduce a zoning approach. Briefly, this would entail Local Authorities or metropolitan regions conducting surveys of their local area to get a better understanding of the housing stock, local sources of low carbon heat and existing infrastructure. Through consultation with local citizens and stakeholders (e.g. distribution network operators for gas and electricity), this would then be translated into different zones within the Local Authority area – for example, a heat network zone in the inner-city area, electrification of heat in a suburban area without significant network constraints etc. Once these zones have been defined, national policy for each of those zone types would come into force in that zone. This might include, for example, incentives or obligations under planning policy as well as eligibility for national low carbon heat subsidies. For example, in a heat network zone, commercial properties may have an obligation to connect under planning policy that they would not have outside of those zones. Similarly, households may be eligible for subsidies for domestic heat pump installations if they are in a heat electrification zone but hydrogen subsidies in a hydrogen zone.

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 CCC should revisit the level of these budgets in light of the net zero target.

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: Investment in energy efficiency to support decarbonisation will also offer significant co-benefits; including reducing excess Winter mortality rates and reducing fuel poverty. Investment in heat decarbonisation is also likely to improve air quality.
More generally, there are significant benefits to UK industrial and commercial competitiveness if the energy transition improves their ability to earn revenue from the energy system, not just pay towards it, through increasing use of decentralised energy.

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: In addition to the recommendations already set out in the 2050 technical report, the ADE also highlights –

- As highlighted above, the need to not only overhaul the Government's present approach to low carbon heating and energy efficiency but to establish a strategic zoning approach that has mechanisms for tackling retrofit, as well as new build
- Much greater policy attention is needed for the capture and use of waste heat, particularly as a way to decarbonise non-domestic heating demand
- Continued primary energy efficiency gains, in addition to building energy efficiency, will also be needed to reach net zero
- Whilst we support the CCC's recommendation that policy and regulatory frameworks should encourage flexibility, this needs to be strengthened. Under National Grid's net zero Two Degrees Future Energy Scenario sensitivity in 2019, net zero by 2050 required up to 13GW of non-domestic load flexibility alone – compared to approximately 1GW or less today – and significant levels of domestic flexibility. To reach this magnitude of DSR participation will require very significant reform to deliver adequate signals.

Question 10: How should the Committee take into account targets/ambitions of UK local areas, cities, etc. in its advice on the sixth carbon budget?

ANSWER: n/a

Question 11: Can impacts on competitiveness, the fiscal balance, fuel poverty and security of supply be managed regardless of the level of a budget, depending on how policy is designed and funded? What are the critical elements of policy design (including funding and delivery) which can help to manage these impacts?

ANSWER: n/a

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: n/a

D. Scotland, Wales and Northern Ireland

Question 13: What specific circumstances need to be considered when recommending an emissions pathway or emissions reduction targets for Scotland, Wales and/or Northern

Ireland, and how could these be reflected in our advice on the UK-wide sixth carbon budget?

ANSWER: n/a

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: n/a

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

ANSWER: n/a

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

ANSWER: n/a

Question 17: In what particular respects do devolved and UK decision making need to be coordinated? How can devolved and UK decision making be coordinated effectively to achieve the best outcomes for the UK as a whole?

ANSWER: Heat decarbonisation will require coordination between the UK and devolved administrations to ensure zoning is developed simultaneously and to coordinate where certain relevant powers are not devolved; for example, regarding connection to the gas networks and energy consumer protection.

E. Sector-specific questions

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

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

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

ANSWER: n/a

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

ANSWER: n/a

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

ANSWER: n/a

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

ANSWER: n/a

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

a) Manufacturing sectors at risk of carbon leakage

b) Manufacturing sectors not at risk of carbon leakage

c) Fossil fuel production sectors

d) Off-road mobile machinery

ANSWER: n/a

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: n/a

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

ANSWER: n/a

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

ANSWER: n/a

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

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

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

ANSWER: The ADE would note current innovation around whole house retrofit may reduce the timescale for a given retrofit. However, we do not yet have evidence on

whether this has the potential to quicken the decarbonisation of the entire building stock ahead of 2050.

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 does not currently have the right skills in place. Key gaps include: installation of new low carbon heating technologies and the development and establishment of heat networks.

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:

Scotland
In Scotland, the Scottish Government has already been piloting Local Heat and Energy Efficiency Strategies (LHEES), which allow local councils in Scotland to tailor heat and energy efficiency policy to their local context. Part of this has included the designation of heat network zones.

Scottish Government has since consulted on making identification of LHEES compulsory and is looking to ensure that all local councils have piloted LHEES in the next cycle.

It is proposed that identification of LHEES is based on socioeconomic assessments and heat mapping, to identify the best solution for an area. To support this, Scotland has created a Scotland Heat Map[1].

London
In London, the Greater London Authority (GLA) has made deployment of heat networks a priority. As such, the GLA has introduced the London Heat Hierarchy, which prioritises connection to a heat network under planning policy[2]. The New London Plan will also include Heat Network Priority Areas[3], which will identify specific areas of London best suited to heat networks.

The Netherlands
In the Netherlands, the National Climate Agreement is moving towards a local district-level process for identifying energy solutions. The Strategy says that “a meticulous process will have to be completed to determine the best solution for each district, for when houses are no longer heated with traditional central-heating boilers.”[4] Municipalities are expected to “decide on the future of the district in consultation with residents and building owners”, much as the Association is proposing as part of the Local Plan process.

[1] Scottish Government, Heat Map
[2] GLA, London Plan
[3] GLA, Draft New London Plan
[4] Klimaatakkoord, National Climate Agreement for the Netherlands, 2019

Much as the ADE is proposing for the UK, the plans are expected to generate a phased approach, creating early action that can be scaled up and rolled out over time. The Netherlands will support early-moving districts to begin this process, "which will allow us to learn and experiment systematically and move forward with cost-effective upscaling and implementation", before full-scale rollout of energy efficiency and heating policies commence.

Energy Innovation Zones
The West Midland's Policy Commission has identified that Energy Innovation Zones (EIZs) could be used to deliver good outcomes for consumers and industry. "EIZs are the missing link in the UK innovation eco-system for energy. We have small-scale technology demonstrators and we have competitive national market structures, but we lack a supportive space in which to prove and deploy new integrated approaches at scale."
The West Midlands Policy Commission recommended the introduction of EIZ, identifying the main benefits of EIZ's as: faster progress; lower emissions and potentially lower bills; lower system costs; local supply chains, jobs, skills and markets; system integration; improved productivity and faster growth; and standards for innovative technologies to help establish market.

The EIZ's did not go as far as the proposals identified by the ADE, as the aim of the EIZ was to create a proposal that could be taken up by authorities within the current funding and policy framework to encourage energy innovation and deliver system integration. However, the success of the EIZ helps to demonstrate how zoning at a local level can help to deliver good outcomes across the energy market.

Accelerator Cities Pathfinder
The Accelerator Cities Pathfinder project, part of the Climate-KIC Pathfinder programme, works with ambitious city authorities and stakeholders in the UK to create proposals for long-term, city-led home retrofit programmes. They aim to move "beyond stop-start policy and short-term pilots, and instead provide a stable way of achieving the scale of home retrofit needed if we are to meet the UK's target to be net zero by 2050"[5].

Simplified Planning Zones
Simplified Planning Zones (SPZs) were areas in which local planning authorities encouraged development by removing the need to apply for planning permission for certain development types. SPZs were removed from the NPPF and replaced with a combination of Development Orders and LEPs.

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: Further development of flexibility will be an important part of minimising the cost of decarbonising the power sector and would be come even more important if no new renewable plant can receive revenues from CfDs.
The main priorities must be –

- Removing barriers to accessing existing flexibility markets: Moving to day-ahead markets for flexibility that better suit renewable energy and DSR and ensuring distribution-connected flexibility is dispatched in the Balancing Mechanism when it

[5] UKGBC, Accelerator Cities Pathfinder, 2019

is unconstrained and cheaper than Transmission assets and reforming balancing services

- Developing flexibility markets on the Distribution networks: Developing liquid, pay as clear markets for intra-day network management to minimise renewable energy constraints as well as longer-term markets as an alternative to network reinforcement

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:

b) i. It is important to bear in mind that 'flexible demand' is likely to cover many different areas. It will include industrial and commercial sites as well as how households change their energy demand as well as responsive export from domestic and non-domestic prosumers. It will also involve much greater sector coupling – for example, making use of large-scale thermal storage on heat networks, flexible power export from decarbonised or abated peaking plants and CHP and smart EV charging.

b) ii. The ESO's net zero Two Degrees sensitivity in 2019 estimated that up to 13GW of non-domestic load flexibility would be needed by 2050 and a very high percentage of EV and heat installations being smart.

It is important if this magnitude of DSR is reiterated in the further, more detailed work in this year's FES, this represents almost all of the available flexible load – the UK would effectively be moving to a world where the norm is for demand to be flexible. Reaching this would require very significant changes to markets and regulation.

Question 31 (Hydrogen): The Committee has recommended the Government support the delivery of at least one large-scale low-carbon hydrogen production facility in the 2020s. Beyond this initial facility, what mechanisms can be used to efficiently incentivise the production and use of low-carbon hydrogen? What are the most likely early applications for hydrogen?

ANSWER: n/a

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

ANSWER: n/a

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

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

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

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

ANSWER: n/a

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

ANSWER: n/a

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

ANSWER: n/a

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: n/a

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

ANSWER: Local building stock (e.g. its energy efficiency or opportunity for improvements through retrofit), local resources (e.g. presence of waste heat or energy intensive industrial operations) and other factors of local context that impact decarbonisation decisions (e.g. demographics, vulnerability, topography, flooding, proximity to water, space availability, etc.) should all be factored in. This should be done in consultation with the DNOs, GDNs and distributed generation. In particular, grid constraints will play a key factor in determining least cost local decarbonisation pathways.

Heat density is very important to identifying where heat networks are viable. Typically, 50GWh/sq.km is see as a suitable heat demand. Atkins also cite 0.5MWh/m length of pipe. However, heat networks have been viable in areas with lower density, particularly where networks are making use of low cost, low carbon heat sources, e.g. solar thermal or waste heat, as heat losses are not as detrimental to carbon or revenue expenditure.

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: n/a