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 400 words per question and provide supporting evidence (e.g. academic literature, market assessments, policy reports, etc.) along with your responses.

Background

The Anaerobic Digestion and Bioresources Association (ADBA) is the trade association that represents the range of interests and matters related to the anaerobic digestion (AD) of organic materials across the UK, including the collection of waste for use as feedstock. ADBA understands the complex range of skills required by developers of new AD plants, from feedstock management through technology to energy production, markets and resources-to-land. ADBA is also a founding member of the World Biogas Association (WBA).

Our organisation has over 300 members from across the AD industry, including several manufacturing companies who have successfully integrated AD into their operations; other members come from a wide range of industries, comprising farms, supermarkets, local councils, private financiers, and specialist equipment suppliers. There are currently 672 AD plants in the UK, with an installed capacity of 992 MWe-e which is directed at electricity, heat and transport sectors.

Ready-to-use technology

AD is a ready-to-use technology, which is ever-improving through pioneering research; the extent of environmental benefits is likely to only increase over time. AD already reduces the UK's carbon emissions by over 1% and, if all available feedstocks were processed, could cut them by a further 4-5%. This proportion is set to increase as the UK reduces its total emissions, and innovation continues to increase plants' biogas yield. The CCC has consistently identified biomethane as a "no regrets option", advising that greater quantities of the green gas are urgently required.

Cost effective carbon abatement

AD delivers multiple carbon savings. Not only does biomethane displace fossil gas, but also prevents the release of methane from organic wastes directly into the atmosphere, for example when food waste is left to break down in landfill or sent to incineration. AD also reduces emissions from rotting manure, farm wastes and slurries, while still providing a low carbon, renewable biofertiliser. The CCC itself claims that AD needs to be used more widely on farms if the UK is to meet its fifth carbon budget.

Carbon capture and utilisation

Biogas produced during anaerobic digestion comprises biomethane and carbon dioxide. To upgrade biogas to grid-ready biomethane, the CO_2 must first be separated. At this point, it can be captured and utilised; Westons Cider, for example, feeds apple-based waste into their AD plant, generates renewable energy and utilises the bio-CO_2 to carbonate their cider. Alternatively, power-to-gas technology uses excess renewable electricity from wind and solar to produce hydrogen through electrolysis; this hydrogen can be mixed with raw biogas, reacting with AD's CO_2 to create more biomethane. This can nearly double the biomethane yield and convert AD from a carbon-neutral to a carbon-negative technology.

Fuel switching

Industries dealing with organic materials (e.g. food and drinks manufacturers) could develop an on-site AD plant to power and heat their operations. For example, around 80% of the UK's waste water is already processed through AD, where biogas generated typically powers Combined Heat and Power (CHP) units to provide electricity for their energy-intensive treatment procedures. Moreover, CHP units' heat can be utilised and integrated into a manufacturing process, such as pasteurisation, to cut the energy demand from the national grid.

Energy efficiency

Similarly, on-site AD increases energy efficiency through the localisation of industrial processes. Organic wastes do not need to be transported to external plants, and artificial fertilisers do not need to be produced and imported. As one UK-based cheese manufacturing company currently demonstrates, over 70,000 tonnes of dairy effluent can be processed through AD each year on-site, thus significantly cutting transport distances of waste around the country and providing a steady supply of biofertiliser for their cattle.

Biomethane: pathway to 2030 report

We are attaching our latest report tackling biomethane and its projected pathway to 2030. The report contains the AD industry's assessment of the required infrastructure, the available usage opportunities, the GHG savings and an overview of policies required in order to boost the sector towards achieving its highest potential. The report includes cost-modelling of biomethane yields, as well as AD plant commissioning. Please note that we are providing an embargoed copy of the report and the information contained is confidential and expected to be used for reference only in the framework of the CCC's 6th budget planning. The report will be launched in March for wider audiences and is expected to achieve a certain level of capitalisation through online sales.

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: We now have just 10 years to cut global emissions by 40-60% from 2010 levels[1] to prevent a temperature rise above 1.5°C, above which the consequences of climate change are increasingly catastrophic. Arguably we need to act much faster given that we are already seeing the severe impacts of climate change on our planet, its biodiversity and humanity itself. It is therefore vital that the sixth carbon budget seeks to be the most ambitious yet, not just adjusting emissions in line with the new net zero by 2050 target, but also taking into account the urgency to make significant carbon savings by 2030.

[1] https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/

As one of the first countries to set net-zero target by 2050, but also in consideration of Brexit, the UK must continuously seek collaboration with other countries within the EU, as well as the rest of the world, especially regarding innovation in relevant technology. The 6th carbon budget should aim to facilitate sharing of intellectual property, expertise and technology. In this regard, we propose that new trade deals the UK will be entering into contain clauses on green economy and provide a framework for import and export restrictions of goods that are carbon intensive. There is a huge potential to become a global leader on the green economy. If the biomethane industry is supported to deliver its full potential, cutting UK emissions by 6% each year, its expertise, service and technology can be exported around the world.

It is also important that the budget takes into account supply chain emissions and does not encourage the export of emissions abroad. One such example refers to vehicles that after a use period of around 5 years are disposed to countries in the Global South, where the economic landscape may not allow for deployment of infrastructure, political measures and funds to sponsor green economy on parity with the UK. In this context, while the UK can report continuous achievement or overachievement of its carbon targets reduction, third countries are bound to serve the needs of disposal generated by the consumerist business models and individual behaviours perpetuated within the UK. It is, therefore, fundmental that the UK takes into account the disposal of its technology and takes appropriate measures to ensure that other countries within the supply chain are not negatively affected.

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: In the context of Brexit and COP26, the UK must demonstrate to the world its continued commitment to the Paris Agreement. Global leadership has never been more fundamental for the UK's economy, and the green economy is an area with huge potential for growth and first mover advantage. The current momentum requires specific commitments on the part of the UK government, businesses, investors and other. A new NDC, now that the UK has left the EU and so will no longer be bound by its NDC, must set out the countries commitment to supporting this green economy and its ambition to become a global leader. This NDC must include biogas and the huge contribution it can make to cutting emissions in the hardest to decarbonise sectors, including heat, transport, waste management and agriculture. AD is a ready to use technology that must be deployed now.

We have prepared guidance on how to incorporate the wide-ranging benefits of biogas in the new UK NDC. Please find attached along with this document.

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: Consumers must be aware of where their waste ends up and must take personal responsibility for appropriately separating food waste from other waste streams. Information on best waste management practices is already shared across the nation,

because certain towns/cities more advanced than others. Experience must be shared by local authorities and marketing tools (pamphlets, TV announcements, newspaper news, etc.) should be employed to further inform the public of best practice. This kind of public awareness campaign is vital for the effective implementation of consistent separate recycling of food waste across England by 2023. Local authorities must provide the service and the public must be educated to make sure it is effectively utilised. For additional enforcement, inappropriate waste disposal must be penalised.

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 of the upmost importance that the majority of carbon savings are calculated based on technologies that are ready to use and can be deployed now to deliver the necessary decarbonisation. We cannot rely on technologies in development to make these savings.

AD is the technology that is ready to be used now and can deliver 30% of the current carbon budget for 2030, while hydrogen requires an immense amount of further investment to be commercially deployed, including to upgrade our infrastructure to make it hydrogen compatible. These measures need to be undertaken but take time which we do not have. Measures that can cut emissions now, must be put in place now.
Relying on the large-scale deployment of hydrogen, and the supporting infrastructure, will introduce significant risk to the budget scenarios. However, both biogas and hydrogen are believed to be complementary to each other and any investment in biogas now will be available in the future for hydrogen to utilise.

Current policy uncertainty is not sufficiently encouraging the biogas industry to grow and, therefore, not enough resources are being deployed towards further advancing the production of biomethane nor green hydrogen. This is attributed to the lack of certainty with regards to the schemes such as RHI, RTFO and SEG. These schemes run for periods of 5 years and are reviewed closer to the deadline without much prior communication by the government on future plans.

- RTFO, for example needs to be guaranteed continuity post-2032 so that investors are prepared to invest today in biomethane production that will guarantee transition to hydrogen.
- SEG that came to replace FiT requires additional funding towards generation tariffs, in order to promote construction of new plants.
- RHI is expected to be extended, but it is unknown for how long and under what conditions.

In this sense, the government is expected to guarantee the existence of schemes that respond to industry's needs through legislative amendments (yearly quota targets for biomethane and hydrogen production, for instance) and continuous incentives.
It is vital that a strategy is put in place setting out the continued commitment to green gas, and the complementarities between biomethane and hydrogen, giving investors confidence that they can fund projects and develop new industry technology, with confidence that support, in whatever form, will not be withdrawn.

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: If we consider the fact that the AD industry is able to achieve 30% GHG emissions reduction by 2030 it is important to revisit the targets set for both the 4th and the 5th carbon budgets. With appropriate support more ambitious targets can and should be set to bring the targets in line with the UK's net zero by 2050 commitment.

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: AD brings benefits not only towards energy security from a renewable source and reduction of emissions associated with energy production, but also allows for the following co-benefits that are in line with the circular economy principles:

1. Management of biodegradable wastes (food waste) that would usually be sent to landfill or incineration;
2. Production of a natural fertiliser for the soil – digestate and a potential partial displacement of chemical fertilisers – improving food security;
3. Promotion of social responsibility with regards to both a reduction of waste and better waste management as well as changes in individual behaviour;
4. Creation of 30,000 direct jobs in the green economy, spread across the country including in rural areas;
5. Investment into green industry of £20 billion.

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:

<u>Heat:</u>

- Immediate interim support beyond March 2021 in the form of an energy tariff to urgently increase deployment, closer to the rates seen in 2013-2015 which delivered deployment of around 100 plants per year, while more tailored policy is developed. Lessons learnt from the RHI and FiT should inform the design of this interim policy, including lengthening commissioning deadlines and tiering of the tariffs.
- A green gas obligation on the gas grid, with gradually increasing targets to stimulate demand and a minimum price for certificated gas to provide a level of certainty to investors.

<u>Transport:</u>

- Commitment to extending RTFO beyond 2032.
- Infrastructure funding for the development of alternative refuelling networks, delivering biomethane as a transport fuel.
- Align classifications of waste between government departments to simplify the participation across multiple incentive schemes, such as RHI and RTFO.

- A price guarantee should be introduced within the Renewable Transport Fuel Obligation to provide greater certainty to investors and to ensure a more stable supply of biomethane for transport.

Agriculture:

- A renewable biofertiliser obligation to stimulate the market for digestate and transition towards a more circular use of fertilisers based on nutrient recovery.
- In line with legislation requiring all digestate and manures stores to be covered by 2027, appropriate support/grants are required to effectively prevent emissions and draw value from captured gas, without adversely impacting farmers and operators.
- AD should be included in the Environmental Land Management Policy in the Agricultural Bill to recognise the benefits it can deliver in terms of reduced on-farm emissions, alongside generating renewable energy and generating renewable biofertiliser.
- Tighten the end-of-waste standards for digestate, including restrictions on feedstock contamination, to give farmers greater confidence in the quality of digestate.

Waste management

- Support for small business and community circular economy projects, transforming local waste into local heat and power.
- Encourage the treatment of all organic wastes through AD, including manure and slurry, by developing hierarchies, like the food and drinks material hierarchy, for all organic material, and introduce mandatory measures to ensure these hierarchies are enforced.
- Urgently implement separate collection of food and green waste for diversion to AD with the possibility of co-mingled collection in localities with dry-AD infrastructure.

Overarching

- Targeted innovation funding to unlock key aspects of the AD industry that reduce cost, including digestate upgrading; biomethane yield; and utilisation of bio-CO2.
- Increased administrative capacity in Ofgem and streamlining of processes to ensure there is confidence that payment will be made on time and accreditation will be received in a timely manner, such as accreditation for innovative new feedstocks.
- Lower business rates for the AD industry and review of other tax allowances that could be offered to incentivise deployment.
- Support best practice by tying policy to independent certification schemes, such as the Anaerobic Digestion Certification Scheme, to ensure plants are adhering to environmental standards, plant optimisation and health and safety, thus minimising risks and costs.

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: AD is a local decarbonisation solution that delivers local waste management, local green energy, local circular economy and local jobs creation. It is important that local climate emergency plans are integrated into all aspects of local policy and delivery objectives. For example, waste management strategies should be integrated into climate action plans due to the important impact this has on delivering carbon savings. AD is also

an appropriate technology to rural areas that do not have access to the gas grid, nor central heating solutions.

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: The government is expected to impose price controls on energy supplies, ensuring government funding is allocated where renewable energy deployment has not yet reached commercial scale.

Because the fossil fuels infrastructure has monopolised energy delivery to households and price controls are determined by the market, when renewable energy is deployed its costs are expected to be initially higher, with gradual decrease over time. The government is expected to support households that cannot afford the difference in those prices so prevent fuel poverty becoming a barrier to decarbonisation and ensure that energy is still affordable to consumers. This should also be mitigated by means of redirecting the current support for the fossil fuels industry (all tax breaks and beneficial support for fossil fuel exploration and sales) to other viable energy sources, such as biomethane.

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: At its full potential, the AD sector can generate 30,000 direct jobs and allows for an additional income through green gas certificate trading. In the same manner, AD can generate over £20 billion of investment into UK industry from both domestic and overseas investors, with appropriate support from the government.

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: Different regions in the UK provide access to varied feedstocks for the AD sector. Rural areas, in particular struggle with grid access and, therefore, must ensure other means of energy security. AD, is a perfect solution for those areas.

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: n/a

E. Sector-specific questions

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

a) What percentage of trips nationwide could be avoided (e.g. through car sharing, working from home etc.) or shifted to walking, cycling (including e-

bikes) and public transport by 2030/35 and by 2050? What proportion of total UK car mileage does this correspond to?

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

ANSWER: n/a

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

ANSWER: n/a

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

ANSWER: n/a

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

ANSWER: Biomethane is considered the most efficient fuel to address the needs of the HGV and bus fleets AD technology has not been mentioned and must be included in any future CCC budget planning to help unlock this ready to use technology for decarbonising HGVs. At the moment, however, investment is the biggest impediment, especially with fleets operating a low number of vehicles. Access to the refuelling infrastructure is also a barrier as fleets must undertake the responsibility of ensuring availability of refuelling stations, especially for longer distance travel.

Refuelling infrastructure for biomethane requires additional support from the government not only in terms of funding, but also in terms of comprehensive guidelines and a large enough team of public officials to ensure compliance is guaranteed and different cases are reviewed in a timely manner. Under the current circumstances the construction permitting, for example, is problematic to obtain, and local authorities need to be better educated with regards to new infrastructure needed for the future. In the same manner, private-public partnerships should be promoted to further propel the infrastructure build-up.

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:
a) Manufacturing sectors at risk of carbon leakage[2], especially those relevant to the biogas industry and with easy access of biodegradable wastes, should be incentivised to process those on site to prevent GHG emissions and produce additional electricity/heat/fuel to either power their manufacturing sites or export to the grid for additional income. Such practices of circular economy should be incentivised with tax breaks, industrial transformation funding, and green energy generation tariffs for technologies that provide non-monetary benefits otherwise not considered in business decisions. This should be supported by regulation mandating the collection of organic wastes and enforcing the adherence to a materials hierarchy for all organic matter, similar to the food and drinks materials hierarchy.

c) Fossil fuels production sector must partner with alternative power sources and promote transition by ensuring the infrastructure already in place can be reused with specific changes. The government must remove all tax breaks and beneficial support for fossil fuel exploration and sales. As per the Energy Network Associations recent report[3], our energy system can be fully decarbonised by 2050 if action is taken now to facilitate the transition. With support for fossil fuels removed, public spending can be redirected to other renewables such as biomethane.

d)There are already off-road mobile machinery such as agricultural tractors on the market that can use biomethane. Policy should support switching to biomethane as fuel, for example within the replacement of CAP within the Agricultural Bill.

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: Investment in the green energy sector will create replacement jobs for those expected to lose work due to the decline of the fossil fuels industry. At its full potential, the

[2] Carbon leakage occurs if costs of climate policies result in offshoring of production to other countries.
[3] http://www.energynetworks.org/assets/files/gas/Navigant%20Pathways%20to%20Net-Zero.pdf

AD industry will create 30,000 direct jobs and more indirect jobs, across the country. We can achieve this by 2030 with appropriate policy support. Jobs can also be created. Below is the potential per MWe-e:

Type of job	**Jobs per MWe-e**
Number of jobs in plant design/development over 2 year period - Per MWe-e	2.1
Number of jobs in plant construction and commissioning over 1 year period - Per MWe-e	11.8
Operation & maintenance over plant lifetime - Per MWe-e	2.4
Number of jobs in feedstock procurement over plant lifetime and sourcing - Per MWe-e	0.5

It is also important to protect consumers from increased energy prices as we transition to a green economy. It is therefore vital to design policy to incentivise innovation, for example with innovation funding, that focuses in on the areas of the sector that can significantly reduce the cost of generation.

In addition, the transition should start with industries that are able to integrate AD operations along with their industrial production by treating the generated organic waste through AD. Closely integrating AD within the industry's operations often promotes best practice, with companies recognising the importance of training and plant safety, and the need to maintain efficiency of the supply chain. At scale, industries may profit from AD's multiple revenue streams and cost saving benefits – saving on energy, waste treatment, and fertiliser costs.

Additional income can also be generated in cases where surplus biogas produced is sold to third parties.

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: There are currently 672 AD plants in the UK, with an installed capacity of 992 MWe-e. This is enough to heat close to a million homes. Of these plants, 108 are biomethane plants, in which the biogas is upgraded so it can be injected into the grid or used as transport fuel, with a total installed capacity of over 85,000m^3/hr, equivalent to the gas demand of Edinburgh[4], with a population of over 500,000 people[5]. The sector is currently injecting 2.1 TWh of biomethane into the grid each year, which is enough to heat more than 170,000 homes.

Biomethane can be used as a direct alternative to fossil gas, as it has the same chemical structure, meaning it is already compatible with the UK's existing gas infrastructure. Unlike biogas electricity, biomethane cuts emissions in the hard to decarbonise sectors of heat and transport, where there are very few alternative technologies and few that are at technological maturity. Biomethane is, therefore, the key solution to decarbonise heating and heavy goods vehicles in transport, with a great deal of potential for shipping and planes, over the critical 10 years ahead of us. At its full potential, the AD industry would be able to save over 27 million tonnes of CO_2(e) from being emitted into the atmosphere *every year* – greater than the current emissions of all HGVs operating within Great Britain[6].

Feedstock	**Biomethane capacity of today's AD industry** million m^3	**Equivalent homes heated**	**Biomethane potential from 2030 feedstock** million m^3	**Equivalent homes heated**	**GHG emission abatement from 2030 feedstock,** $MtCO_2$(e)
Food waste	456	380,000	443	369,000	1.81
Sewage	272	227,000	616	514,000	5.55
Farm waste	83	69,000	1,992	1,660,000	10.46
Industrial waste	924	770,000	1,364	1,137,000	2.62
Green waste	3	2,000	748	623,000	1.44
Bioenergy crops	463	386,000	514	428,000	0.99
Subtotal	**2,201**	**1,834,000**	**5,677**	**4,731,000**	**22.86**
Power-to-Gas			2,271	1,892,000	4.36
Total			**7,947**	**6,623,000**	**27.22**

For further discussion please see Element Energy and UCL for the CCC (2019) Analysis on abating direct emissions from 'hard-to-decarbonise' homes, with a view to informing the UK's long term targets, p88.

[4] https://www.gov.uk/government/statistical-data-sets/gas-sales-and-numbers-of-customers-by-region-and-local-authority

[5] https://www.nrscotland.gov.uk/files/statistics/council-area-data-sheets/city-of-edinburgh-council-profile.html

[6] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/787488/tsgb-2018-report-summaries.pdf

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 gas grid is already compatible with biomethane and the recent ENA report on the pathway to net zero proposed a zoning system of biomethane and hydrogen for the future gas grid, minimising disruption to users.

Question 28 (Buildings): How can local/regional and national decision making be coordinated effectively to achieve the best outcomes for the UK as a whole? Can you point to any case studies which illustrate successful local or regional governance models for decision making in heat decarbonisation?

ANSWER: n/a

Question 29 (Power): Think of a possible future power system without Government backed Contracts-for-Difference. What business models and/or policy instruments could be used to continue to decarbonise UK power emissions to close to zero by 2050, whilst minimising costs?

ANSWER:

- Innovation could significantly reduce cost of anaerobic micro-scale digesters, enabling factory line production. This would enable a business model in which households can recycle their organic wastes (food-waste, sewage, agricultural waste) into energy. The target markets are farms and eco-neighbourhoods.
- Additional innovation is expected to cut costs and improve efficiency of the technology on the market.
- An effective carbon trading scheme, that rebalances the pricing system in markets to account for the climate impact, would significantly improve the financial equation of many green technologies, including AD.
- The certificate trading schemes, covering green gas, transport fuel, and renewable fertilisers, are expected to further propel decarbonisation, and should be accompanied by progressively increased obligation quotas to stimulate demand.
- A more effective shadow pricing of environmental benefits and/or services will allow for new business models to be generated and strengthen demand for co-products of biomethane and digestate, making them more independently viable.

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:

i) AD should have a significant role in the 2030/35 energy mix to urgently decarbonise heating and transport, making use of all available feedstock to generate renewable green energy. As technologies currently in development reach maturity, and infrastructure is adjusted to accommodate these new technologies this may shift, but we will always need to treat our organic wastes and prevent the emissions they generate. Biomethane with therefore always be an important part of the future energy mix, but depending on the future price competitiveness, may be best utilised as a platform for generating green hydrogen.

ii) During summer, high solar and wind energy production can exceed the UK's electrical demand, yet there is no means of storing this electricity at scale. AD offers an opportunity to utilise and store this excess energy, through the production of additional biomethane. In short, surplus electricity can be used to produce hydrogen (via the electrolysis of water) which, when mixed with AD's biogas, combines chemically with the CO2 to generate extra biomethane; upgrading biogas to grid-ready biomethane, and minimising the venting of bio-CO2. This allows this excess energy to be stored in the gas grid. Here, innovation can help plants make the best-use of their energy output. Depending on capacity, wind/solar electricity may be fed into the grid or used to support biomethane production at any given time.

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 gas grid is not yet compatible with more than 20% hydrogen, incorporation into the AD process allows for the best use of green hydrogen to capture carbon and generate grid-ready biomethane. Recent innovation is looking to integrate AD with wind and solar farms to optimise their respective strengths. During summer, high solar and wind energy production can exceed the UK's electrical demand, yet there is no means of storing this electricity at scale. AD offers an opportunity to utilise and store this excess energy, through the production of additional biomethane. In short, surplus electricity can be used to produce hydrogen (via the electrolysis of water) which, when mixed with AD's biogas, combines chemically with the CO2 to generate extra biomethane; upgrading biogas to grid-ready biomethane, and minimising the venting of bio-CO2. Here, innovation can help plants make the best-use of their energy output. Depending on capacity, wind/solar electricity may be fed into the grid or used to support biomethane production at any given time.

Post 2030/35, as the energy networks develop to become hydrogen-ready, hydrogen generation through wind/solar hydrolysis can be used directly as an energy source rather than used to generate biomethane, which is already compatible with our existing infrastructure. Going forward hydrogen is expected to become one of the primary fuels for domestic heating, alongside biomethane, to heat homes and fuel transport. Furthermore,

biomethane itself could act as a renewable supply of hydrogen gas, if hydrogen became the dominant energy source further down the line. With a molecular structure containing four hydrogen atoms (CH_4), biomethane can be used to create hydrogen, instead of the fossil gas generally used in the generation of blue hydrogen, and requires much less energy than splitting water (H2O) molecules through electrolysis.

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: There is great opportunity in the shipping industry to move to a more circular model. Cruise ships coming into port could unload organic waste to on site AD facilities. These plants could treat the large quantities of organic waste, currently expelled to the sea, and generate biomethane at the port to be used in gas fuelled ships, which are becoming more popular, particularly for cruise liners.

Similar models could be used in airports, with potential for the biomethane generated to be upgraded to alternative aviation fuel.

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: Bioenergy crops should be sustainably integrated into the UK agricultural systems, using the land to provide for the multiple needs of the society. By implementing sustainable agricultural practices, farms can supplement productivity and income through the growth of bioenergy crops, without loss of biodiversity, environmental degradation or reduced food yields. Such agricultural practices will include, but are not limited to, crop rotations, use of cover crops, sequential cropping, herbal lays.

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: Biogas produced during anaerobic digestion comprises biomethane and carbon dioxide. To upgrade biogas to grid-ready biomethane, the CO_2 must first be separated. At this point, it can be captured and utilised; Westons Cider, for example, feeds apple-based waste into their AD plant, generates renewable energy and utilises the bio-CO_2 to carbonate their cider. Alternatively, power-to-gas technology uses excess renewable electricity from wind and solar to produce hydrogen through electrolysis; this hydrogen can be mixed with raw biogas, reacting with AD's CO_2 to create more biomethane. This can nearly double the biomethane yield and convert AD from a carbon-neutral to a carbon-negative technology.

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: The gas grid is already compatible with biomethane and the recent ENA report on the pathway to net zero proposed a zoning system of biomethane and hydrogen for the future gas grid, minimising disruption to users.

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