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

BEAMA introduction – our sector's commitment and work to achieve net-zero

BEAMA members recently signed a commitment to the Net-Zero by 2050 target[1]. This commitment was twofold. Firstly, it set out their commitment to reduce their own emissions as businesses. Secondly, it set out the commitment from our sector to the known policy and regulatory changes that will need to happen in order to ensure Net-Zero is achievable. The focus of our attention and interest as a sector is very much in the transport (associated charging infrastructure for Electric Vehicles), buildings, and transmission and distribution network infrastructure investment.

As a key sector to take early steps in committing to this target, we are pleased to feed into this call for evidence and welcome any additional opportunity to discuss barriers to achieving the carbon budgets that may relate to our sector.

In terms of our member's work to reduce their own emissions as businesses it is clear that those that have signed this commitment are all at different stages in the developments of their plans in achieving Net-Zero. In many cases the next 5-10 years will focus on reducing emissions from their built assets (UK based offices etc) and associated business transport in the UK. Many of our members are multinationals and are part of larger company groups, in this case company emission reduction plans are developed centrally, and will contribute to emissions reductions far further afield than just the UK.

The challenge our members are now discussing within BEAMA, and looking for further support and guidance on, is how to decarbonise their overall supply chain and manufacturing processes. The nature of our supply chains means this is global in reach and our members are in some instances reliant on other emitting sectors (e.g. metal industry). We do not claim to have all the answers but as a sector our members are keen to engage in constructive discussions with Governments and independent organisations including the CCC to develop our understanding of what trade and market mechanisms could be put in place to facilitate emission reduction from the electrotechnical manufacturing industry, and how this can be done in such a way to limit the cost burden on manufacturers (recognising also BEAMA represent many smaller UK based companies), and ensure the transition to Net-Zero remains commercial viable.

Several of our members have set their own company targets to achieve Net-Zero earlier than 2050, and in some of these cases the ability to offset emissions initially (2020-2035) will be key. In this instance we are working to learn more on best practice in the market and facilitate the development of harmonised and sector driven standards (working closely with BSI) that will ensure the methodologies for claiming emission reduction through offsetting are legitimate and applicable for our sector. Furthermore, we hope to also gain a better understanding of where businesses should invest for offsetting where a genuine benefit can be realised in terms of global emission reduction.

With regards to the 6th carbon budget this will be absolutely key in driving the harder to reach areas of industry and emission reduction of UK supply chains. Given the need for early clarity and for us to make progress before the 6th carbon budget commences, we strongly support the need to review the

[1] BEAMA Net-Zero by Design, September 2019, http://www.beama.org.uk/resource-library/net-zero-by-design.html

4th and 5th carbon budget as well to ensure these are bought into line with the new target, and the reality and practical barriers to meeting these can be addressed now.

In our Net-Zero by Design report we outline important practical barriers to the delivery of net-zero that need to be tackled in the next 2 years. We believe as a sector that failure to tackles these barriers will make it difficult to achieve the transition to net-zero e.g. building regulations and certainty over the transition to low carbon heat. In such cases these will require significant changes to our members' production lines and therefore certainty is needed soon in order to drive the appropriate investment. We ask that the CCC review the points raised in our Net-Zero by Design report to inform the review of the carbon budgets but especially in the review of policy and regulatory levers that will ensure the target is achievable.

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.

A. 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?

Homeworking could result in annual savings of over 3 million tonnes of carbon and cut costs by £3billion in the UK. UK business is looking closely at the progression to home working to help reduce emissions and we believe this could play a key role in reducing car miles.
Supporting evidence:
https://www.carbontrust.com/resources/reports/advice/homeworking-helping-businesses-cut-costs-and-reduce-their-carbon-footprint/
Bicycle use would help achieve 12 to 26% of the 2050 target reduction set for the transport sector, depending on which transport mode the bicycle replaces.
https://ecf.com/files/wp-content/uploads/ECF_BROCHURE_EN_planche.pdf
The ECF states that if the EU is to meet its emissions target, which currently calls for a drop of between 80% and 90% on 1990 levels by 2050, major changes will be required somewhere, and that transport is a the ideal place to start. From 1990 to 2007, transport-based emissions on the continent rose 36%, while those from other sources fell 15%. It also points to the example of cities such as Seville in Spain, where the construction of segregated bike lanes and other policies saw cycling increase tenfold in just three years.

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?

BEAMA's sector is specifically focused on the delivery of infrastructure to support the deployment of Electric Vehicles. The biggest barrier that could exist and prevent the phasing out of conventional vehicles will be if infrastructure deployment is slow and or insufficient to accommodate the growing demand for electric vehicles. To meet the target by 2030, urgent action is needed to advance progress already being made in infrastructure deployment, as many consumers will only transition to electric vehicles with the knowledge that the infrastructure is compatible and widespread. There is a concern that once cost and access to charging become acceptable, there could be a rapid uptake of EVs, so network infrastructure must be capable of meeting the expected demand.

With this in mind the barriers linked to network reinforcement and management of the increasing load from electric vehicles need to be urgently addressed. The next price control (RIIO2) will be key in determining the preparedness of the system to accommodate for the growth in electric vehicles and this will need to drive some investment ahead of need to manage the growing demand for electricity during the price control period.

BEAMA have been an active member of the Electric Vehicle Energy Task force, working closely with OLEV and BEIS to develop the recommendations for what needs to be done in order to remove barriers to uptake for electric vehicles. These recommendations, as agreed by industry will need to be acted on to open up access to infrastructure across the UK. This will include the development of standards for market deployment (for which work is already underway in BSI).

https://www.lowcvp.org.uk/projects/electric-vehicle-energy-taskforce.htm

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

Policy implementation across all manufacturing sectors could prove unbalanced & potentially detrimental to the electrical manufacturing sector.

To uphold the strength of the carbon price signal in the EU ETS, its design should reflect that the scale of any leakage will actually be small , but concentrated in a few sectors. For instance: implementing the current EU ETS Phase III targets to 2020 without any free allocation of Allowances or protection would drive less than 2% of emissions abroad, but this average

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disguises that, for instance, 5-10% of cement or steel emissions (and production) might leak, and leakage from coastal areas may be greater than those that are landlocked.

Leakage could retard low carbon investment and innovative solutions for the exposed sectors, increasing the cost of meeting carbon targets for the rest of the economy. Given the current EU emissions target, granting free allowances to cement, steel and aluminium could increase the carbon price faced by the rest of industry by 10-30%; whilst cement sector profits could rise by £0.7bn – £3.4bn annually during Phase III, depending on how the sector responds, without necessarily preventing leakage.

In the carbon trust study iron, steel and aluminium are identified at being particularly at risk of carbon leakage, and these are linked to our sector's supply chains and for the sourcing of raw materials.

https://www.carbontrust.com/media/84908/ctc767-tackling-carbon-leakage.pdf

While the electrotechnical manufacturing sector is not directly at risk of carbon leakage, this is still an acknowledged issue and the risk that our sector and others will suffer due to lack of harmonisation regarding global emissions trading. Work to develop a form of carbon adjustment mechanism is also something our members anticipate could form part of the existing ETS system, and it does represent a way to tackle supply chain emission reduction.

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?

Germany - Renewable Electrification and - 90% GHG Reduction
http://deepdecarbonization.org/wp-content/uploads/2015/09/DDPP_DEU.pdf

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

Lots of research has been carried out, but they all have a common finding that further work is required to understand the wider distributional implications of low-carbon transitions, beyond the just Transitions agenda, encompassing all of the possible adverse risks of rapid low-carbon transitions. This includes: a more thorough understanding and evaluation of the costs and benefits of these transitions and their distribution (across people, groups, sectors, and regions); case studies and comparative analysis of transition governance (strategies, mechanisms, organisations, and processes) in different countries and contexts; analysis of the social and

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political dimensions of transitions; and evaluation of transition policies in light of how effectively they meet their desired goals. Example research below.
https://www.imperial.ac.uk/media/imperial-college/grantham-institute/public/publications/briefing-papers/26.-Towards-a-just-and-equitable-low-carbon-energy-transition.pdf

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)?

1. Study carried out by defra - savings to range between 29.1 and 38.3 MtCO2e.
2. The mean annual savings opportunity is estimated to be 33.7 MtCO2e

- We haven't been able to source much evidence regarding the cost savings for fuel switching in electrotechnical manufacturing industry. In many cases we do know this to likely incur significant costs on a company, and this is especially hard to manage as an SME. There can be savings (e.g. investment in renewables), but ultimately market incentives needs to be appropriate to ensure businesses can re-coup their investment over time and the benefits are clearly advertised e.g. if companies are to switch to electricity then steps need to be taken to ensure electricity prices are reflective of their carbon intensity.
- Circular economy - resource efficiency measures for products

Considering the resource efficiency and material substitution for the design of products our members manufacture, we don't have evidence available to demonstrate cost savings that can be made from introducing more resource efficient alternatives, but we can comment on actions that need to be taken by Government that will ensure this transition is economically viable for business, and unnecessary costs are not transferred to consumers.

Our members fully accept the drivers for change in the resource and material efficiency of products. We have been engaged in the European Standardisation work (M/543) in the last few years to set in place the standardised basis on which measures can be developed in the market for the improved circularity of products. Key deliverables include:

- TR 45550 Definitions related to material efficiency
- EN 45552 General method for the assessment of the durability of energy-related products
- EN 45553 General method for the assessment of the ability to remanufacture energy-related products
- EN 45554 General methods for the assessment of the ability to repair, reuse and upgrade energy-related products
- EN 45555 General methods for assessing the recyclability and recoverability of energy-related products
- EN 45556 General method for assessing the proportion of reused components in energy-related products

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- EN 45557 General method for assessing the proportion of recycled material content in energy-related products
- EN 45558 General method to declare the use of critical raw materials in energy-related products
- EN 45559 Methods for providing information relating to material efficiency aspects of energy-related products.

To make this economical for industry the key is ensuring effective regulation drives change and can create market value for the new products. The Eco Design framework has been used as a good example of a regulatory framework which has in the past driven up the minimum standard for the energy efficiency of products, removing less efficient, polluting technologies from the market (e.g. hot water storage ref p22 of the BEAMA Net-Zero by Design report[2]). We anticipate this framework and/ or something similar, to be used to drive the improved resource and material efficiency of product design going forward. As measures come up for review under eco design the new standards developed under M/543 will form a basis to start incorporating resource efficiency measures.

It is important that as a framework for improved resource efficiency is developed this is consistent and aligned with other countries to reduce the risk of non-tariff trade barriers, and ensure the transition to circular economy is economical for business as well as seen as a mass market solution, rather than bespoke national requirements.

There are already examples of emerging regulatory measure that can help incentivise the placement of more circular products on the market before resource intensive products are able to be phased out of production or replaced with suitable alternatives. This includes the proposed modulated fees under the new Waste Framework Directive for EEE products. This ensures products that fall within existing extended producer responsibility schemes are incentivised to provide more resource efficient products through reduced fees.

Extended producer responsibility is viewed as a viable regulatory route to manage the resources placed on the market and help finance their end of life treatment to avoid unnecessary environmental impact. Looking at the CCC technical report some of the product sectors highlighted for improved resource efficiency measures are currently being covered by EPR or will be e.g. Electrical products and appliances, plastic packaging. In these cases often it is the responsible party placing the finished product on the market (manufacturer or wholesalers) who may be highlighted at the 'responsible' party under these schemes. However, BEAMA members are recognising this presents some barriers to limiting the supply of inefficient/ polluting resources at source, and therefore, while harder to regulate, future EPR aimed at driving down the polluting resources applied to products more responsibility/cost needs to be placed on the producers of the original material e.g. plastic rather than the party placing a finished product on the market.

[2] http://www.beama.org.uk/resource-library/net-zero-by-design.html

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Overall when BEAMA consult our members on resource efficiency measure and future regulation to drive down the use of high emitting fuels, the response always includes an emphasis on enforcement. Our members see failure to adequately enforce existing regulatory measures in the market (e.g. WEEE, product compliance generally), and therefore with any new product regulation, or added responsibility on them as manufacturers they look for where the additional enforcement will come from to find companies who are non-compliant, as this undermines the market and potential cost they are investing in their business to comply. Enforcement will be vital in meeting the net-zero target.

Resource efficiency and reducing consumption - leasing models.

When looking at how to reduce consumption of products within BEAMAs sectors, and also aligning benefits of taking action here with other key drivers linked to net-zero (e.g. heat and buildings), we have been considering the benefits of advancing work developed by the Energy Systems Catapult for heat as a service measures. This is reported in more detail in our Net-Zero by Design report[3] (P31).

BEAMA members who manufacture heating, hot water and ventilation products are overall supportive of the idea around moving more towards a leasing model for home appliances, and in some cases this may already have commercial viability. However, linking this to the urgent need to retrofit existing homes across the UK with low-carbon heating systems and the leasing model, improves the potential viability of mass retrofit programs.

It is well documented that the cost of retrofit for some homes could involve significant upfront cost. While there are known savings overtime in moving to low carbon, more efficient heating, the energy as a service model removes the barrier of upfront cost, ensure savings overtime can be delivered to the customers, and fits well with a leasing model for home appliances where by the consumer doesn't own the technology installed but pays a monthly contract for their 'energy service'. In this instance not only are we targeting the retrofit challenge, enabling a suitable platform for flexible energy services, but we are also creating a market for circular products. In any leasing model for appliances a stronger emphasis is placed on the value of the repairability, warranty and life expectancy of a product, as the business model is based on the lifespan of an asset, not upfront sale. This is one example of action that can be taken today to help meet the 4th and 5th carbon budget and tackle some of the most challenging aspects of meeting net-zero.

[3] [3] http://www.beama.org.uk/resource-library/net-zero-by-design.html

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?

The ability to decarbonise buildings by 2050, or even earlier, is dependant on regulatory and policy reform to drive this change. Of most significance is the building regulations. We are currently feeding into the Consultation on the Future Homes Standard for new build and will be commenting on the latter consultation for Part L existing and commercial homes. We have reporting on the barriers existing building regulations pose to the ability to reach net-zero by 2050 in our Net-Zero by Design report[4].

Very limited progress has been made in the last 10-20 years despite previous governments setting out their commitments to improve the efficiency of buildings. E.g.
Prime Minister Gordon Brown in the 2007 Budget statement which announced that the government would ensure that by 2020 all homes would meet their cost effective energy efficiency potential, however this definition of 'cost- effective' looks only at short term payback and does not factor in any value for the cost of carbon. Since 2007 we are still on the same journey with very little policy change & public up take.

Therefore, change must be set in regulation, and not dependant on changing government objectives and policies.

https://s3-eu-west-1.amazonaws.com/assets.eti.co.uk/legacyUploads/2015/03/Smart-Systems-and-Heat-Decarbonising-Heat-for-UK-Homes-1.pdf
"33% Savings A basic 'Retrofit' package" of measures could achieve CO2 savings of 33% at costs in the range of £7,500 to £21,000 per building.
A more extensive 'Retroplus' package could reduce CO2 by around 45% for between £15,000 and £31,000 per dwelling.
26 million homes require a significant level of intervention across just 25 years, so the consumer pull, market push and resource capabilities need to be stimulated to consistently deliver at the rate of some 20,000 home upgrades per week from 2025.

The current regulatory framework and arguably the proposed changes as we know them so far under Part L will not achieve this scale of change, and so the idea of decarbonising housing before 2050 is hard to imagine.

Example of fast transition is Energiesprong a Dutch initiative which transforms existing housing stock into net-zero energy houses. Net zero energy means that the house generates as much energy as it needs for heating, hot water, lights and household appliances. This is made possible by technology such as prefabricated facades, new smart heating and cooling installations and

[4] BEAMA Net-Zero by Design, September 2019, http://www.beama.org.uk/resource-library/net-zero-by-design.html

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insulated rooftops equipped with solar panels. The retrofit can take place within one week, which means that people do not need to leave their homes.
The system has already been trialled in Nottingham, initially with 17 houses. It is now to be scaled up to 155 homes. https://www.energiesprong.uk/projects

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?

No.In our Net-Zero by Design report, we documented the known lack of skilled trades people to deliver the scale of action necessary in the mass retrofit of UK homes.

For heat pumps we are currently working closely with the UK heat pump manufactures, certification bodies and training providers and BEIS to review the skills needs for the sector, and assess what the most effective regulatory framework would be to oversee the training of skilled installers in the market. There are currently less than 1000 MCS qualified contractors for heat pumps in the UK today. We also recognise that the minimum competency frameworks on which these training programs are based have not been updated for some time. We are calling for:

- The updating of minimum technical competency frameworks on which new training is to be based
- The creation of a national register for low carbon installers which is centrally managed by government.
- The creation of a steering group by BEIS which includes the heating industry (manufacturers and installers), certification and awarding bodies, and training providers to produce a single, new, recognised, accredited and validated course by an awarding body such as City and Guilds (as a Vocational Qualification). This would allow the course to be delivered by different bodies (training providers, manufacturers) and ensure that the qualification is recognized by industry, especially competent person schemes.
- The creation of a skills car for low carbon installers, which establishes the technologies that they are competent to work based on the training undertaken. An experienced route and grandfathering rights should be allowed.
- Funding incentives from Government to incentivise installers to undertake low carbon heat training courses (e.g. voucher schemes)

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More detail can be provided on this program of work by contacting BEAMA technical management adrian.regueira-lopez@beama.org.uk

The skills issue is also a know contributor to the performance gap in buildings, while we aren't able to provide exact evidence on what this could be, it is known that especially for more complex, new technologies and systems an installation may not achieve its recorded efficiency, and actual efficiency levels can fall way below what is expected. Some useful work has been conducted by Assured Performance Process which outlines the performance gap issue in more detail for new build and existing homes. http://www.assuredperformanceprocess.org.uk/

It should be noted that the skills shortage is both a barrier and an opportunity. There are many high quality jobs that can be created in this sector. The installer community will be a key driver for the retrofit of UK homes. In the BEAMA Net-Zero by Design report we review the 'replacement opportunity' in light of the 2050 target and the barriers currently existing in the market which will prevent the transition to low carbon heating. Heating systems are predominantly on a 15-20-year cycle of replacement therefore necessitating the urgency of action now to target installers to drive the retrofit of existing homes.

In many cases it is easier to replace like for like, and installers often focus on the most profitable installations, which is not always consistent with working towards the net-zero target. We need to make low carbon profitable for installers and incentivise them to move away from fossil fuel technologies.

Key steps to incentivise the installer community:

Building regulations: Arguably this will be the main trigger for action across the marketplace. With the current 2025 Future Homes Standard consultation some steps are being seen to progress the move away from high carbon fuel heating, but this currently only applies to new build. For most heating installers it is probably changes to the Building Regulations for existing homes as they apply to changing boilers that will be the trigger factor. The concern is major long term steps to change heating in existing homes may only appear when there is clarity on the degree to which the existing gas network can be harnessed to deliver hydrogen to existing homes, as this is a key aim for Government for overall decarbonisation of heat. But action needs to be taken now to target existing homes for retrofit and creating the commercial viability to do so.

1.6 million boilers are replaced every year.

A skills omission is for a design to be carried out to size replacement boilers adequately for the heat load of the property. Boilers are generally sized to match the boiler removed (regardless of any improvements to the building fabric) and where these are combination boilers they will generally be sized to the hot water load which makes them significantly oversized for the heating load. The net result is that the boiler runs less efficiently, meaning extra carbon emissions in the period before a low carbon alternative is installed, and even the addition of modulating controls may not be able to optimise the output. Correct design should be standard practice and will also help to prepare installers for fitting heat pumps where accurate design is essential.

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1% of hot water cylinders are removed from UK homes annually – based on a flawed market mechanisms (ECO) we are removing future storage capacity in buildings which will be vital for the delivery of net-zero.

Transferable Skills:

- Refrigeration industry for heat pump installations
- Re-train existing smart meter installers. These installers have existing expertise in IOT devices, electricity and gas supply, controls and instrumentation. An idea is these installers could be retrained to conduct house retrofit assessments for energy efficiency, heat and control requirements. As they already have relationships with the energy suppliers, the retraining and assessment program could be delivered through the supply sector – often linked to home boiler cover, prompting local supply chains to deliver the retrofit needs again clearly set out market incentives (reduced electricity tariffs, DSR, energy as a service etc)

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?

BEAMA has long advocated for a regional approach to delivering mass rollout of low carbon heating and hot water systems. This ensures technology rollout can be matched with regional energy system characteristics, building type and customer base, as well as helping to stimulate local supply chains for installers, services and provision of technologies. This encourages B2B relationships and the targeted approach required for electrification. The pathway to low carbon heating and hot water requires collaborative working that can help build a supply chain capable to deliver our needs. With this comes quality assurance, relevant and consistent marketing campaigns and integrated finance offers. Most importantly of all, with local authority involvement as a trusted access route to data and local demographics, strategies can be developed and implemented that promote finer targeting and essential B2B derived technology and service offering to develop local strategies.

When looking at the requirements for retrofit linked to net-zero, there are huge benefits in co-ordinated local action. Not only do housing types vary considerably, but so do the network characteristics and constraints. The case for effective delivery of net-zero for energy use in UK homes is linked to the additional effective management and investment in electricity networks to manage demand and variability on the system from renewables. Any retrofit program should look to bring this all together, installing new low carbon technologies and systems alongside the deployment of new energy services. This ensures the cost viability of retrofitting and the

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transition for UK residents and can help keep energy prices down during the transition to net-zero.

The overall market incentives and financing for this transition is something that has to be determined at a national level e.g. green finance options, electricity prices, running costs, grants, market frameworks for new flexible energy services, building regulations, training programs, consumer guidance and awareness.

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?

BEAMA have been working with Energy UK on a report soon to be published outlining the current barriers facing the development of market for flexibility in UK. This report reviews the progress against the UK Smart Systems and Flexibility Plan. It is commonly acknowledged across the energy industry that progress in this area has been slow.

Research performed by Carbon Connect and Imperial College London in 2016 informed the development of a joint Government and Ofgem plan for delivery of a smart flexible energy system in GB. This research set out the potential reductions in cost that could be delivered by effective competitive markets for flexibility, estimating this at between £17-40 billion by 2050 and around £8 billion per year up to 2030**.**

The initial confidence developed in the market following the publication of the Smart Systems and flexibility plan is faltering. We therefore see considerable risk that the level of flexibility that could be achieved to deliver net-zero will not be realised. This could leave the UK at considerable risk of realising a pathway aligned with a 'slow start' scenario and therefore £9bn cost to consumers.

This report will be published in February, and will outline key actions that need to be taken in order to align the development of policy and regulation that will facilitate a market for flexibility

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services. But to date the market is suffering from a lack of coherent action between BEIS and Ofgem and is not able to meet its full potential.

Boost renewable and low-carbon electricity generation. Urgent actions: A program to deliver a more than a tripling in the collective output of solar and offshore and onshore wind within a decade. Immediate and substantial investment and support to bring other key technologies to market at scale within a decade, in particular marine energy. It is assumed that the UK's nuclear generating capacity is maintained at its current level.

The modelled scenario simulated by Cambridge university assumes that, of the possible technical potential:
• 84% of heating control and upgrade measures are installed
• 50% of available homes are fitted with waste water heat recovery
• 60%* all remaining boilers not replaced by low carbon heat are upgraded (*40% of homes will have zero carbon heat)
• 60% of homes have enhanced double glazing
• 62% of homes have floor insulation
• 66% of solid walls are insulated
• 88% of remaining lofts are insulated
• 92% of cavity walls are insulated
• 59% of other building fabric measures are deployed.
The modelling also assumes a significant additional role for wastewater heat recovery systems (WWHRS). These work by extracting heat out of the water as it washes down the drain pipe of a bathtub or shower.

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?

Making renewable or zero carbon hydrogen: A primary challenge for hydrogen in maximising renewable and low-carbon energy by 2030 is producing hydrogen in a way that is renewable or zero carbon. Currently, the majority of the world's hydrogen is produced by reforming natural gas, which releases high levels of GHG as part of the process, and so is neither renewable or zero

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carbon, and so would not contribute towards renewable and low-carbon supply. However, there are two alternative solutions for producing suitable hydrogen:

• Natural gas reformation with carbon capture and storage – As outlined above, a key long term solution for staying within carbon budgets, and given its remaining an immature technology at scale, will be invested in as part of this strategy, with moderate capacity expected by 2030. However, it is simply not possible today or in the next 5-10 years, to go out and buy such a plant at commercial scale. It will not be deployed at enough scale by 2030 to permit large scale hydrogen production for heating. There are also other concerns around locking-in long term dependence on natural gas, a fossil fuel, for heating, for instance around long term pricing and energy security. Of the two options this is the one preferred.

• Electrolysis of water using renewable electricity – This is the preferred option or a number of reasons:

- Is a genuinely renewable and indigenous energy source, and so avoids the risks and concerns
Enables higher penetrations of renewable energy across the board, both in heating but also power/transport, because it allows capture of excess available renewable power at points where demand not high, providing option for large volumes of long term storage. This However, despite the above strengths, and reasoning for this being a long-term option to be energetically pursued, currently the cost of electrolysis is extraordinarily high, several times more than gas reformation, due to the high costs of electrolysis equipment and lack of economies of scale. It is therefore not a commercially viable option currently, and so does not feature explicitly in the plan before the later 2020s.