1. Pathway considerations: Have we captured the main technological, social, economic and commercial factors we should be considering in our pathways? Do you have any evidence for barriers in specific sectors and technologies?

Regarding barriers for historic buildings, the government recently (Jan 2024) published its review into the barriers when adapting historic homes for energy efficiency, alongside measures it will take to address these. Heritage & Carbon: Addressing the Skills Gap further demonstrates the skills gap in the construction industry. We note, however, that many of the issues are not limited to listed homes or homes in conservation areas. Barriers associated with industry skills, funding and information and guidance for homeowners/occupiers are equally as valid for non-designated traditionally constructed buildings, including non-dwelling buildings. We raise this because the use of listed building and conservation area data, when used alone as a proxy for all 'heritage buildings', especially when determining complexity and cost, can have limitations. Many of the issues are associated with a building's construction type and use, rather than whether a building is designated or not. Designation is designed to be a tool to help manage change via the planning system and the data does not represent the full stock of traditionally constructed buildings.

Regarding technology, there is a lot of unhelpful misinformation in the public domain about the suitability of heat pumps in historic buildings, including assumptions that historic buildings are a barrier to heat pump uptake. This is simply not true. Our own research on ground source heat pumps in small scale buildings suggests heat pumps are an efficient technology for historic buildings if designed, installed and used well. Where heat pumps have been unsuccessful, this is often due to poor design, installation and use. We are about to publish further research into the viability of: 1) air source heat pumps in larger non-domestic historic buildings; 2) ground source heat pumps in historic buildings; 3) water source heat pumps in historic buildings. We can share this with the CCC once published, if helpful. Our research is also supported by the Government-funded Electrification of Heat project which demonstrates there is no property type or architectural era that is unsuitable for a heat pump (Energy Systems Catapult, 2022).

2. Additional Action Pathway and contingency plans: What types of government measures do you think should be included in the Additional Action Pathway and/or as contingency options rather than in the Balanced Pathway? Please explain why.

We recommend a measure to further maximise the potential to decarbonise historic buildings, although suggest this should be accounted for in the Balanced Pathway if possible. To achieve this, policy and initiatives to decarbonise buildings must account for the special consideration needed to retrofit historic and traditionally constructed buildings at the design stage to avoid heritage becoming a barrier in the delivery stages.

The UK has the oldest building stock in Europe. Around 6 million buildings were built before 1919 (21%). Around a further 4.3 million built before 1944 (15%). 350,000 listed dwellings in England, and an estimated 2.8 million homes in conservation areas. The potential to decarbonise historic buildings is not yet being maximised. To decarbonise the stock of historic buildings faster the government must address the barriers set out in its recent review into the barriers when adapting historic homes for energy efficiency. Opportunities to decarbonise faster, and to lower costs for building owners, include:

- **Developing clearer national planning policy** to better guide decision-makers on balancing the need to improve energy and carbon efficiency alongside heritage protection, which could enable faster, more consistent and positive local decisions.
- **Improving local authority skills and capacity** to enable faster and more consistent local decision-making.
- **Increasing the availability of skilled advisors and construction workers** to speed up delivery, reduce demand-related costs, and to ensure changes to buildings are safe and effective for the occupants and the building itself.
- **Improving standards, methods and tools** used to calculate energy efficiency of buildings and design of energy efficiency saving measures, such as Energy Performance Certificates (EPCs) and building regulations and standards to ensure they are fit for purpose for traditionally constructed buildings.
- **Maximising the potential for historic homes to be eligible for government-backed funding schemes** by ensuring heritage considerations are built-in at the design stage to avoid heritage becoming a barrier in the delivery stage. Delivery timescales need to account for the time needed to design safe and effective energy efficiency options for traditionally constructed homes, and funding needs to cover the full range of costs, including repair and maintenance of existing fabric, design and installation of new measures.
- **Historic England strongly recommends national governance arrangements are put in place to bring together the relevant departments and stakeholders** - such as the heritage sector and industry – to better integrate policies, regulation and standards, skills and training, and funding support. Designing new policy and initiatives to improve energy efficiency of buildings must be done so with the specific challenges and considerations for historic buildings built in at the design stage. This is essential given the large proportion of buildings built pre-1919 to avoid heritage being a barrier at the delivery stage.

3. Uncertainty: Are there any major sources of uncertainty that should be considered in our uncertainty analysis? For example, for which technologies are costs or performance likely to be particularly uncertain?

As stated in question 1, there is currently a lot of contradictory misinformation in the public domain about the efficacy of heat pumps in historic buildings. This leads to negative public opinion and lack of confidence and uptake, which can also stifle commercial investment, including investment in skills and training. Our own research suggests heat pumps are effective when designed, installed and used well. If public opinion changes it could act as a catalyst for uptake, particularly if demand triggers investment and skills, and if costs reduce. There are many interdependent variables at play, including public behaviour, which cause a degree of uncertainty around cost and uptake.

There are also limitations with the current format, assessment process and delivery of domestic Energy Performance Certificates (EPCs). The methodologies which underpin domestic EPCs include many assumptions in the calculation of the thermal performance of traditional buildings, among other things, which are incorrect. The Department for Energy Security and Net Zero Heat Pump Ready project demonstrated a significant bias towards overestimating the heat loss in domestic EPC's, especially regarding the performance of older existing properties where more assumptions

are made. With the current model underestimating the performance of our traditional stock by nearly 50%, we have a much smaller problem to solve than previously thought.

9. Whole-economy costs and benefits: What are the most important elements of impacts on the economy and competitiveness that should be considered in our assessment?

While public opinion and confidence on the use of heat pumps in historic buildings is low, and while specialist skills to design and install heat pumps are lacking which drives up costs, public uptake and demand has not yet tipped enough to drive commercial investment. If this tipping point can be reached, it is possible we may see exponential uptake. Furthermore, our own research Heritage and carbon (grosvenor.com) shows that scaling-up the construction sector with the skills necessary to retrofit the UK's historic buildings would lead to an additional £35 billion of output annually, supporting around 290,000 jobs.

10. Social impacts and distributional analysis: What are the most important elements of social impacts and the distribution of costs and benefits society that should be considered in our analysis?

The government's review into the barriers when adapting historic homes for energy efficiency recognises costs as a significant barrier for those wishing to decarbonise historic buildings. We would stress caution if using data on listed buildings and buildings in conservation areas only, as a proxy for those who may experience higher costs due to living in a historic building. Listed building and conservation area status are designed as tools for managing change - via the planning system - to buildings with historical or architectural interest. They do not represent all historic or traditionally constructed buildings that may require special considerations to ensure decarbonisation measures are safe and effective for building performance, energy efficiency, and the thermal comfort, health and safety of occupants. Energy efficiency and decarbonisation measures must be carefully designed and installed for traditionally constructed buildings regardless of whether they are designated or not, and the current skills gap means demand for specialist advice and installation is high, which means costs are also high, even for people occupying non-designated properties. If listed building and conservation area data is the best available, the assumptions derived should include the necessary caveats.

11. Methodology: Are there any key methodological issues we have missed or, in your view, are mistaken for our Seventh Carbon Budget advice?

We highlight four key areas and would welcome the opportunity to discuss if and how the assumptions can be improved using current best available data, and opportunities to work with the Climate Change Committee to further develop the evidence and data where needed.

1) The 6th Carbon Budget's assumptions about the stock of historic buildings is incorrect and should be corrected for the 7th Carbon Budget

The supporting evidence for the 6th Carbon Budget estimates that there are around 540,000 'heritage homes' in the UK including listed buildings and homes in conservation areas (Element Energy, 2021). Conversely, the 6th Carbon Budget documentation includes estimates for heritage

estimates around 1.3 million 'heritage homes', including 400,000 listed buildings (CCC, 2020b). It is unclear which data was used in the final model but both estimates are an underestimate of the historic stock.

There are approximately 10,000 conservation areas (CAs) in England. A study by Noble (2017), mapping CA polygons with Output Areas matched to Census 2011 data estimated that there is a total of 2.8m households in CAs. Historic England are currently updating these data with the latest Census 2021 data. These can be made available to the CCC in whatever format is most suitable.

Research by the Ordnance Survey in 2015 matching the National Heritage List for England to Postcode Address File (PAF) data found that there are an estimated 357,376 listed building that are dwellings in England (Heritage Counts, 2021). PPAF data for these assets can be provided.

2) The 6th Carbon Budget's assumptions about what can be done to historic buildings are not correct

The 6th Carbon Budget assumes that only 50% of detached, semi-detached and terraced homes with a heritage classification are suitable for air-source heat pumps, while for a ground-source heat pump, the suitability is set at 75%.

As mentioned previously, our own research suggests heat pumps are an effective solution for historic buildings. The Government-funded Electrification of Heat project has proven that there is no property type or architectural era that is unsuitable for a heat pump **(**Energy Systems Catapult, 2022**).** This suggests that amendments to the modelled assumptions for heritage are required for the 7th Carbon Budget.

3) Evidence suggests that the 'fabric first' approach is not the correct one for historic and traditionally constructed buildings

The fabric-first approach usually means improving the thermal performance of residential buildings by prioritising and maximising the performance of the fabric of the building (materials and components) (Hill, 2023). In this approach deep retrofits tend to emerge as the most effective. Currently, in the 6th Carbon Budget's assumptions, fabric measures and deep retrofits are estimated to provide the greatest savings particularly wall insulation measures. This assumption alongside the assumptions about "heritage homes" not being suited to external wall insulation measures and only 50% suited to internal wall insulation measures, explains why "heritage homes" are characterised as "hard/ difficult to treat".

There is a growing body of evidence, however, that questions fabric first as the most effective approach for historic buildings, and indeed for the whole housing stock more generally. With the urgent need to decarbonise our buildings, and with renewable energy prices falling compared to the increasing prices of fossil fuels, the fabric first approach may not be the most convenient approach to follow (Eyre, 2023). The key issues with the fabric first approach for heritage are:

- A recent study modelling different packages of retrofit measures including fabric improvements, heat pumps, and photovoltaic installations, of a total of 4500 buildings containing around 33,000 dwellings found that fabric improvements by themselves delivered only a 13% decrease in gas used, compared to a 95% drop in gas use when combining the fabric improvements with installing heat pumps (Evans, *et al.*, 2023).
- High levels of insulation are not essential to the deployment of heat pumps and are only likely to be cost-effective in easy-to-treat properties. (Lowe & Oreszczyn 2021: summary)

- Heat pumps can be up to three to four times more efficient than fossil fuel boilers (Eyre, 2023), and unlike the fabric improvements, there is a growing body of evidence that all houses are suitable for heat pumps.
- We have already mentioned the government-funded Electrification of Heat project which demonstrates there is no property type or architectural era that is unsuitable for a heat pump (Energy Systems Catapult, 2022).
- The Second National Infrastructure Assessment finds that buildings with an energy efficiency rating (EPC) D or above, which make up 90 per cent of English homes, are likely to have a peak heat loss rate that makes them suitable for heat pumps with minimal to no energy efficiency improvements.
- A survey conducted in the UK about the use of heat pumps, shows that satisfaction was not related to the age of the building or to the type of the building which supports the idea that heat pumps are suitable for all houses (Nesta, 2023).
- Retrofit and retrofitting materials can have high embodied carbon impacts. A recent study found that the most commonly used insultation materials are petrochemical materials which have large embodied carbon footprints (Greenspec, 2022). Materials like mineral wool and polyurethane need large amounts of energy to be produced. This means they cause higher embodied carbon than the operational carbon that can be saved by the retrofit (Historic England, 2020).

As Evans, *et al.* (2023) conclude "improving energy efficiency and cutting emissions are not the same goals". We believe it is important to re-evaluate the assumptions about savings from the different retrofit technologies in light of this emerging evidence and the embodied carbon debate.

4) More primary research is needed on cost of retrofit for the 7th Carbon Budget

In the 6th Carbon Budget energy efficiency measures for "heritage homes" is estimated to have an average cost uplift of 183 per cent relative to non – heritage buildings. This figure is significantly higher than that provided by other sources:

- Previous research by Parity Projects, considering retrofit of pre-1919 homes found that it would require about £2,500 or 9% more investment per home to bring them up to a similar standard (Parity Projects, 2021). This does not include professional fees so is not directly comparable with the CCC projections but is significantly different suggesting further research in this area is very much needed.

The Element Energy research found limited evidence in the public domain on the cost uplifts which can be associated with retrofitting 'heritage' homes (Element Energy, 2021). This is accurate. Given the scale of the assumptions, the fast pace by which new evidence is coming forward in the retrofit sphere, we believe it is necessary to undertake primary research to validate this evidence base.

12. Engagement: How best can we engage with experts and stakeholders to build our evidence base and test our emerging thinking?

Historic England would be very happy to provide further advice and assistance on accounting for historic buildings in the 7th Carbon Budget. We would welcome further discussion on the limitations of using listed buildings and conservation area data as a proxy for other attributes such as complexity and cost, and the data and evidence gaps that may need to be addressed to improve

modelling in the future to inform our own evidence and research priorities to ensure they support the needs of the Climate Change Committee in this important area of work.

13. Sharing our advice: What would help make our advice accessible to wider stakeholders, such as citizens, financial institutions, businesses and local government? For example, video explainers, stakeholder specific briefings or social media threads

Evidence gathered to inform the government's review into adapting historic homes for energy efficiency, including Historic England's 2022 Listed Building Owners and Occupiers Survey, demonstrated that, whilst there is a large range of information and guidance available to homeowners and occupiers on what they can/can't, should/shouldn't do regarding improving energy efficiency and reducing emissions in historic buildings, the advice is often contradictory, misleading or too technical. There is, in fact, a great deal that can be done to listed buildings and those within conservation areas and we are working hard to dispel the myths and misconceptions. Where CCC information regarding heritage buildings is shared in future, especially where listing and conservation area status has been used as a proxy, it will be important to set out why this data has been used and the limitations and caveats that apply; this will help to avoid the risk of inadvertently suggesting that historic buildings cannot accommodate the necessary changes due to their designation status alone. The challenges come from a broader set of issues which are set out in response to question 2.

Questions we will not respond to:

4. Speculative technologies: In our carbon budget advice, we take a low-risk approach by avoiding reliance on speculative technologies, to ensure that our pathways are deliverable2. Is there any new evidence on the feasibility of technologies that support decarbonisation since our 2020 advice on the Sixth Carbon Budget that we should consider?

5. Reduction in high-carbon activities and choices: What are the main factors we should consider when assessing a potential shift in patterns of travel and diet in our Balanced Pathway and our Additional Action Pathway?

6. Considerations for Scotland: What are the distinctive characteristics that should be considered when developing pathways and costs for Scotland?

7. Considerations for Wales: What are the distinctive characteristics that should be considered when developing pathways and costs for Wales? 8. Considerations for Northern Ireland: What are the distinctive characteristics that should be considered when developing pathways and costs for Northern Ireland?