Additional evidence from The Alliance for Sustainable Building Products' (ASBP)

Following the appearance of Jane Anderson representing the ASBP at the EAC oral evidence session on the 14th July 2021, the ASBP has provided additional written evidence in response to a number of questions raised during the examination of witnesses.

Q4 Chair: Is there any evidence that the building industry is moving faster than the Government and adopting the sorts of standards that will allow current homes to be built to a low carbon or zero carbon basis?

Both government and the building industry need to move much faster than they currently are. In terms of take up of embodied carbon assessment, there are around 500 UK organisations that have paid subscriptions for embodied carbon tools, and of the UK's four most recognised free to use embodied carbon tools, each has had over 1000 downloads.

More than 1000 UK architecture practices together with 200+ structural engineering practices, 120+ civil engineering practices, 100+ building services engineering practices, and 50+ contractors have signed declarations to address climate change through their work by via Construction Declares.

In the UK 224 buildings are rated BREEAM outstanding and 4029 BREEAM Excellent.

Q20 Jerome Mayhew: Looking around the world, are there other countries where you can see good ideas for housing standards that you would recommend the Government to incorporate into the Future Homes Standard?

Close to home, the 'Development Quality Requirements for housing associations and local authorities: 2021' recently published by the Welsh Government provides an example of how standards can be used to encourage circularity and low embodied carbon measurement and reduction. https://gov.wales/development-quality-requirements-housing-associations-and-local-authorities-2021

The following web sites provide a good overview of approaches to embodied carbon adopted in national and regional regulation outside the UK:

https://www.embodiedcarbonpolicies.com/

https://www.oneclicklca.com/wp-content/uploads/2018/12/Embodied_Carbon_Review_2018.pdf.

As an example, Netherlands, France, Sweden and Finland have all introduced regulations to address the embodied impact of buildings (the Netherlands since 2012). Approaches between these countries vary slightly in ways such as:

- Whether the assessment covers solely carbon or other environmental impacts;
- Whether the scope is "upfront carbon" up until practical completion of the building or an embodied carbon assessment over the building's whole life cycle;
- The building type and size of covered by the regulation.

Variations aside, all the above countries have adopted the European Standard EN 15978 as the basis for assessment, ensuring national implementation of the standard, providing default assumptions, standardised approaches, and national databases offering generic data for assessments where EPD are not available.

They have also introduced embodied impact limit values which will decrease over time, and they have also used pilot phases or introductory periods, and provided support for those undertaking assessments, for example, Finland has set up an advisory service that helps construction and real estate operators with issues related to low-carbon construction

The UK has foundations that can be built on. There is scope for the RICS Professional Statement on Whole Life Carbon in the Built Environment to be used as a vehicle for national implementation of EN 15978 which could be incorporated in regulation. The proposed RICS material database could function as the UK national database, providing both generic embodied carbon data for materials and Environmental Product Declarations[1] where available.

Other approaches to regulation of embodied carbon include:

- A requirement to provide Environmental Product Declarations in line with EN 15804 if environmental claims relate to a construction product in the UK. This approach to regulation has been used in both France and Belgium meaning that EPD are only required if the manufacturer wishes to make claims about the environmental impact of their product – in which case they need to be justified by a verified EPD.
- The Buy Clean California Act states public projects procuring steel, glass and mineral wool need to obtain EPD for the products used which show that they meet specific limit values in terms of embodied carbon. One issue with this approach to regulation is that projects can still be high carbon if they use lower carbon products inefficiently. For some products, such as concrete, using lower carbon products can increase impact because, for example, you may need to use more low strength concrete to achieve the same functionality as you can with less high strength concrete. Another issue is that small manufacturers would face a greater burden to produce EPD than larger producers. In Oregon, the state government has provided assistance to concrete manufacturers to produce EPD.

Q36 Helen Hayes: What methods are available for accounting for embodied carbon?

Standards

Standards and related guidance have been available in the UK since 1999[2] to measure embodied carbon and other impacts. Since 2011, European standards ensure a level of consistency in the assessment of environmental impacts for construction products and buildings. European Standard, BS EN 15804:2012 covers the assessment of embodied impact at product level, which includes a number of impacts including embodied carbon. This has resulted in Environmental Product Declarations (EPDs) covering more than 10,000 construction products[3,4]. BS EN

[1] Environmental Product Declarations (EPD) are a way of providing standardized declarations of environmental impact for a product using Life Cycle Assessment. EN 15804 and ISO 21930 are very similar standards which provides the core Product Category Rules for construction products to enable the production of environmental information about construction products for use in building assessment, and for comparison of construction products at the building level. EPD need to be verified by an independent expert to show the standards have been followed and the results are plausible. There are now over 10,000 EPD to EN 15804 and nearly 400 UK produced construction products have EPD. See https://bit.ly/2021-EPD and https://asbp.org.uk/online-briefing-paper/epd-uk-products.

[2] BRE Methodology for Environmental Profiles of construction products, components and buildings (BRE, 1999) and various editions of the BRE Green Guide to Specification, e.g. The Green Guide to Housing Specification (BRE, 2000)

[3] https://bit.ly/2021-EPD

15804:2012+A2:2020 has recently been updated with new indicators and some additional, more transparent, reporting requirements.

The building level assessment standard BS EN 15978:2011 — is part of the CEN/TC 350 suite of standards alongside EN 15804 providing a common format and set of indicators that enable the straightforward use of Environmental Data from EPD for construction products to be used at building and civil engineering works level.

EN 15978 provides the methodology for life cycle assessment used to assess the environmental performance of a building and gives the means for the reporting and communication of the outcome of the assessment. EN 15978 has just entered the process of revision. A new CEN/TC350 standard, EN 17472, will be also published shortly providing the rules for environmental assessment of civil engineering works.

The RICS Professional Statement on Whole Life Carbon provides guidance on how to assess embodied carbon in the UK context according to EN 15978 in a way which will bring about more consistency for UK assessments. For example, it provides freely available guidance on sources of data, default assumptions for transport to site, reference service lives and end of life which can be used during the early design stages providing consistency in assessment for benchmarking. BRE also has its own LCA methodology, IMPACT though this is not publicly available.

There are various tools available to undertake embodied carbon assessments and life cycle assessments at both product and building level but there is not one standard industry tool for the UK. In countries where there is regulation at building level (e.g. the Netherlands, France, Finland, Sweden), the common approach is to provide a national methodology (in line with EN 15978) which provides default assumptions etc in the same way as the existing RICS methodology does, a national database of EPD and generic data (including gate to grave data), and a system of tool approval, which ensures that the methodology and database are being used consistently.

Currently there can be variation between the answers produced by existing tools in the UK which is largely due to the different data sources that are used to underpin the tools, the boundaries of their assessment, and the assumptions that the tools use for transport, waste, service life and end of life disposal, together with some different approaches to assessment and reporting adopted by some tools.

The different approaches to accounting for the benefits of sequestered carbon in building materials has the potential to cause confusion. Sequestered carbon is atmospheric carbon which is sequestered into growing biomass such as timber which is then stored within building materials and in turn buildings. This type of sequestered carbon is commonly referred to as biogenic carbon. As discussed below, the full benefit of such biogenic carbon may or may not be accounted for depending on which approach is taken.

Nationally Determined Contributions & Dynamic LCA

Under nationally determined contributions (NDC), sequestered carbon stored within buildings can be considered in an NDC based on the annual increase of carbon stored within stocks of harvested wood products from timber **grown in that country**. This means the UK can only account for sequestered carbon within buildings for timber which has been grown in the UK. Imported timber used in UK construction is considered as part of the exporting country's NDC, for example Sweden's, rather than our own. Since around 60% of the timber used in UK construction is imported, as it

[4] See ASBP Briefing Paper (https://asbp.org.uk/briefing-paper/epd-where-to-find)

stands we can only account for about 40% of this benefit, though at global level other countries will have report the remaining 60%.

As explained below, UK standards assume that all sequestered carbon is transferred from a building or emitted to atmosphere at the end of the building's life meaning that no benefit from sequestering carbon in materials is registered. This also means that no benefit from delaying the emission or transfer of sequestered carbon is registered despite the existence of mechanisms for doing so.

The embodied carbon building assessment according to EN 15978 and the RICS Professional Statement on whole life carbon shows the benefit of carbon sequestered within timber at the start of the assessment. However, at the end of life of the building, the sequestered carbon will be released (if the timber is burnt) or transferred to the next product life cycle (if the timber is recycled or reused). Very little timber is landfilled now, but where it is, the sequestered carbon is tracked at end of life to emissions of CO2 or methane, and biogenic carbon stored in landfill is considered as a transfer to nature. In all cases therefore, at the end of life, there is a balancing emission or transfer of biogenic carbon to match the sequestered carbon at the start of the life cycle.

Dynamic LCA can show the benefit of delaying emissions from sequestered carbon such as biogenic carbon where conventional life cycle assessment (LCA) will not. This is a measurable benefit in climate change impacts from delaying the emission of sequestered carbon by storing it in buildings. By using dynamic LCA, the benefit can be measured using calculations of radiative forcing based on IPCC methodology and researchers at Bath University have produced a spreadsheet which enables these calculations, with Hawkins et al's (2021) paper setting out how such calculations can be used to show the benefits of carbon storage within timber construction. French Regulation (RE2020) has suggested a dynamic LCA approach to recognise the value of sequestering carbon, and of the greater value in reducing emissions occurring today than those in the future.

It should be noted that there are a number of other situations where project level assessment using EN 15978 and the RICS Professional Statement will show benefits for a project which are not actually likely to be obtained at national or global level using NDCs. For example, projects which use steel or aluminium with high recycled content are likely to show benefits in reduced embodied carbon over those using typical steels. However, as the amount of scrap steel and aluminium is constrained globally and all available scrap is recycled, as a consequence, this behaviour will not result in any reduction in embodied impacts globally. Similarly, projects using concrete with 30% Ground Granulated Blast furnace Slag (GGBS – a low carbon cement replacement sourced as a by-product from steel production) are likely to show benefits in reduced embodied carbon over those using typical concrete. However, again, as the production of GGBS is constrained and almost all slag globally is already converted to GGBS, this behaviour will not result in any reduction in embodied carbon globally. It is possible that many of the "quick wins" in terms of embodied carbon at project level are achieved by changes such as these, but this will not result in beneficial change at national or global level. Instead, we need to encourage changes in design which will reduce embodied carbon at both the project and national/global level.

Modern Methods of Construction and Embodied Carbon

It is important to fully consider the potential conflict between the UK's focus on Modern Methods of Construction (MMC) as a solution to many of the construction industry's issues, and the possible effect this will have may have on embodied carbon impacts.

Whereas MMC offers many benefits, projects should be assessed on their individual merits rather than viewing MMC as a catch all solution. MMC as a means to reduce on-site waste is well evidenced (evidence to support reduced on-site waste). Nonetheless, this type of reduction needs to be viewed against other aspects that may outweigh the benefit.

A blind assumption that all MMC are more resource efficient and lower embodied carbon solutions will inevitably have negative consequences. All construction solutions should be considered in view of their overall embodied carbon impact as a measure of resource efficiency, including but not limited to reduced site waste.

To be most effective MMC should take measures to address aspects such as:

- Duplication of structure for volumetric MMC with each unit requiring both a floor and ceiling structure
- Increased use of materials through the need for MMC units to be structurally stable during transport and lifting
- Increased use of materials – for example use of CLT for low rise construction uses more timber per m^2 of wall than a conventional timber frame to provide the same function.
- Off-site solutions such as precast requiring quick curing times using less cement replacements compared to in-situ concrete solutions.
- Providing evidence to demonstrate lower site waste for factory production from cradle to practical completion compared to on-site construction.
- Ensuring appropriate end-off life considerations. The Green Construction Board 2020 Zero Avoidable Waste in Construction interpretation report highlighted concerns that off-site solutions may be problematic at end of life if they are more complex materials/products combined that are harder to separate.

Studies show the benefits of moving from conventional construction to offsite, many of which are also moving to timber based offsite construction (e.g Monahan and Powell 2011). Other studies show the increased embodied impacts of moving to offsite construction, eg. Cameron and Di Carlo, (2007) showed 10-15% more materials were consumed, Aye et al (2012) showed prefabricated steel construction had 13% more impact than conventional concrete construction.

Appendix 1 provides examples of low carbon building.

Circular Economy

There is a direct link between the application of circular economy principles (at their simplest – reduce, reuse and recycle) and the amount of carbon that can be saved. Various studies such as Green Alliance, (2018) have shown this for buildings, largely through more efficient use of materials (the construction industry is extremely material resource intensive) and the increase of reuse and recycling.

There is a need to greater encourage the reuse of buildings for refurbishment. This is a key element of circular economy and from a product or material perspective will almost always provide the largest carbon saving when compared with building new. It is therefore imperative that we keep products and materials in use for as long as possible, ensuring at the end of their life cycle products and materials can be either reused or recycled.

End of life considerations are key at the design stage ensuring appropriate materials and products are selected. Products and materials must be constructed and installed to the appropriate standards to ensure the designed end of life options are maximised. It is therefore critical that the sector has the skills and training required to build and install products and materials in line with design criteria.

The sector needs to give much greater consideration to end of life options. What happens at the end of life for the products that we use in the buildings is too frequently overlooked. For 'natural' products this is particularly important to ensure that the biogenic carbon sequestered in that product, remains sequestered and is not released into the atmosphere through burning or landfill.

Natural materials can also be returned to the biosphere in a restorative manner, meaning that they breakdown naturally without harm or waste.

As has been mentioned during examination, the Greater London Authority are leading the way requiring circular economy statements and more Standards are being developed to ensure consistency in the application of circular economy.

Q29 Ian Levy. What materials can be used to design a low carbon building?

Each building is a combination of many components, products and materials. Whether a material is low carbon or otherwise will depend on the context of its design and use. Choosing the lowest carbon material firstly requires choosing the most appropriate material for a particular end-use (this may noy necessarily mean choosing the least carbon intensive) then selecting the most appropriate product within that material category.

The carbon intensity of a material (CO2e/kg) is important, but the carbon intensity of the product or system will also depend on quantities of each material within the building and the impacts of installing and maintaining those materials or products. For low rise construction, timber construction is generally shown to be a low carbon approach in comparison to masonry construction. The lower mass of timber compared to brick and block to produce the same functionality in terms of structure and fabric means fossil carbon impacts are lower. As an example, the Passive House Association of Ireland (2021) showed that changing from rendered concrete block cavity wall to a timber frame solution for an end of terrace house could alone reduce embodied carbon by 25%. If the benefit of sequestered biogenic carbon was factored in through methods such as dynamic LCA then the embodied carbon reduction becomes even greater.

Once a material and product type has been selected carbon reductions can be achieved by procuring products within that material category from a manufacturer which can demonstrate that their products have lower carbon impacts than other similar products. For this, the manufacturers need to provide Environmental Product Declarations (EPD – verified declarations of environmental impact calculated according to EN 15804).

There is evidence from studies such as (Anderson & Moncaster, (2020), Rasmussen et al., (2021), Silvestre et al., (2015), Hodková and Lasvaux, (2012) and Ganassali *et al.*, (2018) which have examined variation in EPD for individual product groups, that there can be considerable variation in GHG impact for a particular product – potentially caused by the use of different energy sources, the overall energy efficiency of the process, and the type of input materials used amongst other potential factors. As we note in the response to Q36, were low carbon input materials (e.g. recycled metals, GGBS, fly ash) are constrained, then the resulting low carbon products and projects using them are unlikely to result in reduced embodied carbon at national or global level due to displacement (with other projects/countries using less of the low carbon inputs).

Notwithstanding the importance of embodied carbon, health and well-being of occupants is vital for truly sustainable buildings, as has been mentioned during previous inquiries. Products and materials and the way they are designed and installed greatly influences their sustainability. Low embodied carbon should not be achieved at the expense of other factors, most notably poor and unhealthy indoor air quality resulting from poor design or poor material source control.

Approaches to producing low carbon buildings which are not materials related include such measures as:

- Utilising the structure and fabric of existing buildings, rather than demolition and redevelopment of sites, as discussed by Baker et al (2018);

- Reducing the "form factor" (the ratio of walls to floor area) which Make Architects have shown you can reduce embodied carbon for a large office building by 36% by reducing form factor with no other changes;
- Increasing the density of low rise development – Pomponi et al (2021) have investigated both density and the height of developments to demonstrate the low rise, high density development has the lowest carbon footprint, with high density, high rise development having the highest carbon footprint.
- Using material more efficiently – Moynihan and Allwood (2014) showed that a 36% reduction in the amount of construction steel used in buildings could be achieved by specifying individual beam sizes rather than using the same sized beams across a floor (they found the five most common sections sizes make up almost three-quarters of the beams in a building).

It is important to recognise that these non-material related approaches are also of great relevance in reducing the embodied carbon of the built environment, and that a focus only on low carbon materials is likely to miss many opportunities.

Q33 Chair: In relation to the increasing use of timber in buildings, does the tragedy at Grenfell and the concern about flammable building materials cause any second thoughts about its use? Are any of you able to address that?

The Grenfell fire of 2017, The Hackitt Review and the ongoing Grenfell Inquiry have led to an increased focus on the risks associated with all combustible materials, not just those that were used at Grenfell. These events directly led to a number of measures being introduced that preclude the use of timber in certain applications in residential buildings such as:

- 2018. Changes to The Building Regulations Part B banned the use of combustible materials in any part of the external wall build-up of residential buildings with a floor above 18m.
- 2020. A consultation on further changes to The Building Regulations Part B was held by The Government. The Government consulted on lowering the threshold for the ban on combustible materials to 11m. The consultation is yet to be concluded.
- 2021. The Greater London Authority published the Affordable Homes Programme 2021-2025 funding guidance, which includes a ban on combustible materials in any part of external wall of residential buildings at any height, a measure which effectively rules out the use of structural timber for any scheme seeking funding from the program.
- 2021. The British Standards Institution published a consultation on changes to 'BS 9991: Fire safety in the design, management and use of residential buildings'. The proposed new BS 9991 introduces a clause that 'precludes the use of timber' for any loadbearing element, within internal or external walls, in 'single stair' residential buildings with a floor above 18m.
- 2017-2021. The ongoing cladding scandal has revealed serious defects in residential buildings of all types, leading to a general lack of trust in the ability of the construction industry to deliver high quality buildings.

The measures listed above, although limited to residential buildings, have had a major impact on commercial building typologies as well. This regulatory context has created major doubts and concerns about the use of structural timber amongst Clients, Designers, Approved Inspectors and Fire Brigades, despite the fact the technology is tried and tested for many applications within this country and in many others.

On top of this, the perception of the risks associated with combustible materials have led to hugely unfavourable insurance market conditions for timber, regardless of building typology, which are outlined below. In many cases, especially in developments over £20m in value, the use of structural timber is precluded by these conditions.

Q34 Chair: That is quite a considerable inhibitor. If buildings cannot get insured because of the cladding material, they are not going to get built that way.

It is important to note that rather than being a cladding material, timber is used as a structural material. The application of timber offers the greatest potential for embodied carbon emissions reductions. As mentioned in answer to Question 36, the adoption of Dynamic LCA methods will enable the benefit of biogenic carbon sequestered in natural materials such as timber to be fully and realistically quantified.

In addition to the regulatory context outlined in the answer to Q33, insurance market conditions have become unfavourable for all buildings in recent years. The combination of capacity withdrawal and the need of insurance providers to return underwriting books to profit has meant that since 2018 the market has seen significant rate increases, a dramatic restriction in policy coverage and a strong reluctance to provide cover for more volatile or challenging risks. This is known as a hardening, or hard market.

Due to a combination of all these factors, the availability of insurance has become the major barrier to the adoption of timber as a structural material in many developments. This is causing a further imbalance in the mix of construction materials and precluding timber as a major climate change mitigation measure within construction. The UK is now heading in the opposite direction of major economies such as France and Germany that are creating conditions to increase the use of timber and other natural materials in construction for the reasons previously mentioned.

To outline the situation; the Timber Accelerator Hub (TAH) recently held a roundtable with representatives from some of the country's leading private property developers; British Land, Argent, Grosvenor, Stanhope, Land Securities, Lendlease, Derwent. From the head of development at just one of these companies, we learnt that 6 developments had recently been 'flipped' from a mass timber or hybrid frame to concrete or steel due to the lack of available property insurance. All others present reported the same issue was preventing them from using timber to reduce the carbon footprint of their developments. This is a major inhibitor that warrants considerably investigation in its own right.

September 2021

Appendix 1 – Examples of low carbon building

Examples of cost and environmental savings from retaining structure/façade:

- Angel Building, Islington https://www.ahmm.co.uk/projects/reuse/angel-building/ (saving 7,400 tons of CO_2 of embodied energy (the equivalent to running the entire new building for 13 years)
- Business in the Community – Advancing Circular Construction Case Studies https://www.bitc.org.uk/wp-content/uploads/2020/09/BITC_Casestudiesdoc_AdvancingCircularConstruction_September2020.pdf

General embodied carbon case studies:

- https://media.stridetreglown.com/wp-content/uploads/2021/03/23114044/152858_LCA-Case-Study_Gwynfaen-final .pdf
- http://www.cam.ac.uk/research/news/better-building-through-design
- http://www.steelconstruction.info/images/5/5c/TZ_Summary_Paper_TSE.pdf
- http://www.building.co.uk/whole-life-carbon-shopping-centres/5052340.article (free registration required)
- http://greenconstructionboard.org/images/stories/pdfs/case_studies/GCB%20CS10_NetworkRail_web.pdf
- http://greenconstructionboard.org/images/stories/pdfs/case_studies/GCB%20CS3_AnglianWater_web.pdf
- https://www.balfourbeatty.com/media/29482/reducing_embodied_carbon_through_gammon_green_concrete.pdf
- http://learninglegacy.independent.gov.uk/documents/pdfs/sustainability/425009-145-reducing-carbon-aw.pdf
- https://www.2degreesnetwork.com/groups/2degrees-community/resources/making-embodied-carbon-count-case-study-1_2/
- http://www.theplanetmark.com/clients/case-studies/land-securities-group-plc/
- http://www.cundall.com/Cundall/fckeditor/editor/images/UserFilesUpload/file/WCIYB/IP-12%20-%20Embodied%20carbon%20case%20studies%20for%20office%20buildings.pdf
- http://www.bioregional.com/one-brighton-achieves-deep-carbon-cuts/
- https://www.bkstructures.co.uk/case-studies/sainsbury-s-dartmouth