Future Homes Hub

Embodied and Whole Life Carbon:

2023-2025 Implementation plan for the homebuilding industry

January 2023

Supported by verco

Acknowledgements

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Foreword

David Thomas
Chair of the Future Homes Hub

Climate change is the greatest challenge facing our society. It will affect how we live and work and will fundamentally change the places we call home.

As homebuilders, we need to makes changes to how we build - not just to reduce carbon emissions, but also to ensure the homes and communities we build are comfortable and resilient as our summers get hotter and drier, and our winters warmer and wetter. The record temperatures we saw this summer were a stark reminder of this.

Homebuilders up and down the country are already tackling 'in use' emissions by improving the way we heat and insulate our homes. Last year's changes to building regulations will see new homes emit 31% less carbon than before, and the upcoming Future Homes Standard in 2025 will result in a reduction of around 75%-80%.

But that is only part of the story. The process of building new homes – extracting materials, transporting them to site, preparing the ground, and the construction and installation processes – also leads to carbon emissions. Research conducted by Barratt suggests that the construction process generates twice as much carbon as the homes in use throughout their lifespan. The carbon intensity of these processes depends on how long the homes last, and what's required to maintain them.

So if we are to reach our carbon targets, we need to tackle these emissions, the "Whole Life Carbon" of the homes we build.

This is no small task. If we are to succeed, we need to make sure the decisions we take are based on correct and accurate information.

We need to know not just how individual components perform over time, but also the emissions resulting from their extraction, manufacture and installation, how long they will last, and how to maximise the lifespan of the homes and developments they comprise.

That is the aim of this piece of work: to better understand what we know, what we don't, and how to fill in the gaps.

It lays out a clear set of actions for the homebuilding industry to find the most practical ways to measure and reduce whole life carbon, at scale, while continuing to build better homes and communities for those who live in and near them.

This is a journey that housebuilders have to take. We fully expect that over the next few years, government policy will start to focus more heavily on whole life carbon, be that through regulation, procurement or planning requirements – and it is right that it does so.

Homebuilders need to understand the full implications for the homes they build. Larger businesses like Barratt have a responsibility to help smaller builders understand the whole life carbon of their activities, and the steps they can take to reduce them.

I am hugely grateful to the wide range of government, expert and manufacturing organisations who have worked with homebuilders through the Future Homes Hub in recent months to produce this report.

As we look forward to next year, I am excited to implement its findings and continue to work with colleagues across the homebuilding industry and beyond to find the best possible solutions to reduce carbon emissions from the homes we build.

We need all parts of the housing sector to pull together and reduce the embodied carbon of our buildings – it is essential to reaching net zero.

I welcome the excellent work of the Future Homes Hub to rally housebuilders to start measuring and reporting their whole life carbon data.

This is vital work, and will help the Government, housebuilders and all parts of the supply chain make informed decisions that will reduce embodied carbon while delivering the homes this country needs.

Richard Goodman
Director General for Safer and Greener Buildings, Department for Levelling Up, Housing and Communities

Executive summary

As the homebuilding sector rapidly reduces the 'operational' carbon emissions of new homes through new standards in 2021 and 2025, the next big area of focus is the 'embodied' emissions arising in the products, construction and maintenance of homes and, in total terms, the 'Whole Life Carbon' (WLC) performance of homes.

This report summarises a first phase of work undertaken by the homebuilding industry in collaboration with relevant government, expert and stakeholder bodies through the Future Homes Hub (FHH) to tackle embodied and whole life carbon in new homes. The aims of this initial phase of work have been to:

- establish an initial baseline of whole life carbon emissions for new homes
- evaluate the potential to reduce embodied and whole life carbon
- propose a framework of measurement suitable for new homes
- develop a roadmap and implementation plan to support the sector in measuring and reducing whole life carbon.

The report finds that embodied carbon in new low-rise homes is lower than originally estimated, but clearly there is more work to do. It concludes that there are currently important gaps in the framework for collecting data and measuring WLC consistently. The report then identifies the actions needed for an effective and smart approach to measuring and reducing carbon at all stages of the new development lifecycle. Core elements of the 2023-2025 implementation plan are to prepare the sector for mainstream measurement and reduction of WLC including to:

- develop and refine a simple measurement method for homebuilders, with consistent defaults and assumptions, and focussed on providing useful information to inform decision-making
- facilitate voluntary mainstream measurement, analysing data to improve understanding of the baseline and reduction options
- develop benchmarks and targets for the sector
- coordinate engagement with supply chain to improve current data and understand future carbon reduction pathways.

The timeline for these activities is summarised in Figure 1.

The programme of work will be governed by an oversight group joining the dots between the homebuilding and manufacturing industries, Government decision-makers, expert bodies like Royal Institution of Chartered Surveyors (RICS), and skills and training bodies.

Collectively, we have a common goal to reduce carbon emissions across the homebuilding sector and the built environment as rapidly as we can. By working collaboratively, we can make sure that we develop wholly practical methods and mechanisms, accessible to all, at the same time as building better homes and communities.

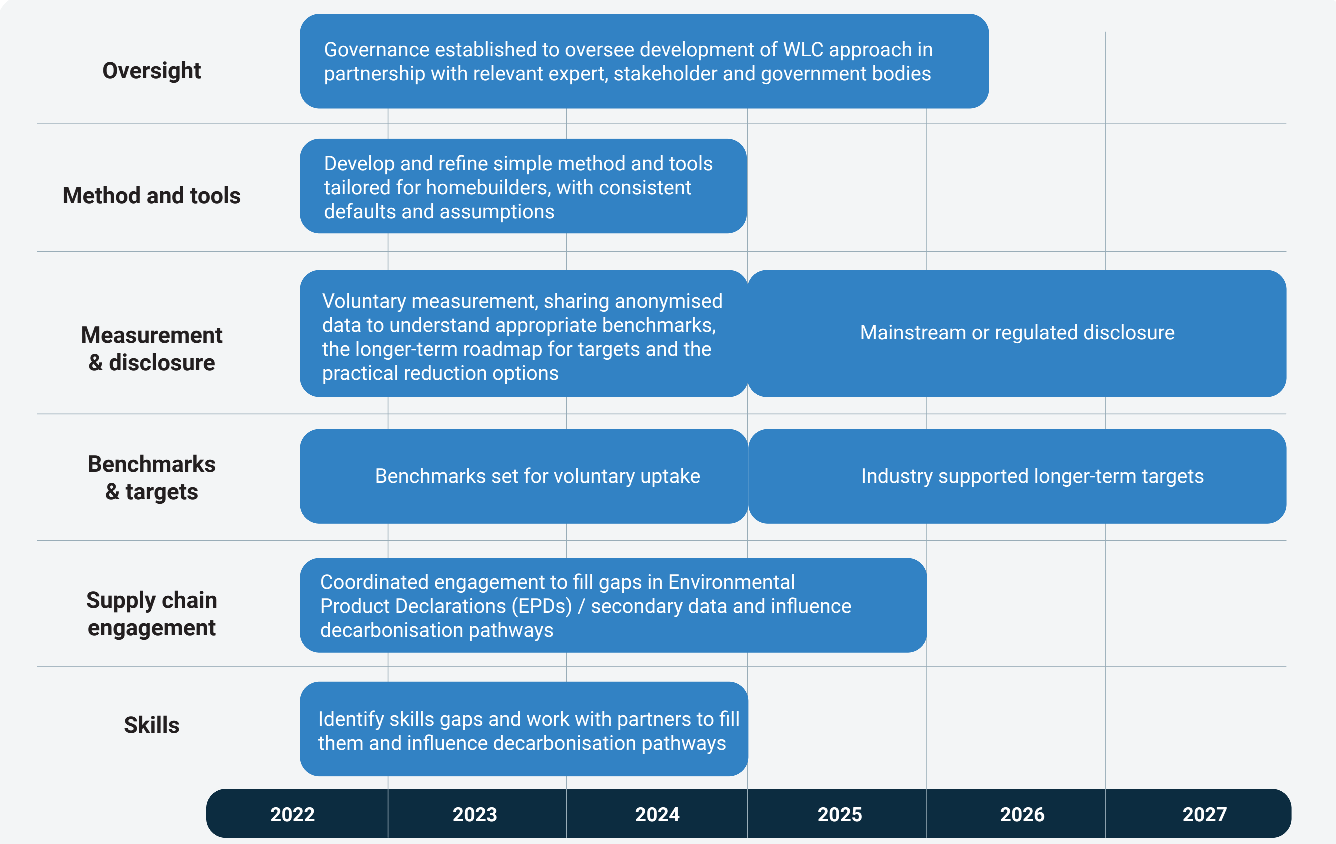

Figure 1 – Summary level implementation plan timeline

Background and context

Context to reducing the embodied and whole life carbon of new homes

Tackling climate change is arguably the defining challenge of our times. In response, the UK Government has committed in law to achieve Net Zero greenhouse gas emissions by 2050[1].

The homebuilding industry already has a clear pathway to reducing the operational carbon emissions of new homes through implementation of the 2021 uplift and the Future Homes Standard (FHS) in 2025, respectively reducing the carbon emissions by over 30% and 75%. Furthermore, the 2025 Standard is intended to be a net zero standard as the grid decarbonises.

Responding to the changing policy and regulatory landscape, reinforced by signals from investors and the environmental and cost-of-living concerns of their customers, most homebuilders are well underway with plans to reduce operational energy and carbon of their product.

However, as operational emissions continue to be reduced, there is an increasing need to focus on whole life carbon.

Some larger homebuilders and aspirational SMEs, especially those with carbon reporting commitments or science-based targets[2], are already starting to measure and even set targets for whole life carbon.

Some Local Authorities are already requiring WLC assessments to be carried out, and setting targets for new development.

However, WLC has not been a focus for the majority of developers, particularly the smaller and less well resourced companies. The challenge is how we build on the experience of those at the vanguard to lower the barrier to entry for developers that have not yet engaged with embodied carbon as a design issue, and make WLC measurement and disclosure mainstream.

In the UK Net Zero Strategy published in 2021, the Government set out its ambitions to help the construction sector improve reporting on embodied carbon, with a view to exploring a maximum level for new builds in the future.

Subsequently, the Environment Audit Committee (EAC) published a report[3] in May 2022 recommending that the Government introduce mandatory whole life carbon assessments and targets. They underline the urgency, given the UK's commitment at COP26 to achieve a 68% reduction in the UK's carbon emissions by 2030 – which includes embodied carbon of the construction sector. This is only seven years away.

As yet, there is no clear plan or detailed policy for how embodied or whole life carbon should be achieved. However, the Government's response to the EAC report states:

"Government intends to consult in 2023 on our approach and interventions to mainstream the measurement and reduction of embodied carbon in the built environment.

"We acknowledge the recommendation from the Committee that a requirement should be established through the building regulations. We will consider through the feedback received from the above consultation and parallel stakeholder engagement what levers, including building regulations, will be needed to tackle embodied carbon. In addition, research and analysis will be carried out to understand the full practical, technical and economic impacts of potential interventions. This will be particularly important for minimising impacts on SMEs and ensuring that interventions deliver for the climate but do not undermine other objectives to level up the country and deliver more, safer homes. Our planned consultation in 2023 will therefore consider the outcomes of this analysis and research. As part of this work, we will also consider what types and sizes of homes and buildings should be included."

To prepare for this, there is a need for standardisation of measurement of embodied and whole life carbon, shared data and learnings, and a collaborative approach to tackling this across the homebuilding industry.

> Government intends to consult in 2023 on our approach and interventions to mainstream the measurement and reduction of embodied carbon in the built environment.

Industry commitment to develop an implementation plan through the Future Homes Hub

The homebuilding industry have committed through the Future Homes Delivery Plan to develop an industry led roadmap and plan for reducing the whole life carbon emissions of new homes – see Appendix A.

Developing this plan in more detail has been an early priority for collaboration through the Future Homes Hub.

The aims of this first phase of work have been to:

- Establish an initial baseline for whole life carbon in new homes based on existing assessments carried out.
- Evalute the potential to reduce embodied carbon based on comparative assessment of options for a typical house.
- Propose the framework of measurement suitable for new homes development and infrastructure, identifying the barriers to accurate measurement and also who needs to do what to overcome them.
- Develop a roadmap and implementation plan to support industry-wide reduction in whole life carbon.

[1]In Scotland the target is to reduce carbon emissions by 2045. Scotland and Wales have differing building regulations. However, no UK administrations have yet developed detailed policies for whole life carbon of residential developments, [2]whole life carbon is a component of scope 3 emissions for those companies who have set science-based targets, [3]See Appendix E for links to both the EAC report and the Government's response

Initial assessment of the baseline and reduction options

Baseline assessment

A baseline dataset was developed with input from the homebuilder members of the steering group. A total of 35 embodied and whole life carbon assessments, from 10 homebuilders, were gathered and collated; covering various dwelling and construction types, all completed over the last few years. The detailed project methodology is given in Appendix C with tables, charts and discussion in Appendix D.

Based on this phase 1 FHH project dataset, initial indicative upfront and whole life embodied carbon intensities are shown in Figure 2:

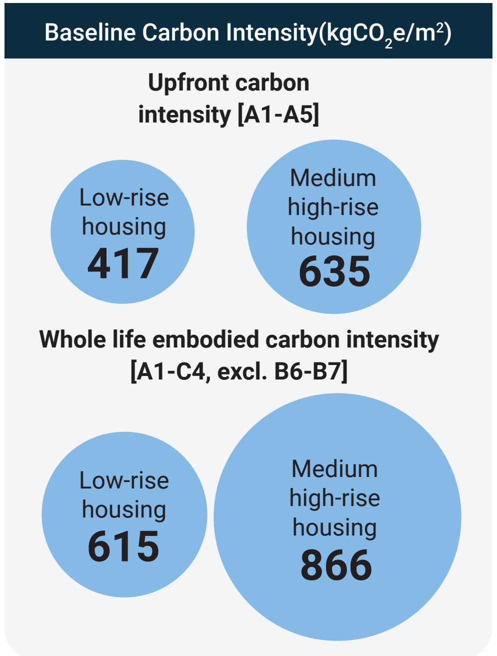

Figure 2 – Baseline upfront and whole life embodied carbon intensities from phase 1 dataset

Figure 3 shows the comparison between phase 1 FHH baseline carbon intensity and existing benchmarks. The error bars represent the range of assessments, and the number above the bar the sample size. Points to note from this analysis include:

- The FHH database is a better reference point for developers looking to set targets for low-rise housing than existing benchmarks (LETI/RIBA and GLA), which are more representative of medium and high-rise schemes.
- The project sample size was relatively small – a total of 35 assessments – and the vast majority are houses. The baseline should be updated as the size of the data set grows. It may also be possible in future to distinguish between baselines for different low-rise house archetypes or based on other characteristics.
- Analysis of the initial project data set showed little to no correlation between WLC and characteristics such as floor area, house-type or construction systems. This highlights the need for a larger dataset to investigate these relationships.
- In fact, there was significant unexplained variability between apparently similar buildings. This is thought to be a result of differing assumptions, generic defaults and EPDs that may be selected by the assessor – all acceptable within the scope of the RICS Professional Standard[4]. This highlights the need for consistency and guidance to those carrying out assessments in terms of secondary data used (i.e. anything except manufacturer EPDs for the actual products used).

[4] Refer to Appendix B

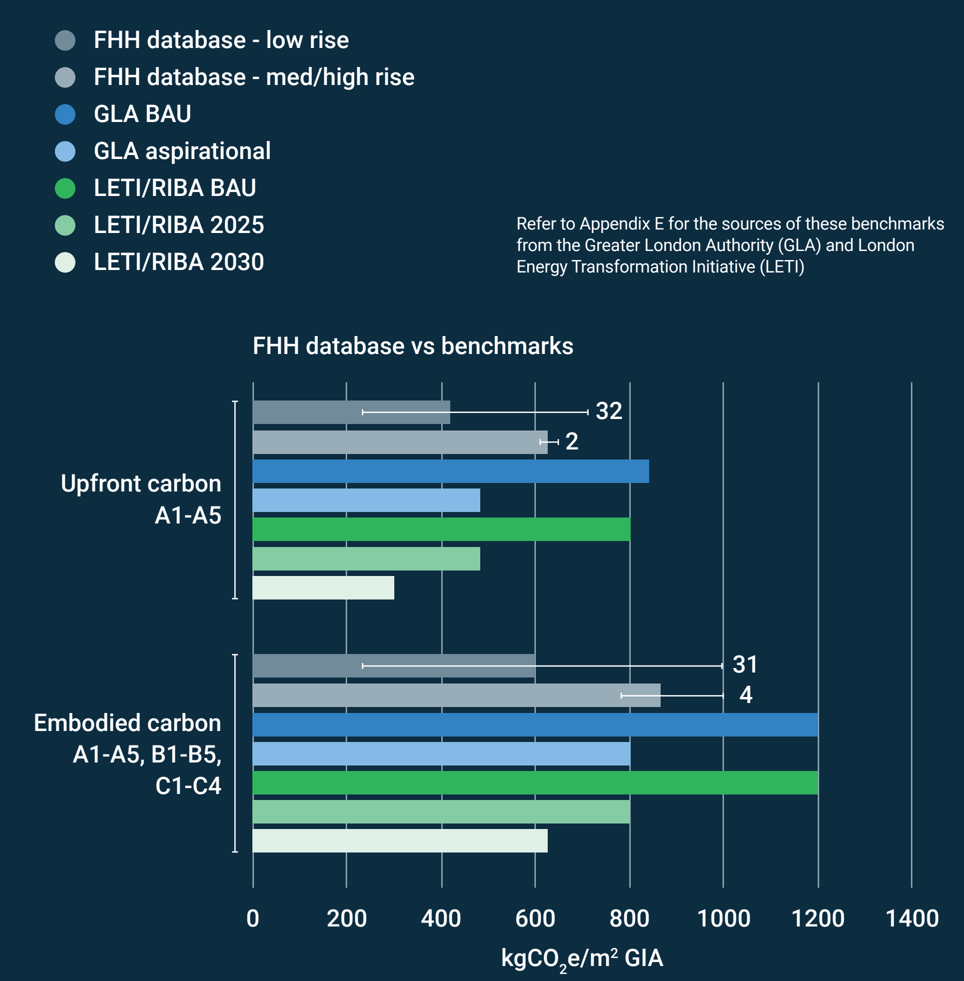

Figure 3 – Comparison between phase 1 baseline intensities and existing benchmarks

Carbon emissions reduction options

Building on three representative bills of quantities provided by working group members for different low-rise house types, additional whole life carbon modelling was carried out by Verco to understand the potential benefit of different design or specification decisions.

A number of fabric and services options were considered, including masonry vs. timber superstructure, cladding and roofing options, and gas boiler vs. air source heat pump.

It should be noted that:

- In this initial study, the scope of options was by no means exhaustive. The options presented are illustrative, rather than fully considered designs, and were based on individual to just three similar low-rise house types.
- We don't generally have enough or sufficiently robust data yet to make firm conclusions about the carbon intensity of different build options or recommendations on the best actions. See Appendix D for full discussion of the results.
- Further work will be needed during the next phase to identify a wider range of potential scenarios, such as:
    - additional archetypes for baseline models, including apartments and mixed-use development.
    - additional options to reduce embodied carbon – including substructure (reused steel piled foundations), superstructure (steel-frame), other pre-manufactured elements, and additional insulation to reach FHS-level fabric specification.
    - any unintended consequences of specific proposals that may affect buildability, such as movement joints when changing block type.
    - additional insulation to different levels of fabric performance, to better understand the trade-off between embodied and operational energy for different options.

Element	Baseline	Options Considered
Outer leaf	Clay facing brick & mortar	• Concrete facing brick & mortar • Lightweight cladding - fibre cement board
Inner leaf	Aerated concrete block & mortar	• Timber frame
Ground floor	Beam & block	• Beam & EPS infill
Upper floor	Timber	• Offsite floor cassette
Roof covering	Clay tiles	• Concrete tiles • Slate tiles • Fibre cement slates
Services	Gas boiler	• ASHP (R32) • ASHP (R32) + PV • ASHP (R32) + PV + Battery

Figure 4 – Fabric and services options considered in comparative assessment

> The phase 1 baseline is a better reference point for developers looking to set targets for low-rise housing than existing benchmarks

Option	Upfront intensity (kgCO_2e/m^2)	% Change from baseline
Baseline	435	
2a - timber frame	363	-16%
4a - offsite floor cassette	395	-9%
1b - fibre cement board	398	-9%
3a - beam & EPS infill floor	412	-5%
5a - concrete roof tiles	426	-2%
5b - slate roof tiles	428	-2%
5c - fibre cement slate tiles	428	-2%
1a - concrete bricks	432	-1%
6a - ASHP (with baseline spec)	443	2%
6b - ASHP + PV	453	4%
6c - ASHP + PV + Battery	464	7%

Figure 5 – Comparative assessment outcomes – upfront carbon intensity

In terms of upfront carbon, the greatest saving from the data analysed was achieved by moving from masonry to timber frame (-16%) with other options achieving <10% saving on the baseline.

In terms of whole life carbon (including operational carbon based on SAP assessment calculations), the greatest saving was achieved by moving from gas boiler to air source heat pump (-49%) with fabric options achieving up to -7% saving on the baseline.

Option	WLC Intensity ($kgCO_2e/m^2$)	% Change from baseline
Baseline	1351	
6a - ASHP (with baseline spec)	692	-49%
6b - ASHP + PV	713	-47%
6c - ASHP + PV + Battery	731	-46%
3a - beam & EPS infill flooring	1256	-7%
2a - timber frame	1283	-5%
4a - offsite floor cassette	1304	-3%
1a - concrete bricks	1325	-2%
1b - fibre cement board	1365	1%
5a - concrete roof tiles	1393	3%
5b - slate roof tiles	1396	3%
5c - fibre cement slate tiles	1396	3%

Figure 6 – Comparative assessment outcomes – whole life carbon intensity

Note: Biogenic materials (e.g. timber) and whole life carbon. The RICS methodology for whole life carbon does not currently account for the time value of locking away carbon in the timber structure for the life of the building, which could be in excess of the assumed 60 years.

Note: Assumed carbon abatement curves for grid electricity and materials. The whole life carbon benefit of using ASHP and electric heating sources comes partly from the projected decarbonisation of the grid in future years. In line with the RICS Professional Statement methodology, embodied carbon of replacement materials within the building lifetime was not assumed to abate over time, although UKGBC Whole Life Carbon Roadmap suggests that it will.

Conclusions from the initial assessment

Overall, data available from existing embodied and whole life carbon assessments is not sufficiently consistent nor robust to draw firm conclusions about current levels of emissions for different archetypes, what current benchmarks or future targets should be and what are the best options for reducing whole life carbon.

However, some initial observations can be made, for example that:

- It is valuable to consider whole life carbon rather than just embodied carbon or operational carbon.
- Whole life carbon emissions are likely to differ by archetype. For example, low rise housing already typically outperforms LETI and RIBA's benchmarks for 2025 and in some cases outperforms the 2030 benchmark.
- Inconsistency in current data appears to stem largely from variance in the assumptions being made for example in the defaults used for embodied carbon in products.
- While current data is not sufficiently robust to make a full set of conclusions about design choices, it does point to some conclusions such as that while heat pumps increase embodied carbon, overall, they substantially reduce whole life carbon.
- Some level of emissions reduction is possible from design and material choices. However, substantial reduction of embodied carbon will rely in addition on decarbonisation of construction products.
- There was clear consensus that rapid action is needed to create an easy-to-use tool for developers to gain a more accurate and consistent understanding of whole life carbon.

The observations above confirm some urgent actions for the industry, including to:

- Agree a consistent approach to measurement, including what assumptions to use, and continue to engage with decision-makers and expert bodies to promote alignment
- Engage as widely as possible with developers and design teams to feed into the evidence base and understand how WLC assessments can help them identify where carbon savings can be made in their live projects
- Work in a more coordinated way with the manufacturing sector to map and fill gaps in and update EPDs, and understand emissions reduction pathways.

2023-2025 Implementation plan

The implementation plan was put together through iterative dialogue with the steering group. Its purpose is to prepare the industry for scaling up measurement and reduction of whole life carbon including through regulation. The implementation plan needs all parts of the sector to work together.

There are four key elements:

1. **Measurement and disclosure** of upfront and whole life carbon assessments at both an individual home design level and whole development project site level. The measurement framework developed through this project is in appendix B.

2. Setting of **benchmarks** for voluntary uptake for upfront and whole life carbon, using data gathered from carbon assessments carried out by UK homebuilders and initially disclosed via the Hub.

3. The pathway to setting **industry supported targets** for voluntary uptake prior to potential introduction of regulation.

4. Coordinated **engagement with the supply chain** to ensure that EPDs and relevant default assumptions are increasingly available to support mainstream disclosure.

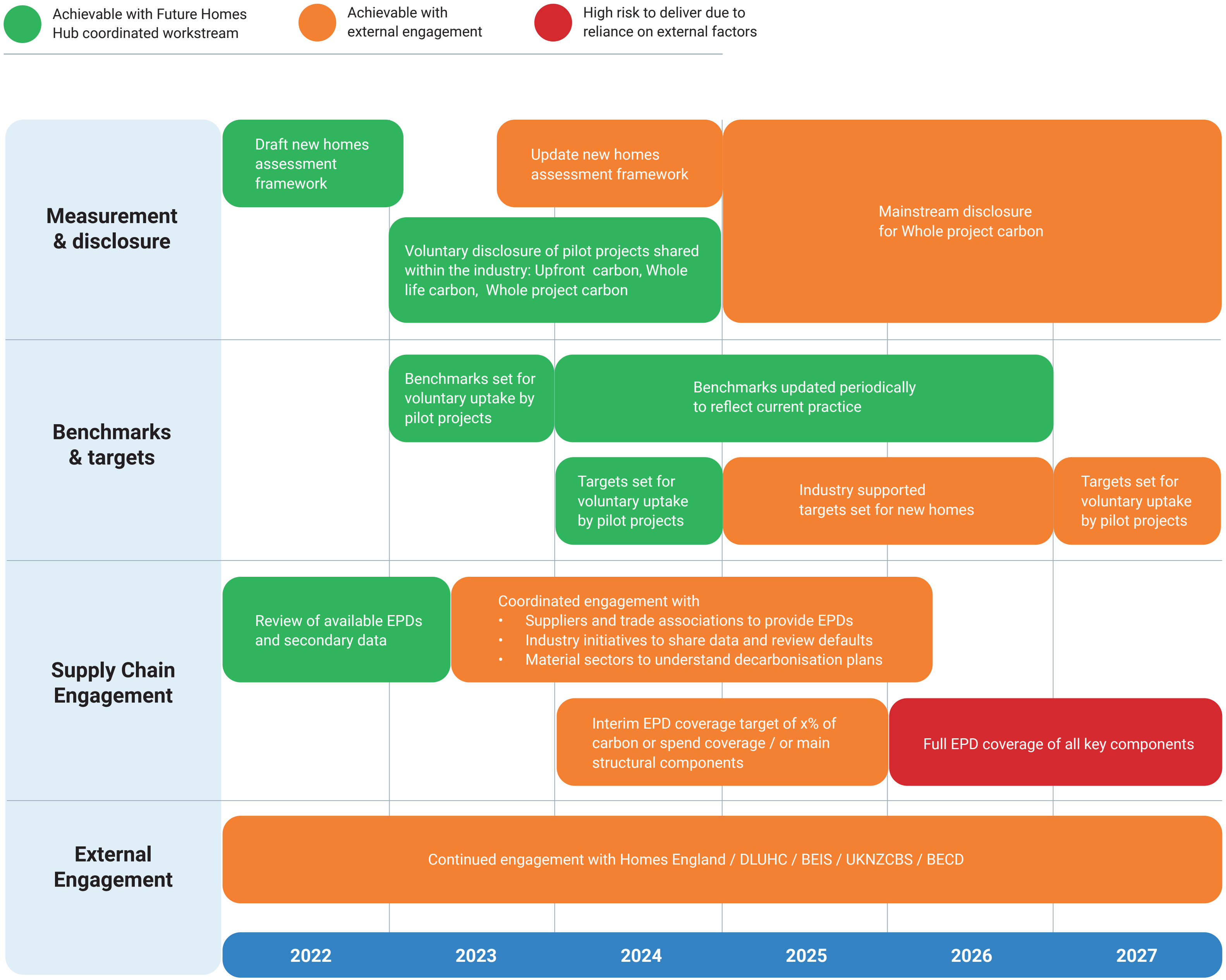

Figure 7 – Implementation plan timeline: engagement

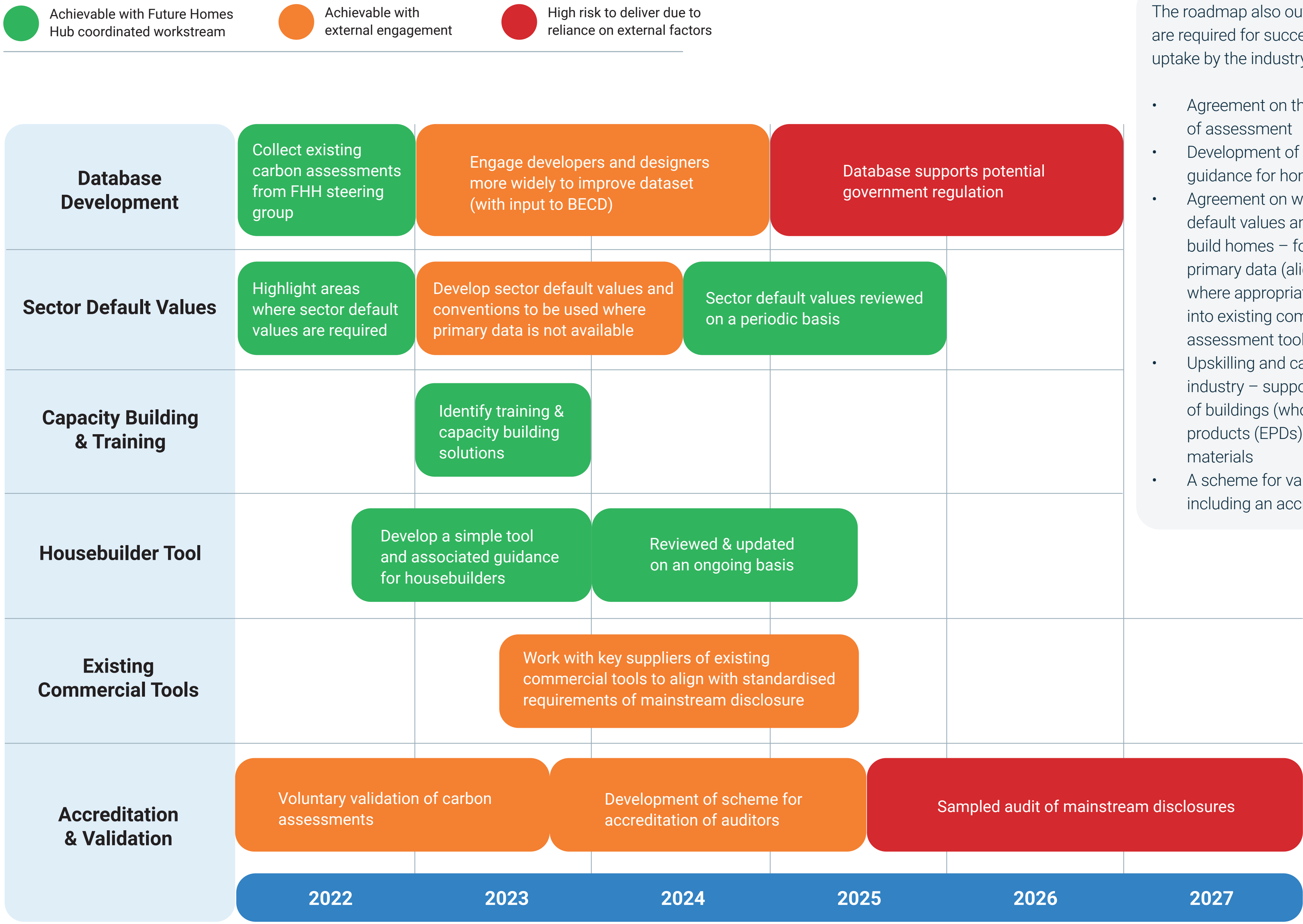

Figure 8 – Enabling activities: data, skills and tools

The roadmap also outlines enabling activities that are required for successful implementation and uptake by the industry. These include:

- Agreement on the proposed framework of assessment
- Development of a simple tool and associated guidance for homebuilders
- Agreement on whole life carbon sector default values and assumptions for new build homes – for use in the absence of primary data (aligning with existing sources where appropriate), and integration of this into existing commercial whole life carbon assessment tools
- Upskilling and capacity building within the industry – supporting life cycle assessment of buildings (whole life carbon assessments), products (EPDs) and the use of low carbon materials
- A scheme for validation of assessments including an accreditation route for auditors.

Next steps/calls to action

Oversight

There are several essential enabling activities needed to prepare the industry for potential government regulation and to ensure that any targets set are proportionate, achievable, and viable but stretching enough to meet the urgent need for climate action.

The Hub will set up a group to oversee the implementation of the plan and enabling activities, alongside working groups of homebuilders to test the proposed assessment framework and roadmap. The Hub will also co-ordinate the collation of the carbon assessment data provided during voluntary measurement and disclosure.

Assessment framework

The proposed assessment framework for upfront and whole life carbon assessments at dwelling (buildings only) and project (including site-level infrastructure) level will be used for pilot phases.

It will be formally reviewed and updated by the WLC oversight group following the pilot phase, with input and feedback from users, to ensure it is effective and fit for purpose and aligns with other frameworks as appropriate.

The approach, which will continue to be developed in line with any changes to the RICS professional statement, should enable developers to measure WLC in a way that is consistent, quick, low cost and straightforward enough to drive significant uptake.

Outcome: The industry has a consistent methodology and conventions for new build homes.

Sector defaults & assumptions – secondary data

A set of new homes sector default values will be developed in 2023 using the data collected from carbon assessments shared by UK homebuilders with the Hub. It should align with existing defaults, where appropriate, and is intended to be used where primary data is not available at either individual product or life stage level – for example, for embodied impacts (A1-A3), transport (A4) and construction activities (A5) and of standard material build ups.

As the coverage of primary data increases in the inputs to carbon assessments, the outputs will become more representative of industry practices and will inform more accurate default values.

These defaults can be built into calculation tools, reducing the burden of carbon assessments on SMEs and allowing simplified calculations at early project stages, or where detailed data collection has not taken place.

Outcome: A set of defaults and assumptions specific to the new homes sector that can be used by consultants within WLC assessments generally.

Tools

To make carbon assessments as accessible as possible to the widest range of homebuilders, there is a need for a simple tool – or specification to embed into existing tools – and associated guidance, allowing the inputs to be as high-level or as detailed as required, but ensuring the outputs are comparable across the board.

The workstream to develop the tool will commence in early 2023. The Hub will engage with homebuilders and manufacturers, as well as existing initiatives, tool providers and EPD providers to develop the specification for this tool and any supporting data sets that will be required.

Outcome: The barrier to entry is lowered for developers that have not yet engaged with embodied carbon as a design issue.

Measurement and disclosure – pilot programme

During 2023, the Hub will establish a more formal phase of voluntary disclosure for upfront and whole life carbon at dwelling and project level. The Hub will invite a wider group of developers to participate with the objective of preparing the wider industry for mainstream measurement and informing the design of the future framework for whole life carbon including through regulation.

A preliminary step will be to specify the precise objectives for the pilot phase and, with greater clarity of the measurement method and tool, in dialogue with Government and homebuilders the appropriate scope and parameters for measurement and disclosure.

The assessment outputs will be disclosed and shared within the Hub for benchmarking and analysis initially. Ultimately, the data can support other industry initiatives, such as the Net Zero Carbon Buildings Standard (NZCBS) and Built Environment Carbon Database (BECD) with prior consent of the participating homebuilders.

Outcome:
Larger and willing smaller developers:

- participate to share the experience that they have with others in the sector.
- collaborate in engaging with their customers and supply chain.

As many smaller developers as possible have started on the journey; completing a whole life carbon assessment on at least one house type or development.

All developers broadly view embodied carbon as a non-compete issue, which benefits from collaboration.

Data & Benchmarks

The Hub will continue to review collected whole life carbon assessments with the aim of improving the accuracy and relevance of benchmarks in due course.
By analysing the data, we will seek to understand:

- underlying reasons for variance between assessments and how we can improve consistency of measurement
- the relationships between different construction types, dwelling archetypes and other characteristics with their embodied and whole life carbon
- where statistically significant variation between dwelling archetypes indicates they should be considered separately with respect to benchmarks and targets.

Outcome: A set of building and infrastructure benchmarks for upfront and whole life carbon that accurately reflect the new homes sector, so that developers can set realistic yet stretching targets for their developments.

Engagement with supply chain EPDs – Primary data

In the next phase of the project, the Hub will lead coordinated engagement with the Construction Products Association, BEIS and the manufacturing sector. It's likely that short-, medium- and long-term objectives can be defined, with the ultimate aim of having a large, consistently measured library of manufacturer EPDs freely available to carry out whole life carbon assessments, and

low-impact products and materials being valued by developers.

Initially, the Hub will look towards understanding the current availability of primary data for WLC assessments of new homes; potentially setting a target EPD coverage for materials (for example, by x% of carbon or spend coverage) per assessment. Ultimately, the goal would be to have full EPD coverage (at detailed design / as-built stages) for the main building components.

Engagement with the manufacturing sector and trade associations will also be sought to understand the projected decarbonisation plans of key material suppliers, building on the UKGBC Whole Life Carbon Roadmap projections.

Outcome: Suppliers routinely produce EPDs for most of their product lines. They have the data available from their own drive to improve sustainability reporting and it's quicker, easier, and therefore less expensive for new EPDs to be produced.

Outcome: EPD data is available and easily comparable across products and different systems. Ideally, that means getting the data off PDFs and into a database that is free to access. The Hub could support the building of an EPD library, which could then feed into calculation tools.

Engagement with skills providers

Work will be undertaken to identify new skills required to carry out the carbon assessments to the agreed methodology, and in 2023 training and capacity building solutions will be identified and developed for roll-out to the industry, facilitated and coordinated by the whole life carbon oversight group.

This is likely to require new skills across the value chain, from the development and life cycle analysis of manufactured products, through low-carbon engineering and design to measurement of building whole life carbon assessments.

Outcome: An accreditation / competent person's scheme is developed for whole life carbon assessors, EPD assessors and other relevant professionals.

Outcome: Major (private and institutional) training providers are engaged. The projected demand for life cycle analysis drives the development of vocational courses.

Engagement with Government

The Hub will work with government to identify what information may be needed from voluntary measurement to help inform the anticipated consultation on potential future policy.

Any embodied or whole life carbon regulation would ideally be introduced at the same time as other changes to the regulations, to ease the burden on developers by reducing the frequency of design changes driven by new regulation.

Outcome: The industry is prepared to comply with any future regulations around embodied and whole life carbon, but also in the intervening period has developed a more accurate and representative evidence base of whole life carbon assessments that can inform the government consultation in 2023.

Appendix A – The roadmap relevant to embodied and whole life carbon in the Future Homes Delivery Plan

ROADMAP: production and construction

Report of Future Homes Task Force

Key: New government policy or target | Potential target | Enabling activity done or catalysed through hub | Precondition

PRODUCTION AND CONSTRUCTION

	2021–2025	2025–2050
	FHS: 1	Full Future Homes Standard.
Systematic approach	2022: Agree measurement methods, reviewing existing measurement standards, including with supply chain. Measure and publish current performance across the industry. Assess what reductions can be made when, reflecting the whole life environmental impacts. Set targets and a detailed roadmap for how carbon, resources, water and air pollution can be reduced during the construction lifecycle, including the specific mechanisms and actions needed. Understand clashes and synergies with the Future Homes Standard and other changes. Meanwhile, identify quick wins that can be implemented across the sector. 2023: Publish and support materials for the sector.	
Zero embodied carbon	Work with supply to achieve: • EPDs for each product • Expanded supply of low/zero carbon materials • Support SMEs in selecting materials and product types	Ambition to meet or exceed the World GBC Net Zero pathway, with rapid analysis to set robust and stretching targets for 2025, 2030 and 2040 and/or other dates as appropriate.
Resource efficient	Work with supply chain to drive action on plastics and other waste.	2025: Incremental improvement and target to be set for 2025, 2030 and 2040. 2030–2050: Zero avoidable waste at all stages of the construction lifecycle by 2050.
Water efficient	Connect to meter at site start to measure water use for baseline. Working with suppliers and water companies to trial and develop lower water usage options to allow scale up prior to meet the 2025 – 2040 pathway.	2025: Up to 30% reduction. 2030: Up to 40% reduction. 2040: Up to 50% reduction.
Low air pollution	Collaboration with manufacturers on future machinery and site facilities.	Air quality targets to be set for 2025, 2030 and 2040.

Report of Future Homes Task Force

Page 11 of the Delivery Plan Summary
Available at: www.futurehomes.org.uk/roadmap

Appendix B – Proposed assessment framework for new build homes

Framework overview

Informed by the call for evidence and feedback from the Hub steering group members, a proposed framework has been developed to facilitate collection of a consistent data set for new build homes. Three levels of reporting have been identified that reflect different assessment scopes. Developers can choose to disclose at a building-level ether 'upfront carbon' or 'whole life carbon', or at project-level, including site-level infrastructure and external works.

The intention is that a detailed set of conventions can be defined (in a similar way to SAP) that will reduce the observed variability between similar assessments and provide the sector a more consistent platform from which to understand benchmarks and set targets.

Dialogue will be maintained with the UK Net Zero Carbon Buildings Standard (NZCBS), BECD and the other embodied and whole life carbon initiatives currently in progress in order to ensure alignment as we look to finalise a set of conventions for assessing new build homes.

The assessment framework outlined here aligns with the RICS Professional Statement[1], building on them to meet the specific needs of the UK homebuilding industry.

Framework detail

The FHH assessment framework for embodied carbon assessments is summarised in Figure B2 for dwelling level upfront and whole life carbon assessments, and for project level whole life carbon assessments. The dwelling level assessments are a subset of the project level calculations. The breakdown by building element and life cycle stage should be reported in each case.

Building elements

The RICS professional statement only requires substructure and superstructure to be included as a minimum. The FHH assessment framework builds on this to also include internal finishes, fixed FF&E, and services as these were commonly measured and accounted for in the baseline dataset gathered by the steering group members.

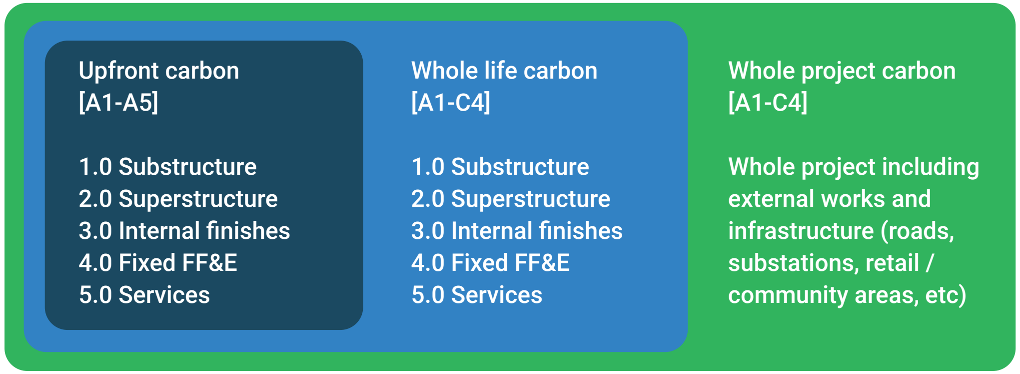

Figure B1 – Proposed assessment framework; high level

[1]Note that the RICS Professional Statement, often referred to in the UK construction industry sets out specific mandatory principles and supporting guidance for the interpretation and implementation of BS EN 15978:2011 methodology.

		Dwelling level - upfront	Dwelling level – whole life	Project level – whole life
Life-cycle stage	Sequestered carbon & carbonation	-	✓	✓
	[A1 – A3]	✓	✓	✓
	[A4]	✓	✓	✓
	[A5]	✓	✓	✓
	[B1 – B5]	-	✓	✓
	[B6 – B7]	-	✓	✓
	[C1 – C4]	-	✓	✓
	[D]	-	Optional	Optional
Building element	Demolition	-	-	✓
	0.0 Facilitating works	-	-	✓
	1.0 Substructure	✓	✓	✓
	2.0 Superstructure	✓	✓	✓
	3.0 Internal finishes	✓	✓	✓
	4.0 Fixed FF&E	✓ (Building related)	✓ (Building related)	✓ (Building & non-building related)
	5.0 Services	✓ (Building related)	✓ (Building related)	✓ (Building & non-building related)
	6.0 Prefabricated buildings and building units	-	-	✓
	7.0 Works to existing buildings	-	-	✓
	8.0 External works	-	-	✓

Figure B2 – Proposed assessment framework; detail by life cycle stage and building element

Life-cycle stages[1]

The RICS professional statement also only requires [A1-A5], [B4], and [B6] to be included as a minimum. However, to fully understand the whole life carbon impact of design decisions, the FHH assessment framework includes all stages [A1-C4], including carbon sequestration for the whole life carbon calculation at dwelling and site level. Module D can be reported as optional and is commonly calculated in commercial whole life carbon software tools as standard.

Reference study period

In line with the RICS professional statement, the reference study period should be 60 years.

Carbon data sources

In line with the RICS professional statement guidance, the hierarchy for carbon data sources for construction materials to be used for whole life carbon assessments is:

- Supplier & product specific EPD (no older than 5 years)
- EPD for an equivalent or similar product (no older than 5 years)
- Carbon data for generic material (e.g. ICE database)

Sequestered carbon and carbonation

Sequestered carbon and carbonation are to be included in the whole life carbon assessments at dwelling and project level, in line with the RICS methodology.

Sequestered carbon is excluded at 'Dwelling level-upfront' scope, but can be reported separately from stages [A1-A5] for information.

Carbonation should be accounted for in stages [B1] and [C3-C4] and reported separately in addition, provided that the conditions in the RICS guidance are met..

"Data from EPDs or equivalent sources can be used to account for the impact of carbonation in stages [B1] and [C3-C4], provided that the conditions in the scenario selected in the data source coincide with the anticipated project-specific ones. In case the assumptions are either not sufficiently transparent or diverge from what is expected to apply to the specific project being assessed, carbonation figures should either not be taken into account or adjusted accordingly."

Default values

The assessment framework allows default values to be used in the absence of actual data, but also allows improvements and meaningful reductions in carbon to be accurately reflected in embodied carbon assessments where actual data is available.

The default dataset for the FHH assessment framework initially relies on the RICS professional statement guidance (2017). This document is due to be updated in 2023 and the Hub will input to this process. As the Hub's database of carbon assessments grows and increases in accuracy, the default values will be transitioned to values based on this dataset to represent the current state of the UK homebuilding industry.

The RICS professional statement outlines the default assumptions that should be made in the absence of primary information.

- [A1-A3]: Default specifications to be used for the main building materials including concrete, steel, blockwork, timber, aluminium, plasterboard, and insulation – section 3.5.1, pg 17
- [A4]: Default transport distances for locally, nationally, European, and globally sourced materials – section 3.5.2, pg 19
- [A5]: Average emissions for construction site activity – section 3.5.2, pg 20
- [A5]: Average site waste rates by material - WRAP net waste tool reference
- [C1-C4]: End of life scenarios – section 3.5.4 pg 25,26
- Product expected lifespans: section 3.5.3, pg 23

Areas for further study and consultation

There are some key areas that require further work:

- The Hub will engage with the development of the new RICS professional statement to explore:
  - The treatment of solar PV and how it should be considered in the scope of upfront and whole life carbon disclosures and targets.
  - The predicted decarbonisation of materials and how it should be accounted for in assessments and targets
  - The treatment of sequestered carbon at end-of-life:
    - including uncertainty of difficult to predict events a long way into the future and the appropriate assumptions
    - the ambiguity caused by quoting it as a separate figure
  - Whether the 60-year reference period for low-rise dwellings, is reflective of reality.
- The Hub will work with the Construction Products Association and the issuers of EPD certificates to:
  - look at how EPDs can be quicker, cheaper, and easier for manufacturers, giving specifiers more choice with more up-to-date data
  - to encourage more EPDs.

[1]Refer to Appendix E for definition of life-cycle stages.

Appendix C – Detailed project methodology

Call for evidence

As a starting point, the Future Homes Hub issued a call for evidence on embodied and whole life carbon asking about the scope of embodied carbon assessments, existing and required skills, and the challenges faced by respondents in data collection and calculation activities.

There were 17 respondents, and the responses can be summarised under three key themes;

1. Scope of embodied carbon assessments for new build homes

Most respondents favoured a whole life carbon approach including operational energy, and while the RICS guidance for whole life carbon should be adopted, more clarity is required around some areas, especially end of life treatment of materials and the treatment of carbon sequestration.

2. Existing and required skills within the industry

Knowledge and skills are still developing within the industry, and a simplified approach and calculation tool tailored for UK homebuilders would be valuable, especially for smaller projects and organisations.

3. Data and tools to carry out embodied carbon assessments

One of the main challenges recognised in the responses is in collecting material quantities data and EPDs. There is a need for a homebuilder specific standard database of default values for use where primary data is unavailable. Suppliers will need support to provide EPDs to fill knowledge gaps.

Steering & sub-groups

A steering group was set up consisting of developers, suppliers, industry bodies, government bodies and technical experts. Two sub-groups of developers were formed; the first to focus on the technical data analysis for baseline and comparative upfront and whole life carbon assessments, and the second to focus on the assessment framework and roadmap development.

The focus for sub-group 1 was to:

- Collect data relating to the scope from within their own business and share within the realms of the team.
- Input on the scope of design and material options to be compared.
- Input on the proposed calculation methodology and assumptions.

The focus for sub-group 2 was to:

- Highlight knowledge gaps and areas for further investigation.
- Input on the enabling activities and the pathway to industry preparedness for possible regulation.
- Input on the timing of the implementation plan.

Methodology for baseline assessment

Existing embodied and whole life carbon assessments were gathered from the homebuilder members of the steering group and collated to develop an initial baseline for upfront and whole life carbon intensities. The dataset contains various configurations of low-rise, 2-3 storey, 2-5 bed, mid-terraced, semi-detached, and detached houses of timber, masonry and steel frame construction, and a smaller sample set of mid/high-rise residential apartment schemes; shown in Figures C1 and C2.

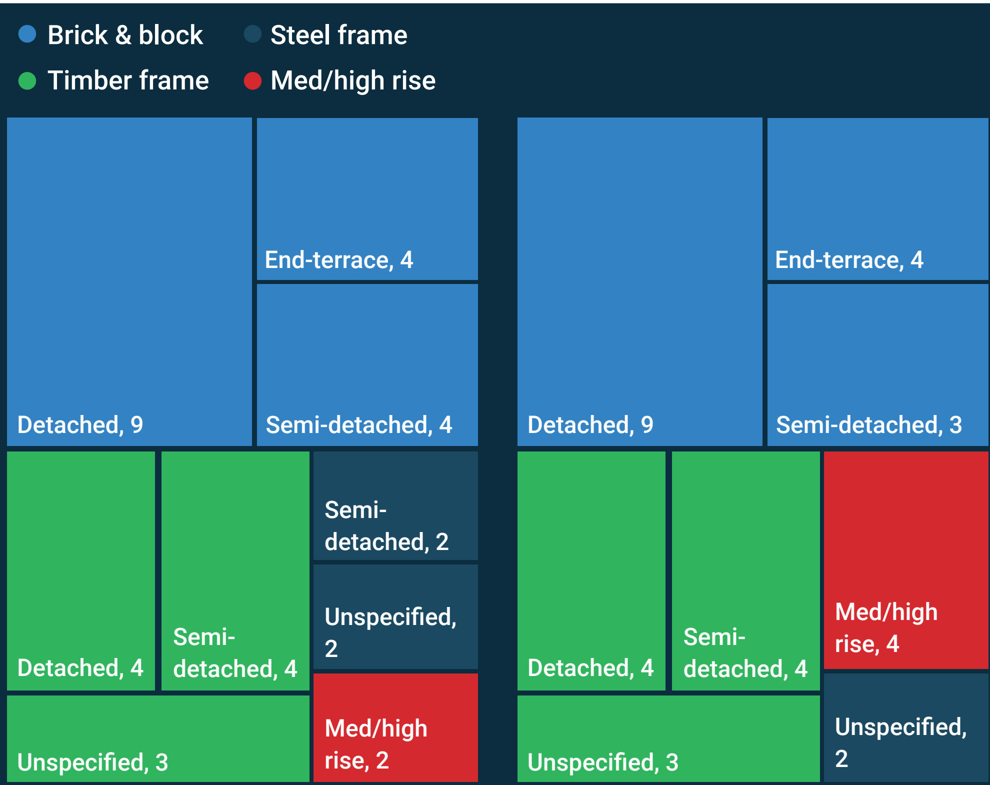

Figure C1 – Upfront carbon dataset: Sample size by type

Figure C2 – Whole life carbon dataset: Sample size by type

Notes:

- All assessments included in the baseline dataset were carried out on homes built to 2013 building regulations.
- WLC assessments were all carried out at design stage, though generally it wasn't stated which RIBA stage. They mostly represent developers' standard house types, rather than specific buildings. As such, there were no as-built assessments available to be included.
- A portion of the timber frame assessments analysed did not specify whether construction was open- or closed-panel, therefore all timber frame constructions are grouped together.
- Some reports did not detail the configuration of the home, so they are listed as 'unspecified'.
- Many of the assessments did not report on operational carbon [B6-B7] so – in common with existing benchmarks – this has not been included in this baseline (see Figure 1). However, it is accounted for in the comparative assessment detailed in the following section.

Methodology for comparative assessment

An assessment was undertaken of the potential whole life carbon impact of design decisions to reduce carbon and to support upcoming regulation changes to Part L and the Future Homes Standard (FHS), relying on currently available technology and data.

This comparative assessment was based on three low-rise bills of quantities provided by steering group members, comparing the options in Figure C4 to the baseline specification in Figure C3.

The comparative options were discussed and agreed with Sub-group 1 as being representative of current available options, but this list is not exhaustive. The assessment was intended to show the order of magnitude impact of each individual option when compared to the baseline. Combinations of options were not assessed. The assessment was carried out using the One Click LCA software.

The three house-type configurations analysed were:

- 4-bed two-storey detached
- 3-bed two-storey semi-detached / end-terrace
- 3-bed mid-terrace

Element	Baseline
Substructure	Concrete
Ground floor	Beam & block
Upper floor & roof structure	Timber
Roof covering	Clay tiles
Outer leaf	Clay facing brick & mortar
Inner leaf	Aerated concrete block & mortar
Windows	uPVC double glazing
Heating system	Gas boiler

Figure C3 - Baseline specifications

	Baseline	Option 1	Option 2	Option 3
Outer leaf	Clay facing brick & mortar	Concrete facing brick & mortar	Lightweight cladding – fibre cement board	
Inner leaf	Aerated concrete block & mortar	Timber frame	Light guage steel frame *(ultimately this was not assessed against the baseline as comparable bills of quantities were unavailable)*	
Ground floor	Beam & block	Beam & EPS infill		
Upper floor	Timber	Offsite floor cassette		
Roof covering	Clay tiles	Concrete tiles	Slate tiles	Fibre cement slates
Services	Gas boiler	ASHP (R32)	ASHP (R32) + PV	ASHP (R32) + PV + Battery

Figure C4 – Comparative options

Scope

The assessment covered substructure, superstructure, internal finishes, fixed furnishings, fittings, and equipment, and MEP and services. External and site works were not included within the scope of the dwelling-level assessment.

The life stages included in the assessment were [A1-A5], [B1-B5], [B6] and [C1-C4], a cradle-to-grave assessment, but unregulated energy consumption was not included in the scope, as there is no operational control for the homebuilders, and it will decarbonise in line with the UK electricity grid. Module D was also calculated but not reported in the whole life carbon totals. The Reference Study Period was 60 years.

FAQ: Why has a 60-year calculation period been chosen?

The 60-year life is set in the RICS professional statement and follows on from the assumption used in whole life costing calculations. There was consensus that the 60-year period does not reflect actual lifespans of low-rise homes but that it was important that calculations should be consistent with the RICS professional statement. It was agreed that the Hub should explore with RICS the scope to make the professional statement more reflective of reality.

Assumptions

Default values were used for:

- Upstream transport & distribution (distance, mode of transport, avg. loading factors);
- Building component expected lifespans (where EPD data was unavailable);
- End of life treatment of materials; and
- Waste rates onsite and disposal routes per material type for onsite waste and end-of-life.

It was assumed that any materials and building elements with less than a 60-year projected lifespan would be replaced like-for-like. No decarbonisation of the supply chain and replacement materials was assumed so the results are conservative. This is an area of further work to agree a standard approach to the decarbonisation of materials and will likely refer to the expected update to the RICS professional statement and reference the UKGBC Whole Life Carbon Roadmap.

The RICS guidance recommends using the FES Average future electricity, UK (2022-2082) - Steady Progression 2050 scenario to calculate the projected emissions reductions from electricity consumption within the reference study period. However, on consultation with the steering group and sub-groups, the HMT Green Book projections were used.

Carbon data

The hierarchy for choosing the appropriate material and associated embodied carbon factor followed the RICS guidance, as described in Appendix B.

Materials & bills of quantities

The level of detailed material specification in the input dataset was variable, ranging from specific products and suppliers to generic material grouping (e.g. 'Redland Rosemary traditional clay tile' versus 'roof tile'). Where the exact product was unknown, the RICS default material specification was chosen at the input stage for the comparative assessment. In the baseline dataset of assessments gathered by the Hub, it is difficult to gain certainty around the proportion of the assessment that is reliant on product specific EPDs versus industry average carbon factors.

Appendix D –Tables, Charts and Discussion

Baseline assessment

The average upfront and embodied carbon intensities for the sampled dataset of low and medium-high rise housing provided by the steering group members is given in Figure D1. The sample sizes indicate how many assessments in the database were compared, and only assessments with comparable scopes were included. All carbon figures are normalised by m^2 of floor area to allow comparability.

The sample size for medium/high rise housing is small, so the following baseline analysis only relates to low rise housing.

There is little to no correlation found between upfront and embodied carbon intensities and characteristics such as floor area, house-type configuration, and construction systems in the phase 1 dataset, shown in Figures D2, D3 and D4. This is a relatively small dataset and again this highlights the need for continued data collection to assess any statistically significant correlation between building characteristics and upfront and embodied carbon.

Many of the reports assessed as part of the baseline did not report operational energy and water emissions [B6-B7] so whole life carbon is not shown on these charts. However, to fully assess the whole life carbon impacts of design decisions, [B6-B7] will need to form part of the assessment and disclosure framework within the implementation plan.

	Low-rise housing	Medium / high-rise housing
Upfront carbon intensity [A1-A5] $kgCO_2e/m^2$	417	635
Sample size	32	2
Embodied carbon intensity [A1-C4, excl. B6-B7] $kgCO_2e/m^2$	615	866
Sample size	27	4

Figure D1 - Average carbon intensities for housing in the Hub database

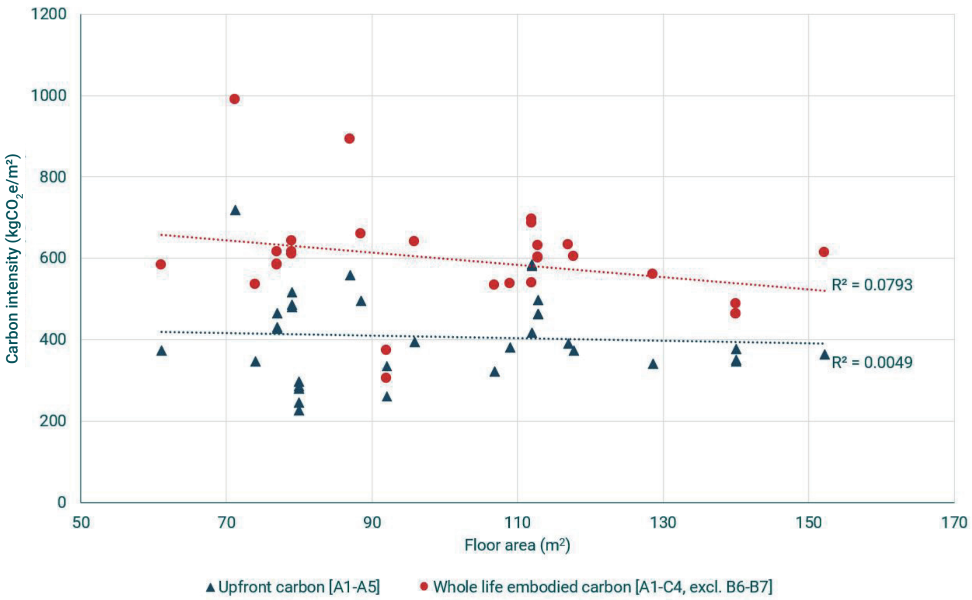

Figure D2 – Upfront & whole life embodied carbon intensity within the phase 1 dataset

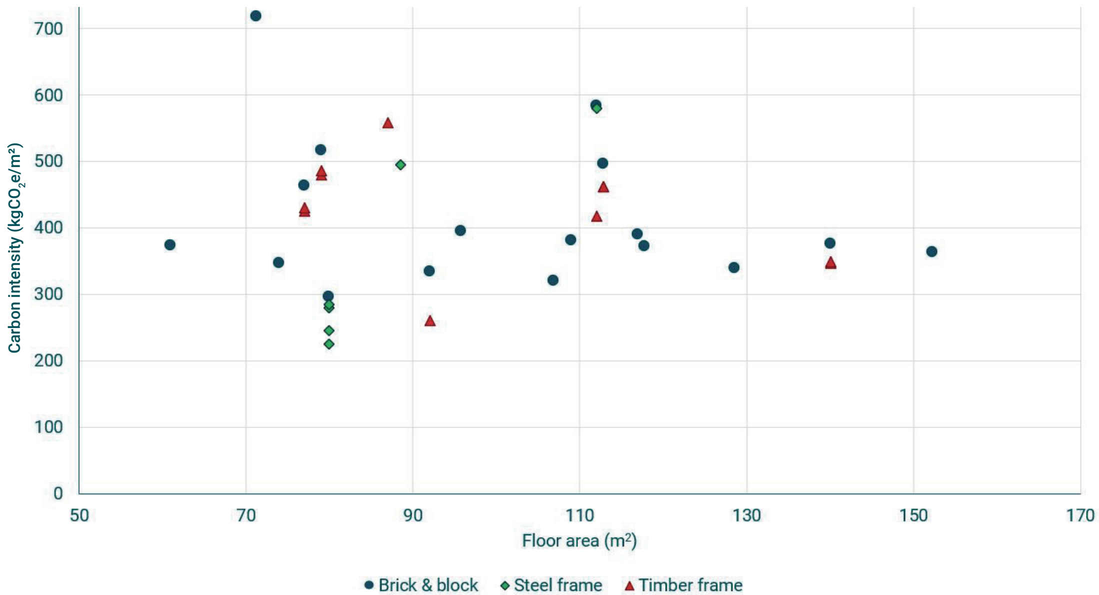

Figure D4 – Upfront carbon intensity by construction system within the phase 1 dataset

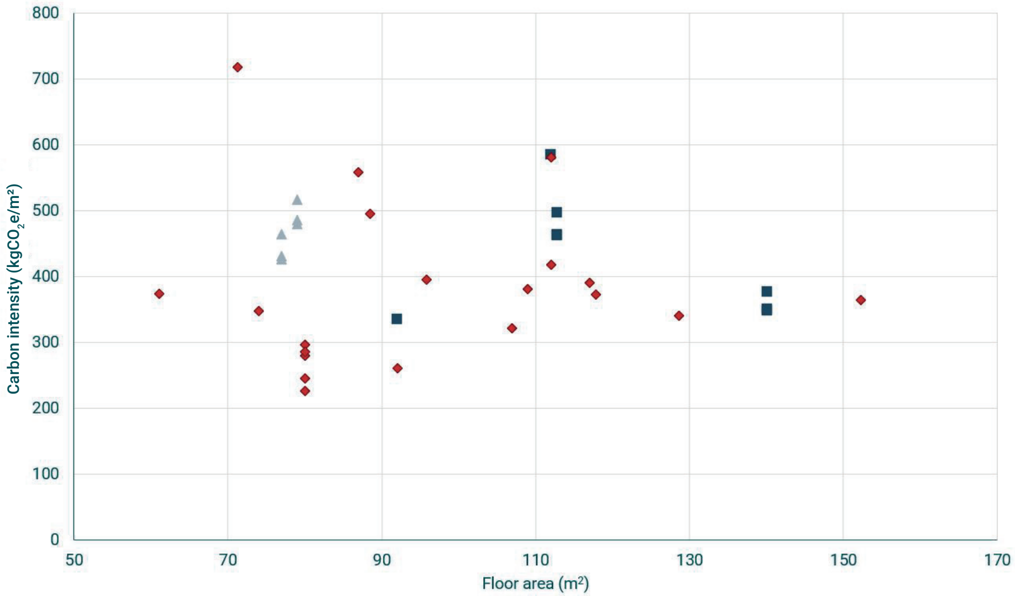

Figure D3 – Upfront carbon intensity by house-type configuration within the phase 1 dataset

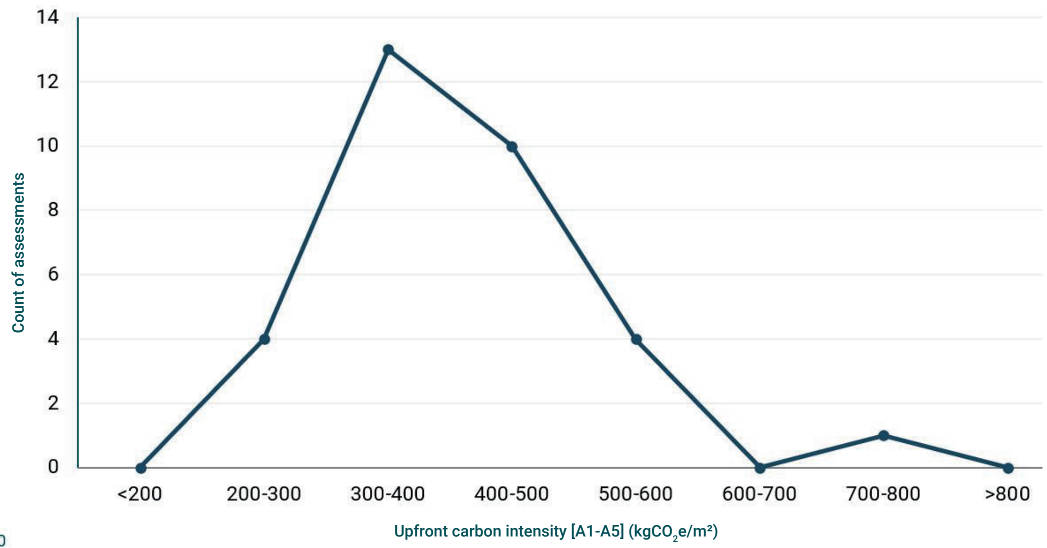

Figure D5 – Distribution of upfront carbon assessment outcomes within the phase 1 dataset

	2020	2025	2030
LETI [A1-A5], [B1-B5], [C1-C4]	800 $kgCO_2e/m^2$	< 500 $kgCO_2e/m^2$	< 300 $kgCO_2e/m^2$
GLA [A1-A5] excl. sequestration	< 850 $kgCO_2e/m^2$		<500 $kgCO_2e/m^2$
GLA [B1-B5], [C1-C4]	< 350 $kgCO_2e/m^2$		<300 $kgCO_2e/m^2$
RIBA [A1-A5], [B1-B5], [C1-C4] incl. sequestration	1200 $kgCO_2e/m^2$	<800 $kgCO_2e/m^2$	<625 $kgCO_2e/m^2$

Figure D6 – Existing residential benchmarks

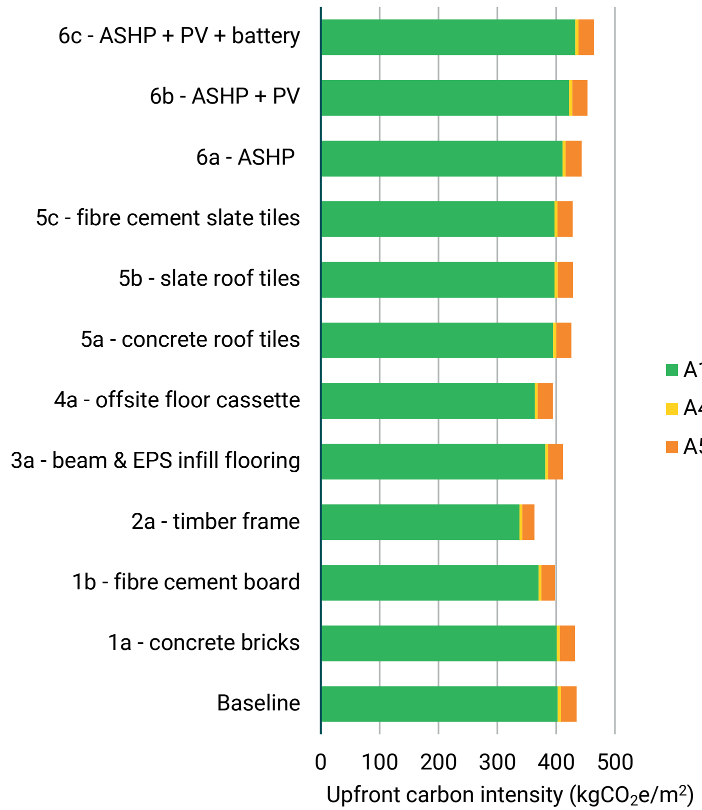

Figure D7 – Upfront carbon impacts of options on 4-bed detached home

Option	Upfront Intensity ($kgCO_2e/m^2$)	% Change from baseline
Baseline	435	
1a – concrete bricks	432	-1%
1b – fibre cement board	398	-9%
2a - timber frame	363	-16%
3a - beam & EPS infill floor	412	-5%
4a - offsite floor cassette	395	-9%
5a - concrete roof tiles	426	-2%
5b - slate roof tiles	428	-2%
5c - fibre cement slate tiles	428	-2%
6a – ASHP (with baseline spec)	443	2%
6b - ASHP + PV	453	4%
6c - ASHP + PV + Battery	464	7%

Figure D8 – Upfront carbon impacts & % change

The distribution curve of the upfront embodied carbon of the low-rise homes within the database is shown in Figure D5. It follows a normal distribution, with one outlier assessment of >600$kgCO_2e/m^2$. This outlier had a concrete upper floor structure which was the only example of this configuration in the dataset.

Comparison with existing benchmarks

LETI, RIBA, and the GLA have published benchmarks and targets for 2020, 2025 and 2030 for upfront and embodied carbon, outlined in Figure D6. There are a couple of important points to note about these benchmarks and targets; they exclude operational energy and water emissions [B6-B7] and the figures quoted are consistent with what would be expected for medium to high-rise residential schemes.

See Figure 2 (page 5) for the comparison of the FHH phase 1 dataset for both low-rise and medium/high-rise housing with the LETI, RIBA, and GLA benchmarks and targets for upfront and embodied carbon intensity.

On average, low-rise housing already performs better than the GLA, LETI, and RIBA business as usual benchmarks, the GLA aspirational targets, the LETI & RIBA 2025 targets, and the LETI & RIBA 2030 embodied carbon target. The only target not already being achieved on average within the low-rise dataset is the LETI/RIBA 2030 target. The sample size of medium-high rise residential apartments was much smaller and performed well against the business-as-usual benchmarks. This finding supports the need for an additional set of benchmarks and targets for low-rise housing. Medium and high-rise residential schemes should continue to follow LETI, RIBA, and GLA benchmarks and targets.

Comparative assessment

Upfront carbon [A1-A5]

The upfront carbon impacts of the different options are shown in Figures D7 and D8. The largest savings in upfront carbon are achieved by replacing the internal leaf of the external wall with a timber frame, the offsite manufactured first floor cassette, and the fibre cement board replacement of the external leaf of the external wall. As additional insulation and PV is added to the building the upfront carbon increases.

Whole life carbon [A1-A5], [B1-B7], [C1-C4]

The whole life carbon impacts of the options for the 4-bed detached home are shown in Figures D9 and D10. The most material impact on the whole life carbon is switching the gas boiler for an ASHP and removing the reliance on natural gas consumption for the occupant over the calculation period. It is important to note here that this analysis relied on a small sample of SAP assessments provided by the steering group members and was not calculated for each comparative option.

The benefit of adding extra PV and batteries is not fully recognised here as it will reduce the occupant reliance on purchased grid electricity. As the grid decarbonises, the carbon impact will be negligible, but the occupant will have greatly reduced energy bills.

Module D is optional for reporting following the RICS guidance, but many commercially available LCA software packages calculate it as standard. It is shown in Figure D9 but is not included in the totals in Figure D10.

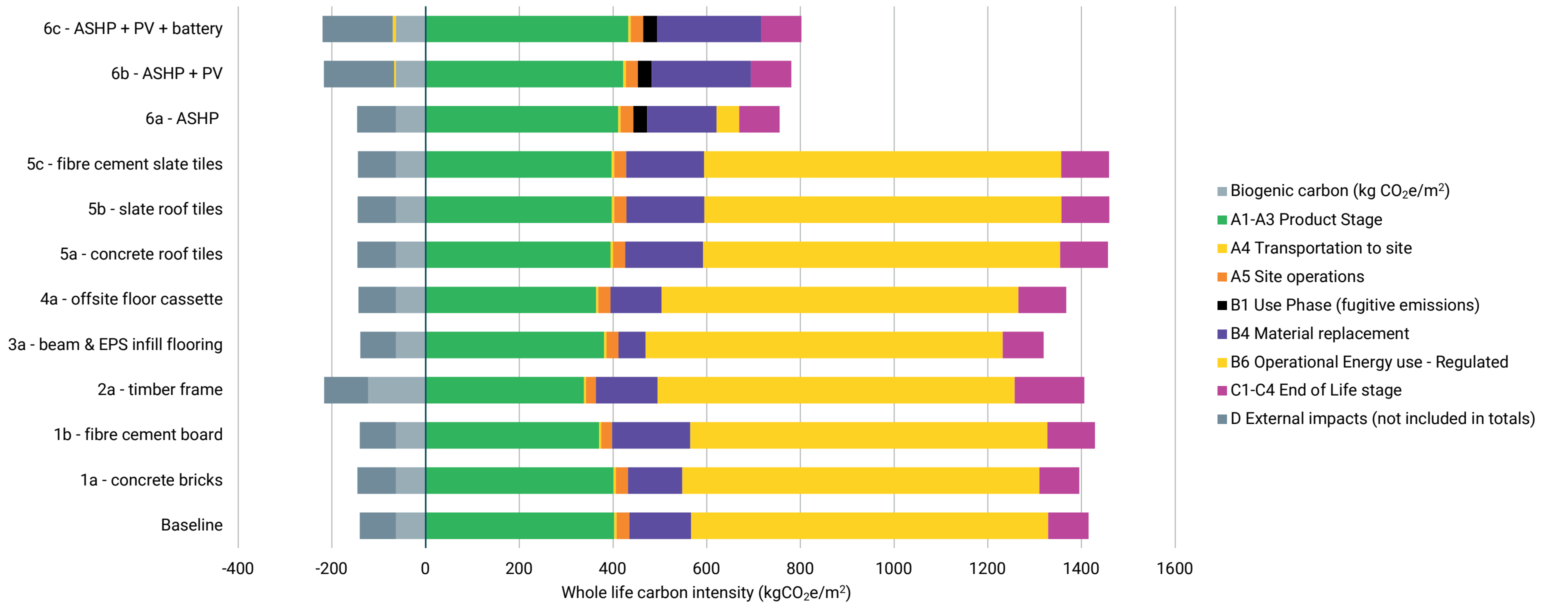

Figure D9 - Whole life carbon impacts of options on 4-bed detached home

Option	WLC Intensity ($kgCO_2e/m^2$)	% Change from baseline
Baseline	1351	
1a - concrete bricks	1325	-2%
1b - fibre cement board	1365	1%
2a - timber frame	1283	-5%
3a - beam & EPS infill flooring	1256	-7%
4a - offsite floor cassette	1304	-3%
5a - concrete roof tiles	1393	3%
5b - slate roof tiles	1396	3%
5c - fibre cement slate tiles	1396	3%
6a - ASHP (with baseline spec)	692	-49%
6b - ASHP + PV	713	-47%
6c - ASHP + PV + Battery	731	-46%

Figure D10 - Whole life carbon impacts & % change

Appendix E – Additional resources

Guidance and publications

RICS Whole life carbon assessment for the built environment
www.rics.org/uk/upholding-professional-standards/sector-standards/building-surveying/whole-life-carbon-assessment-for-the-built-environment/

IStructE - How to calculate embodied carbon
www.istructe.org/resources/guidance/how-to-calculate-embodied-carbon/

GLA Whole Life-Cycle Carbon Assessments guidance
www.london.gov.uk/what-we-do/planning/implementing-london-plan/london-plan-guidance/whole-life-cycle-carbon-assessments-guidance

LETI Climate Emergency Design Guide
www.leti.uk/cedg

LETI Embodied Carbon Primer
www.leti.uk/ecp

UKGBC Net Zero Whole Life Carbon Roadmap for the Built Environment
www.ukgbc.org/ukgbc-work/net-zero-whole-life-roadmap-for-the-built-environment/

CIBSE TM65 Embodied carbon in building services
www.cibse.org/knowledge-research/knowledge-portal/embodied-carbon-in-building-services-a-calculation-methodology-tm65

ICE Embodied Carbon Footprint Database
www.circularecology.com/embodied-carbon-footprint-database.html

UK Net Zero Strategy
www.gov.uk/government/publications/net-zero-strategy

Part-Z Proposal
www.part-z.uk/proposal

BS EN 15978:2011
www.thenbs.com/PublicationIndex/Documents/Details?DocId=299697

Environmental Audit Committee: Building to net zero: costing carbon in construction
www.committees.parliament.uk/publications/22427/documents/165446/default/

Government response to the Environmental Audit Committee report
www.committees.parliament.uk/publications/30124/documents/174271/default/

ASBP Briefing Paper: EPD: An introduction
www.asbp.org.uk/briefing-paper/epd-an-introduction

[A1-A3]	PRODUCT stage	[A1]	Raw material extraction & supply
		[A2]	Transport to manufacturing plant
		[A3]	Manufacturing & fabrication
[A4-A5]	CONSTRUCTION stage	[A4]	Transport to project site
		[A5]	Construction & installation process
[B1-B7]	MATERIAL IN-USE stage	[B1]	Use
		[B2]	Manufacture
		[B3]	Repair
		[B4]	Replacement
		[B5]	Refurbishment
	OPERATIONAL IN-USE stage	[B6]	Operational energy use
		[B7]	Operational water use
[C1-C4]	END OF LIFE stage	[C1]	Deconstruction & Demolition
		[C2]	Transport to disposal facility
		[C3]	Waste processing for reuse, recovery or recycling
		[C4]	Disposal
[D]	Benefits and loads beyond the system boundary	[D]	Reuse Recovery Recycling potential

Reminder of whole life carbon stages

Element	Baseline	Resource name	Maufacturer	EPD number	Year	Country
Substructure	Concrete	GEN3 (C20/25), CEM I	Hanson HCG	BREG EN EPD 000191	2018	UK
Outer leaf	Clay facing brick	Red brick, average production, UK	Brick Develop-ment Association (BDA) Ltd	BREG EN EPD000002, issue, 04	2019	UK
Inner leaf	Aerated concrete block	Autoclaved aerated concrete blocks	BPCF	EPD-BPC-20170093-CCD1-EN	2017	UK
Ground floor	Beam & block	Precast concrete ground beam	British Precast	EPD-BPC-20170148-CCD1-EN	2017	UK
Upper floor & roof structure	Timber	Structural sawn timber, kiln dried, planed or machined	Wood for Good	BREG EN EPD 000124	2017	UK
Roof covering	Clay tiles	Roof tiles	Quinn	EPDIE-18-12	2018	UK
Windows	uPVC double glazing	Double-glazed PVC frame window	Munster Joinery	EPDIE-21-50	2021	Ireland

Baseline EPDs for comparative analysis

If you have any queries or would like to give feedback on the report please contact us.

Email: **admin@futurehomes.org.uk**
Website: **www.futurehomes.org.uk**

Future Homes Hub