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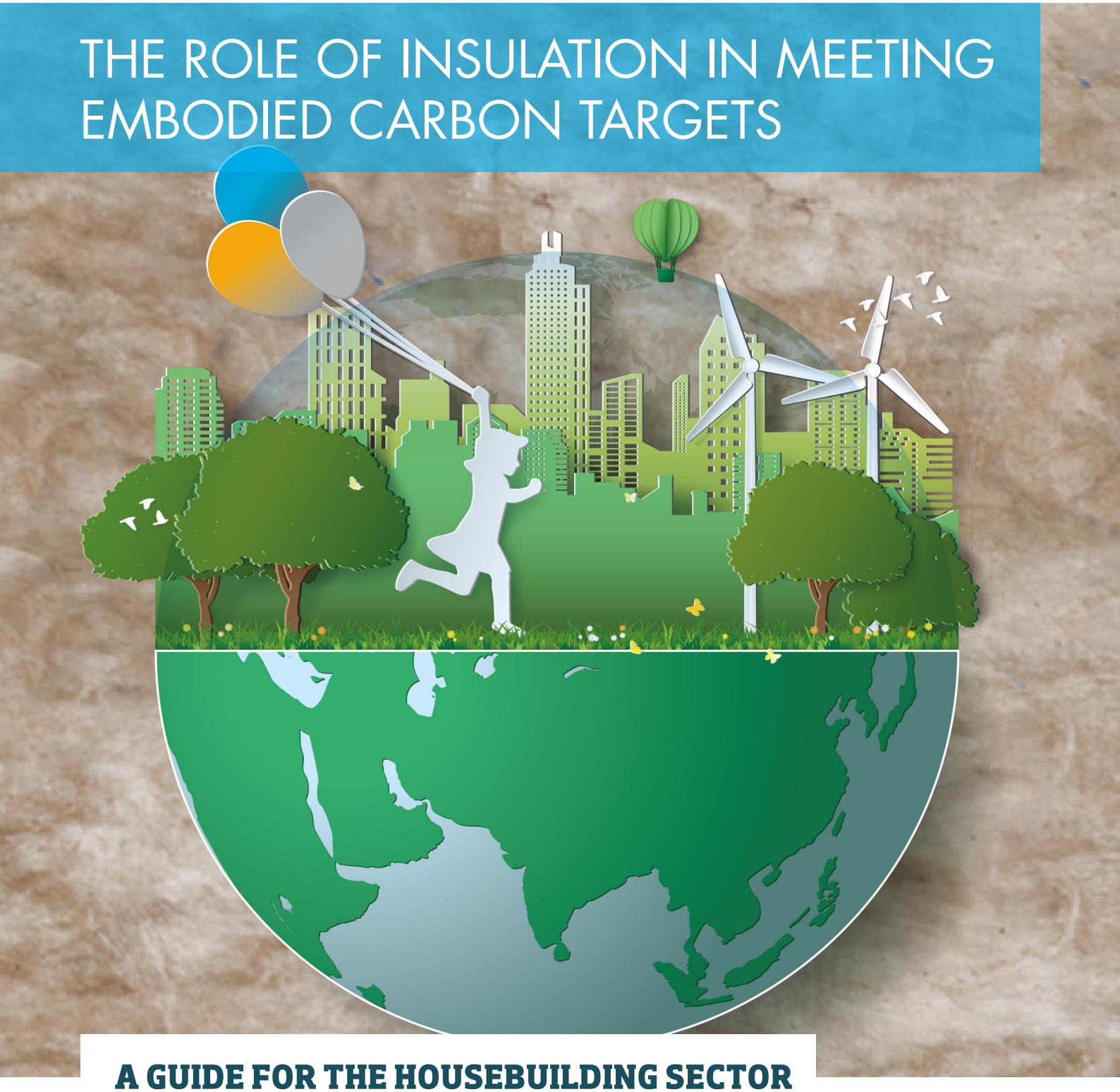
THE ROLE OF INSULATION IN MEETING EMBODIED CARBON TARGETS



A GUIDE FOR THE HOUSEBUILDING SECTOR

November 2022

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AN INTRODUCTION TO EMBODIED CARBON

The construction sector has a critical role to play in addressing the climate crisis

With the built environment responsible for around **25%**[1] of global greenhouse gases, there is simply no path to achieving the UK's net zero targets without reducing the carbon emissions related to our homes.

While progress has been made to improve the energy efficiency of UK homes – thereby reducing the operational carbon associated with running them – there's another side to the CO_2 equation that is only just beginning to get the attention it needs: embodied carbon.

Embodied carbon vs. operational carbon

EMBODIED CARBON[2] is the total greenhouse gas (GHG) emissions (often simplified to "carbon") generated to produce a built asset. This includes emissions caused by extraction, manufacture/processing, transportation and assembly of every product and element in an asset.

In some cases, (depending on the boundary of an assessment), it may also include the maintenance, replacement, deconstruction, disposal and end-of-life aspects of the materials and systems that make up the asset. It excludes operational emissions of the asset.

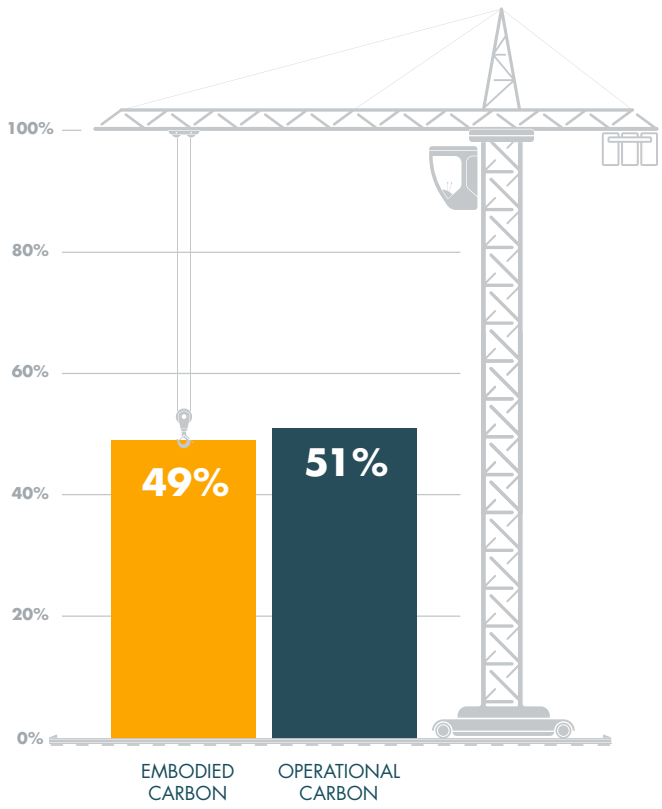
OPERATIONAL CARBON refers to the carbon emitted during the 'in use' stage of a building's lifecycle.

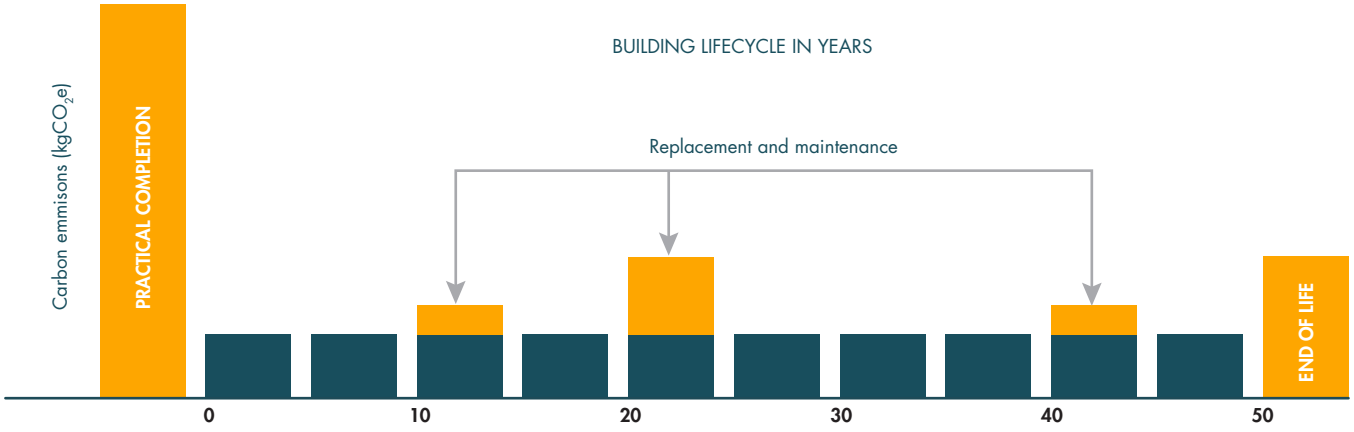
WHOLE LIFE CARBON describes the combined embodied carbon and operational carbon of a building.

If left unchecked, embodied carbon emissions are projected to make up **49%**[3] of all carbon emissions from new construction projects over the next thirty years.

Retrofitting with new energy-efficient technologies can reduce a building's operational carbon during its lifecycle. Conversely, the embodied carbon contribution to a building's whole life carbon is fixed at the start of its construction. The decisions housebuilders make about material choice are therefore key to each building's overall carbon footprint.

TOTAL CARBON EMISSIONS OF GLOBAL NEW CONSTRUCTION
from 2020-2050 - business as usual projection





Source: London Energy Transformation Initiative (LETI)

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DID YOU KNOW?

Embodied carbon in buildings is estimated to total **11%**[4] of all human-caused emissions on the planet.

Measuring embodied carbon and understanding declarations

Environmental targets can't be hit without tackling embodied carbon – the emissions 'hidden' within construction supply chains.

For housebuilders, and the designers and SAP assessors who advise them, this begins with knowing the declared embodied carbon of each of the materials proposed for each house design. Only when the full carbon cost of each material is known can low carbon options be identified and considered. What can be measured, can be managed.

The data needed to understand the embodied carbon of materials comes from Life Cycle Assessments (or LCA's) – which examine a range of different environmental impacts of a product at each stage in its life cycle.

A UPFRONT CARBON

Product stage

- **A1** RAW MATERIALS SUPPLY
- **A2** TRANSPORT MATERIALS SUPPLY
- **A3** MANUFACTURING

Construction stage

- **A4** TRANSPORT
- **A5** SITE WORKS

B USE STAGE EMBODIED CARBON

Use stage

- **B1** IN USE
- **B2** MAINTENANCE
- **B3** REPAIR
- **B4** REPLACEMENT
- **B5** REFURBISHMENT

C END OF LIFE CARBON

End of life stage

- **C1** DECONSTRUCTION
- **C2** TRANSPORT
- **C3** WASTE PROCESSING
- **C4** DISPOSAL

D

- **D** REUSE RECOVERY RECYCLE

EMBODIED CARBON

- **B6** OPERATIONAL ENERGY USE
- **B7** OPERATIONAL WATER USE

OPERATIONAL CARBON

WHOLE LIFE CARBON includes A,B,C and D

Beginning with the extraction of the raw materials neevded to manufacture a building product, through to a building's eventual demolition, disposal and recycling, each stage in the life cycle causes greenhouse gas emissions. Embodied carbon of building materials is the emissions footprint from their full life cycle – from 'cradle to cradle'.

When these emissions are added together, the embodied carbon of a given amount of a material can then be expressed as its GWP – its **Global Warming Potential.** This gives a standardised measure that allows direct comparison between materials, and therefore, informed materials procurement choices.

Indicator	Unit
GWP	$KgCO_2e$

The unit of measurement for GWP is $KgCO_2e$ (kilogrammes of carbon dioxide equivalent)

1. 'Net Zero Whole Life Carbon Roadmap – A Path to Net Zero for the UK Built Environment' – UK Green Building Council, November 2021
2. 'Embodied Carbon: Developing a client brief' – UK Green Building Council, March 2017
3. UN Environment Global Status Report 2017
4. 'New report: the building and construction sector can reach net zero carbon emissions by 2050' – World Green Building Council, September 2019

DID YOU KNOW?

EPDs for every single Knauf Insulation product can be found on our website and on **oneclicklca.com**

The GWP, multiplied by the specified amount of that material used in construction, indicates that material's total embodied carbon contribution to a building.

A product's GWP can be found within its **Environmental Product Declaration** – a document that carbon-conscious manufacturers produce to provide peer-reviewed information on a product's make-up and environmental impact.

It costs over 50 tonnes of CO_2 to build an average-sized UK house[5]

The total embodied carbon of a new home can vary hugely depending on the materials used in its construction. It takes over a quarter of a tonne of CO_2 to create a tonne of bricks, and a lot more for a tonne of steel.

As most houses in the UK are of brick construction with concrete foundations, an average-sized masonry house in the UK produces an estimated 50 to 80 tonnes of CO_2 to build.

When managing the embodied carbon of a project, the choice of materials needs to be considered across all aspects of a refurbishment or a new build.

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WHY THE HOUSEBUILDING SECTOR NEEDS TO REDUCE EMBODIED CARBON

The regulatory landscape and direction of travel

The need to 'do the right thing' and address climate change should be powerful motivations in themselves, but there are other compelling reasons for housebuilders to put in place embodied carbon reduction strategies now.

Building Regulations have brought about a reduction in operational carbon emissions. However, despite embodied carbon being almost half of total emissions over a building's lifetime, there are currently no national regulations that require embodied carbon emissions to be reduced, or even measured.

But that looks set to change.

The changes to Part L of the building regulations are expected to reduce carbon emissions by 31% compared with today's standards – a significant step forward, but a long way off the level that will be ultimately needed. A further tightening is expected with the Future Homes Standard in 2025.

RIBA

Proposals have already been made by various construction industry groups, that include the RIBA, for the addition of new 'Part Z' Building Regulations that would require public disclosure of embodied carbon emissions for projects.

Climate Change Committee

Similarly, the UK Climate Change Committee has called for mandatory whole-life carbon reporting, followed by minimum whole-life standards for all buildings, roads and infrastructure by 2025.

The UKGBC (UK Green Building Council) has produced a playbook to help local authorities drive up the sustainability of new homes.

Intended as a hands-on resource for planning officers, the playbook sets out recommended minimum requirements for the management of embodied carbon for **all** new homes:

> *All developments shall demonstrate actions taken to reduce embodied carbon and maximise opportunities for reuse through the provision of a Circular Economy Statement.*

And the following is recommended for major developments:

> *Major developments (defined as those with 10 or more dwellings or 1,000 square metres of floor space) shall calculate whole lifecycle carbon emissions (including embodied carbon emissions) through a nationally recognised Whole Lifecycle Carbon Assessment methodology and demonstrate actions taken to reduce lifecycle carbon emissions.*

The playbook goes on to include stretched requirements, that require the meeting of specific $KgCO_2e/m^2$ targets, from 2025 onwards.

How net zero targets translate to embodied carbon budgets for individual houses

For housebuilders looking to build homes with low embodied carbon, what numbers should be aimed for?

The embodied carbon targets for individual homes are rooted in the UK's 2050 net zero target. Since the 1990's, the UK's carbon emissions have been falling, but there is more to do, and further progress towards achieving net zero emissions by 2050 is dependent on significant reductions in embodied carbon.

For this reason, the RIBA has developed the 2030 Climate Challenge to provide a stepped approach for architects to meet net zero (or better) whole life carbon for new and retrofitted buildings by 2030.

It sets a series of targets for practices to adopt to reduce operational energy, potable water and embodied carbon.

The targets consider the latest recommendations from the Green Construction Board and have been validated through consultation with UK professional bodies.

RIBA 2030 Climate Challenge target metrics for domestic/residential

RIBA Sustainable Outcome Metrics	**Business as usual** (new build, compliance approach)	**2025 Targets**	**2030 Targets**
Embodied Carbon $KgCO_2e/m^2$	**1200** $KgCO_2e/m^2$	**<800** $KgCO_2e/m^2$	**<625** $KgCO_2e/m^2$

For embodied carbon specifically, the current 'minimum acceptable' budget of 1200 $KgCO_2e/m^2$ will almost halve in just the next ten years to 625 $KgCO_2e/m^2$, so housebuilders must take action now. In fact, the RIBA recommends that new houses being built now, are to the 2025 target of 800 $KgCO_2e/m^2$.

So we have recommended embodied carbon budgets for new homes.

GENERAL EMBODIED CARBON REDUCTION STRATEGIES FOR HOUSEBUILDERS

Now how do housebuilders work within them?

There are useful resources for housebuilders that are setting their own carbon reduction strategies. Of particular note are the recommendations for developers contained within The World Green Building Council's 'Bringing embodied carbon upfront' report:

The factors that contribute to the embodied carbon of insulation materials

FROM 2020

All developers commit to relevant industry roadmaps when available and require disclosure of supply chain LCA data for structural elements.

Indicator:

Percentage of projects that require 100% disclosure of structural elements.

Key actions:

- Collaborate with other public and private organisations to create joint commitments and shared knowledge and experience, and define clear strategies for the supply chain.
- Set prescriptive and performance-based procurement requirements for materials using available public procurement guidelines, specifications, or databases.
- Create new contractual obligations that require transparency in the disclosure of embodied carbon data from the supply chain (such as EPDs).

FROM 2025

All developers set embodied carbon reduction targets and benchmarks for all new construction and large renovation projects and require mandatory disclosure of supply chain data and track construction site emissions.

Indicator:

Percentage of projects that achieve best practice embodied carbon reduction targets.

Key actions:

- Use a whole lifecycle approach in building and infrastructure development and construction.
- Require low carbon or carbon positive materials and promote circular principles that meet defined performance requirements.
- Monitor and disclose material and energy related carbon emissions for all new construction and for large renovation projects.
- Develop new business and collaboration models such as building or product leasing services or alliances between client and key suppliers.
- Use financial incentives, contractual obligations or carbon commitments to set performance-based requirements for best practice embodied carbon targets or benchmarks.

FROM 2030

All construction sites are highly resource and energy efficient and, along with site-related transport processes, are powered by renewable energy.

Indicator:

Percentage of construction sites with 100% of demand met from renewable energy sources.

Key actions:

- Convert all plant and equipment to operate on carbon neutral biofuels or renewable electricity.
- Adopt best available technologies and processes to replace those with higher carbon emissions.
- Increase the energy efficiency of construction processes.
- Minimise the impact of construction processes on the natural environment.

FROM 2035

Developers only build projects that have net zero embodied carbon.

Indicator:

Percentage of projects that achieve net zero embodied carbon.

Key action:

- N/A

WHY YOUR CHOICE OF INSULATION MATTERS

Addressing embodied carbon will eventually influence every aspect of housebuilding.

The transition will present housebuilders with a unique set of challenges. Balancing the need to minimise embodied carbon against other factors – whether performance-related (longevity and non-combustibility, for example), or more prosaic supply chain concerns regarding availability and reliability.

What action can housebuilders take today to address embodied carbon in the homes they build, without having to completely overhaul their operations?

Insulation choice is an embodied carbon 'quick win'

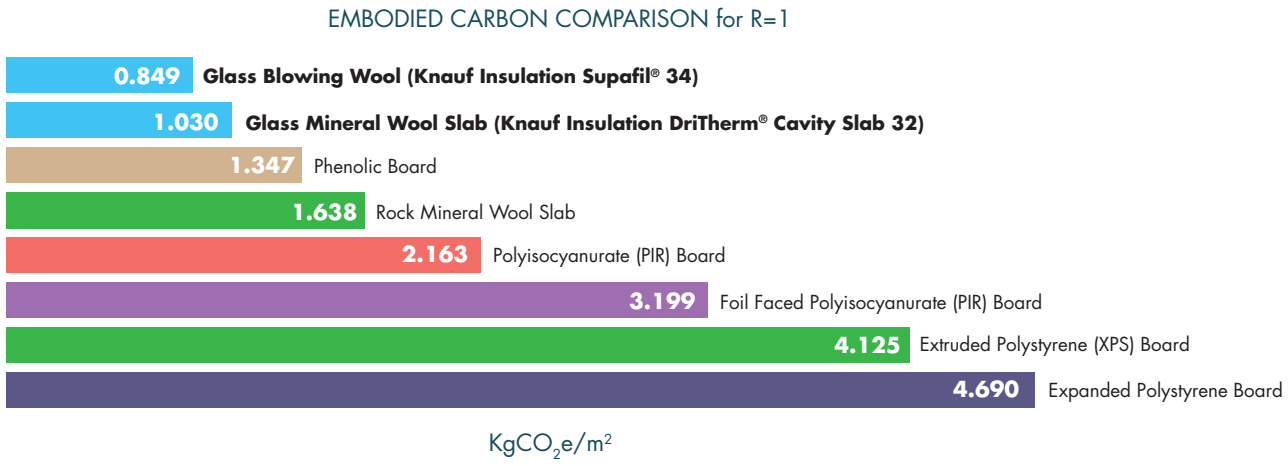
Although insulation accounts for only a small proportion of the total embodied carbon cost of a building, it's some of the 'easiest' embodied carbon to address. For mainstream housebuilding at scale, a simple product swap can make a material difference to a home's carbon budget without the need for substantial redesigns.

Even where their theoretical performance in terms of operational carbon is identical (i.e. in the R-values the insulation achieves), there can be substantial differences in the embodied carbon cost of mainstream insulation materials.

Embodied carbon of mainstream insulation materials

How insulation material is made, transported and installed can make the difference between it having low levels of embodied carbon, or having more than five times the amount of Global Warming Potential. Clearly, for housebuilders, the choice of insulation is hugely important in proactively managing embodied carbon budgets.

The chart below uses published data from manufacturers' Environmental Product Declarations to compare the embodied carbon of common insulation materials used in cavity walls.



Recommendation one: Preselect insulation materials that are typically lower in carbon.

Glass Mineral Wool has the lowest embodied carbon of any mainstream insulation material.

Even within material categories, embodied carbon will vary widely depending on an individual manufacturer's location, operations and sustainability strategy.

Recommendation two: Review EPD data to find specific low-carbon solutions.

Compare EPD data from manufacturers to determine products with the lowest carbon cost.

Raw material type – Some insulant types (e.g. rigid foam boards) have higher embodied carbon due to the energy-intensive extraction and processing of the oil needed to make them. Insulation made from recycled glass, natural sand or stone have less embodied carbon related to their raw materials, compared with rigid foam boards.

Location of raw materials – The transportation of raw materials to a manufacturer's production facilities has a significant impact on the embodied carbon of its products. Ideally, raw materials would be locally, or at least nationally, sourced.

Supply chain management – How the manufacturer of a particular insulation material manages its own supply chain affects the embodied carbon of its products. Look for manufacturers that hold their partners to recognised standards – e.g. BES 6001 for Responsible Sourcing.

Energy used to manufacture – The energy used to power production lines and furnaces at manufacturing plants also adds to the embodied carbon of all insulation materials.

Gas or blowing agent used – Insulation requires trapped gas or air to be effective. Some insulants use Pentane gas, which has a GWP score of between 5 or 10 (so 5 or 10 times more harmful than CO_2). By contrast, trapped air has a GWP of 0.

Location of manufacture – As with the location of raw materials, emissions related to the transportation of final product to customers and end-users should also be factored. UK-based manufacturers score better here than those that have distant, off-shore manufacturing sites.

Packaging compression – Another factor affecting transportation-related emissions. The more the manufactured insulation can be compressed, the more m^2 of insulation can be fit into a single load, meaning fewer trucks on the road overall.

Installation fixings needed – Some insulation materials require additional fixings for their installation – e.g. wall ties or retaining discs. Each additional component adds embodied carbon from its own manufacture and transportation.

Installation method used – Lastly, although minimal, the energy required to power the tools used in the installation of insulation should also be considered in the calculation of its total embodied carbon.

HOW KNAUF INSULATION CAN HELP

Knauf Insulation is fully committed to being the go-to low carbon partner for housebuilders.

We stand ready to provide the products, services and guidance housebuilders need to build lower carbon, comfortable homes – and to do so more efficiently.

Insulation with lower embodied carbon

We are in the business of reducing carbon emissions. As the UK's leading provider of whole-house insulation solutions for new build homes, this starts with the manufacture of products that deliver the best mix of thermal, fire safety, acoustic and environmental performance.

Every day, our customers use our products to actively reduce operational carbon emissions in the homes they build. But truly lower carbon homes need lower carbon insulation, which is why we're taking action to improve not just the operational carbon performance of our products, but their embodied carbon too.

We have set ourselves a target to reduce the embodied carbon of our products by a further 15% by 2025 – against a 2019 baseline – as a landmark step towards our long-term company goal of being zero carbon.

The recycled glass cullet we use to make our Glass Mineral Wool insulation comes from used bottles and jars collected and processed locally. This alone saves 375,000 road miles each year and reduces the energy needed in the melting process.

with ECOSE® TECHNOLOGY

Our products are manufactured with ECOSE® Technology, our unique bio-based binder made from rapidly-renewable raw materials, no added formaldehyde or phenol, and is 70% less energy-intensive to manufacture than traditional binders.

Declare. Red List Free

Our entire Glass Mineral Wool range of products has been awarded the DECLARE 'Red List Free' label. This allows product transparency disclosure that identifies where a product comes from and what it is made of.

BES 6001 Responsible Sourcing

We have been independently certified across all of our manufacturing plants as achieving BES 6001 – very good – for Responsible Sourcing of Construction Products, which shows that our products are made with constituent materials that have been responsibly sourced.

MENSCHLICHKEIT · COMMITMENT · ENTREPRENEURSHIP · PARTNERSHIP · BUILDING A CI CULTURE

We have a programme of continuous improvement at our manufacturing sites to increase efficiency, which includes equipment upgrades and extensive energy management.

Generic BRE Green Guide Rating A+

All of the above has contributed to the majority of our products earning the BRE Green Guide A+ rating for environmental performance.

MADE IN BRITAIN

We manufacture our insulation here in the UK, with sites in St Helens, Queensferry and Cwmbran.

We have upgraded the compression of some of our products further to a 10:1 ratio, so we can fit more insulation in every pack or pallets, more products on trucks – which means fewer trucks on the roads, and less plastic packaging per metre of our insulation.

10:1
compression

The packaging we do use contains a minimum 30% recycled plastic content and uses less ink, which means it is less harmful for the environment and easier to recycle.

30% minimum

15% MORE
product per roll*

25% MORE
packs per pallet*

*on average

Our Embodied Carbon CPD

Suitable for design, technical and procurement professionals, our Embodied Carbon CPD gives you the opportunity to explore the subjects from this guide, and put your questions to a member of the Knauf Insulation technical team. Scan the QR code to book your place.

knaufinsulation.co.uk/cpd-knauf-insulation-sustainability-series#register

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