RESEARCH

Decarbonising UK real estate

Recommendations for policy reform

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RICS

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Report written by Fabrizio Varriale
RICS Place and Space Analyst

Edited by Sam Birch
RICS Editor

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Glossary

Term	Definition
Building life cycle	The BS/EN 15978 standard divides the building life cycle into four stages: • **Stage A: Product and construction process** • **Stage B: Use** • **Stage C: End of life** • **Stage D: Benefits and loads** Each stage is further divided into 'modules'.
Carbon intensity	The magnitude of carbon emissions associated with an activity or product, often compared to its alternatives. For example, travelling by car is more carbon intensive than travelling by train.
Carbon offset	Offset emissions are reduced or avoided emissions meant to compensate for an equivalent quantity of emissions occurring elsewhere.
Embodied carbon	The total greenhouse gas emissions and removals associated with materials and construction processes throughout the whole life cycle of a building (Modules A1–A5, B1–B5, C1–C4; see *Building life cycle*).[1]
Energy Performance Certificate (EPC)	A document containing the results of an assessment of the operational performance of a building, based on a model of its physical properties, typical weather conditions and occupancy patterns.
Environmental Product Declaration (EPD)	A document containing the results of a life cycle assessment conducted on a product, which typically includes embodied carbon information.
Final energy use	The energy that is effectively consumed to operate all the building's equipment mentioned above. Energy demand is the energy needed to deliver specific conditions, such as a room temperature of 20 degrees. The difference between final energy use and energy demand is determined by the efficiency of the equipment being used. For example, a gas boiler with 95% efficiency needs 1 kWh to deliver 0.95 kWh of actual heat.
Life cycle assessment (LCA)	An assessment of the environmental impact of a product or service.

1 These definitions are adapted from the following source: WLCN, LETI and RIBA, 2021. Improving Consistency in Whole Life Carbon Assessment and Reporting – Carbon Definitions for the Built Environment, Buildings and Infrastructure. Version A: May 2021.

Term	Definition
Minimum Energy Efficiency Standards (MEES)	Regulation requiring minimum EPC ratings for private domestic properties to be rented.
Net zero (whole-life) carbon	A net zero (whole-life) carbon building is one where the sum total of all building-related greenhouse gas emissions over a building's life cycle, both operational and embodied (Modules A1-A5, B1-B7, C1-C4), is minimised; meets local carbon, energy and water targets; and, with residual 'offsets', equals zero.[1]
Net zero carbon operational energy	A net zero carbon operational energy building is one where no fossil fuels are used, all energy use (Module B6) has been minimised, it meets the local energy use target (e.g. kWh/m^2/y, kilowatt-hours per square meter per year) and all energy use is generated on- or off-site using renewables that demonstrate additionality (i.e. they are newly built for this purpose). Any residual direct or indirect emissions from energy generation and distribution are offset (see *Carbon offset*).[1]
Operational carbon	The greenhouse emissions arising from all energy consumed by a building in use, over its entire life cycle (Module B6).[1]
Primary energy	The total energy needed to be consumed (beyond the boundary of the building) to deliver one unit of final energy, depending on the energy source being used. For example, to deliver 1 kWh of final energy through natural gas, about 1.13 kWh of primary energy is needed, as it takes into account the energy required to extract and transport the gas.
Reduced SAP (RdSAP)	The methodology used in England, Wales and Northern Ireland to conduct an EPC assessment and verify compliance with Building Regulations Part L for existing domestic buildings.
Simplified Building Energy Model (SBEM)	The methodology used in England, Wales and Northern Ireland to conduct an EPC assessment and verify compliance with Building Regulations Part L for non-domestic buildings.
Standard Assessment Procedure (SAP)	The methodology used in England, Wales and Northern Ireland to conduct an EPC assessment and verify compliance with Building Regulations Part L for new domestic buildings.
Whole-life carbon emissions	The sum total of all building-related greenhouse emissions, both operational and embodied, over the life cycle of a building, including its decommission (Modules A1–A5, B1–B7, C1–C4). Overall whole life carbon building performance includes separately reporting the potential benefit from future energy recovery, reuse, and recycling (Module D).[1]

Units of measurement

Unit	Definition
$kWh/m^2/y$	Kilowatt-hours per square meter per year: this is the energy consumed by a building over a year. The total energy is divided by the floor area, as a measure of the operational energy intensity of the building.
$kgCO_2eq/m^2$	Kilograms of carbon dioxide equivalent per square meter: this represents the total embodied carbon emissions divided by the floor area, as a measure of the embodied carbon intensity of the building.
$kgCO_2eq/m^2/y$	Kilograms of carbon dioxide equivalent per square meter per year: this is the operational carbon emitted over a year by using energy in the building. The total carbon is divided by the floor area as a measure of the operational carbon intensity of the building.

Foreword

The events of 2022 have given rise to a new set of urgent policy challenges for the UK to resolve. Combined with the ongoing transition to a post-COVID and post-Brexit world, the Russian invasion of Ukraine has altered geopolitical balances and made national energy security more salient. In turn, rising living costs – particularly energy bills – have put great strain on disposable incomes and forced difficult choices onto many households already impacted by fuel poverty and other inequalities.

In the built environment, longstanding issues of low supply and low-quality housing units sit within a context of disparate regional economic development, and the formidable overarching task of accelerating decarbonisation in line with legislated climate targets.

Within this dynamic, chartered surveyors and other professionals involved in the real estate life cycle have a unique position and a responsibility to play a meaningful role in addressing these challenges. The low energy efficiency of the building stock, in addition to causing drag for household fuel budgets, aggravates health problems, contributes significantly to national energy demand and generates large quantities of carbon emissions. It also makes communities more vulnerable to extreme weather events like floods and heatwaves.

In short, there is an urgent need to make buildings, their construction and management in the UK more sustainable. It would bring multiple benefits across the economic, environmental and social spheres, allowing the UK to address the challenges of the present while putting itself on a more resilient footing for the future.

Many stakeholders – from universities to companies and organisations – have advanced our understanding in recent years of what a sustainable built environment would look like, offering practical solutions to lower carbon emissions across the building life cycle. A new generation of professionals is eager to contribute positively to society by implementing these solutions, using their expertise and thought leadership to encourage collaboration across the whole value chain and deliver meaningful progress towards our net zero goals. However, clear policy direction is also needed to create a level playing field and supportive financial conditions.

The scale of the decarbonisation challenge demands an urgent update of UK regulation of construction and real estate. To enable the sector to deliver its full value to society by meeting its carbon reduction targets over the coming decade, the policy recommendations in this report present clear priorities for improving the measurement and regulation of energy use and carbon emissions from buildings.

In this way, chartered surveyors will need to engage in fruitful dialogue and collaboration between professionals, industry and policymakers to deliver the prosperous future that society demands. I look forward to working on these recommendations with all partners and our communities, in order to improve the way we design, build and use our buildings, today and in the years to come.

Clement Lau FRICS, RICS President

Executive summary

This report outlines the main policy reforms needed to accelerate the reduction of both embodied and operational carbon emissions arising from real estate in line with national decarbonisation targets. Through the Nationally Determined Contribution and the amended *Climate Change Act* 2008, the UK has committed to reducing its emissions by at least 68% by 2030 (in comparison to 1990 levels), and to reach net zero carbon by 2050.

In 2019, emissions generated in buildings by using electricity and by burning fossil fuels for heating and cooking (operational carbon emissions) accounted for 23% of the UK total. Another 7% were ‘embodied’ into buildings during the manufacturing and construction stages due to the energy used in those processes. Operational emissions have declined since the 1990s, mainly thanks to the switch to gas and electricity from coal, while embodied emissions have remained fairly stable, which has increased their relative importance. Overall, both operational and embodied emissions must be dramatically reduced (by around 95% and 85% respectively) to reach net zero by 2050. To achieve such substantial reductions, a number of actions must be delivered in conjunction:

- designing and retrofitting buildings to minimise their operational energy demand (via passive design techniques) and the resulting carbon emissions (by meeting the energy demand with low-carbon services)
- actively managing energy demand during the use stage to ensure that buildings perform to the best of their capacity
- reusing and adapting existing buildings rather than constructing new ones
- designing spaces and structures efficiently, minimising waste and avoiding superfluous elements, and
- reducing embodied carbon through design and procurement choices of materials and products, as well as at the manufacturing stage.

Reducing the carbon intensity of electricity also has a role to play in reducing emissions but should not be seen as the primary means to decarbonise real estate. Minimising energy demand via efficient design and operations carries the additional benefits of lowering energy bills, increasing asset value and generating jobs, as well as reducing energy demand at the national level.

Achieving reductions through policy

The main avenues of policy intervention to deliver the actions listed previously are:

- introducing and increasing performance requirements set out in planning and building regulations, as well as at the later stages of the building life cycle
- incentivising owners and tenants to reduce energy use and carbon emissions from buildings through efficient management, and
- funding comprehensive retrofit measures for energy-efficiency and low-carbon improvements.

To ensure that these actions can deliver the reductions needed to reach national targets, decarbonisation targets at subsector (e.g. residential, commercial, industrial) and asset (individual building) levels need to be developed. This must take into account the fact that the reductions possible for individual buildings vary depending on their type, age of construction, climatic zone and other factors. At the same time, the metrics used in policies to regulate building performance need to be aligned with those targets, otherwise it becomes impossible to evaluate policy effectiveness. The current metrics used in Building Regulations and Minimum Energy Efficiency Standards (MEES) to mandate building performance do not easily translate into absolute carbon emission rates ($kgCO_2eq/m^2/y$, kilograms of carbon dioxide equivalent emissions per square meter per year). In the case of domestic Energy Performance Certificates (EPCs), their ratings are not even based on carbon emissions, but rather on energy costs.

As well as this critical misalignment between metrics and targets, the set of UK government policies already put in place or proposed for the near future show significant gaps when compared to the actions listed previously. The government's planned measures to decarbonise real estate mainly consist of:

- raising MEES requirements for privately-rented properties in the 2020s, and possibly extending them to all buildings in the 2030s
- updating Building Regulations through the Future Homes and Future Buildings standards to reduce operational emissions in new and retrofitted buildings
- introducing a mandatory performance-based rating scheme for large non-domestic buildings
- delivering 600,000 installations of heat pumps in homes by 2028 and
- gradually phasing out the most carbon-intensive fuels in the 2020s and natural gas in the 2030s.

The devolved governments of Wales, Scotland and Northern Ireland are working to develop their own national retrofit programmes. In England, after the early closure of the Green Homes Grant scheme, support for energy efficiency measures in existing buildings is limited to the Energy Company Obligation and relatively small grants for individual measures. As noted by the Climate Change Committee, this is a significant gap because improving the existing stock is absolutely essential for reducing carbon emissions from real estate as a whole. Reliance on heat pump installation as the primary measure is not effective, because poorly-performing buildings need to have their energy demand reduced (e.g. through insulation) before they can be fitted with heat pumps. Under current conditions, buildings that are too costly to be retrofitted without financial support will continue to be used as they are, and to emit large quantities of carbon. Failing to retrofit these buildings also means that households and businesses will continue to pay high energy bills.

The lack of policy action to incentivise energy management at the use stage risks undermining the efforts made to construct and retrofit buildings to high levels of performance. Well-designed buildings must be efficiently operated in order to close the 'performance gap' and deliver their expected carbon savings. A mandatory monitoring and disclosure rating – as is currently proposed by Government– is the necessary first step, but actual incentives or penalties are needed to push owners and occupiers into action.

In terms of embodied carbon, the complete lack of regulation creates a situation where an increasingly significant part of real estate emissions is not only uncontrolled, but not even measured. This means that we have little understanding of how much carbon is actually embodied in buildings, and very few incentives to reduce it. If the UK wants to deliver its ambitious national decarbonisation targets, the opportunity to reduce embodied emission in buildings cannot be missed.

Policy recommendations

Given these gaps, we recommend the government adopts the following measures:

1. **Define science-based decarbonisation targets for UK real estate at the subsector and individual building levels**, engaging with industry and academia through the Net Zero Carbon Buildings Standard initiative. These targets should form the basis for consistent performance requirements across the policy landscape, from planning to business regulations, covering both embodied and operational emissions.
2. **Demonstrate how the increase in Building Regulations requirements set out in the Future Homes and Future Buildings standards will deliver the reductions needed to reach the decarbonisation targets of 2030 and 2035**. Net zero carbon emissions should be mandated for all new buildings as soon as possible, and any delay in this approach should be justified with solid evidence.
3. **Improve the EPC scheme to make it fit for the different purposes that it serves**. Besides implementing the recommendations of the Making SAP and RdSAP 11 fit for Net Zero report, significant improvements can be made to the way EPCs are calculated, presented and used:
   - a **Clearly present three metrics as the main results of the EPC assessment: final energy use, carbon emissions and energy cost**. These metrics should be shown as absolute figures, as well as rating scores with associated bands. Making the three metrics available and equal in importance will enable policymakers to choose the correct one to track and regulate against for the specific policy objective, including for decarbonisation targets.
   - b **Include four additional metrics** to provide a more comprehensive evaluation of building performance: fabric energy efficiency, space heating demand, peak energy load and on-site renewable generation.
   - c **Make it clear that the three main metrics are the results of a calculation based on typical weather and occupancy models**, and therefore should be used as indicators of building performance under controlled conditions, not as reliable predictions of energy use, cost and emissions under all circumstances.
   - d **Fully digitalise EPC data, calculations, results and presentation**. EPC data should be accessible via a digital platform, which could also provide the infrastructure for a comprehensive building passport. A new module should be added to replicate the original EPC calculations and allow users to modify parameters to produce a new set of results. This would provide more tailored information to consumers about the impact of occupants' patterns and energy efficiency improvements.
   - e **Campaign to inform the general public about the value of EPCs and how to use them correctly**. The current rise in energy prices and the increase in extreme weather events caused by climate change provide a big opportunity to raise awareness about the condition of the UK building stock and establish a clear link between building performance, energy cost and carbon emissions.

4 **Establish a national programme to fund retrofit projects**, following the direction set out in the National Retrofit Strategy developed by the Construction Leadership Council. In the current context of rising energy bills and supply uncertainty, driving energy improvements in the existing stock on a large scale would carry multiple benefits: reducing emissions and energy bills, reducing energy demand at the national level, improving indoor conditions and asset value, and generating employment.

5 **Accelerate the development of a national performance-based rating scheme based on the NABERS UK system**, ensuring that final energy use and carbon emissions are publicly available metrics. The government should undertake the following, in order:

a **Mandate performance monitoring and disclosure for large non-domestic buildings from 2024**, and engage with the industry to understand how this requirement could be progressively extended to all non-domestic buildings.

b **Develop a policy to stimulate improvements in building operations via fiscal incentives by 2030**, rewarding buildings that show annual improvements as well as buildings that perform above specific thresholds. These thresholds should be established on the basis of good practice, and then progressively increased to align with science-based targets.

6 **Introduce embodied carbon requirements in a new section of the Building Regulations** as proposed by the Part Z initiative. More explicitly, the government should:

a **Adopt the RICS standard Whole life carbon assessment for the built environment as a national methodology**, as recommended by the Environmental Audit Committee.

b **Require embodied carbon assessments to be conducted on buildings** larger than 1,000m^2 or ten dwelling units from 2025, to be extended to all buildings from 2030.

c **Introduce maximum limits on embodied carbon** to be verified both at design stage and post-completion. Limits should be initially established on the basis of good practice benchmarks, and then progressively increased to align with decarbonisation targets.

To fully address the need for embodied carbon reductions, the government should also:

d **Require manufacturers to publish Environmental Product Declarations (EPDs) for all their products**. Availability and quality of data at the product level need to improve in order for embodied carbon assessments to be more reliable.

e **Work with devolved governments and local authorities to agree on a national strategy** favouring the reuse of existing buildings and setting carbon budgets for new developments.

1 Introduction

The purpose of this report is to influence the UK government to improve the set of policy instruments used to decarbonise real estate, with a particular focus on metrics and targets. The report also provides a framework for understanding how different policies affect emissions across a building's life cycle. The scope includes all emissions produced by the UK residential and commercial building stock, so both 'embodied' and 'operational' carbon are included. Throughout the report, the terms 'carbon', 'emissions' and 'carbon emissions' are used as synonyms for 'greenhouse gas emissions' for ease of reading, although 'carbon-equivalent emissions' would be the correct terminology.

The report is structured in four sections:

- **This introduction** presents the scale of carbon reductions needed from UK buildings and highlights the main issues with the current policies.
- **Section 2** contains our recommendations to resolve these issues.
- **Section 3** details how carbon emissions can be reduced through policy intervention at different stages of the building life cycle.
- **Section 4** provides an overview of both current and upcoming policy instruments relevant to the decarbonisation of UK real estate.

1.1 Carbon emissions of UK real estate

Energy use in buildings is the cause of a significant part of carbon emissions in the UK. In 2019, direct emissions from buildings (87 million tons of carbon-dioxyde equivalent emissions accounted for 17% of the UK total. These emissions are mainly produced by using fossil fuels for cooking and heating indoor spaces and sanitary water. Residential buildings accounted for 77% of direct emissions, private non-residential buildings for 14% and public non-residential buildings for 9%. Around three-quarters of space and water heating demand in the UK is met with natural gas, while the rest is met by petroleum (around 10%) and other fuels. Electricity use in buildings (required for heating, cooling, lighting, appliances and equipment operation) accounted for 59% of UK electricity consumption in 2019 and added a further 31 $MtCO_2eq$ of indirect emissions that can be attributed to buildings. This brought all building-related emissions in 2019 up to 23% of the UK total.[1]

Energy use in buildings, and the related emissions, are largely affected by climatic conditions (see section 3.1). Cold winters increase the need for space and hot water heating, while hot summers result in higher electricity demand for space cooling. Other factors can also impact energy use and emissions; for example, the large amount of people staying at home during the COVID-19 pandemic is estimated to have been the main cause of the 1% increase in emissions from UK residential buildings between 2019 and 2020.[2] In terms of emissions resulting from electricity use, the main factor is the carbon intensity of the electrical energy grid, which has been steadily decreasing in the UK thanks to the switch from coal to natural gas and the rise of renewable energy sources.

1 Climate Change Committee, 2020. The Sixth Carbon Budget - Buildings (p.6).
2 BEIS, 2022. 2020 UK Greenhouse Gas Emissions, Final Figures (p.20).

In addition to emissions resulting from energy use in the operation of buildings, real estate is also responsible for emissions that are 'embodied' in buildings during the manufacturing, construction and demolition stages (see section 3.2).

Figure 1 shows the quantities of embodied and operational emissions from residential and non-residential buildings in the UK from 1990 to 2018. While embodied emissions are lower than operational ones, the latter have been steadily decreasing since 2010, while the former have remained fairly stable. The figures given for carbon quantities from 2019 to 2050 indicate the maximum annual emissions that can be allocated to buildings in order to reach climate change mitigation targets ('science-based targets') according to the decarbonisation roadmap published by the UK Green Building Council (GBC) in 2021. Operational emissions need to decrease consistently every year, with a steep acceleration for residential buildings between 2025 and 2035 resulting from a large-scale retrofit effort. This is expected to increase embodied emissions due to the demand for construction materials that will be used to retrofit homes. Overall, Figure 1 shows the dramatic extent to which emissions associated with buildings must be progressively reduced to meet climate targets. For every year that these reductions are delayed, the curve to reach net zero by 2050 becomes steeper, meaning that greater reductions must be achieved yearly.

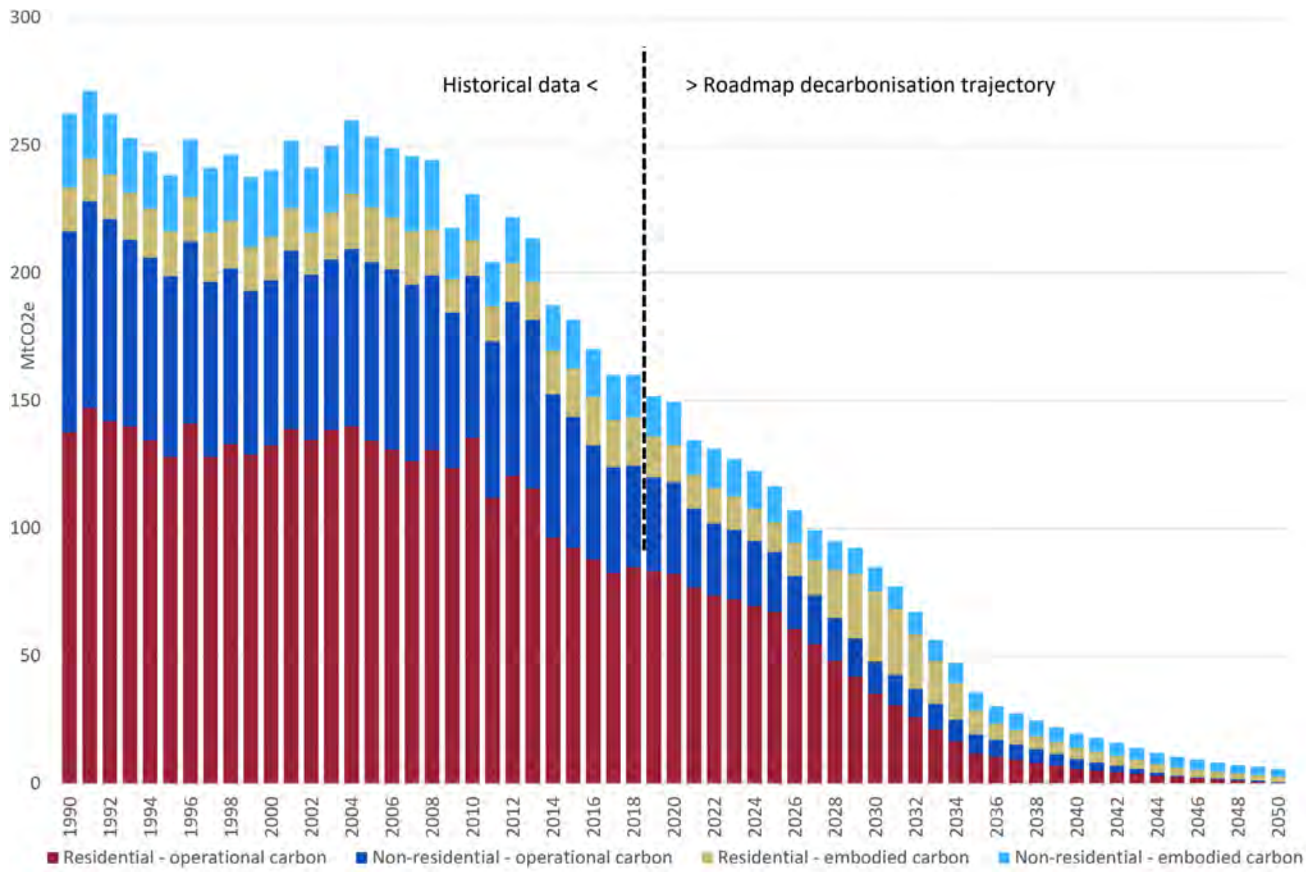

Figure 1: Historical and projected carbon emissions from UK real estate (source: UK GBC 2021)

To understand how these targets at the sector level translate into reductions needed at the level of single buildings, a top-down allocation of the available 'carbon budget' must be conducted on the basis of a reasonable division between embodied versus operational emissions, and taking into account how the potential for carbon reductions of different buildings is impacted by variations in type, age of construction, climatic zone, etc. This work is currently being carried out by the UK Net Zero Carbon Buildings Standard initiative.

1.2 Reducing operational emissions at the individual building level

The trajectories produced by the CRREM project (Figure 2) provide an idea of the stark decrease that is needed across different building types in the UK on an average basis. By 2050, all building types must reduce operational carbon by 95% from 2018 levels. Building types that start at relatively low levels of emissions (e.g. multi-family houses) might have an easier path, since their reductions in absolute values are smaller than those required from more carbon-intensive building types (e.g. high street retail).

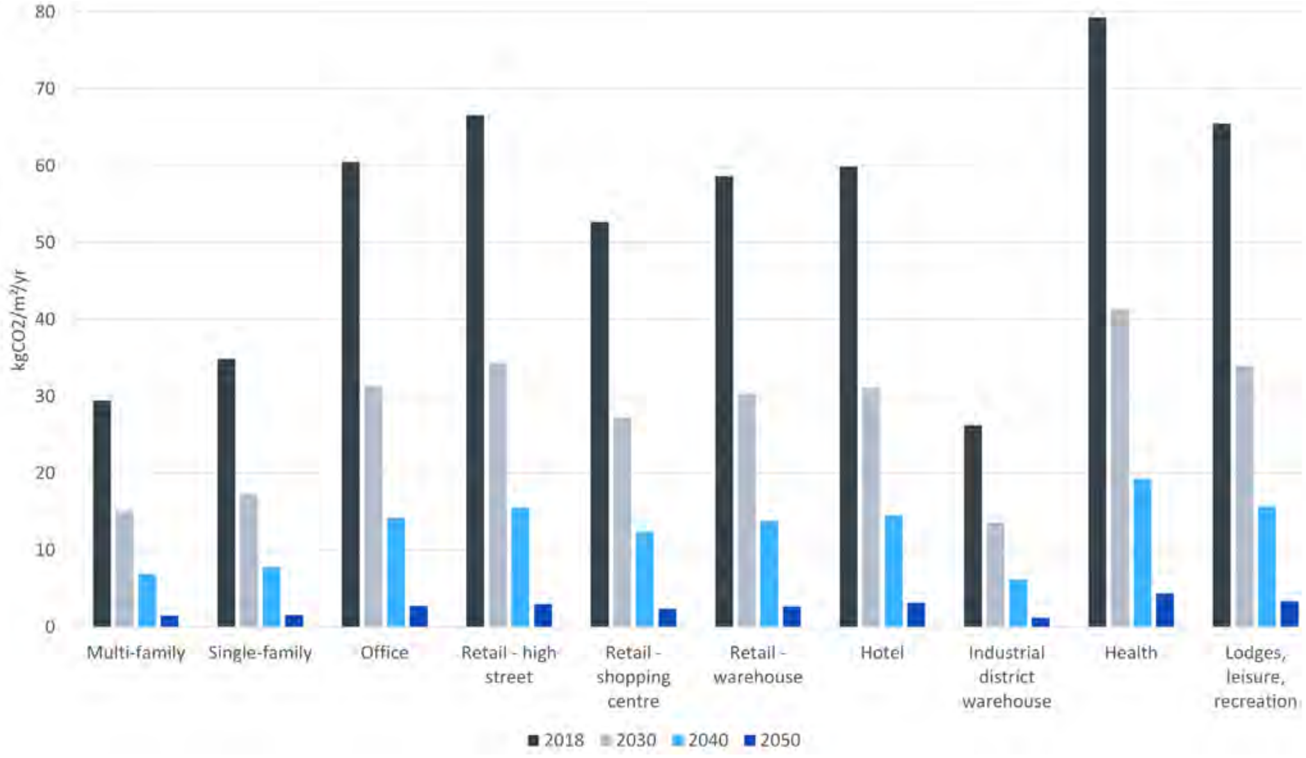

Figure 2: CRREM decarbonisation trajectories for operational emissions in the main UK building types (source: CRREM pathways 2021)

To achieve substantial reductions in operational carbon, two different actions must be delivered in conjunction. Firstly, buildings must be designed (or retrofitted) to minimise their energy demand and the resulting carbon emissions. This is done via passive design techniques (e.g. through building orientation and shape) and by meeting energy demand with efficient and low-carbon services (e.g. heat pumps and LED lights). Secondly, energy demand must be actively managed during the use stage to ensure that the building performs to the best of its capacity (see section 3.1 for a detailed explanation).

Both efficient design and efficient operations are needed to achieve the greatest carbon reductions. A well-designed building that is not managed efficiently cannot deliver its expected performance, and energy management cannot raise the performance of a poorly-designed building beyond its physical limitations.

Therefore, two avenues of policy intervention are needed:

- The efficiency of the building 'in itself' – its theoretical performance determined by its design, materials and equipment – can be addressed through planning and Building Regulations requirements, as well as through requirements imposed at the point of selling or leasing.
- The efficiency of building operations – its actual performance – can be addressed through the management and regulation of occupants' activities, e.g. by installing smart controls or requiring annual emissions to remain below specific thresholds.

1.3 Reducing embodied emissions at the individual building level

Determining the extent of embodied carbon reductions at this level is even more difficult than for operational carbon, since there are wide variations across buildings (depending on the type of materials used) and data on embodied carbon is less consolidated. Figure 3 shows typical ranges for the 'upfront' embodied carbon (resulting from manufacturing and construction) associated with different building types. These ranges have been produced by bringing together different databases from developed countries, without consideration for climatic differences, since embodied carbon is much less affected by the local climate than operational carbon. Instead, embodied carbon is dependent on the quantities of materials used in construction, their transportation and their carbon intensity (which is in turn affected by the carbon intensity of the electricity grid accessed by manufacturers). This explains the large variation in values seen in Figure 3, but it must also be noted that methodological choices (what is accounted for and how) also have a significant impact on the results.

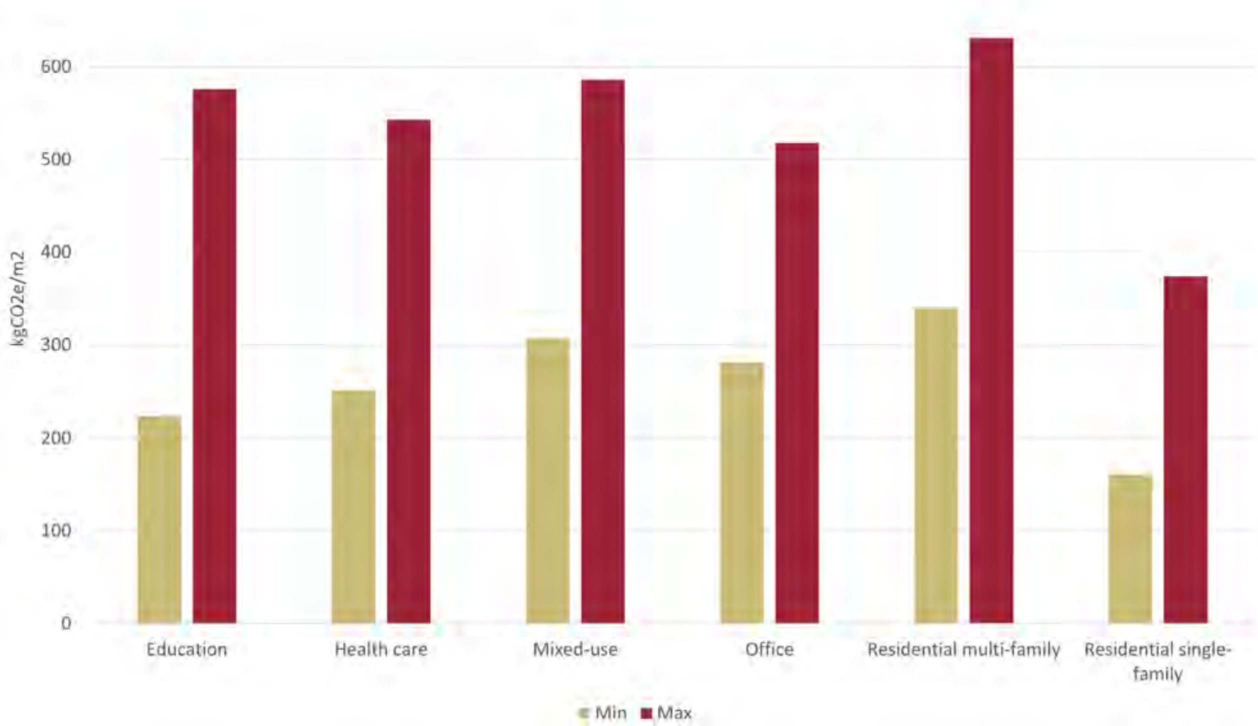

Figure 3: Typical ranges of upfront embodied carbon (life cycle stage A only) in different building types (source: Simonen et al. 2017)[1]

1 Simonen, K., Rodriguez, B.X., Wolf, C. 2017. *Benchmarking the Embodied Carbon of Buildings*, Technology|Architecture + Design, 1:2, 208-218, DOI: 10.1080/24751448.2017.1354623.

In comparison to operational carbon, reducing embodied carbon is more straightforward, although not necessarily easier to achieve in practice. The main factors determining the embodied carbon of a building are the quantities of materials used and their carbon intensity. For example, the construction of buildings in developed countries often relies on large quantities of conventionally-produced concrete and steel, which are among the most carbon-intensive materials. Therefore, reducing embodied carbon is achieved firstly by minimising the quantities of materials used. At the project level, this means designing spaces and structures efficiently, minimising waste and avoiding superfluous elements. At the planning level, it means favouring the reuse and adaptation of existing buildings rather than the construction of new ones. Secondly, the carbon intensity of the materials being used must be reduced. This comes down to design and procurement choices, and it is heavily affected by the availability and cost of low-carbon products versus conventional ones. Therefore, there are three complementary avenues of policy intervention to reduce embodied carbon:

- Planning instruments can favour building reuse and impose limits on new constructions.
- Design and procurement requirements can affect both the quantities and carbon intensity of the materials being chosen.
- Industry regulations can incentivise or require manufacturers to minimise the carbon intensity of their products.

While operational emissions can be brought down to net zero by reducing energy demand as much as possible and meeting the remaining demand with renewable sources, there is a hard limit for embodied carbon. This is reflected in the decarbonisation trajectory in Figure 1, where residual embodied emissions are expected to occur even in 2050. Any new construction or retrofit activity is bound to require an input of virgin materials that results in embodied emissions. In some cases, careful design and procurement choices may be able to bring embodied emissions down to zero (or even lower) by employing reused materials and/or locally-sourced bio-based products. So far, this has occurred only in exceptional projects on a small scale, and it remains to be seen to what extent these strategies are feasible on a large scale for more conventional projects.

1.4 Whole-life approach to carbon reductions

Taking a whole-life approach to carbon reductions means striving to minimise both embodied and operational emissions. So far, policy efforts in the UK and the rest of the world have largely focused on operational carbon, but governments are becoming more aware of the importance of embodied carbon, especially for new construction. In a context where significant reductions must be achieved as soon as possible, it is worth noting that savings in operational carbon are spread over the years of the use stage, while savings in upfront embodied carbon are achieved in the initial stages of the life cycle. Also, when significant efforts are made to reduce operational emissions, there can be trade-offs with embodied emissions due to the need for more materials and equipment.

Finally, it must be noted that grid decarbonisation also has a role to play in reducing both operational and embodied carbon in buildings. However, this should not be seen as the primary means to decarbonise real estate. Reducing operational carbon by minimising energy demand via efficient design and operations carries the additional benefits of lowering energy bills, increasing asset value and generating jobs, as well as reducing energy demand at the national level.

1.5 UK policy overview

In its 2020 Nationally Determined Contribution, the UK has committed to reduce its carbon emissions by at least 68% in comparison to 1990 levels by 2030. In addition, the 6th Carbon Budget contains a target for a 78% reduction by 2035, and the *Climate Change Act* 2008, amended in 2019, binds the UK to reach net zero emissions by 2050. The policies envisioned to deliver these reductions were outlined in the Clean Growth Strategy of 2018 and the Ten Point Plan for a Green Industrial Revolution of 2020, and developed further in 2021 with the UK Net Zero Strategy and the Heat and Buildings Strategy (for England and Wales). In both documents, the main actions directed at buildings are:

- for privately-rented domestic buildings, updating Minimum Energy Efficiency Standards (MEES) to require at least EPC band C by 2025 for new tenancies, extended to all tenancies by 2028 (the current minimum requirement is band E)
- for privately-rented non-domestic buildings, updating MEES to require at least EPC band C by 2027, and B by 2030 (the current minimum requirement is band E)
- for all domestic buildings, introducing MEES to require at least EPC band C by 2035
- updating Building Regulations through the Future Homes and Future Buildings standards to ensure new buildings (both domestic and non-domestic) have 75–80% lower emissions than required by the current Building Regulations
- mandating a performance-based rating scheme for large non-domestic buildings
- supporting households and manufacturers to reach 600,000 installations of heat pumps in homes by 2028, and
- phasing out the most carbon-intensive fuels (oil, coal and liquified petroleum gas) in non-domestic buildings by 2024 and in homes by 2026, and natural gas in all buildings by 2035.

Financial support for these actions is planned through a range of different measures, such as:

- Boiler Upgrade Scheme (England and Wales only)
- Energy Company Obligation
- Green Heat Network Fund (England only)
- Home Upgrade Grant (England only)
- Public Sector Decarbonisation Scheme
- Social Housing Decarbonisation Fund (England only)

Due to the devolution of powers in the UK, Wales, Scotland and Northern Ireland have the capacity to establish their own requirements in terms of Building Regulations and MEES. Therefore, some of these actions only apply to England, although there are no substantial differences with the policies (both current and proposed) of the devolved nations. However, it must be noted that the governments of Wales, Scotland and Norther Ireland are working to develop their own national retrofit programmes, whereas there seems to be no intention to establish such a programme for England.

1.6 Policy gaps

The effectiveness of the package of policies presented by the UK government to deliver decarbonisation across the economy has been called into question. In July 2022, the High Court ruled the Net Zero Strategy to be in breach of the requirements set by the Climate Change Act 2008, since it does not contain sufficient information to quantify the effects of individual policies. Focusing on buildings and considering the possible avenues for intervention discussed earlier for operational and embodied emissions, significant shortfalls can be identified in the policies currently in place, and those announced in both the Net Zero and the Heat and Buildings strategies.

1.6.1 Targets and metrics

Firstly, there is a lack of clear decarbonisation targets at the sector and individual building levels. The 6th Carbon Budget imposes a limit on total emissions between 2033 and 2037, but does not specify how this total should be spread over the period nor allocated among sectors. The report by the Climate Change Committee backing the 6th Carbon Budget does contain targets for the main sectors of the economy, including buildings, but these are only of an advisory nature and do not go down to the subsector or building level. Without such targets, it is impossible to evaluate whether current and future policies are sufficient to deliver the necessary carbon reductions in line with the overall national target.

This problem is aggravated by the metrics used to mandate performance at the level of individual buildings. MEES requirements are based on EPC bands, which are determined by the underlying EPC performance rating. This is a numerical scale from 0 to 100, which has no direct link to the annual rates of operational emissions, since the performance of the building is evaluated against the performance of a 'notional building' rather than against absolute numerical thresholds. And while non-domestic EPCs at least use operational carbon as a metric for the performance of the notional building, domestic EPCs use energy cost, which is a rather poor proxy for operational carbon.

This means that, even if building-level targets are available, it is impossible to know whether mandating EPC band C is sufficient to reach those targets, because EPC bands do not directly correspond to carbon emissions expressed in absolute terms. This is less problematic for EPCs in Scotland, where there is a linear correspondence between EPC rating and the underlying metric.

A similar issue applies to the current Building Regulations and the planned updates under the Future Homes and Future Buildings standards. The methodologies used to determine performance requirements in the Building Regulations (SAP for domestic buildings and SBEM for non-domestic ones) are the same as those used to produce EPC ratings: they are based on the performance of a notional building. This is a theoretical building with the same shape as the project being assessed, and characterised by specific levels of performance for materials and services (e.g. wall insulation). While this relative approach has its benefits, it ultimately means that the Building Regulations cannot mandate performance in a way that can be directly compared to building-level targets derived from the Carbon Budget and expressed in absolute terms.

Although Building Regulations requirements are based on a relative approach, both SAP and SBEM methodologies produce a measure of operational emissions expressed in absolute terms. This metric appears on the EPC documentation, but it is never used in policy, despite being a direct measure of the carbon intensity of the building and being directly comparable to building-level targets. The SAP and SBEM methodologies also produce an energy metric expressed in absolute terms, which could be used to evaluate the level of energy efficiency determined by the building design and mitigate the risk of overreliance on grid decarbonisation. However, the resulting metric from SAP and SBEM is **primary energy**, while **final energy** would be a better indicator and directly comparable to actual energy use as measured by electricity meters (see section 3).

1.6.2 Building retrofit

Although some funding is available through grants for individual measures, there is no plan for a programme to support the comprehensive energy retrofitting of existing buildings in England, or at the UK level. A lot of expectation has been invested in the large-scale replacement of carbon-intensive heating systems with heat pumps, but this is only a partial measure with significant limitations. Buildings that lose a lot of heat due to poor insulation and air-tightness need to undergo fabric improvements before they can be equipped with heat pumps. More generally, there is limited leverage for policy to improve the quality and performance of the existing stock. The MEES requirements apply only at the point of leasing, and therefore only cover a share of existing buildings, and there are several exceptions. The government has announced the intention to eventually move past the point of leasing and apply MEES to all existing properties, but no details have been given.

The Future Homes and Future Buildings standards apply to existing buildings, but only when undergoing retrofits and extensions. In these conditions, buildings that are too costly for their owner-occupiers to retrofit without financial support will continue to be used as they are, and to continue to emit large quantities of carbon as a result. While it is understandable that the government may be reluctant to develop a retrofit programme after the failures of the Green Deal and Green Homes Grant, improving the existing stock is absolutely essential to reduce carbon emissions from real estate as a whole. In 2021, more than 150,000 homes took advantage of government grants to make improvements to their energy efficiency. According to the Climate Change Committee, this number needs to rise to 500,000 homes per year by 2025, and one million per year by 2030.[1]

1 Climate Change Committee 2022. Progress in reducing emissions - 2022 Report to Parliament.

1.6.3 Building operations

There appears to be no intention to reduce operational carbon by acting on building operations, besides the introduction of a mandatory monitoring and disclosure scheme for large buildings. The latest proposal on the matter (which underwent consultation in early 2021) outlines a shift from the existing Display Energy Certificate scheme (which only applies to some public buildings over 1000m^2) towards a scheme based on the NABERS UK system. The scheme consists of a publicly-available rating given to buildings on the basis of their energy and carbon performance as measured in the previous year. This would be mandatory only for buildings over 1000m^2, and in the initial phase only for offices. The visibility of the rating is expected to incentivise owners and occupiers to improve performance in order to achieve a better rating.

1.6.4 Embodied carbon

There is a complete lack of intervention on embodied carbon, despite the declared intention to take a whole-life approach to carbon reductions, and even though the industry has made large steps in recent years and is openly asking for regulation in this space. This issue has been extensively explained in the recent report of the Environmental Audit Committee to the House of Commons.

1.7 Risks of inaction

Failing to address the policy gaps discussed above carries the risk of jeopardising the essential contribution of real estate to the national decarbonisation targets. The lack of subsector- and building-level targets, and the mismatch with the metrics used in policy, means that there can be no certainty on whether the mandated levels of performance are sufficient to deliver the necessary carbon reductions. Using the wrong metrics also carries the risk of directing resources to the wrong places, missing green finance opportunities and so leaving buildings to be stranded in the near future due to their poor performance. This can translate into more fuel poverty and derelict neighbourhoods, as well as loss of asset value and increased risk for those who may have invested in those assets, such as pension funds. Similar risks are carried by failing to improve the existing stock due to the lack of regulatory leverage and funding opportunities. This is relevant to the entire building stock, but particularly so for owner-occupied homes, and has been identified as the most significant policy gap in the sector by the Climate Change Committee in their 2022 report on progress in reducing emissions.

For building operations, the lack of policy intervention risks undermining the efforts made to construct and retrofit buildings to high levels of performance. As mentioned earlier, well-designed buildings must be efficiently operated in order to close the performance gap and deliver their expected carbon savings. A mandatory monitoring and disclosure rating – as currently proposed – is the necessary first step, but without incentives or penalties to improve the rating, it creates an additional cost for owners and occupiers while its impact in terms of actually lowering emissions may be negligible.

In terms of embodied carbon, the lack of regulation creates a situation where an increasingly significant part of real estate emissions is not only uncontrolled, but not even measured. This means that we have little understanding of how much carbon is actually embodied in buildings, and very little incentive to reduce it. Albeit slowly, other countries and some UK local authorities are realising the importance of embodied carbon and taking regulatory action. If the UK wants to deliver its ambitious national decarbonisation targets, the opportunity to reduce embodied emission in buildings cannot be missed.

2 Policy recommendations

These recommendations have been prepared on the basis of the analysis presented above and in detail in sections 3 and 4, and build upon existing industry initiatives such as the Part Z proposal, the Net Zero Whole Life Carbon Roadmap and the National Retrofit Strategy. The key rationale is the need to provide the sector with a coherent set of long-term policies using the right instruments to measure and regulate carbon emissions across the life cycle of buildings, while also supporting the overlapping objectives of energy security and fuel poverty reduction. It should be clarified that these are not the only actions needed to decarbonise real estate, only the most urgent in the current conditions. For a more comprehensive set of recommendations covering both policy and industry actions, we refer to the Summary for Policy-Makers and Stakeholder Action Plans of the Net Zero Whole Life Carbon Roadmap.

2.1 Decarbonisation targets

To ensure its policies are sufficient to reach national climate targets, **the government should engage with industry and academia to define science-based decarbonisation trajectories for UK real estate at the subsector and individual building levels**. These trajectories will provide robust emissions targets, against which the performance of individual buildings can be tracked and regulated at different points of leverage throughout a building's life cycle. Once established, these targets should form the basis for consistent performance requirements across the policy landscape, from planning to business regulations, covering both embodied and operational emissions. Two industry-wide initiatives – the Net Zero Whole Life Carbon Roadmap for the Built Environment (completed) and the Net Zero Carbon Buildings Standard (ongoing) – should be taken as the basis to define these trajectories and targets. Meanwhile, the absence of such targets should not be an excuse to delay action through policy intervention.

2.2 Operational carbon

Operational emissions are reduced in two complementary ways: by designing and retrofitting buildings to minimise energy demand and carbon emissions, and by efficiently operating buildings during the use phase (see section 3.1). The first way is addressed by improving the Building Regulations (including the underlying SAP and SBEM methodologies, and the resulting EPCs) and by accelerating retrofit rates. The second is addressed by driving owners and occupiers to actively manage and reduce energy use.

2.2.1 Building design

Energy use and carbon emissions – as calculated under normalised conditions on the basis of the building design, materials and equipment – are the right metric to measure and regulate building performance at the design stage (including design for retrofit). The Building Regulations are the key policy instrument for this purpose. In order to justify the increase in performance requirements set out in the Future Homes and Future Buildings standards for 2025, **the government should demonstrate how the updated Building Regulations will contribute to the emission reductions needed to deliver the decarbonisation targets of 2030 and 2035**. Net-zero carbon emissions should be mandated for all new buildings as soon as possible, and any delay in this approach should be justified with solid evidence.

The government should also take action to improve the EPC scheme, in order to make it fit for the different purposes that it serves. Initially, EPCs were only meant as a way to inform consumers of the level of energy efficiency of properties on a comparative basis, but consumers have come to expect EPCs to provide an accurate prediction of their energy costs. Over the years, EPCs have also become a source of information for ESG finance and the main measure for MEES requirements; in this way they have assumed legal relevance. But the underlying calculation methodologies (particularly RdSAP for existing dwellings) have not been updated in line with research developments and the different purposes that EPCs should serve, and the presentation and availability of EPC data remains problematic. The substantial changes foreseen for the SAP11 update (expected to come into force from 2025) will provide a better methodology for the assessment of building performance, especially if the recommendations of the Making SAP and RdSAP 11 fit for Net Zero report are implemented.

However, there are still significant improvements that can be made to the way EPCs are calculated, presented and used, including the alignment of residential and non-residential EPCs. To improve the usefulness and readability of EPCs, the government should:

1 **Clearly present three metrics as the main results of the assessment: final energy use, carbon emissions and energy cost**.[1] These metrics should be shown as absolute figures (kWh/m^2/y, kgCO_2eq/m^2/y and £/y respectively), as well as rating scores (from 0 to 100) with associated bands (G to A). Making the three metrics available and equal in importance would enable policymakers to choose the correct one to track and regulate against for the specific policy objective:

   - The energy metric is relevant to energy supply and efficiency policies; primary energy demand does not work as well as final energy use for this purpose.
   - The carbon metric is relevant to decarbonisation policies.
   - The energy cost metric is relevant to fuel poverty policies.

   Expressing the three metrics both as absolute figures and as ratings will facilitate a wider use of EPC results. Ratings and bands are more easily understood by the general public and can be used in policy as a way to segment the building stock by performance level, while absolute figures allow expert users of EPCs to make direct comparisons, and enable policymakers to track and regulate against climate targets expressed in the same physical units.

2 **Include at least four additional metrics** to provide a more comprehensive evaluation of building performance: fabric energy efficiency (i.e. the capacity of the building fabric to retain heat, in kWh/m^2/y), space heating demand (i.e. the share of energy required only for heating. in kWh/m^2/y), peak energy load (i.e. the maximum energy damnd at one point in time, in kW) and on-site renewable generation capacity (in kWh/y).

3 **Align residential and non-residential EPCs in terms of metrics and presentation**. While it makes sense to retain a different methodology for non-residential buildings, there is no reason to maintain the current situation where residential EPC ratings are based on energy cost while non-residential ones are based on emissions. All EPCs should provide the main and additional metrics described in points 1 and 2.

4 **Make it clear that the main metrics are the results of a calculation based on typical weather, occupancy and appliances models**, and therefore should be used as indicators of building performance by itself and not as reliable predictions of energy use, cost and emissions under specific circumstances. This is essential information for anyone who does not have a background in building assessment, and therefore should be clearly stated on the EPC itself.

5 **Enable SAP11 and SBEM calculations to include unregulated energy use** in the performance assessment, but keep the results across the three main metrics separated from the results of the regulated energy use. This will draw attention to this key distinction and allow consumers and policymakers to use the most relevant figures for their purposes.

6 **Fully digitalise EPC data, calculations, results and presentation.** The data collected for the EPC assessment and its full results represent valuable information for owners, tenants, surveyors, designers and other stakeholders. EPC data should be accessible via a digital platform, which could also provide the infrastructure for a comprehensive building passport: a place to collect and

1 This is aligned with the current proposal for EPC reform by the Scottish government, as set out in the consultation of July 2021.

access all the information pertaining to a property.[1] With appropriate consideration of privacy and security issues, input data of EPC calculations (such as building dimensions and materials) should be freely available for non-commercial purposes. This would increase transparency, allow experts to better judge the accuracy of the assessment and enable testing the impact of different parameters and improvement measures. In terms of improving the usefulness of EPCs, full digitalisation would allow the integration of new functionalities. Most notably, a new module could be added to replicate the original EPC calculations and allow users to modify parameters to produce a new set of results. The new results would not replace the original EPC results or have legal validity, but rather be used to provide more tailored information to consumers on two aspects:

- **Occupancy**: by replacing default occupancy parameters with values that better represent the number, demography and behaviour of the occupiers (current or prospective), consumers would get a more reliable prediction of the building's performance and its related costs under specific circumstances.
- **Improvements**: by changing the parameters that represent the physical properties of the building elements to simulate the effect of improvement measures (such as adding insulation or replacing a boiler), consumers would get a clearer idea of the potential impact of such measures on the building's performance.

To ensure clarity and transparency, the digitalised EPC should be designed so that the user is always able to compare these customised results against the original ones, while also having the option to include/exclude some elements of the assessment (such as unregulated energy use).

7 To maximise the impact of the changes described in this list, **the government should campaign to inform the public about the correct use of EPC values**. The current rise in energy prices and the increase in extreme weather events caused by climate change provide a big opportunity to raise awareness about the conditions of the UK building stock and establish a clear link between building performance, energy cost and carbon emissions.

2.2.2 Building retrofit

As discussed in section 1.6, the main policy gap with regards to operational carbon is the absence of funding opportunities for comprehensive energy retrofits. The poor state of large parts of the domestic and non-domestic stocks requires high energy consumption to heat and cool those buildings, creates unhealthy indoor spaces and increases the costs of living and running businesses. In the current context of rising energy bills and supply uncertainty, driving energy improvements in the existing stock on a large scale would carry multiple benefits: reducing emissions and energy bills, reducing energy demand at the national level, improving indoor conditions and asset value, and generating employment.[2] Therefore, **the government should establish a national programme to fund retrofitting projects, following the direction set out in the National Retrofit Strategy** developed by the CLC. When creating such a programme, it will be important to learn from past experience and avoid funding the wrong measures by ensuring that a detailed analysis of each building's condition and potential for improvement is conducted by relevant professionals.

1 GABC 2021. The building passport: a tool for capturing and managing whole life data and information in construction and real estate.
2 Greenpeace and Cambridge Econometrics 2022. The economic impact of decarbonising household heating in the UK in an era of high fossil fuel prices.

2.2.3 Building operations

The right metrics to evaluate improvements in building operations are energy use and carbon emissions, the data for which is taken from from metered consumption data (see section 3.1). Monitoring and reporting these metrics are essential for understanding whether the efforts made at the design stage to reduce operational energy and emissions are realised in practice. This is somewhat problematic in domestic buildings, since energy data is considered personal data and so is subject to privacy regulations. Therefore, policy action in this area should be limited to raising awareness and encouraging energy savings through behavioural change and the provision of smart controls. The scope of action on non-domestic buildings is much wider, so the government should do the following:

1. **Accelerate the development of a national performance-based rating scheme based on the NABERS UK system**, ensuring that final energy use (in $kWh/m^2/y$) and carbon emissions (in $kgCO_2eq/m^2/y$) are publicly available metrics, in conjunction with the energy and carbon ratings.
2. **Mandate performance monitoring and disclosure for non-residential buildings** larger than $1{,}000m^2$ from 2025, and engage with the industry to understand how this requirement could be progressively extended to all non-residential buildings, taking into account the limited resources available to small businesses.
3. **Develop a policy to stimulate improvements in building operations via fiscal incentives by 2030**, rewarding buildings that show annual improvements (e.g. a 5% reduction in energy consumption) as well as buildings that perform below specific thresholds (e.g. with energy consumption below 30 $kWh/m^2/y$). These thresholds should be established on the basis of good practice, and then progressively increased to align with science-based targets.

2.3 Embodied carbon

Reductions in embodied emissions are mainly achieved through choices at the design and construction stages, and by reducing the carbon intensity of manufacturing processes (see section 3.2). To address the first factor, embodied carbon should be covered in a new section of the Building Regulations as proposed by the Part Z initiative. More explicitly, government should:

1. **Adopt the RICS standard Whole life carbon assessment for the built environment as a national methodology**, as recommended by the Environmental Audit Committee in their report of May 2022.[1] Given the complexity of carbon assessment, providing a clear and robust method to the industry is essential.
2. **Require embodied carbon assessments to be conducted on buildings** larger than 1,000m^2 or ten dwelling units from 2025, to be extended to all buildings from 2030. Assessments should be conducted twice at the design stage (concept and technical) and once at completion.
3. **Introduce maximum limits for embodied carbon**, to be verified both at the design stage and post-completion. Limits should be established on the basis of good practice benchmarks, and then progressively increased to align with science-based climate trajectories.

To fully address the need for embodied carbon reductions, the government should also:

1. Require manufacturers to publish Environmental Product Declarations (EPDs) for all their products in accordance with EN15804 and the ICLD+EPD digital format. The availability and quality of data at the product level need to improve in order for embodied carbon assessments to be more reliable.
2. Work with devolved governments and local authorities to agree on a national strategy favouring the reuse of existing buildings and setting carbon budgets for new developments. This could include, for example, establishing a hierarchy of development for planners, requiring developers to conduct a survey of local alternatives as part of the planning applications and to justify the need for new developments, and mandating pre-demolition audits.
3. Consult with the industry on the need to guarantee that whole life carbno assessments, particularly post-completion, are conducted by professionals in accordance with EN15978 and the RICS standard.
4. Provide funding to increase carbon literacy in the industry, in particular by supporting the training of design and construction professionals on the assessment of whole-life carbon emissions.
5. Consult with the industry to develop a strategy to reduce the emissions associated with manufacturing the most carbon-intensive construction products (such as concrete, steel and glass).
6. Establish the Built Environment Carbon Database (currently being developed by an industry-wide consortium) as the official UK repository of whole-life carbon assessment data, in order to improve the availability and quality of data at the individual building level.

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1 We recognise that this has been adopted throughout different aspects of both the Welsh and Scottish governments' works, including the Welsh Housing Quality Standards and the regional development plan carbon management guidance for Scotland.

3 Reducing energy and carbon through policy action

This section explains how energy use and carbon emissions in buildings are assessed throughout the building life cycle, and how policy can address them at different stages. The building life cycle is described according to the framework defined in the EN15978 standard, shown in Table 1. On top of this framework, there are phases and instances that are part of a wider 'real estate life cycle' (e.g. planning, design, procurement, surveying, selling and leasing) and provide significant points of leverage for policy action.

Stage A: Product and construction process	Raw material supply	A1
	Transport	A2
	Manufacturing	A3
	Transport	A4
	Construction & installation process	A5
Stage B: Use	Use	B1
	Maintenance	B2
	Repair	B3
	Replacement	B4
	Refurbishment	B5
	Operational energy use	B6
	Operational water use	B7
Stage C: End of life	Deconstruction	C1
	Transport	C2
	Waste processing	C3
	Disposal	C4
Stage D: Benefits and loads	Reuse/recovery/recycling potential	D1

Table 1: Stages and modules of the building life cycle as defined in EN15978

3.1 Operational carbon

Operational carbon refers to emissions arising from the energy consumed in a building during its use stage (stage B in Table 1). This includes energy use for building services (heating, cooling, ventilation and lighting), mechanical installations (elevators, escalators, automatic doors, etc.) and any appliances connected to the electric supply of the building. In the context of building physics, **energy use** is more appropriately referred to as **final energy use**, to distinguish it from primary energy. While the latter is a useful metric for understanding the wider impact of energy use in buildings, final energy is the more appropriate metric to assess the energy performance of a building in terms of its direct cost and carbon emissions. Throughout this report, the term 'energy use' refers to final energy, unless specifically stated otherwise.

It is also useful to distinguish between emissions from **regulated energy use**, which covers building services and mechanical installations, and emissions from **unregulated energy use**, which covers appliances. While the former can be seen as an integral part of the building, the latter is much less so. However, at times this distinction can be blurred, as for example a portable electric heater is clearly an appliance that can be removed from the building, but its purpose is to heat part of it. Apart from such cases, it is useful to think of regulated energy use as related to the use of equipment that is fixed and directly affected by the building design. A room with small windows needs more artificial lighting than a room with large windows, so lighting equipment is considered part of regulated energy use. Conversely, a TV will require the same amount of energy independent of the building in which it is used, so it is considered part of unregulated energy use.

For this reason, emissions arising from unregulated energy use cannot be significantly affected by design, as they are mostly dependent on the behaviour of the occupants. On the other hand, emissions arising from regulated energy use can be affected by efficient design, although they also depend on occupant behaviour. An architect might design the most energy-efficient house possible, but if the occupants set the thermostat at 25 degrees and keep windows open in winter, the building is still going to consume a lot of energy for heating. This is why having a highly-efficient building 'on paper' is not sufficient to ensure low energy use without proper energy management. At the same time, operating a building efficiently can only go so far if the building itself is poorly designed.

This issue introduces the difference between **predicted** energy use and **measured** energy use. At the design stage (and at any time before the building is used), energy use can only be predicted through a modelling exercise considering four main factors:

- **external conditions**: air temperature, humidity, wind speed, cloud coverage, etc.
- **required internal conditions**: the desired ranges of air temperature, humidity, velocity, illumination, etc.
- **occupants**: their number and behavioural patterns that affect energy use
- **building design**: including its shape, orientation and the physical properties of its material constituents (e.g. the capacity to retain heat), as well as the technical specifications of its services (e.g. the efficiency of a boiler).

All these factors affect the energy use of the building, in a modelling exercise as well as in real conditions. Basic models simulate these factors with crude values (e.g. average monthly temperatures) and simple formulas, while advanced models use more accurate values (e.g. hourly temperatures for each day of the year) and complex formulas solved by software applications.

Clearly, advanced models produce more accurate results than basic ones; however, no model is able to predict energy use exactly, for the following reasons:

- Climatic conditions vary from year to year and cannot be predicted in advance with absolute certainty. Moreover, the data used to represent climate cannot account for microclimatic differences between the location of the weather station and the location of the building.
- Occupants cannot be expected to behave exactly like their model counterparts.
- Both physical properties of materials and technical specifications of services are typical values measured under particular conditions, which do not reflect the real conditions of materials and services over time.

This does not mean that modelling energy use in buildings is a pointless exercise. Advanced models can be very accurate, but it must be understood that there will always be a difference between energy use as predicted through a simulation and energy use as measured in reality through a meter. The serious issue arises when this difference is significant, despite having used an advanced model. This performance gap can be caused by a combination of factors, such as errors in the model or materials and services not performing as they are expected, as well as more generally by the building not being operated as it was meant to be.

The problem of closing the performance gap is the subject of substantial research and outside the scope of this document. But it should be clear that both predicted and measured energy use have a role to play as metrics to evaluate and regulate the performance of buildings.

Conceptually, evaluating building performance through predicted energy use is akin to measuring the fuel consumption of a car in a controlled laboratory environment, while looking at measured energy use is more like measuring fuel consumption when a particular individual is driving on a particular road. Measured energy use is clearly the right metric to use when we want to understand how efficiently a building is being operated over a defined period by its current occupants. But since it is significantly affected by weather and occupants' behaviour, it is of little use if we want to understand how efficient (well-designed) the building is as an asset in itself. Predicted energy use is the right metric to use in this case, because it evaluates building performance against a standard set of climatic conditions and occupancy patterns. Moreover, since each metric only tells half the story, it is only by considering both metrics that building performance can be fully understood and improved. Predicted energy use should be seen as the target towards which measured energy use is driven through efficient management. For more information about energy use in the context of building operations management, we refer to the International Building Operation Standard (IBOS).

3.1.1 Reducing operational carbon

The differences and complementarity between predicted and measured energy use discussed so far are carried over when looking at the related carbon emissions. Operational carbon emissions are not measured as they occur, but rather calculated on the basis of established conversion factors for each energy source used in the building. Therefore, emissions calculated on the basis of predicted energy use show the same drawbacks of this metric: they are the result of a simulation. At the same time, they are more representative of the carbon intensity of a building as an asset in itself (independent of weather variations and occupant behaviour) than carbon emissions calculated on the basis of measured energy use. For these reasons, 'predicted operational carbon' and 'measured operational carbon' have different roles to play when it comes to policy regulating building performance at different stages of the real estate life cycle. When the intent of policy is to lower operational emissions by requiring buildings to be designed (or retrofitted) to high standards, predicted operational carbon is the right metric to use. Conversely, when the intent of policy is to lower operational emissions by requiring buildings to be operated efficiently, measured operational carbon is the right metric. This is illustrated in more detail in Table 2. In this context, 'reducing predicted operational emissions' effectively means improving the building design, materials and services, while 'reducing measured operational emissions' refers to improving building operations.

Real estate life cycle	How to reduce predicted operational carbon in each stage – as asset	How to reduce measured operational carbon in each stage – as actual operations
Urban planning	Predicted operational emissions occurring at a later stage (operation) can be reduced by applying passive design principles to urban design, and by providing access/spaces for low carbon energy sources (e.g. local renewables generation or district heating provision). Emissions can also be reduced indirectly by setting thresholds for planning applications.	n/a
Building design	Predicted operational emissions occurring at a later stage (operation) can be reduced by reducing the energy demand of the building (through passive design) and by choosing low-carbon energy sources.	n/a
Construction (Stage A)	n/a	n/a
Selling/ buying	Predicted operational emissions occurring at a later stage (operation) can be reduced indirectly by setting thresholds for selling/ buying buildings. This compels owners to retrofit their properties to the required level in order to be able to sell them.	n/a
Leasing/ renting	Predicted operational emissions occurring at a later stage (operation) can be reduced indirectly by setting thresholds for leasing/ renting of buildings. This compels owners to retrofit their properties to the required level in order to be able to lease them.	Measured operational emissions occurring at a later stage (operation) can be reduced by requiring efficient building management through lease clauses. Specific carbon emissions thresholds can be required to be met.

Real estate life cycle	How to reduce predicted operational carbon in each stage – as asset	How to reduce measured operational carbon in each stage – as actual operations
Operation (Stage B)	n/a	Measured operational emissions occurring at this stage can be reduced by efficiently managing building operations that require energy use (which lowers energy demand) and by choosing to meet energy demand with low carbon sources (where applicable).
Maintenance	n/a	Measured operational emissions occurring at a later stage (operation) can be reduced by adequately maintaining HVAC and other building equipment.
Retrofit design	Predicted operational emissions occurring at a later stage (operation) can be reduced by reducing the energy demand of the building (through passive design) and by choosing low-carbon energy sources.	n/a
Retrofit works	n/a	n/a
Disposal (Stage C)	n/a	n/a

Table 2: Opportunities to reduce operational carbon across the real estate life cycle

As mentioned previously, operational carbon emissions are the result of two elements: the energy used in the building and the energy-to-carbon conversion factor (or 'emission factor') that is specific to each energy source. This factor represents the emissions associated with each unit of energy (kWh) and includes the carbon that is emitted when the energy is consumed, as well as the carbon embodied in the upstream supply chain of the energy source. In the case of natural gas, the emission factor includes the carbon released when the gas is burned by the boiler, as well as the carbon released when the gas is extracted and transported. Emission factors change over time as the carbon intensity of the energy source increases or decreases. This is clearly visible in the emission factor of electricity, which has been steadily declining in the UK thanks to the progressive switch from coal to natural gas and renewable sources.

As the carbon intensity of electricity continues to decline and eventually reaches net zero, it becomes possible for a building to be low-carbon or net zero by simply switching its energy sources from fossil fuels to electricity (this applies mostly to energy for heating, since cooling and other demands are already dependent on electricity). Technically, such a strategy is entirely legitimate from a decarbonisation perspective. A building may be very energy-intensive but also net zero carbon, as long as it meets all its energy demand with net zero electricity. However, at a large scale the sustainability of this choice is rather questionable. If a substantial quantity of energy is required by buildings, it cannot be used for other purposes, so more plants must be built and operated to meet the total demand, with all the associated economic cost and embodied carbon. Moreover, electricity might be net zero carbon, but it does not come at zero cost to the consumer. The current context of rising energy prices and uncertain supply makes it abundantly clear that decarbonising buildings without reducing their energy demands in the first place, and relying only on the decarbonisation of electricity, is an easy win that yields more problems in the future and does not address other aspects of sustainability related to energy supply. Therefore, energy efficiency must always come first.

In terms of building design, the 'energy efficiency first' principle means striving to minimise the need for energy as much as possible, and then meeting the energy demand through low-carbon sources. Therefore, the most complete way to evaluate a building is to consider both predicted energy use and predicted carbon emissions. This means that policy should use both metrics to regulate the decarbonisation of real estate at the design stage, since looking only at carbon carries the risk of hiding the real cost of energy-intensive buildings that rely on low-carbon electricity. As an alternative, design factors affecting energy demand (such as surface-to-volume ratio and insulation levels) can be considered in conjunction with predicted carbon emissions.

In terms of building operations, the 'energy efficiency first' principle is easier to implement since reducing energy demand is under the control of the occupier (e.g. by choosing to turn off heating in unoccupied areas), while it is less common for the occupier (be it a facility manager or the resident of a house) to be able to switch between different energy sources. Since energy bills are paid by the occupier, it is also in their direct interest to reduce energy demand first, rather than opting for a low-carbon energy source. Therefore, policymakers might choose to focus on predicted carbon emissions as the key metric to regulate building operations.

3.2 Embodied carbon

Embodied carbon includes:

- 'upfront' carbon embodied during life cycle module A (through manufacturing, transport and construction)
- carbon embodied during life cycle module B (through maintenance and retrofit) and
- carbon embodied during life cycle module C (through demolition/deconstruction).[1]

The embodied carbon of a building is calculated through a life cycle assessment (LCA), which can be conducted at the design stage and/or post-completion. EN15978:2011 is the international standard for LCAs at the building level. The RICS standard Whole life carbon assessment for the built environment provides guidance on how to apply EN15978:2011 in the UK, covering both embodied and operational carbon.

For embodied carbon, the procedure entails accounting for the emissions associated with the materials and works necessary to construct, retrofit, maintain and demolish/deconstruct a building. The starting point is the creation of an inventory of all materials and works. For a building LCA at the design stage, the inventory can only be an estimate on the basis of the building design and the expected works, while for a building LCA conducted post-completion, the inventory can, and should,

1 WLCN, LETI and RIBA, 2021. Improving Consistency in Whole Life Carbon Assessment and Reporting - Carbon Definitions for the Built Environment, Buildings and Infrastructure. Version 'A' - May 2021.

be based on the actual quantities as measured on site. In both cases, emissions are not measured directly, but rather calculated through values resulting from previously-conducted LCAs on individual materials and works. Therefore, a building-level LCA is effectively the result of the sum of several product-level LCAs. This highlights the importance of using LCAs for materials and works that are relevant (that represent the actual materials and works being used in the building as closely as possible) and reliable (that have been conducted rigorously). Conceptually, this process of 'carbon accounting' is not different from cost accounting, insofar as quantities of materials are multiplied by factors representing their carbon emissions, as would be done with their price. In fact, the latest version of the International Cost Management Standard (ICMS3) has been developed to allow joint reporting of carbon emissions and construction costs.

As in all LCAs, when assessing a building it is necessary to draw a boundary to avoid accounting for emissions that are technically associated with the building but occur far away in upstream and downstream processes. For example, emissions associated with the travel of employees working in the factory that supplies bricks for the building being assessed are not accounted for, although a tiny fraction of those emissions could technically be attributed to the building.

3.2.1 Reducing embodied carbon

Table 3 shows how embodied carbon can be reduced in different stages of the real estate life cycle. It must be noted that actions taken at one stage often aim to reduce emissions occurring at later stages. For example, requirements set at the planning stage impact on the embodied emissions that occur at the construction stage.

Real estate life cycle stage	How to reduce embodied carbon
Urban planning	Embodied emissions occurring at later stages (construction, retrofit and disposal) can be reduced indirectly by setting thresholds for planning applications.
Building design	Embodied emissions occurring at later stages (construction, retrofit and disposal) can be reduced through design choices, such as by minimising the quantities of materials needed and by choosing materials that have low embodied carbon.
Construction (stage A)	Embodied emissions at this stage can be reduced by minimising waste (which avoids emissions embodied in the wasted materials and energy) and by using low-carbon energy sources for on-site works.
Selling/buying	n/a
Leasing/renting	n/a
Operation (stage B)	n/a
Maintenance	Embodied emissions can be reduced by adequately maintaining materials and services, and choosing low-carbon replacements when necessary.
Retrofit design	Embodied emissions at the retrofit works stage can be reduced through design choices (as in the building design stage).
Retrofit works	Embodied emissions at this stage can be reduced by minimising waste and by using low-carbon energy sources for on-site works.
Disposal (stage C)	Embodied emissions at this stage can be reduced by using low-carbon energy sources for on-site works, and by deconstructing the building rather than demolishing it, which allows materials to be reused in other works or recycled into new products, rather than being landfilled or incinerated. These practices avoid emissions that would be embodied in newly-manufactured materials that are not associated with the building being assessed, so they are accounted for in stage D.

Table 3: Opportunities to reduce embodied carbon across the real estate life cycle

4 UK policy approach

This section provides an overview of the UK approach to measuring and regulating carbon emissions from real estate. It covers the main current policy instruments, new proposals from the government and proposals put forward by industry-wide initiatives.

4.1 Operational carbon: Building Regulations

Levels of building performance for operational energy and carbon emissions are mandated in the UK through the Building Regulations: Part L for England and Wales, Part F1 in Northern Ireland and Section 6 in Scotland. These regulations affect choices in terms of design, material and services: those factors that determine a building's performance in itself and are therefore correctly assessed through a simulation of the building's 'behaviour' under typical conditions (see section 3.1). Domestic properties are assessed through the **Standard Assessment Procedure (SAP)** method, while non-domestic ones through the **Simplified Building Energy Model (SBEM)**. The latter is more complex than SAP, but both are based on the 'notional building' approach. This is a theoretical building with the same location and shape of the building being assessed, with standard values for fabric and services performance.

In order to comply with Part L, the predicted performance of the building must be equal to (or better than) the performance of the notional building as measured by three metrics: primary energy rate, emissions rate and fabric energy-efficiency rate. The first two are affected by fabric and services, while the latter only by fabric. In addition, Part L also sets absolute minimum requirements for fabric and service performance to reduce heat gains and losses.

What really sets the level of required performance in the Building Regulations are the standard values for fabric and services, which determine the performance of the notional building. These values will be tightened through updates to the Building Regulations set out in the Future Homes and Future Buildings standards, planned to come into force in 2025. These updates are meant to ensure that new buildings will produce 75–80% less carbon emissions compared to current regulations.

While this is certainly a positive change, measuring improvement on the basis of current levels in the absence of absolute thresholds (e.g. $kgCO_2/m^2/y$) means that it remains unclear whether these reductions will be sufficient to reach sector decarbonisation targets. Moreover, the Future Homes and Future Buildings standards continue to use primary energy as a metric rather than final energy, which is problematic since primary energy is dependent on the wider energy system.[1] The Future Buildings Standard also introduce a new Part O to address overheating in new buildings, but crucially not yet in existing ones.

1 RIBA 2020. RIBA Future Homes Standard Response.

4.2 Operational carbon: Energy Performance Certificates (EPCs)

The SAP and SBEM methodologies are updated by the Building Research Establishment (BRE) every few years, and successively adopted into the Building Regulations. The latest SAP version (10.2) came into force in England in June 2022. SAP and SBEM are also used to produce EPC ratings for domestic and non-domestic properties respectively. For existing dwellings, the simplified **Reduced SAP (RdSAP)** method is used. These methods are essentially physics-based model that predict the energy performance of buildings (explained in section 3.1). The resulting final energy use (covering regulated energy only) is used to calculate primary energy, energy cost and carbon emissions. These metrics are then converted into EPC ratings through non-linear formulas that result in numbers on a scale from 0 to 100, with 0 being the worst.

The main rating shown on domestic EPCs is based on the energy cost metric, while the rating of non-domestic ones is based on the carbon metric. The fact that both ratings are labelled as a measure of energy efficiency is rather misleading, since neither of them is based on a straightforward measure of energy. Absolute values – such as primary energy use in kWh per year – are reported in the full EPC documentation, but most of the public are only familiar with the EPC bands (from A to G) that are based on the underlying rating. These bands are also used in MEES to mandate minimum levels of energy efficiency, although there is no specific level of energy performance that can be associated with an EPC band, since these bands are not based on an energy metric and do not directly correspond to a numerical scale expressed in absolute values.

The situation in Scotland is clearer, since EPC ratings (and the resulting bands) are derived from absolute thresholds. This means that two buildings with the same rating have the same performance (be it energy cost or carbon emissions, per unit of floor area) and so can be directly compared, which is not the case for EPCs in England, Wales and Northern Ireland.

These issues around EPC methods and metrics would be less significant if EPCs were only used for their original purpose, which was to provide an indication of the level of energy efficiency of a property to a non-expert consumer. In practice, EPCs have become the main source of information about the performance of the existing building stock, and the policy instrument used to mandate levels of performance at the point of letting. Neither of these purposes were originally intended for EPCs. Moreover, many consumers appear to assume that EPCs are meant to provide accurate predictions of energy costs. This is incorrect, since it is impossible for a model to accurately predict future energy use under specific conditions, as explained in section 3.1.

This problem has been aggravated by the extreme simplicity of the RdSAP method used to assess the performance of existing buildings, and the inaccuracy of its assumptions. Without a thorough survey of the building, RdSAP calculations are often based on incorrect assumptions about the conditions of a property (e.g. the presence of loft insulation) that lead to questionable results. Combined with the lack of access to the underlying parameters used in the calculations, this has led many built environment professionals to be sceptical of the validity of EPC results.

The issues described here have been known for years. This has been acknowledged in the government's EPC Action Plan of 2020, and more specifically in the Making SAP and RdSAP 11 fit for Net Zero report (2020), which sets out the key changes expected for the upcoming substantial update of the SAP method (SAP11). The Action Plan recognises that EPCs have multiple roles, such as providing 'a trusted, accurate and reliable measure of a building's energy performance', supporting 'action to reduce energy use in buildings' and enabling 'consumers and third parties to access the data they need to make decisions'. The Action Plan says that we should prepare for 'a future where an EPC rating has increased financial value'. In fact EPC accuracy and reliability already have economic and legal implications, since they are used to disallow the leasing of poor-performing properties and often represent the main source of information used to evaluate the ESG credentials of property investments. Data accessibility is also a key aspect, as the Action Plan states that 'homeowners, landlords, and operators of commercial buildings need to easily access EPC data, including the data underpinning the EPC rating.'

Beside these promising developments, the Action Plan also contains some questionable ideas. In particular, it says that 'EPCs will need to move from a reflection of the features of a building (fabric, services and installed improvement measures) to a true measure of "in use" building performance.' This appears to confuse assessing building design and assessing building operations, as described in section 3.1.

More specific details on the necessary changes to the EPC system are contained in the Making SAP and RdSAP 11 fit for Net Zero report, although this only covers changes to the SAP method, which itself only applies to domestic EPCs. Several significant changes are recommended by the report authors to make SAP and RdSAP 'fit for net zero', such as:

- replacing the notional building approach with absolute thresholds
- producing three metrics: final energy use, carbon emissions and space heating demand
- replacing short-term carbon factors with long-term ones (averages over 25 years)
- including unregulated energy use
- including an assessment of overheating risk and
- becoming fully digitalised.

If these and the other changes recommended in the report were to be implemented in SAP11, it would address several of the issues discussed here and represent a significant improvement of the SAP method. It would also make sense to replicate these improvements to update the SBEM method, which applies to non-domestic buildings, in order to align domestic and non-domestic EPCs.

4.3 Operational carbon: in-use performance rating

In-use performance ratings assess building performance on the basis of measured energy use, typically over a one-year period. As described in section 3.1, this is the correct type of metric to evaluate the efficiency of building operations. Display Energy Certificates (DECs) are the current public scheme for in-use performance rating of buildings in the UK, but they are only mandatory for buildings that are over 250m^2, at least partially occupied by a public authority, and frequently visited by the public. DECs are valid for 10 years for buildings smaller than 1,000m^2, otherwise they must be renewed every year. DECs are not required in Scotland, although they are available on a voluntary basis.

DECs provide information based on metered energy consumption over the period of a year. The main rating represents annual CO_2 emissions on a numerical scale (not in kgCO_2eq), where 0 stands for a zero-emissions performance and 100 represents the typical emissions performance for the type of building being assessed. These typical values are based on benchmarks produced by the Chartered Institution of Building Services Engineers (CIBSE). The rating is calculated via the government-commissioned Operational Rating Calculation Methodology (ORCalc) software, which is only available to qualified DEC assessors. The methodology allows for the adjustment of the benchmarks to account for differences in weather and occupancy rates.

The resulting main DEC information must be visible to the public. This information includes the operational rating (which is confusingly called **energy performance operational rating**, despite being based on emissions), the resulting band (from A to G), the actual CO_2 emissions and energy consumption (split into its main components). The rating and emissions of the previous two years must also be shown when available. The DEC also comes with an advisory report; however, this information is not displayed to the public. DECs only have an informative purpose, so there are no levels of performance that building operators are required to deliver.

Recently, the UK government has announced the intention to introduce an in-use performance rating scheme in England and Wales to assess energy use and carbon emissions in non-domestic buildings larger than 1000m^2. This proposal has been subject to consultation between March and July 2021, but the government has yet to publish a response. As it stands, the proposed scheme aims to build on the experience of DECs but moving towards a more advanced framework based on NABERS UK, which is an adaptation of the original Australian NABERS scheme. Since its launch two decades ago, the NABERS scheme has been very successful in Australia, and its more recent British counterpart has also gained significant traction in the UK. It is generally considered to be based on a reliable and accurate method with high levels of quality assurance, which results in a trusted rating that is often used to make investment decisions. If the government scheme adopts the NABERS UK approach, building owners and tenants will be required to annually submit metered energy data and other information to the scheme administrators. The resulting rating will be publicly disclosed and will be expressed on a scale from one to six stars, to avoid confusion with EPC ratings.

In comparison to the DEC scheme, the proposed NABERS-like scheme will represent an improvement in terms of methodology, although its adoption might render the experience of DEC assessors obsolete. The proposed scheme will also extend the mandatory rating beyond the limited group of buildings covered by DECs, starting with offices and successively including all non-domestic buildings. However, it will exclude buildings smaller than 1,000m². This is a somewhat arbitrary exclusion, since those building consume energy just as much as larger ones. In fact, the consultation document itself reports that buildings larger than 1,000m² consume about 53% of all the energy used by the private non-domestic stock, which means that the remaining 47% is attributable to smaller buildings. It may be that this limit of 1,000m² was established to avoid imposing the additional cost of compliance with the proposed scheme onto the owners and tenants of smaller buildings. If so, it would be better to develop a lighter version of the scheme for these buildings, rather than excluding them completely.

The main gap in the government proposal is the absence of follow-up actions after the rating is obtained. In this aspect, there is no difference from the current DEC scheme, since there is no incentive or obligation to improve the rating by operating the building more efficiently. Awareness and visibility of the rating may be enough to encourage some stakeholders to act, especially when this could increase the appeal of the property to investors, but there is no guarantee that the rating itself will have sufficient impact to deliver the carbon reductions that are needed to reach decarbonisation targets. Finally, the adoption of an in-use performance rating scheme should not be seen as a replacement for the assessment of building performance in itself. As thoroughly argued in section 3.1, both building performance (predicted) and in-use performance (measured) assessments are necessary and complementary ways to deliver reductions in operational energy and carbon emissions.

4.4 Embodied carbon

In the last decade, embodied carbon has shifted from being a niche topic to being recognised as an important component of the environmental impact of the built environment. Although some local authorities require an embodied carbon assessment to obtain planning permissions, embodied emissions in buildings are not currently regulated in the UK at a national level. Nonetheless, parts of the industry have started conducting such assessments on a voluntary basis and are openly calling for the regulation of embodied carbon through the Part-Z proposal. This initiative sets out three steps for regulating embodied carbon through the Building Regulations:

1. Establishing a national assessment and reporting methodology. To be considered legitimate, a building LCA must be conducted according to the EN15978 standard. However, this standard leaves several choices (e.g. calculation scope and assumptions, choice of product-level data and presentation of results) up to the assessor. The RICS standard Whole life carbon assessment for the built environment provides guidance on how to apply this standard in a uniform way. Since its release in 2017, it has become the unofficial building LCA methodology in the UK, being used by architects and engineers as well as surveyors, as recognised in the Part Z proposal. The standard is currently being updated to improve its clarity and enlarge its scope to cover infrastructure assets.
2. Mandating assessment and reporting of embodied carbon at the design and construction stages.
3. Imposing limits on the quantity of carbon that can be embodied in a building, with fiscal penalties for non-compliant projects.

Although building LCA practice has come a long way since its beginnings, there are significant issue that can explain, at least partially, the reluctance of public bodies to regulate embodied carbon. Firstly, it is still a rather obscure topic for many politicians and civil servants, as well as for most of the general public. Understandably, the public discourse around climate change and buildings generally focuses on operational emissions. And while many built environment professionals have gained at least a basic understanding of embodied carbon, many still remain unaware of its importance. Looking at other countries, the Netherlands is the only one that has regulated embodied carbon through its building code so far, while other European countries are now looking to do the same.

The uncertainty associated with building LCA results is also a factor that hinders a wider uptake. Although there will always be uncertainties associated with building LCAs (or any LCAs), these can be reduced by establishing clear methodologies, ensuring that assessments are conducted by experience professionals and providing robust datasets. Data quality needs to be improved for product-level LCAs, so that building LCAs can be based on better inputs – as well as for building-level LCAs, so that the results of new assessments can be benchmarked against previous ones.

Without large pools of reliable data, it is also difficult to establish reasonable thresholds for regulatory purposes. In the absence of initiative from the government, a consortium of organisations and professional bodies has come together to create a repository of building and product LCA data for the UK, the Built Environment Carbon Database (BECD), based on the reporting guidelines established by the RICS standard.

Finally, effectively integrating embodied carbon assessment in development and construction programmes can be challenging. Without the possibility to re-evaluate design and procurement choices following the results of an assessment, the assessment remains a measuring exercise without any impact on the project. Moreover, assessing embodied carbon and actively trying to reduce it does represent an additional cost for businesses. While this cost may be negligible in large projects, the need to dedicate resources (and training) in smaller projects can be a significant obstacle, especially for SMEs. However, mandating assessment though regulation could reduce this problem, since it would create a level playing field and make carbon assessment a more widely-required professional service.

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Americas, Europe, Middle East & Africa
aemea@rics.org

Asia Pacific
apac@rics.org

United Kingdom & Ireland
contactrics@rics.org

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