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Building the Future: Lessons for a Buildings Breakthrough

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MISSION ZERO 
COALITION

BUILDING THE FUTURE

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Buildings
Breakthrough

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This Report

PREFACE

The buildings that are our homes, workplaces, providers of services, and our public amenities are also one of the greatest contributors to our emissions, both in their construction and in their daily use. As the Mission Zero Buildings Network set out in its first report, Mission Retrofit, the challenge of decarbonising our building stock for the future is largely one of dealing with a legacy of buildings built without regard to the environment, or the opportunity to ensure that these buildings are both efficient and cost effective to run. For too long this legacy has been ignored: limited government action has ensured that the UK is the poor man of Europe when it comes to improving our homes. A lack of energy efficiency measures, combined with an over dependence on gas for heating has meant that our homes and buildings are colder, produce more emissions and cost their owners more in energy bills. As a result, our existing buildings are responsible still for over a quarter of all the UK's emissions.

This legacy of inaction has also stymied the opportunity for the UK to establish a new modern industry that produces modern methods of construction that place energy efficiency and low emissions first. The Net Zero Review highlighted the fact that despite knowing what needs to be in place for buildings to be net zero compliant by 2050, over 1.4 million homes have been built in recent years that will be required to be retrofitted in the future, costing householders tens of thousands of pounds.

There now needs to be no excuses for not ensuring that our new homes and buildings are fit for the future. This second report, Building The Future, from the Mission Zero Buildings Network sets out what needs to be achieved if we are to deliver a future generation of buildings that both do not need to be retrofitted and will deliver on our net zero commitments; at the same time as leaving people and businesses less vulnerable to the changing climate, and with lower bills, not dependent on rising and volatile fossil fuel prices.

The report is the culmination of a series of evidence roundtables and written evidence submissions that has been gathered by the Network. The Network represents some of the UK's leading construction specialists, who have a dedicated interest in delivering on net zero commitments. The Network is Co-Chaired by Deputy Chief Executive of UK Green Building Council (UKGBC), Simon McWhirter, and includes Amazon, Barratt Developments, Centrica, Electric Heating Company, Grosvenor, ISG, Landsec, Lloyds Banking Group, Natwest Group, Paragon Bank, Suez and The Phoenix Group.

While the first report, Mission Retrofit, focused on existing buildings in the UK, this report highlights the need to take immediate action to ensure that we have the sustainable policy frameworks in place to give certainty to an industry to build net zero buildings that undoubtedly will still be in place by 2050 and into 2100. It also highlights the opportunity for the UK to become an international leader in zero carbon new-build construction and design, to ensure that the rest of the world is able to deliver new buildings that are low-emission. While new buildings in the UK will represent 20% of all buildings by 2050, for the Global South, and many emerging economies, this figure is reversed: 80% of the buildings that will be standing in 2050, have not yet been built. Currently, estimates suggest that globally there will be a demand for over 3 billion new dwellings. Many of these will be in cities, that presents future challenges around the future of habitats, but the reality is that we must act now to ensure that we build low carbon buildings that are both resilient and adaptable for the future. At a time when the world is building the equivalent number of buildings to the total of the city of Paris every few weeks, we need to ensure that not only in the UK, but also globally, we have the legislative frameworks, the necessary standards and regulation, the means to develop supply chains in low carbon materials, and methods of construction to meet

the demand that is rapidly increasing. This demand, and the need for leadership on delivering on this demand, should be a prize that the UK should seek. Already the UK has leading experts and organisations that have worked hard to demonstrate what is needed to produce the homes and buildings of the future. It is UK-led organisations such as UKGBC, CIBSE, RIBA, LETI, the Future Homes Hub and others that are leading on future frameworks such as UKGBC's Zero Carbon Roadmap, the Net Zero Carbon Homes and Buildings Standards and the Future Homes Delivery Plan. It is UK companies such as Barratt Developments, with their ZED House, developing new residential properties, and commercial organisations, such as Landsec, that have already built the first net zero commercial property in operation, Grosvenor, that are focusing on wider sustainable development across the life cycle of their buildings and across the entirety of their supply chain, and Amazon investing in lower-carbon concrete and steel technologies.

Indeed, one of the key aspects of this report is to produce vital lessons for building the future, that highlight not merely policy recommendations, but real-world examples of how UK companies and organisations are already producing and operating net zero innovations and pilot programmes of work that have enormous potential to be scaled up both nationally and internationally.

While this report has been in production, at COP28, the final details of the Buildings Breakthrough were launched, with 28 countries committing to taking forward a wider commitment that near-zero emission new buildings would be the new normal by 2030. This is a welcome commitment, but it will require both policy and legislative certainty, and alignment between countries on how to create common, interoperable standards, supply chains and low carbon materials that can help deliver this shared goal. It is an

exciting initiative led by France and Morocco that has the potential to deliver real impact on reducing emissions. This report has therefore also been written with the intention of informing how the Buildings Breakthrough internationally, as well as the UK government nationally, can best deliver on its commitments by 2030. Both the challenges and their solutions are not merely UK specific but are shared problems that the Network believes can best be solved through collaboration and sharing best practice. For this reason, this report not only focuses on policy solutions, but lessons for a Buildings Breakthrough that we have identified in the Network that can deliver rapid, real-world change if they are taken up sooner rather than later.

This new report seeks to both set out what is needed from a policy and regulatory perspective for the UK to lead internationally on how to design, construct and operate new buildings that will be fit for a net zero purpose. It makes clear recommendations on current policy, that has been informed by recommendations in the Net Zero Review. Part One of the report sets out in background what has been achieved so far, and the progress, or lack of, on delivering what is needed and has been recommended both by the Net Zero Review and the Committee on Climate Change on new buildings.

Core to this is achieving a Future Homes and Buildings Standard that is fit for purpose. While there has been much criticism of the standard at present, this is justified as it is critical that we get this right if the UK is to lead on how to deliver new net zero homes. This is an opportunity, as Part Two of the report sets out, for the UK and its companies and organisations to export and inform the rest of the world on how to deliver both residential and commercial dwellings that are net zero in the right way. The economic advantage, in addition to the environmental benefit, is huge, if the UK takes the decision to lead on net zero new buildings.

Part Three of the report sets out the challenges to deliver on new buildings, both residential, commercial and public buildings, and what is the role of the government and the private sector in delivering the necessary legislation, regulation, planning and standards, the enforcement of these standards, in addition to how to ensure that we have the low carbon materials of the future, as well as ensuring the circular economy and reuse and recycling is embedded into a vision that ensures we meet the necessary embodied carbon standards across the lifecycle of a building, and that new buildings by their nature are not adding to the problem by replacing poorly-performing existing buildings. Part Three also focuses on the key issues that future buildings must also meet: how to exist in a future world whose environment is rapidly changing. How will these buildings be both resilient and adaptable to future demand and change?

This report should therefore be viewed as a first attempt to provide a template and framework to all those involved in the Buildings Breakthrough on what needs to happen, and when it needs to take place. Part Four sets out the key 'Lessons for a Buildings

Breakthrough' that provide the real-world examples of what can be achieved if ambition is set high enough. Each of the lessons is not a simple best practice example, but rather informs how to meet a specific challenge head on, whether that be in the form of developing a standard, enforcing the standard or in the methods of construction, or the innovation needed to develop those future methods, that have been drawn from the expertise and knowledge of the Mission Zero Buildings Network.

We have no time to waste. We know now, unlike previous generations in the construction industry, why we need to achieve net zero buildings, and we know also how we need to achieve net zero buildings. There can no longer be any excuses not to build the buildings of the future fit for a net zero purpose, that will not cost future generations more to retrofit. If we do not, we will not only have failed them, we will have failed to meet an opportunity for the UK to lead a global challenge which it is well placed to demonstrate leadership and to deliver the buildings breakthrough we need.

Rt Hon Chris Skidmore OBE
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Part One

The first instalment of the Buildings Network, Mission Retrofit, focused on the existing building stock, which, according to the CCC's 2023 progress report accounted for 17% of UK total emissions in 2022.¹ Thus, they are undeniably a key priority for reaching the UK's net zero by 2050 targets. Although repurposing or refurbishing existing structures is more suitable for reducing emissions from the buildings sector, around 300,000 new homes are expected to be required every year in England, according to government estimates. In 2022, 212,570 were built.² With millions more homes needed in the next decade, plus a range of newly built non-residential buildings, it is imperative that the question How do we ensure that the homes and buildings of tomorrow are fit for a net zero global economy? is the focal point of the design and construction of new buildings. The government must put in place adequate investment, wider financial levers, standards and regulations to guarantee this.

According to the Carbon Budget Delivery Plan (CBDP), the building sectors residual emissions will be 350, 320 and 217MtCO₂e in Carbon Budgets 4, 5 and 6, respectively. To achieve this reduction in emissions, proposed policies will need to be delivered on time and new policies and standards which are ambitious yet feasible must be implemented.³ One such policy is the anticipated Future Homes and Buildings Standard (FHS), which, when implemented by 2025 is intended to create 'zero-carbon ready buildings'.⁴ However, the draft of this standard released for consultation has been deemed the least ambitious option by the UK Green Building Council, for not providing stricter requirements on energy efficiency and neglecting measures on embodied carbon emissions from construction

and issues surrounding protecting against flood risk and wastewater.⁵ In fact, the FHS draft as issued sets energy efficiency standards lower than many homes built today. Therefore, it is clear that Government must go further if we are to meet climate targets.

The Buildings Breakthrough officially launched at COP28 by France and the Kingdom of Morocco has set a mission to make near-zero emission and resilient buildings the new normal by 2030.⁶ This will require strong coordination across actors from the value chain of a building's lifecycle. This year, the first set of priority actions will be developed for the Buildings Breakthrough, setting the trajectory for decarbonising the world's buildings sector. This presents an opportunity for the UK to generate examples of best practice to be showcased on the global stage, for example at the inaugural Buildings and Climate Global Forum taking place 5-7th of March in Paris. The following section will explore the recommendations made by the Net Zero Independent Review, the government's response and delivery on milestones, as well as further policy updates since the response.

The second chapter will lay out the opportunities and benefits provided from decarbonising future homes and buildings across their lifecycle, with chapter three recognising the challenges to achieving this. Finally, chapter four will provide solutions and recommendations for progressing towards a net-zero building stock.

1.1 THE NET ZERO INDEPENDENT REVIEW

The Independent Review on Net Zero made six specific recommendations relating to new homes and buildings, shown in Table 1:

Table 1. Net Zero Review Recommendations

#	Area	Owner	Timing	Recommendation
62	Energy Efficiency	DLUHC	2025	Legislate by 2025 the minimum energy efficiency rating to EPC B for all non-domestic buildings, both rented and owned, by 2030. Legislate for EPC B rating for all new non-domestic buildings from 2025.
63	Energy Efficiency	BEIS/ DLUHC	2027	Government to drive the creation of sustainable material supply chains and influence market development through its public procurement standards by 2027
64	Energy Efficiency	BEIS/ DLUHC	2023	UK to continue to show leadership through ambitious public sector decarbonisation by conducting its own trials to ensure alignment with the targets in the Heat and Buildings and Net Zero Strategies
72	Construction	BEIS	2023	Government to develop a public procurement plan for low carbon construction and the use of low-carbon materials, by the end of 2023.
108	Energy efficiency	BEIS/ DLUHC	2023	Government should bring forward all consultations and work to mandate the Future Homes Standards by 2025 to prevent further delays by ensuring the standard applies to all developments. This should include a consultation on mandating new homes to be built with solar and deliver the Net Zero Homes Standard, ensuring that the planning system (discussed in Pillar 4) is flexible enough to enable this.
113	Energy Efficiency	BEIS	2024	Government should set a legislative target for gas free homes and appliances by 2033, to contribute to a gas free grid in future. Government should legislate for all homes sold by 2033 to also have an EPC rating of C or above in line with the aforementioned NZPC, with exclusions around certain properties (e.g. listed properties, on grounds of affordability). Government should also mandate landlords to include 'average bill cost' alongside the EPC (and possible future NZPC) rating, when letting a property out. This will help renters understand what costs to expect, while also helping to put a premium on energy efficient homes.

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1.2 GOVERNMENT RESPONSE

On legislation for minimum energy efficiency ratings, the government responded that it has consulted on proposals for the private rented sector and will publish the government response in due course. They highlighted that in 2022, over 85% of new non-domestic buildings were rated EPC B or above. However, under revised plans for reaching Net Zero published in September 2023, the Government said it will “scrap policies to force landlords to upgrade the energy efficiency of their properties, but instead continue to encourage households to do so where they can.”⁷

In the response they also stated their intention that from 2025, the Future Buildings Standard will produce extremely efficient non-domestic buildings, which are ‘zero carbon ready’ (meaning that no retrofit work will be necessary to ensure they have zero carbon emissions as the electricity grid continues to decarbonise).

The government shared that it is working to understand the challenges with product supply chains and what can be done by government and industry to grow these and will consider actions once the initial phase of engagement with the industry is complete. They also agreed that decarbonising public sector buildings will demonstrate leadership and encourage action in other sectors, as well as making a direct contribution to net zero.

On developing a public procurement plan for low carbon construction and the use of low-carbon materials by the end of 2023, the government stated that it is committed to decarbonising the infrastructure and buildings that it funds and uses. The Construction Playbook sets out a consistent approach to the procurement of built assets, consistent with achieving the objective of net zero carbon by 2050. The Playbook requires government departments and arm’s length bodies to undertake whole life carbon assessments of projects, and to ensure that decarbonisation is one outcome that project procurement is intended to achieve. To support procurers to achieve decarbonisation and wider mitigation of the environmental impacts of construction, the government has also published a ‘Net Zero Carbon and Sustainability Guidance Note’ to supplement the Playbook. This provides practical advice, identifies useful standards and resources for procurers, and also a set of case studies of large and small construction projects which have successfully reduced carbon emissions.

The government has said it intends to legislate the Future Homes Standards in 2024 ahead of implementation in 2025. As part of the consultation they will explore what transitional arrangements are appropriate to make sure that as many homes as possible are built to the new standard as quickly as possible and as part of the consultation it will continue to explore what role solar should play in new homes.

Furthermore, the response included the government’s ambition to phase out all new and replacement natural gas boilers by 2035 at the latest. They added that, in relation to appliances, the Energy-Related Products Framework sets out plans for improving and building on energy efficiency policies where they can achieve additional benefits to consumers, businesses and our Net Zero objectives. As part of this, they will improve minimum energy performance standards and

energy labelling requirements for energy-using products. This included consulting on updating lighting requirements until April 2023, and on other products over the year that followed. The consultation on new eco-design requirements for lighting products ended on 4th April 2023, however a response is yet to be published.⁸

Finally, the response relayed that there would be a response to the consultation on improving home energy performance through lenders and that they were planning to consult by the end of 2023. As of now, there has not been a response to the consultation on improving home energy performance through lenders and there has not been a published consultation on improving efficiency of owner-occupied homes.

1.3 FURTHER UPDATES

The CBDP states the government will consult on whether to end all new gas grid connections, or whether to remove the duty to connect from the Gas Distribution Networks within CB4 (2023-2028). The purpose of regulating on new connections to the Gas Grid would act as a backstop to the Future Homes Standards and the Future Buildings Standard to ensure the expected timetable for new builds to be built using low carbon heat from 2025 is met.⁹

In May 2023, Homes England published their strategic plan for 2023 to 2028. It states that “quality, decency, good design and the sustainability of what is built must also take centre stage.” Key performance indicators (KPIs) 13, 14 and 15 relate to sustainable homes and places:¹⁰

1. **KPI 13:** Building performance – share of supported completions that are EPC rating B or above.
2. **KPI 14:** Average percentage biodiversity net gain planned on supported schemes.

3. **KPI 15:** Indicator to be developed on embodied carbon of Homes England supported development

In January 2023, the Scottish Government announced plans to introduce new minimum environmental design standards for all new build housing to meet a Scottish equivalent to the Passivhaus standard. The equivalent standard is currently being finalised, with introduction planned for December 2024.¹¹

In June 2023, the Scottish Government laid out the New Build Heat Standard that means that no new buildings constructed under a building warrant applied for from 1 April 2024 will be built with direct emissions heating systems, like gas and oil boilers.¹²

In October 2023, the House of Lords Built Environment Committee launched its inquiry into the future of Modern Methods of Construction (MMC) which is seeking to understand the barriers to the increased delivery of MMC homes and to whether the Government’s approach to supporting the growth of MMC development is appropriate or effective.¹³

On the 11th December 2023, the Department for Environment, Food & Rural Affairs (Defra), Forestry Commission, and Rebecca Pow MP published the Timber in construction roadmap on the opportunities and barriers in England, focusing on seven priority areas: improving data on timber and whole life carbon, promoting the safe, sustainable use of timber as a construction material, increasing skills, capacity, and competency across the supply chain, increasing the sustainable supply of timber, addressing fire safety and durability concerns to safely expand the use of engineered mass timber, increasing collaboration with insurers, lenders, and warranty providers, promoting innovation and high performing timber construction systems.¹⁴

On the 13th of December 2023, the Department for Levelling Up, Housing and Communities launched a consultation on the FHS. The consultation sets out technical proposals for changes to Part 6, Part L and Part F of the Building Regulations for dwellings and non-domestic buildings, the associated Approved Document guidance and calculation methods, as well as seeking evidence on Part O.^{15, 16, 17} The consultation will close on 6th March 2024.¹⁸

However, embodied carbon, the carbon emissions generated from the production and transportation of building materials, construction process and maintenance of a building are outside the scope of the consultation and existing Buildings Regulations. The Government stated its intention to consult on its approach to measuring and reducing embodied carbon in new buildings, however this is yet to materialise. Likewise, the promised review of the National Planning Policy Framework (NPPF), planned for the Autumn of 2023, to more fully integrate climate considerations into the planning system is still pending. Initial proposals consulted on in December 2022 to March 2023 included potential carbon impact assessment in planning, aligned with the Mission Zero Recommendation for a Net Zero test in planning.¹⁹ The Government reiterated in its formal consultation response, published in December 2023, that the NPPF will still be consulted on 'in due course', to better integrate climate concerns.²⁰

Additionally, on the same day the consultation Home Energy Model: Making the Standard Assessment Procedure fit for a net zero future and the consultations on the Home Energy Model, a replacement for the Standard Assessment Procedure (SAP) and Future Homes Standard assessment was opened and also closes on 6th March 2024.

The SAP is the current methodology used to estimate the energy performance of homes,

this will now be replaced by the Home Energy Model, which will be implemented with the Future Home Standards in 2025.²¹ The aim is to develop a new methodology fit for net zero.²²

1.4 CLIMATE CHANGE COMMITTEE PROGRESS REPORT 2023 AND GOVERNMENT RESPONSE

The Policy Assessment in the CCC's 2023 Progress Report concludes policy progress in the buildings sector is not on track.²³ Suggesting that if the government does not plan in advance for new buildings, it could create an even higher risk for meeting its carbon budgets and unacceptable maladaptation liabilities, for example stranded assets due to uninsurable properties. Regarding new buildings, the CCC put forward the following recommendation to DESNZ under the area of low-carbon heat:

Narrow the scope of the strategic decision prior to 2026 by: publicly affirming that electrical heat is the default option in all new buildings and existing properties off the gas grid; prohibiting connections to the gas grid for new buildings from 2025; setting out clear routes for other properties or areas where electrification or heat networks represent low-regret options; and clarifying the Government's position on the economy-wide priority of use-cases for hydrogen – in particular its potential to help manage peak demands for both heat and electricity, and its role in hybrid heating systems.²⁴

The Government responded that "heat pumps and heat networks are established technologies that will be the primary means for decarbonising heating over the next decade and play a key role in all 2050 scenarios. Annual deployment of heat pumps will potentially need to reach up to 1.6 million installations by 2035."²⁵

It is clear the governments ambitions do not go far enough, a large amount of work surrounding net zero standards for future

buildings is taking place independent of the government. The UK Net Zero Carbon Buildings Standard brings together Net Zero Carbon requirements for all major building types, based on a 1.5°C trajectory. It is championed by leading organisations in the built environment: BBP, BRE, the Carbon Trust, CIBSE, IStructE, LETI, RIBA, RICS, and UKGBC.

If the Government successfully delivers a FHS that addresses whole life cycle emissions, the

UK can place itself as a world leader, helping to influence and encourage a wider global buildings breakthrough standard. This report is intended for both immediate U.K. policy makers and the international buildings community, showcasing pioneering examples that can act as lessons for the Buildings Breakthrough. The following section outlines the environmental, economic and societal opportunities and benefits, both in the UK and internationally, that net zero buildings will provide.

Part Two

THE OPPORTUNITY

The buildings of the future present an opportunity to decarbonise and reduce carbon emissions to deliver the net zero pathway required to limit global temperature increases. As various international organisations, such as the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency have noted, buildings emissions represent around a quarter of global energy-related emissions.^{26,27} To ensure access for all to adequate, safe and affordable housing, as well as considering population growth, 3 billion people globally will require new housing by 2030.²⁸ Therefore, the emissions related to the sector are a major concern. Without new buildings meeting the standards and requirements to deliver near zero emissions, it is unlikely that we will be able to reach the net zero target or be suitably adapted to cope with the realities our changing climate.

Yet our future buildings also present an economic opportunity to deliver significant investment and infrastructure growth. A large proportion of the building stock that will exist in 2050 is yet to be built; for example, in Africa this amounts to 80%.²⁹ Now is the time to ensure that these buildings are both green, low emissions and can meet the adaptation requirements necessary to remain liveable in for decades to come. This economic opportunity can deliver significant returns on investment, due to factors such as higher asset values and lower operating costs.³⁰

Countries that are able to lead the development of new international buildings standards, through the innovation required to produce new materials and MMC, will be well placed to benefit both from international inward investment, as well as export and trade opportunities in low carbon goods and services, for which the global export market could be worth up to £1.8 trillion by 2030.³¹

As stated in the government's own Carbon Budget Delivery Plan, the package of proposals

and policies to reduce emissions from heat and buildings will result in more efficient, low-carbon buildings, reduced energy bills and healthier, more comfortable (and indeed in some cases, liveable) environments, attract greater private investment and strengthen supply chain resilience.³² The UK can be in a leading position to help inform the standards and frameworks that will be needed to deliver the global challenge on decarbonising and future-adapting both residential and commercial buildings. This is why progress and delivery of a FHS is so important: not only can it act as a standard for successful decarbonisation that recognises the importance of the carbon emissions from a building's life cycle and the embodied carbon of that building, it can also become a template for other countries to emulate and follow.

The work of the UK Green Building Council, the Future Homes Hub, the Net Zero Carbon Buildings Standard, RIBA and LETI – among others – is world-leading and can have the ability to deliver the policy requirements set out in the Buildings Breakthrough. We should not miss this opportunity to lead, especially when so many UK organisations in the buildings and construction sectors are in a position to help set the agenda and create the standards for the buildings of the future.

While limiting ambitions to weaker measures to introduce fully insulated buildings that have the ability to generate energy from solar and battery storage might be seen as a lower-cost solution, ultimately to not act is to delay the inevitable: indeed, the worst-case scenario will be for the buildings of tomorrow to require retrofitting in the future, at significant cost to homeowners. We must build properties that won't require retrofit interventions again in the next few decades. Now is a once in a generation opportunity to ensure that we deliver the buildings of the future that will be a benefit, and not a cost. New net zero and climate resilient buildings are a win-win for the

UK construction industry, whereas to delay, and to continue with the status quo, will only cost the industry, householders and small businesses in the longer term. This chapter sets out the benefits in seven conclusions that can be realised if we act now.

2.1 NEW NET ZERO HOMES AND BUILDINGS CAN DELIVER A RENAISSANCE FOR THE UK CONSTRUCTION INDUSTRY

The UKGBC's report Trends in Sustainable Solutions in the Built Environment 2023 states "a sustainable built environment requires our industry to more widely and rapidly implement the innovative, market-ready solutions that are already available to us."³³ By striving to set net zero homes and buildings as the norm, the UK construction industry can create a pathway for itself as a solution, not a cause of the triple planetary crisis, ultimately creating a number of benefits for the UK economy.

CBI Economics measured the scale of the UK's net zero economy and found that the energy and construction sectors within the net zero economy created the most economic growth, accounting for 16% and 11% of the total £71 billion GVA contribution, respectively. The CCC's brief A Net Zero Workforce highlights that a fifth of the current total workforce are in sectors playing a core role for the delivery of net zero, including buildings construction sector. Their analysis of literature found between 120,000 to 230,000 new jobs by 2030 will need to be added to the current buildings construction and retrofit sector.³⁴ Job creation will amount namely from the growth in the solar PV, heat pump and battery storage industries, as well as new innovative technologies such as infrared panels and heated skirting boards.³⁵ A research collaboration between the Boston University Institute for Global Sustainability (IGS) and the Schneider Electric Sustainability Research Institute (SRI) estimated the job creation from solar PV, heat pumps and battery storage in

eighteen regions, including the UK. The results indicated that the largest share of job years results from construction and installation, with solar PV contributing moderately more to job creation than battery storage or heat pumps.³⁶ The Government's Heat Pump Investment Roadmap amplifies the expected rapid growth of the heat pump market and the opportunity for companies currently supplying the fossil fuel boiler sector, heat pump manufacturers and new entrants.³⁷ By signalling a clear intention to establish a net zero building stock moving forward, the investment in R&D and manufacturing of the aforementioned technologies can be driven towards the UK.

2.2 NET ZERO HOMES, INCLUDING CLEAN HEAT, WILL SAVE HOUSEHOLDERS MONEY ON BILLS, AND COMMERCIAL BUSINESSES ADDITIONAL MONEY

Designing zero emissions into the construction plans of homes, for example improving the fabric, enabling or fitting solar panels, battery storage and heat pumps engenders long-term benefits for both developers and homeowners. The World Green Building Council (WGBC) concludes in their Beyond the Business Case report that lower operating costs of green buildings outweigh cost uplifts to create return on investment.³⁸ Further, heat pumps are not only gaining a reputation as a central technology to ensuring secure and sustainable heating, they also save billpayers money over their lifetime and provides protection from price shocks.³⁹ In addition, ensuring properties are suitably resilient to our changing climate will be vital for avoiding further costs to people, businesses, government.

Octopus Energy Zero Bills guarantees that for those living in new properties designed to the Zero Bills standard - meaning they must be off the gas grid, kitted with a combination of solar panels, a domestic battery and a heat pump and use smart technology to optimise

consumption – they will not pay energy bills for 5 years.⁴⁰ Additionally, Barratt Developments' 'ehome2' shows a current energy cost of £85 a month, compared to £315 for a traditional Victorian house.⁴¹ Whilst this is currently a novel concept, it exemplifies the near future of homes which are not only energy efficient, but also have the ability to generate their own energy. In 2022, an estimated 13.4% of households were in fuel poverty, which was projected to increase in 2023 to 14.4%.⁴² Under the Low Income Low Energy Efficiency (LILEE) indicator, a household is considered fuel poor if: they are living in a property with a fuel poverty energy efficiency rating of band D or below and when they spend the required amount to heat their home, they are left with a residual income below the official poverty line.⁴³ Therefore, making zero emission homes the norm, thus bringing down capital costs, will help achieve a dramatic reduction in fuel poverty – removing the need for households to decide whether to heat, or eat.

In addition, ensuring properties are suitably resilient to our changing climate will be vital for avoiding further costs to people, businesses, government.

2.3 NET ZERO HOMES AND BUILDINGS THAT ARE DESIGNED EFFECTIVELY TO MEET THE CHALLENGES OF A WARMING WORLD AT THE SAME TIME AS BEING ENERGY EFFICIENT ARE BETTER FOR QUALITY OF LIFE AND PEOPLE'S HEALTH

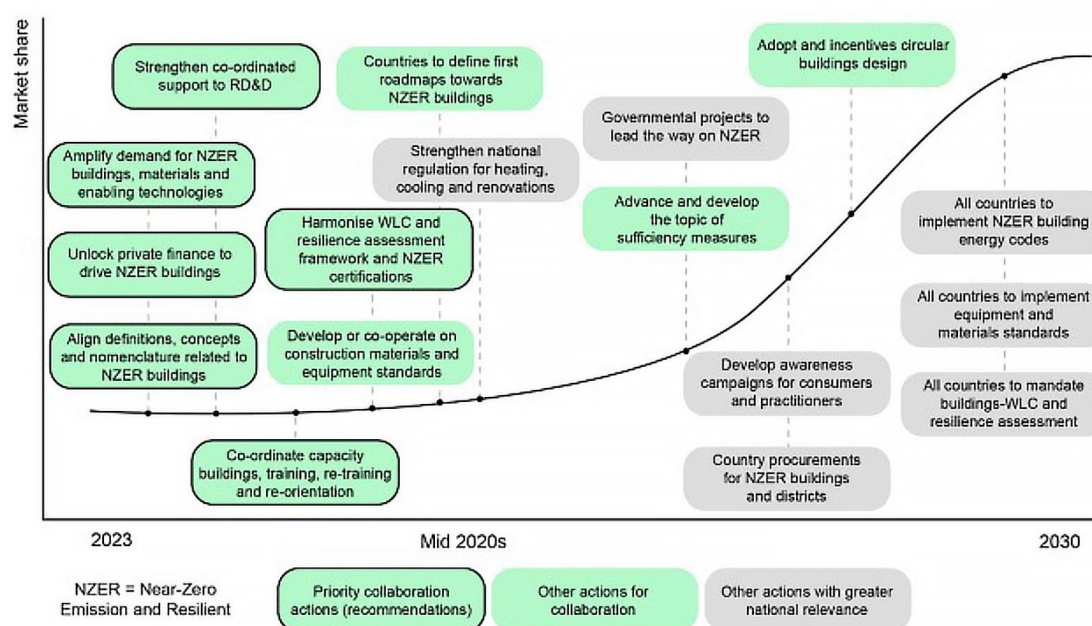
Heat stress and heatwaves are one of the most significant climate risks facing the UK. Of the eight priority climate risks in the Climate Change Risk Assessment (CCRA) three that must be tackled in the next two years, the risks to human health, wellbeing, and productivity from increased exposure to heat in homes and other buildings were identified as amongst the most urgent to address and most severe.⁴⁴ Likewise at current weather levels, more than half (55%) of UK homes suffer from overheating

risk.⁴⁵ Extreme heat already kills thousands of people every summer and is projected to increase by 250%.⁴⁶

Included in the House of Commons Environmental Audit Committee report on Heat Resilience and Cooling, a joint analysis from the Office for National Statistics (ONS) and UKHSA, over the five heat-periods in the UK between June and August 2022 there were 3,271 excess deaths—6.2% above the five-year average—of which 2,803 were in the most vulnerable age group of over 65. Additionally, the impacts of heat also affect mental health, wellbeing and productivity, costing lives and billions of pounds annually. Therefore, there is a clear human and economic case for accelerating heat adaptation measures.⁴⁷ When looking globally, a 2°C temperature increase from pre-industrial levels would increase the number of people living in areas affected by extreme heat stress from 68 million to around one billion.⁴⁸ Actions taken to reduce emissions, such as dual-function heat pumps, simultaneously reduce the risk of overheating.

A failure to act to enhance the resilience of buildings risks substantial financial and economic implications, for both government and businesses. Already in the insurance market in the United States, insurers have responded to the rising risks and liabilities associated with climate change and maladaptation by limiting their appetite and reducing capacity, alongside greater emphasis on related property valuations.⁴⁹ Without regulatory action in the UK to ensure properties are sufficiently resilient, there is a significant risk of a similar market contraction, stranded, uninsurable assets and the need for further related state-funded regimes, such as Flood Re for flood risk. Given that Flood Re will cease to function in 2039,⁵⁰ it is imperative the flood resilience standards, regulations and actions are expedited to ensure its exit from the market does not leave homeowners -present and future - with uninsurable assets.

Figure 1. Critical Path to 2030 for the Buildings Sector



Further, pollutants such as particulate matter and Volatile Organic Compounds can cause adverse health effects, and exacerbate respiratory conditions such as asthma and allergies, however adequate ventilation and switching to modern cooking fuels, including electricity, for cleaner cooking can reduce these levels.^{51, 52}

Moreover, the IPCC’s report *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* addresses local-level management, including structural measures such as strengthening buildings to protect against flooding and severe weather, as well as providing adequate shelter for occupants, it also protects against high repair costs due to extreme weather impacts.⁵⁴

2.4 UK LEADERSHIP ON A NET ZERO CARBON BUILDINGS STANDARD – COVERING HOMES AND NON-DOMESTIC BUILDINGS - CAN BE AN INTERNATIONAL OPPORTUNITY TO DELIVER A STANDARD

THAT CAN BE OPERATED GLOBALLY- ENHANCING FURTHER UK ECONOMIC PROSPECTS IN CONSTRUCTION AND BUILDINGS

The Breakthrough Agenda was launched at COP26, with the aim of strengthening international collaboration on developing clean technologies and sustainable solutions which are affordable, accessible and attractive in all sectors by 2030. It is backed by 57 countries and covers 80% of global GDP. Its initiatives cover seven key sectors, covering 60% of global emissions, two of which are buildings and cement and concrete.⁵⁵ According to *The Breakthrough Agenda Report 2023*, the buildings sector is not on track for net zero by 2050, partially as growth in floor area is offsetting the increased efficiency and decarbonisation actions. Thus, addressing the sustainability of new buildings is pivotal; so they aren’t substantially adding to the problem. The critical path to the buildings sector laid out in the Breakthrough Agenda is shown in Figure 1. A key challenge of decarbonising the buildings

sector is its highly fragmented nature. It includes a large number of actors throughout long supply chains, which operate within different financing and regulatory environments, making co-ordination and alignment difficult. This problem is exacerbated when trying to collaborate internationally. This led to the call for the Buildings Breakthrough at COP27 from 16 countries, led by France and Morocco, and 13 initiatives/ foundations. By September 2023 there were 25 countries and 15 initiatives/ foundations supporting the breakthrough. The Breakthrough was officially launched at COP28, where the Built Environment was the focus on Day 6 of the Summit. It is co-led by France (Ministry for Ecological Transition and Territorial Cohesion) and the Kingdom of Morocco (Ministry of National Territory Planning, Land Planning, Housing and City Policy), and coordinated under the umbrella of the UNEP-hosted Global Alliance for Buildings and Construction (GlobalABC). To date, 28 countries (including the UK), 19 international initiatives and the European Commission have announced their support for the Buildings Breakthrough. Its mission statement is to make near-zero emission and resilient buildings the new normal by 2030.⁵⁶

According to the Breakthrough Agenda Report 2023, embodied emissions need to fall by 25% and 20% for steel and cement, respectively, by 2030 to get on track with the IEA Net Zero Emissions Scenario.⁵⁷ The Steel Breakthrough co-lead by Germany and the UK currently has 33 endorsing countries, its mission to make near-zero emission steel the preferred choice in global markets.⁵⁸ Recently, the Cement and Concrete Breakthrough was announced by Canada and the UAE at COP28 and is currently endorsed by four other countries, including the United Kingdom. It aims to accelerate investments in the technologies, tools and policies needed for the Cement and Concrete industry to adopt net-zero solutions by 2050. To achieve this, the Breakthrough strives to make clean cement the preferred choice in global markets.⁵⁹ Near-zero emission cement production should be

established and growing in every region of the world by 2030. It is supported by the Global Cement and Concrete Association.

Canada is a leader in this sector, showcased by its Roadmap to Net-Zero Carbon Concrete by 2050, published in November 2022, which aims to position Canada's cement and concrete industry as a global leader in the production of, and technologies related to, low-carbon and concrete. The Action Plan to 2030 follows three priority areas:⁶⁰

1. Drive Canadian market development
2. Drive innovation and transition within industry
3. Position Canada as a world leader in the production, adoption and export of low-carbon cement and concrete products and technologies

The Action Plan to 2050 focuses on technology deployment and collaborations, research and development. As one of four initial endorsing countries of the Cement and Concrete Breakthrough, the UK can harness the chance to show leadership in innovation and use of net-zero carbon concrete, creating an opportunity to become a key exporter to the global market as demand inevitably exponentially increases. The Small Business Research Initiative, funded by Innovate UK, launched its funding competition for decarbonising concrete on 8th January 2024, awarding a share of £3 million to develop solutions to accelerate decarbonising concrete,⁶¹ hopefully paving the way to unlocking further investment and market demand.

New recommendations were presented in the 2023 Breakthrough Agenda for the first set of Priority International Actions in 2024 for Buildings and Cement and Concrete to address.⁶² Recommendations are shown in the Appendix A. For Steel modest or good progress was tracked against the 2023 priority actions and the following priority actions have been developed for 2024:⁶³

- Definitions and standards: Accelerate the development of standards for low emission and near-zero emission steel
- Demand creation & management: Rapidly grow demand commitments for low and near-zero emission steel
- Research, development and demonstration: Collaborate internationally on R&D to develop emerging solutions, and scale the number of demonstration projects for near zero emission steel technologies
- Governance & coordination of steel decarbonization policies to support the trading of near-zero emission steel: Launch a strategic high-level intergovernmental dialogue, serving as an enabling framework for increased cooperation, improved coordination and potential collective action
- Finance and investment: Further enhance the overall public offer of international assistance towards deep decarbonisation of the steel sector by COP29
- Landscape Coordination: Enhance the coordination and transparency of international collaboration on near zero emission steel.

Additionally, at COP28 two Memorandums of Understanding (MoUs) totalling more than \$26 million between the European Bank for Reconstruction and Development and a Moroccan regional government were signed, creating an example for innovative urban financing.⁶⁴

The first-ever Buildings and Climate Global Forum will be held in Paris on 7-8 March 2024, bringing together construction ministers and stakeholders from across the buildings sector value chain. Its role being to “initiate a new impetus in international collaboration for building decarbonisation and resilience after COP28.”⁶⁵ This event will be fundamental for setting the trajectory for the building sector and the standards future buildings will be held to.

Also occurring at COP28, the Global Cooling Pledge was launched, “recognising that, getting on a pathway consistent with limiting global

average temperature rise to 1.5°C will require delivering sustainable cooling which acts as both a climate mitigation and adaptation strategy by reducing greenhouse gas (GHG) emissions, providing protection from heat stress supporting human well-being, reducing food loss, and enhancing access to healthcare and medicines, and supporting just energy transitions.” 63 countries joined, with the National Government Participants committing to work together with the aim of reducing cooling-related emissions across all sectors by at least 68% globally relative to 2022 levels by 2050.⁶⁶ Achieving the Pledge’s targets could cut emissions from cooling by 78 billion tonnes CO2e between now and 2050, noting that this includes cooling for food.⁶⁷

Regarding Standards and Certification, considering the international landscape in FHS can place the UK as a front-runner for near-zero and resilient buildings and the UK can be a key voice in developing Priority Actions.

Furthermore, the EU reached a provisional agreement on the recast of the Energy Performance of Buildings Directive (EPBD) in December 2023, making zero-emissions buildings the standard for new buildings by 2028 for publicly owned buildings and by 2030 for all others. This encompasses ensuring new buildings are fit to host rooftop photovoltaic or

Near-zero = highly energy efficient buildings with a low carbon footprint taking into account a whole LCA approach eg low GHG energy source, low GHG building materials and equipment

Resilient buildings = buildings that integrate specifications related to the future climate in their design, construction, and operation maintenance

New normal = the above concepts are generalised in engineered buildings

solar thermal installations.⁶⁸ It is currently going through a formal adoption process.⁶⁹ Boiler bans are already in place in multiple countries, including in Denmark (2013), Norway (2020), France (2023) and Ireland (2023).⁷⁰ As per the Mission Zero Report “The Future is Local”, ensuring both a consistent approach to, and methodology for, handling carbon in the planning system will be vital for generating the certainty needed to drive green investment in the sector.⁷¹ The UK must not be slow to adapt to an evolving buildings sector and risk being left further behind with an outdated and inefficient building stock.

2.5 MODERN NEW LOW CARBON MATERIALS AND METHODS OF CONSTRUCTION CAN IN TURN HELP CREATE THE DEMAND FOR A BREAKTHROUGH IN LOW CARBON INDUSTRIAL PRODUCTS AND ADVANCED MANUFACTURING PROCESSES SUCH AS STEEL, GLASS, WOOD, CEMENT AND CONCRETE, THAT IN TURN CAN LOWER EMISSIONS EVEN FURTHER

For designers, developers and construction companies, green buildings are starting to offer themselves as the more attractive economic decision. MMC, which includes modular and off-site construction, demonstrates a series of benefits including speed, health and safety, waste reduction and reduction of embodied carbon.⁷² Recent modular projects have already established a solid track record of accelerating project timelines by 20–50%, however this is still exceptional rather than normal practice. According to McKinsey & Company, modular construction could reach \$130bn, in Europe and the US by 2030,⁷³ almost half of the estimated \$278bn global market.⁷⁴ Therefore, as it becomes standard practice economies of scale can be realised.

The Sixth Carbon Budget Delivery Plan states that “new government funding will provide long-term funding certainty, supporting the growth of supply chains and skills. The package will stimulate private investment and increase green finance options, galvanising supply chains, and

increase public and business engagement with energy efficiency, including how to build public understanding of clean heat technologies and deliver greater take-up of support.”⁷⁵

Following Britain’s exit from the European Union, there are significant opportunities for further reforms to public procurement rules and regulations to deliver greener outcomes. Since 2019/20, several updated government sustainable procurement statements have already been issued. Crucially, the Government has indicated, through its Levelling Up and Brexit opportunities papers, alongside the net zero strategy, that it intends to pursue further reform to public procurement rules, in order to drive sustainable outcomes and specifically align with policy goals such as net zero.

2.6 A BUILDINGS BREAKTHROUGH AND GLOBAL ALIGNMENT ON A NET ZERO HOMES AND BUILDINGS STANDARD CAN DELIVER AN ECONOMIC OPPORTUNITY WORTH UP TO \$24.7 TRILLION IN DEVELOPING COUNTRIES

The WGBC published its report *The Business Case for Green Building: A Review of the Costs and Benefits for Developers, Investors and Occupants* in 2013. In 2022, it released its evolution report *Beyond the Business Case: Why you can’t afford not to invest in a sustainable built environment*, which highlighted that since the original report, the building and construction industry has increased its awareness of sustainability and quantifying the premium on green buildings.⁷⁶

The International Finance Corporation estimated in 2019 that the green buildings sector represents a \$24.7 trillion investment opportunity by 2030, with a large proportion of this located in East Asia Pacific and South Asia, shown in Figure 2. Green buildings are a higher value, lower risk asset than the current buildings built under business-as-usual conditions.⁷⁷ Further, buildings account for the largest share of

Figure 2. Investment opportunity across regions (USD billions)



the \$231 billion energy efficiency market. Since 2006, the European Bank for Reconstruction and Development has invested almost €24 billion in green building projects under their Green Economy Transition approach since 2006.⁷⁸

Moreover, green buildings have developed to be one of the most important asset classes in the green bond market.⁷⁹ Since 2014, global sustainable and environmentally responsible asset investments have increased by 68% and now exceed USD \$30 trillion.⁸⁰

2.7 NET ZERO BUILDINGS MUST BE WHOLE LIFE CYCLE COMPLIANT AND TAKE INTO ACCOUNT THE FULL EMBODIED CARBON

EMISSIONS OF A BUILDING IF WE ARE TO MEET THE LONG TERM CARBON DIOXIDE AND NET ZERO EMISSIONS REQUIREMENT TO DELIVER NEAR ZERO EMISSIONS

Embodied carbon from the construction and refurbishment of buildings is responsible for up to 20% of built environment emissions.⁸¹ Thus, addressing this source of emissions is critical for driving down the environmental impact of the industry and meeting climate targets. The UKGBC’s Net Zero Whole Life Carbon Roadmap, shown in Figure 3, sets out the trajectory and policy recommendations needed to drive and enable the transition.⁸²

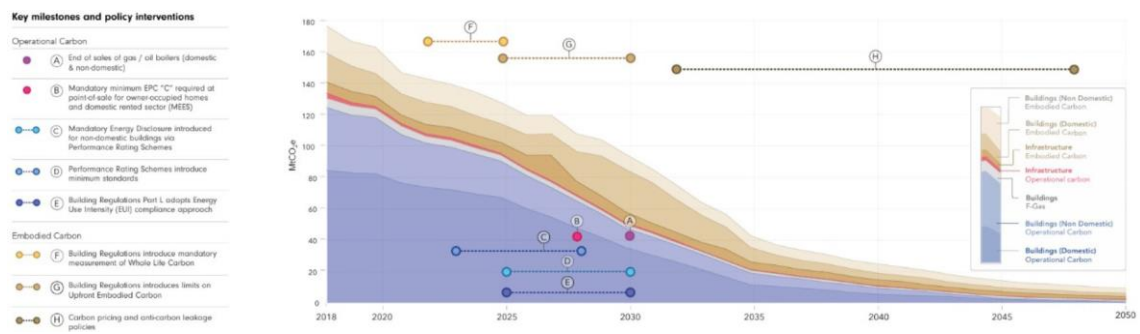


Figure 3. Net Zero Trajectory 2018-2050 (from UKGBC’s Whole Life Carbon Roadmap)

Part Three

CHALLENGES

The 2023 Global Status Report for Buildings and Construction is due to be published imminently (March 2024), and is expected to follow on from its immediate predecessor 2022 report, which concluded that the buildings and construction sector is not on track to achieve decarbonisation by 2050.⁸³ The 2023 Buildings Breakthrough Agenda Report reached the same conclusion.⁸⁴ It is clear a rapid scale up of action and innovation is required. Challenges lie in the large number of actors involved across a building's value chain, and the differences in typologies such as commercial, public and residential buildings. This section explores the challenges faced in the UK, followed by the wider buildings industry globally.

3.1 UK CHALLENGES

In the UK, 3 million houses are to be built by 2033 if the government meets its target to build 300,000 houses per year. When also considering new non-residential buildings which are set to be constructed, there is a monumental challenge in creating a building stock with near zero, eventually net zero, emissions across its lifecycle which doesn't require refurbishment in the long-term. The approach must also be mindful of the Earth's finite resources. It will require the correct mix of standards, regulations, skills, and a strong and resilient supply chain.

3.1.1 ARE THE STANDARDS PROPOSED FIT FOR A NET ZERO FUTURE?

All new buildings in England are expected to be ready for net zero from 2025, through the FHS. In 2025, compliance with the FHS will be mandatory, with the aim that new homes built from 2025 will produce 75-80% less carbon emissions than homes built under current regulations, although one must be mindful of the methodology behind these emissions reductions calculations. These standards are currently going through a consultation,⁸⁵ however the wait for them to be

fully implemented will mean that hundreds of thousands of buildings⁸⁶ are continuing to be built with gas boilers, this means that eventually they will need to be retrofitted. For homes, the retrofit cost to the householder of circa £8,000 is approximately double the cost to the developer, when the cost of the gas boiler and gas infrastructure is discounted, if the standard is met when the property was first built.⁸⁷

In addition, there are serious concerns that the FHS, as the framework currently stands, is not fit for a future net zero purpose.

UKGBC developed five key tests to gauge the appropriateness of the FHS.⁸⁸

1. Energy performance levels that won't require retrofitting
2. A move away from the 'notional' building to regulations based on absolute performance
3. Responsive homes that enable a net zero electricity grid
4. Regulation that drives the measurement and mitigation of embodied carbon
5. New homes designed for our changing climate

Furthermore, with the kaleidoscope of different technologies that can be utilised in zero-emission buildings, a challenge lies in ensuring the FHS sets sufficient technical specifications which ensure the implementation of high standard, but allows flexibility amongst chosen technologies.

Reflecting on the UKGBC five tests and wider issues across the sector, the Good Homes Alliance, BioRegional, UKGBC and a range of other partners have concluded that whilst there are welcome aspects of the FHS, such as the end of fossil fuel heating and the integrated on-site renewables for new homes, it is not a definitive Standard, but rather a mere step towards it. Further, as noted by CIBSE, a change in the reliance on notional buildings is needed, as it does not set clear and trackable targets, and does not sufficiently drive the most efficient designs.⁸⁹

A key concern is the potential omission of photovoltaics (PV) and lowering building fabric standards, which could lead to an additional £600-£700 per year on energy bills for residents of new homes compared to the current Part L 2021 and Option 1, respectively. All new homes should have integrated PV as standard to maximise available renewable energy, especially as the cost of installation continues to plummet.

Moreover, the FHS Consultation has begun a process signposting to a detailed consultation in 2024 with a view to implementation of post occupancy performance testing for new homes, albeit voluntary, in 2026. Whilst this is a step in the right direction, a wholly voluntary approach will not provide the necessary protection from homes built to a sub-standard and mandatory post-completion testing on a proportion of homes is required to confirm thermal and heating system performance.⁹⁰

Additionally, the consultation lacks focus on adaptation for an evolving climate and issues surrounding wastewater.⁹¹ **Whilst Government has separately committed to review Part G (water efficiency) of building regulations, and a call for evidence on Part O (overheating) was included in the recent consultation, much greater ambition, and thorough consideration, is required to ensure key adaptation and resilience considerations are addressed on a par with carbon emissions.** If not, we'll be stranded with ever-more homes and commercial buildings unfit for our warming climate.

A failure to act to enhance the resilience of buildings risks substantial financial and economic implications, for both government and businesses. Already in the insurance market in the United States, insurers have responded to the rising risks and liabilities associated with climate change and maladaptation by limiting their appetite and reducing capacity, alongside greater emphasis on related property valuations.⁹² Without

regulatory action in the UK to ensure properties are sufficiently resilient, there is a significant risk of a similar market contraction, stranded, uninsurable assets and the need for further related state-funded regimes, such as FloodRe for flood risk. Given that FloodRe will cease to function in 2038, it is imperative the flood resilience standards, regulations and actions are expedited to ensure its exit from the market does not leave homeowners -present and future - with uninsurable assets.

Currently, whilst building regulations in England cover a variety of safety issues, such as radon, resistance to contaminants and moisture, there are no direct stipulations on flood risk/resilience. Part C of Building Regulations should require all properties at risk of flooding to include property flood resilience measures, prioritising nature-based solutions, specified and installed in accordance with the CIRIA Code of Practice for property flood resilience.⁹³

Additional Measures Needed

Moving forward, standards must start to move innovative and circular materials from the periphery to the centre of the buildings sector. **To ensure buildings constructed using materials such as cross-laminated timber and reused steel are sufficiently insured and certified, Government needs to show these will be crucial in creating a net zero building stock, signalling through their inclusion in future standards consultations and setting targets for the proportion of such materials used in new domestic and non-domestic buildings, based on rigorous discussions with industry and stakeholders. Government can lead through their own procurement processes in relation to the public estate.**

The establishment of an industry-government FHS Implementation Board should be imminent, as recommended by the Future Homes Task Group prior to the consultation,⁹⁴ is important to signal robust implementation and drive ambition.

It must be emphasised that to make near-zero resilient buildings the norm, the mission of the Buildings Breakthrough, continuous innovation will be required at speed. An element of this is robust monitoring and assessment of new buildings that are designed to reduce carbon emissions across its lifecycle. This will inform design that can be reflected into standards as they are updated and strengthened to eradicate high-carbon and inefficient buildings. Further, buildings must be able to be verified to ensure investment frameworks are reliable. Therefore, **the government should add a mandatory timeframe for monitoring the building in order to incentivise a reduction in the performance gap between design and operation and explore the menu of options to encourage continuous improvements, such as tax breaks.**

Commercial Property

To ensure a shift to operational performance metrics, monitoring and assessment, the government must introduce the planned performance-based rating system for large office buildings (>1,000m²) by May 2022, including mandatory energy performance disclosure. This must be followed by introducing minimum standards and fiscal incentives for large office buildings by 2025, including separate minimum standards for new buildings (with suitable transitional arrangements). Fiscal incentives could take the form of penalties or discounts linked to existing or new taxation mechanisms. A performance-based rating system in other non-domestic sectors (and small office buildings) should be introduced by 2025, followed by minimum standards and fiscal incentives for both new and existing buildings. **By 2028, established performance-based rating systems should be rolled out in remaining non-domestic sectors.**⁹⁵

To ensure performance monitoring is reflected and embedded in regulation, the government must revise the National Calculation Methodology (NCM,

as underpinned by SAP) and the EPC methodology to create a fit-for-purpose predictive methodology for energy performance of dwellings that better reflects in-use energy performance. Building regulations should introduce Energy Usage Intensity (EUI) targets inc. regulated and unregulated loads (kWh/m² /yr) and Thermal energy demand limits (kWh/m² /yr).

Interim amendments to Building Regulations Part L should introduce EUI target compliance approach for additional sectors, aligned with mandatory energy performance disclosure dates. From 2027 amendments should include Offices <1,000m², Hotels, Retail, Warehouses, Higher Education. From 2029, amendments should cover remaining sectors. From 2030, Building Regulations should also include peak load limits demand limits (W/m²) for different building typologies.

The Government must also build on the proposed performance-based framework for large commercial and industrial buildings by committing to only occupy buildings above a minimum performance-based rating. This approach has played a very significant role in ensuring the success of the NABERS rating scheme in Australia. From the beginning of the scheme in 2004, New South Wales set their own procurement standard based on NABERS ratings. They did not allow Government tenants to occupy buildings that had a NABERS rating of below three stars. In 2006 the other Australian states implemented a similar approach, and they have pushed that minimum standard up over time.⁹⁶

Appliances and Energy Usage

Measures to limit peak demand and enable load shifting (with limits on peak demand from 2030) will also be essential to ensure the grid can cope with mass electrification. This should include minimum standards for currently unregulated key appliances with high influence on annual & peak demand, i.e. cooker hobs & showers.

Additionally, the consultation lacks focus on adaptation for an evolving climate and issues surrounding wastewater.⁹⁷ **Whilst Government has separately committed to review Part G (water efficiency) of building regulations, and a call for evidence on Part O (overheating) was included in the recent consultation, much greater ambition, and thorough consideration, is required to ensure key adaptation and resilience considerations are addressed on a par with carbon emissions.** If not, we'll be stranded with homes unfit for our warming climate.

Additional Performance Targets

Interim amendments to Building Regulations Part L should introduce EUI target compliance approach for additional sectors, aligned with mandatory energy performance disclosure dates. From 2027 amendments should include Offices <1,000m², Hotels, Retail, Warehouses, Higher Education. From 2029, amendments should cover remaining sectors. From 2030, Building Regulations should also include peak load limits demand limits (W/m²) for different building typologies.

Beyond the Future Homes Standard: Measuring Embodied Carbon and The Net Zero Carbon Homes and Buildings Standard

Besides concerns the draft FHS is not adequate for ensuring the new building stock will be net zero across its lifecycle, it does not cover standards relating to embodied emissions, a crucial element of a building's environmental impact. The C40 Cities Net Zero Carbon Accelerator, which currently has 29 signatories, pledges to enact regulations and/or planning policy to ensure new buildings operate at net zero carbon by 2030 and all buildings by 2050.⁹⁸ This is a step towards making near-zero emission buildings the norm, however commitments for reducing embodied carbon are still neglected.

Just as the SBTi Corporate Net Zero Standard specifies that a company is only considered to have reached net zero when it has achieved its long-term science-based target (typically an absolute emission reduction of at least 90-95% by 2050) and used carbon removals to neutralise any limited emissions that cannot be eliminated, so should buildings that are claiming to be net zero carbon also have to achieve scientifically pre-determined reductions in both operational and embodied carbon that are then neutralised. This is one of the main reasons why leading industry organisations BBP, BRE, the Carbon Trust, CIBSE, IStructE, LETI, RIBA, RICS and UKGBC have joined forces to develop a Net Zero Carbon Buildings Standard. This standard will include the metrics by which net zero carbon performance is evaluated, as well as the performance targets, or limits, that need to be met across different scopes. New homes will be a priority asset type for this standard, with the consultation completed in 2023, the first test set of standards will be ready this year (2024). Cross-party working groups comprising industry and public sector representatives are important in the development of standards and technical specifications is important to ensure methodology and tools are in place and allow time for industry to develop, test and deliver best solution for business, customers and the environment.

As such, **a key recommendation of this report is for the Government to consult on its approach to measuring and reducing embodied carbon in new buildings as soon as possible, and certainly in the first half of 2024, to ensure embodied carbon is incorporated into the Future Homes and Buildings Standard. Further, the government should seek to adopt the a Net Zero Carbon Buildings Standard when completed, accompanied by an assessment process that validates the life cycle embodied carbon in buildings.**

Meanwhile, other leading commercial organisations are seeking to measure and manage their embodied carbon in their own new buildings. Amazon, for example, told the Network that “Embodied carbon is our biggest challenge in reducing emissions associated with buildings, primarily those associated with the concrete and steel used in construction. We are looking to address this through innovating in materials development, along with improving data and reducing materials demand for future builds”:

Amazon uses the Embodied Carbon in Construction Calculator (EC3) tool to track embodied carbon in their building projects, and in 2022, it tracked embodied carbon from more than 400 building projects worldwide through EC3.

They are working with cement suppliers – responsible for 90% of embodied carbon – to help develop lower carbon materials, through testing the mixture to ensure strength and performance standards.

In 2021, Amazon began purchasing steel from electric-arc furnaces, which use scrap steel and can be powered by renewable electricity, and which commonly results in half of the embodied carbon compared to fossil fuel steel production. In addition, Amazon told the network how they believe that better “Standards and guidance will be essential to establish a level playing field for business, and drive a higher bar for progress towards decarbonisation”:

“In 2023 we worked with the Chartered Institution of Building Services Engineers (CIBSE) to develop guidance on how to reduce the embodied carbon of the equipment within Logistics Buildings. This approach helps logistics operators and their supply chains quantify the embodied carbon of their products by appraising the type and quantity of the materials and components making up the

product. In turn, they can decrease carbon by either reducing the amount of materials and/or switching to lower carbon alternatives”. The full case study can be found in Appendix B.

The importance of recognising the need to focus on embodied carbon is rapidly growing. Early in 2024, 11 industry and built environment expert bodies called on all political party leaders to commit to enacting embodied carbon regulation within the first six months of taking office after the next General Election. A whole life carbon perspective is urgently needed across the industry to ensure comprehensive decarbonisation on the path to net zero, and this UK industry expert group is calling for three specific steps:

- 1. Within six months of taking office:** commit to the issue by signing to process below.
- 2. By 2026:** Mandate the measurement and reporting of whole-life carbon emissions for all projects with a gross internal area of more than 1000m² or that create more than 10 dwellings.
- 3. By 2028:** Introduce legal limits on the upfront embodied carbon emissions of such projects, with a view to future revision and tightening as required.

The promised review of the NPPF, to better incorporate climate concerns, should include proposals to consult on introducing mandatory whole life carbon assessment through planning, following the approach of the London Plan. This approach would have cross-industry support, as evidenced in the recent consultation proposing carbon assessment in the context of the Levelling Up and Regeneration Bill.⁹⁹

Further key actions the government should take include updating the Government Buying Standard for new-build construction and major refurbishments, which has not been updated since 2011, to include up to date net zero and whole life carbon targets.

This should be accompanied by extending the Public Sector Decarbonisation Scheme – beyond 2025 – to set out a longer-term programme for supporting public sector investment into carbon saving measures to at least 2030. A Public Sector NZ Board should be created to share best practice and ensure key requirements are met.

Ultimately, new and more rigorous standards must address every aspect of a building's lifecycle to reach the government's climate targets. Whilst initiatives such as UKGBC's Net Zero Carbon Buildings Framework specifies clearly which scopes of carbon should be included in net zero carbon building claims,¹⁰⁰ it does not yet provide scientifically derived targets in line with sector-level 1.5°C compatible pathways by 2050. Doing this requires a sectoral approach to setting both operational energy and embodied carbon targets for different asset types, defining the acceptable levels of 'residual emissions' for new construction and existing buildings which would ultimately need to be removed or neutralised.

3.1.2 DESIGN FOR THE FUTURE

Good design will be essential for delivering better, low emission, low carbon net zero homes. The Network recognised this as being of key importance. Design not only allows for better efficiencies, lower emissions and a lower embodied carbon solutions to be found, it can also when adopted at scale produce efficiencies of scale and deliver lower costs.

For example, the Network heard from ISG how an initial standardised design for educational buildings has been continuously improved through monitoring and assessment to reach net zero in operation, with a focus now on embodied carbon. The template cuts design and procurement costs, whilst creating demand for a local supply network for clean technologies and sustainable construction materials.

The Vale of Glamorgan Council declared a 'climate emergency' on 29th July 2019, subsequently committing to reducing carbon emissions to net-zero by 2030. The Vale's 21st Century Schools Programme aimed to adopt a standardised approach to delivering new primary school buildings. ISG was then appointed to adapt this framework to achieve the net-zero target across three primary schools following the philosophy of 'evolution vs revolution' through optimising a highly regarded existing template school design standard and delivering a solution that is practical, buildable and affordable. The low-carbon, all electric, operational model was then developed for St David's CIW Primary School through improved building fabric and installing PV panels, as well as maximising natural day lighting and fresh air provision through internal design. Lessons from this model were used to



develop the net-zero carbon in-use model at South Point Primary School, again improving the building envelope and adding an air source heat pump (ASHP) and battery storage. Various low-carbon heating options were analysed from a cost perspective before deciding on the combination of ASHPs and PVs on the roof. To further build on this model for a net zero (operational) and low embodied carbon school the embodied carbon of materials was investigated through four materials scenarios, including factors such as local availability, durability and end-of-life disposability.

Wider adoption of this template design model requires enhanced visibility and confidence in this delivery approach, alongside cultural change around greater collaboration and standardisation that helps fast-track pre-construction activities and eliminate wasteful practices. Public engagement and support is also key, which is why South Point Primary School uses its building as a direct teaching aid to educate pupils about climate change and the role their school is playing in creating a positive planet legacy.

Finally, ISG's real-time post-occupancy data on in-use energy consumption and building performance provides validation for the building design specification and the evidential basis for future investment decisions through more accurate whole life cost analysis. This data is also the benchmark for iterative improvement of the school template and enables like for like quantitative analysis on the introduction of new components, products and materials. This is a crucial element for optimising operational performance and reducing energy consumption from the education estate.

Yet there are a number of barriers that remain both in design codes, guidance and in the planning process that are limiting the ability to deliver better design a scale. **The Government should conduct a review the planning system**

to address any key barriers to relevant technologies and innovations. It must update the NPPF to ensure it actively supports key technologies and design interventions. This should include clear guidance to address arbitrary barriers to key technologies, such as character constraints on rooftop solar, and presumptions in favour of key, low/no regret interventions, similar to current wording on street trees. For example, external wooden shutters to combat overheating.

The Government must ensure guidance is provided to ensure Local Design Codes, currently being produced by Local Public Authorities, encourage sustainable design, with clear stipulations on relevant interventions and design approaches in line with the recommendations & template provided by RTP/RSPP's 'Cracking the Code' guidance on sustainable design codes.

The Government should consider the recommendations and conclusions of the Housing Audit 2020 report, in order to support the delivery of good, sustainable design, particularly, the importance of ensuring a direct connection between specific sites, land allocations and sustainable design codes, similar to RTP's idea for 'Sustainable Development Commitments' linked to sites allocated in the local plan.

As per the Mission Zero 'The Future is Local' report, a 'net zero test' in planning, actioned through a consistent methodology for handling carbon in the development management, decision making and plan making processes, will be essential in ensuring sustainable design is systematically encouraged through planning.¹⁰¹

In addition to establishing a better regulatory and planning framework that can support better future design, there is a need to ensure that new principles of low carbon, low emissions homes are enshrined in the future development and design of homes from the

outset. Balancing the needs and comfort of the customer at the same time as meeting net zero commitments will be key, however this can be achieved through the effective deployment of design for manufacture and assembly (DfMA) and MMC the research and development for which needs greater support. Examples such as Barratt Developments' Zed House are an important demonstration of what can be achieved.



The Zed House is “a unique zero carbon concept home that showcases the future of the sustainable living in the UK” built on the University of Salford’s main campus by Barratt Developments, supported by government funding, in partnership with over 40 leading organisations across the supply chain, including those from sustainability and technology sectors. The coordination of

suppliers and subcontractors requires a large amount of structure surrounding process and implementation, carefully managed through a transition. It is the first home built by a major housebuilder that by far exceeds the Future Homes Standard, reducing carbon emissions by 125%, as well as being highly water efficient.

It adopts DfMA, a methodology that aims to reduce time time-to-market and total production costs, by prioritising ease of manufacture and simplified assembly into the final product during early design phases.^b Additionally, Advanced MMC, which utilises off-site construction to produce components such as panel timber frames with highly insulated cladding, halves the time needed to construct the house.

It is also fitted with a smart heating system coupled with renewable technologies. Cutting edge technologies featured include:

- Overhead infrared panels that can provide instant zero carbon heat
- Air-powered and smart showers will save families hundreds of pounds per year in water and heating bills
- Plaster which eliminates pollutants giving cleaner, healthier air
- Appliances which reduce food wastage and water consumption
- Heated skirting boards delivering 10% more heat than traditional radiators while also saving space
- Artificial intelligence (AI) which optimise when devices consume electricity, ensuring customers maximise use of either free solar energy or low-cost electricity from the grid
- The first car on the market which has Vehicle to Grid technology, meaning electricity can be fed back into the grid
- It will measure how people use the house in the real-world, helping make sure that all new zero carbon homes in the future are easy to use for customers

Zed House is also intended to measure the impacts and identify the challenges of integrating multiple new technologies in one house. A key aspect of the homes of the future is that they must be occupant-friendly and accessible. Barratt Developments primarily sells homes to first-time buyers, therefore affordability is a core consideration. This creates a positive feedback loop whereby increased demand of zero-carbon houses expands the supply chains responsible for innovative technologies and systems and reach economies of scale, thus driving down the cost of development and construction. Two researchers from the University of Salford and large amounts of sensor data will collect information used to inform design and future technology decisions for zero carbon homes, in order to ensure a smooth living experience.

Further, according to a recent inquiry by the Built Environment Committee, there is evidence of real barriers to MMC, including insufficient clarity for building regulations. However, the Government appears to have made limited effort to understand and address these challenges. **This should be addressed moving forward, with a response to the inquiry on modern methods of construction required as soon as possible.**¹⁰²

The Government should make clear its support for MMC and DfMA, which are shown to provide clear benefits for the industry that will increase with the maturity of the market. Through continued funding, for example extending the transforming construction challenge, which was funded under the UKRI Challenge Fund, and clear objectives from the government, these techniques can be integrated into the design of new buildings on a wider scale.

3.1.3 FINANCING AND AFFORDABILITY

Strong financial frameworks to support the deployment of more sustainable and low

carbon buildings is also essential to secure buildings for the future. Above all, creating a better understanding of who will be paying for new zero carbon buildings will be important. It necessitates a set of strategies tailored to various forms of ownership, striking an equilibrium between cost considerations, potential advantages, and financial motivations. Green finance for buyers will stimulate and tap into consumer interest by incorporating energy efficiency into affordability assessments during the decision-making process.

Currently, low or net zero carbon buildings can be more expensive to construct and fit out than standard buildings.¹⁰³ This is largely due to the fact that supply chains for innovative construction materials and low-carbon technologies are still in their introductory and growth stages and thus can have initially higher upfront costs, despite presenting savings in the long run.^{104, 105}

Although housing developers may be able to offset these costs with the higher rental value, this could affect the availability of sustainable affordable housing. Additionally, for public and commercial buildings, inflated construction costs may deter willingness to secure a net zero building stock. However, In UKGBC analysis of the effect on cost across commercial office design scenarios found the cost uplift for the intermediate scenario was 6.2% compared to the baseline.¹⁰⁶ This cost uplift can be considered feasible today given these costs will likely be offset by the value benefits, including increased rental premiums, lower tenancy void periods, lower offsetting costs, and lower operating/lifecycle costs. The wide value case for such design is significant when considering current market trends, such as investor pressure through the Task Force on Climate-related Financial Disclosure (TCFD), stranded asset risks, corporate ESG drivers, and increasing occupier interest in net zero. The report highlights the need for a long-term consistent regulatory trajectory that tightens standards over time, so

as to provide the certainty and level playing field required for the supply chain to innovate and costs to come down.

It must be noted that several Government studies have not found higher standards to be a reason for constraint on housing supply, and as the capability of the sector grows evidence indicates the costs of deployment will fall dramatically.^{107,108} The FHS impact assessment estimates a reduction in costs of 60% for solar PV and 70% for heat pumps over ten years.¹⁰⁹ It is also worth noting the sector has demonstrated an ability to ensure additional future costs are factored into land valuations, negating any meaningful impact on their net cost position.¹¹⁰

UKGBC's report Building the case for Net Zero: Closing the gap towards net Zero Carbon new-build homes examines the design and cost implications of significantly reducing carbon across new homes on a low-rise 750-home residential development.¹¹¹ The study found that both intermediate and stretch targets for both operational and embodied carbon can be achieved on new-build residential

schemes today. In other words, the substantial decarbonisation of this type of new-build home is very much within reach using technical design solutions available in today's marketplace shown in Figure 4.

In terms of the financial feasibility, the case study research found that the intermediate targets could be achieved today with a capital cost uplift estimated to be around 8%. The most significant contributing design factors were the significant upgrades to building fabric and additional building services to deliver ultra-low levels of energy performance, which are considered relatively expensive in today's market. When considering any such capital cost increases, it is worth reflecting on historic trends. In the period between 2009 and 2015, the additional capital costs of delivering new homes that met the Code for Sustainable Homes level 4 had almost halved – principally due to clarity and consistency on medium-term policy direction, allowing the supply chain to confidently invest in the changes required to meet such standards and thereby dramatically reduce the capital cost of doing so over time.¹¹²

Figure 4. Energy and embodied carbon performance targets for new-build home

		Business as usual	Net zero carbon	
			Interim	Absolute
Operational energy	Regulated operational energy emissions	31% carbon reduction (Part L, 2021)	75-80% carbon reduction (Future Homes Standard, 2025)	100% carbon reduction (speculative target)
	Regulated and unregulated operational energy emissions ¹	120 kWh/m ² /year	60 kWh/m ² /year	35 kWh/m ² /year
Embodied carbon	Upfront carbon emissions (construction only, module A) ²	800 kgCO ₂ e/m ²	500 kgCO ₂ e/m ²	300 kgCO ₂ e/m ²
	Embodied carbon emissions (whole life, modules A-C, excl B5 & B6) ³	1200 kgCO ₂ e/m ²	800 kgCO ₂ e/m ²	625 kgCO ₂ e/m ²

The fact that the technical solutions already today suggests that, with some additional policy incentives, the overall cost of delivering these should reduce as mass scale up of adoption is achieved. The overarching conclusion was that any aspiration to deliver credible net zero carbon new-build homes at scale is reliant upon specific and targeted policy interventions to help stimulate the market for low carbon technologies, products, materials and construction practices. For example, setting thermal energy demand limits will drive improvements in building fabric, leading to increased demand and lowering of costs for high-performing insulation.

There are some important pioneering approaches to financing of more sustainable homes that the Network has investigated. Some of these approaches have already been published in the Mission Retrofit report (September 2023), and include the opportunity for energy saving stamp duty, and the support for green mortgages, combined with further taxation incentives from the government.

In addition, the Network heard from Lloyds Banking Group how they have made a commitment to financing sustainable buildings.

For example, the largest housing association in Wales, Pobl Group (“Pobl” is Welsh for “people”), is developing 10,000 new sustainable homes across South Wales over the next ten years. In 2023, Lloyds Bank supported Pobl Group with a sustainability-linked loan of £100mn. Pobl’s goal is to increase the energy efficiency of 95% of the new homes developed over the next four years with a target to have an Energy Performance Certificate (EPC) rating B or above, while delivering close to 1,000 homes which meet EPC A standards.

The sustainability linked loan from Lloyds Bank incentivises Pobl Group to meet its targets on energy ratings for new homes, invest in retrofitting its existing properties, and help to

achieve Pobl’s ambitions for 10,000 new green homes across South Wales in a decade.

As parts of its efforts, Pobl is undertaking the UK’s largest solar energy retrofit scheme – equipping hundreds of homes with solar panels, battery storage and zero carbon energy from renewable sources.

Across the UK, residential housing accounts for 16% of carbon emissions, which is why the leadership of Housing Associations such as Pobl is so critical to Lloyds Net Zero targets. In addition, in 2023 Stonewater, a social housing provider that owns and manages nearly 40,000 homes for more than 78,000 customers, predominantly across central and the south of England secured £200m funding from the Group to support its continued development and improvement programme.

The social housing provider also took the opportunity to transition to a sustainability-linked loan where it will be measured against three KPIs to benefit from savings on its funding. It has committed to investing in retrofitting existing homes to exceed the current minimum regulations. As part of the new agreement, Stonewater has also pledged to deliver new affordable homes that surpass minimum planning regulations in relation to energy efficiency measures, with a high percentage reaching SAP 86 and above.

Anne Costain, Stonewater’s Chief Financial Officer, said: “This is an important agreement for Stonewater as it continues the progress we are making towards more affordable, lower-carbon homes for our customers. It is also a clear demonstration of the financial strength of our organisation, which allows us to focus on existing customers, while delivering much-needed affordable homes for others in society.”

Another example is the £270mn green debt facility secured by Legal & General Investment

Management for its Wandsworth Build to Rent platform. The funding is aligned to the Loan Market Association's Green Loan Principles and one of the largest sustainable finance facilities in the housing sector to date. Eligibility under these principles specify that loan proceeds are to be used to finance green buildings which meet regional, national or internationally recognised standards or certifications for sustainability. The former B&Q and Homebase sites are one of Legal & General's five BTR schemes in London and mark LGIM's largest residential development to date. The scheme will deliver more than 1,000 homes, 35% of which will be affordable, and over 60,000ft² of commercial space.¹¹³

The Government should consider a programme of funding to encourage the use of clean energy for heating and cooling in buildings. A leading example is the Powering Affordable Clean Energy (PACE) program in the US, implemented as part of the Inflation Reduction Act to makes it more affordable for rural areas.¹¹⁴

Examples such as these highlight the opportunity for greater conditionality and sustainability linked loans and investments, to leverage finance in order to deliver on specific decarbonisation and emissions reduction targets.

Additional measures needed

A range of financial incentives and policies would be recommended to help smooth the initial cost differentials and incentivise mass markets/ technology deployment: including green mortgages and an energy performance linked stamp duty rebate. For example, the proposed Energy-adjusted Stamp Duty Land Tax (SDLT),¹¹⁵ this would act as a long-term driver of consumer demand and would also allow grant funding to be focused where it is most needed. **An energy adjustment of the SDLT calculation could catalyse and**

drive the market to deliver both energy efficiency improvements and low carbon heat and power. It would also be revenue neutral to HM Treasury.

Grants could then be focused on early and ambitious adopters, supporting lower income households, accelerating scale-up and driving down costs, with financial products used to help those that are asset-rich yet cash-limited – against a backdrop of clearly communicated regulatory requirements on the horizon and driving towards market-led home decarbonisation at the scale and pace required. Adjusting the SDLT both down and up when a home is purchased to reflect the energy and carbon performance stimulates the market and encourages householders to act. New home builders that want to benefit from the Home Energy SDLT Adjustment would be required to register with a certified building performance body (to be established) to undertake as-built performance monitoring on 5% of their homes annually and publish the results in a prominent place.

For the pensions/insurance sector, Solvency UK will be a critical regime to ensure long-term financial institutions can invest with confidence.¹¹⁶ This means that the government should, where necessary, give investors confidence and regulatory certainty by setting out in, or alongside, legislation the key outcomes it intends to deliver through the reforms, to act as guardrails to the various industry regulators in implementing the changes. This includes:

- i. Codifying in legislation the purpose of the Matching Adjustment as a valuation tool to help prevent pro-cyclical investment behaviour and hence support long-term, illiquid investment.
- ii. The investments that the reforms are intending to facilitate, e.g. infrastructure, etc. as well as the level of investment the government would ideally like to target.

3.1.4 RESOURCING THE SUPPLY CHAIN

The CCC have stated that ‘there is a major skills gap for low-carbon heat and energy’ with an urgent need for the government ‘to develop further plans to ensure that the supply of labour does not constrain supply chain growth’.¹¹⁷ Its Net Zero Workforce report identified several challenges for the labour market transition for the construction industry:¹¹⁸

- There was been a decline of around 184,000 in workers in the construction industry between 2019 and 2020, driven by a combination of the COVID-19 pandemic and EU exit. Attracting new workers and upskilling and retraining existing workers at the pace required, particularly at present under such a tight labour market, could pose a challenge.
- Ongoing uncertainty about future demand for skills reduces the incentives for workers to upskill or retrain. This is compounded by strong demand for existing skills and the nature of most construction firms being SMEs, often with one or very few employees.
- Training or retraining impose financial costs on both workers and firms, both in terms of the upfront fees for instruction, as well as

lost earnings from work not done while in training. These costs compound the issue of uncertainty about future demand.

- The relative lack of certain capabilities (such as heat pump engineers) is limiting the growth of UK-wide supply chains for decarbonised heat. This in turn limits the investment by manufacturers and others which could help drive up demand.

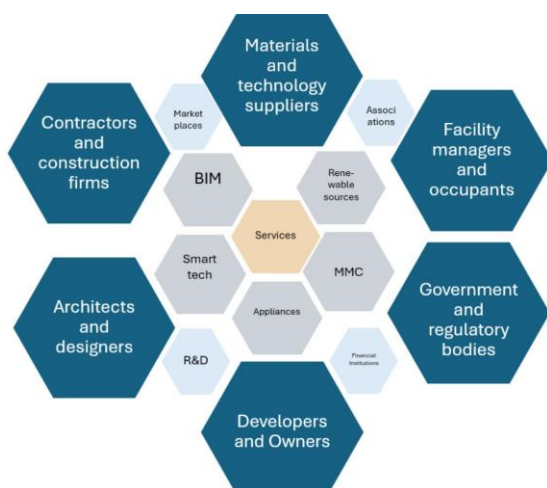
The delivery of net zero buildings will necessitate engaging and supporting all stakeholders, paying special attention to SMEs, and the public, developing the skills of the existing workforce and large-scale training across the value chain and creating a viable and resilient supply chain. Viewing the supply chain as an ecosystem - rather than linearly - allows for a holistic overview of how each element supports one another and creates synergies, Figure 5 lays out the stakeholders, enablers and technologies within the system.

Additional measures needed

The Government should carry out a skills gap analysis on the buildings and construction industry and work with industry actors to identify where apprenticeships and training courses can be enhanced, especially in terms of data tools and analysis.

There is an issue of coordination across the supply chain. Qualified electricians are indispensable to the take up, integration and maintenance of low carbon technologies. Demand for electrical training courses is high amongst school leavers, meaning courses are oversubscribed. Education providers cannot recruit enough qualified teachers to deliver the curriculum in net zero technologies to fulfil demand. In addition, progression rates from short courses to apprenticeships are less than 10% due to inefficiencies in the system and inadequate ties between education and industry. Government, industry and education providers must work together to maximise

Figure 5. Green Buildings Ecosystem



apprenticeship numbers. According to the ECA, we need 12,000 new electrical apprentices each year to install, maintain and integrate low carbon technologies to reach the UK's net zero electrification targets. Classroom based or short courses do not deliver qualified electricians able to ensure a safe and reliable transition to new technologies. The demand from learners is high, but the current publicly funded training routes do not deliver industry approved qualifications.¹¹⁹

The UK Government should produce a national 'Net Zero Skills Strategy', similar to the Welsh Net Zero Skills Action plan,¹²⁰ proposals and timelines for boosting skills in the relevant areas.

The Construction Leadership Council (CLC) National Retrofit Strategy (NRS) sets out a pathway for how this can be achieved, with initial focus on capacity building, supply chain readiness, skills and training, building toward an accelerated deployment of fabric energy efficiency improvements and heat pump installations from the late 2020s to the mid-2030s.¹²¹ There should be high profile promotion throughout the country with communications programme to inspire and recruit, targeting school leavers, those reskilling for career change in declining sectors and existing construction workers in need of upskilling.

A substantive plan for skills should include long-term funding arrangements and commitments, alongside devolution deal and settlements, such as those in Greater Manchester and the West Midlands, to allow local organisations to invest in relevant skills. Apprenticeship and training standards should be updated to align with the required skills delivery programme, optimising digital skills.

3.1.5 MATERIALS FOR THE FUTURE

Innovation and the scale up of the use of low-carbon materials is crucial for reaching net zero targets. The contribution from the private

sector is exemplified by Amazon by switching to renewable technologies whilst also investing in the innovation of core construction materials.

“Amazon is investing in lower-carbon concrete and steel technologies globally through the Climate Pledge Fund, a \$2 billion program supporting the development of sustainable technologies and services. The company has also invested in Brimstone, a start-up developing the first carbon negative process for cement manufacturing, which uses carbon-free calcium silicate rock, and Electra, which produces iron at lower temperatures using low-grade iron ores and renewable energy.”

As buildings and homes seek to become more sustainable, there have been increased calls for an escalation in the use of timber. The CCC have recommended that the use of timber in construction increase to 40% by 2050.¹²² The recent Building to Net Zero report by the Environmental Audit Committee has also concluded that “the use of timber (subject to forestry management) in place of concrete, masonry and steel was one of the most successful strategies to reduce embodied carbon.”¹²³

There are serious gaps however in the UK's capacity to build sustainable timber supply chains. In 2020, the UK imported 80% of its timber, making it the second largest net importer of forest products. The World Bank has estimated that global timber demand will quadruple by 2050, placing pressure on the UK to ensure it can support sustainable timber production that has not been sourced from deforested land or land illegally occupied. This has now been legislated for in the Environment Act, with provisions to make it illegal for large businesses in the UK to use forest risk commodities produced on illegally occupied or used land, yet the government has still to develop a roadmap recommended by the CCC to set out clearly policies to support sustainable wood supply chains. Moreover, there remains

an insurance liability issue around multi-storey timber frame structures. Unless there is a cultural shift in the insurance sector – greater adoption of timber and non-traditional materials will be impacted.¹²⁴

The Government must consult on its current Procurement Act and revise it to create demand for sustainable building materials, thus growing local supply chains in a managed fashion and fostering an ecosystem for green buildings.

When considering the use of timber as a sustainable construction material, the Government must ensure it has a plan in place to mitigate deforestation. The milestones and commitments set out in the Timber in Construction Roadmap must be adhered to to avoid construction staying locked in to traditional methods. These include:¹²⁵

- working with industry and academia to expand and improve the evidence base for timber and embodied carbon by 2025
- work together to assess options and explore opportunities for scaling innovations in housing construction using English timber by 2025
- conduct research to quantify additional workforce requirements for a range of scenarios of increased use of timber in construction by December 2024
- deliver against the statutory woodland cover target to increase the available domestic timber supply, invest in accelerated research, development and manufacturing of long-term products
- work together to facilitate greater dialogue between the insurance sector and developers to foster collaboration during and post construction by 2028
- publish a new universally recognised Publicly Available Specification (PAS) standard (created by the BSI), for homes built using MMC

Furthermore, steel forms a dominant part of the materials used to construct industrial and non-residential buildings in the UK. 95% of all single storey industrial buildings and 65% of multi-storey non-residential buildings use steel for their framing.¹²⁶ 94% of steel is recycled when a building is demolished, yet there is a greater opportunity for domestic scrap to be used within the domestic supply chain. The UK currently produces around 11.3 million tonnes of scrap steel a year, yet only 2.6 million tonnes is used in domestic steel making, with the rest exported, as the UK does not currently have the electric arc furnace capacity to make use of the scrap.¹²⁷

Yet scrap steel production is projected to increase to around 20 million tonnes within the next decade, while the UK's current demand for steel is expected to stabilise around between 10-12 million tonnes per annum. If the UK were to electrify all steel recycling processes at the same time as delivering a net zero grid from renewable and clean power, it would be possible for 70% of its future steel demand to come from domestically recycled steel.¹²⁸

The opportunity for the reuse of steel components, using standardised parts and common design structures that can be dismantled or repurposed is not widely adopted in the UK. The principal barrier to deploying reused steel is the collection, storage, testing and certification of steel components, vital if a building warranty is to be protected. Reuse of structural steel not only saves significantly on emissions, but on costs too. The Net Zero Review stated that “the reuse of structural steel could see a 95% carbon saving kilogram for kilogram, with a cost saving of between 10-40%.”¹²⁹

The example of Grosvenor's redevelopment of Holbein Gardens (see Lesson in Section 4) demonstrates how reclaimed steel can be used in a large development project and how Grosvenor has met and addressed problems of collection, storage, testing and certification of steel components, which vital if a building

warranty is to be protected. Landsec have also showcased the use of cross-laminated timber and reused steel in a large-scale commercial development (see Lesson in Section 4). The Examples such as this must be scaled up to achieve large-scale carbon savings. **The Government can further support expanding the market through integrating procurement of reclaimed steel for use in the construction of new public buildings.**

3.2 CHALLENGES FOR THE BUILDINGS BREAKTHROUGH

While the previous section focused on the UK challenges to delivering future net zero buildings, this next section now focuses on the wider global challenges, many of which are

similar to the UK, yet there is an opportunity to learn the lessons from the UK’s experience, and apply them across a wider global context, particularly if the Buildings Breakthrough wishes to accelerate success and advance deployment of low carbon buildings.

The 2023 Breakthrough Agenda report states “The buildings sector is not on track for net zero by mid-century, with emissions growing at an average of 1% per year since 2015. Global growth in floor area is more than offsetting the increased efficiency and decarbonisation efforts, where the long lifespan of buildings risks “locking in” vulnerable and high emission infrastructure. A major shift is required to decarbonise the sector while also ensuring it delivers resilience for communities.”¹³⁰

Figure 6. Barriers to Green Buildings: Globally and by Region



By demonstrating a strengthening value proposition for a sustainable built environment, WorldGBC and its local network hopes to address some of these barriers, such as the perception of higher costs and the types of projects it relates to.

This report is clear in its recommendation that the real estate and built environment sector cannot afford not to invest in a sustainable built environment, and commit to urgent action to tackle the climate crisis. Social value is on an increasing trajectory of importance that will soon be reflected in financial metrics.

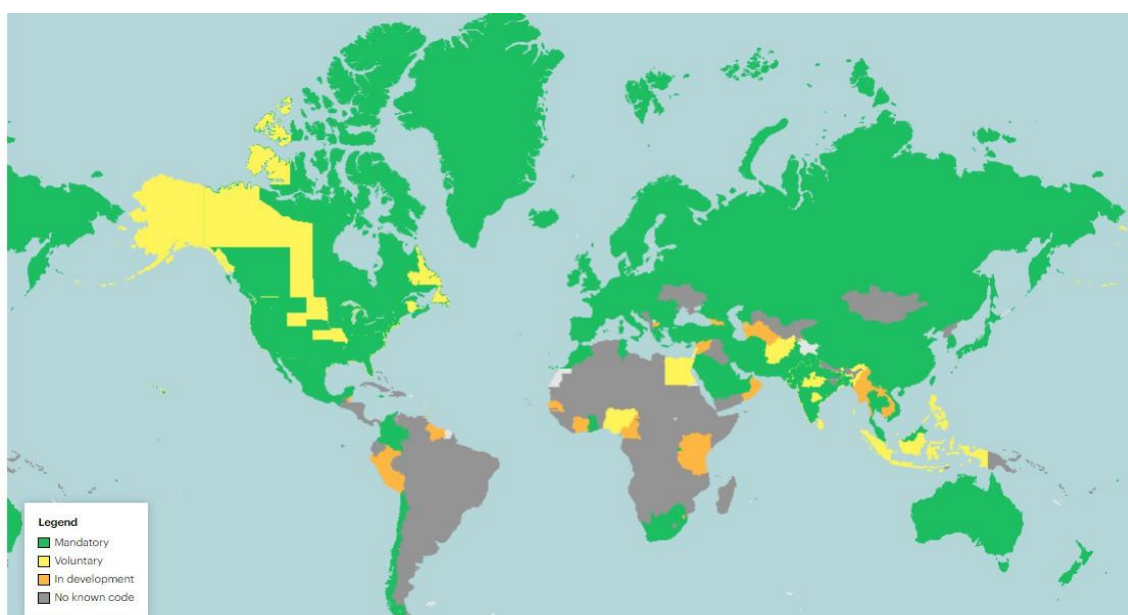
The financial drivers are improving and it’s also the right thing to do. Considering social and environmental value considerations strengthens the business case, making sustainable built assets a powerful financial opportunity. Because in this changing world, you can’t afford not to act.

The total buildings sector floor area is set to continue increasing, with around 80% of growth between now and 2030 set to take place in emerging and developing economies. According to the IEA, currently less than 5% of new buildings are net zero, this needs to increase to 100% by 2030 if net zero is to be achieved by 2050.¹³¹ 28 countries currently endorse the Buildings Breakthrough, however this number needs to expand to reach the required emissions reductions. Factors prohibiting the uptake of commitments to green buildings must be addressed first. Three of the five largest obstacles to sustainable buildings relate to finance. Figure 6 reveals the barriers to green building globally and by region.¹³² Green building practices in European Bank for Regional Development (EBRD) countries are at present below Paris Agreement targets. Currently, efforts are not cost-optimal due to capacity and supply chain limitations, as well as regulatory and policy constraints.^{133, 134}

3.2.1 IMPLEMENTATION OF STANDARDS AND CERTIFICATIONS

A priority for the Buildings Breakthrough will be the harmonisation of definitions on net zero and resilient buildings and whole-life carbon assessments, this will inform the development of a transparent framework of standards and certifications. There are a growing number of sustainable building certifications, many developed and administered by Green Building Councils.¹³⁶ Currently, only 35 per cent of countries have mandatory building energy regulations or codes for some or all building types that regulate how energy efficient a building needs to be when constructed,¹³⁷ shown in Figure 7, and more than two thirds of buildings constructed between 2020 and 2050 are expected to be built in countries without energy codes.¹³⁸ Principal barriers to preventing the sector from reducing emissions include a lack of established standards, tools, databases, and guidance. According to the RICS 2022 Sustainability Report, around 72% of respondents globally from the construction sector stated they make no measurement of operational carbon across project lifecycles and around half reported that they do not measure embodied carbon on their projects.¹³⁹

Figure 7. Building energy codes by jurisdiction 2019-2020¹³⁵



The Science Based Targets Initiative (SBTi) Buildings Project was launched to provide a route for the buildings sector to align their climate mitigation plans with the most up to date science. It addresses the problem that whilst green buildings standards are proliferating, they are not currently aligned with the requirements for a 1.5°C trajectory. Therefore, the Project aims to develop a 1.5°C-aligned pathway for the global building sector's in-use emissions, a pathway for the sector's embodied emissions and to develop guidance for emissions accounting, reporting and target setting for various sector stakeholders. However, the SBTi notes that solely focusing on emissions could result in buildings being hailed net-zero even though it is highly energy inefficient. Energy demand should be reduced before addressing the residual demand with renewable energy. This also acknowledges the current limitations to renewable energy supply. Further, the performance gap between calculated energy use and use in reality can be as high as a factor of four. As such, the SBTi emphasises the need for frameworks for measurement, reporting and verification of progress against science-based targets.¹⁴⁰

3.2.2 SKILLS AND DATA

The RICS Sustainability Report survey also found that gaps in knowledge and skill shortages across the sector was also noted to be a pressing issue.¹⁴¹ Skills and expertise will need to evolve and develop in the design, delivery and monitoring of buildings to ensure the embodied carbon is minimised through the sourcing of materials and energy demand and use is reduced through smart design and low-carbon technologies. This will require understanding and use of life cycle assessment (LCA) methods and software, requiring accurate and trusted data on materials and processes, as well

as skills in building information modelling (BIM). However, more nuanced data may be required to provide a more accurate picture of the whole-life carbon emissions of a building, as energy performance is determined by building characteristics, occupant behaviour, climate and location. Further, environmental product declarations (EPDs) are used to measure the whole-life carbon of a building, although they are currently utilised, their quality and reliability needs to be addressed and improved in order to increase useability.

The Buildings Performance Institute Europe (BPIE) identified gaps in adoption and useability of the EN 15804+A2 standard which describes the general Product Category Rules, used by the European Construction sector. Weaknesses include varying assumptions due to vague rules and scenarios and poor-quality data selectively and/or inappropriately used. A harmonised approach to the practical application of the standard is still lacking. Concerns are summarised in Figure 8.¹⁴²

The UNEP 2022 Global Status Report on Buildings and Construction stated “due to the complexity of supply chains for building materials and systems, emerging computational tools and data visualisation frameworks are key to enabling decision makers to compare the pros and cons of different materials in terms of their embodied, operational and end-of-life climate impact.”¹⁴³ For example, creating a subset of representative buildings, known as building archetypes, allows for modelling on a large scale and benchmarking performance. However, it creates a risk of oversimplification and therefore uncertainty in the results. Figure 9 outlines the process for Urban Building Energy Modelling,¹⁴⁴ providing the relevant skills and training will be a large task for the industry to engender a good understanding of such processes, including their benefits and drawbacks.

Figure 8. Concerns with current EPDs

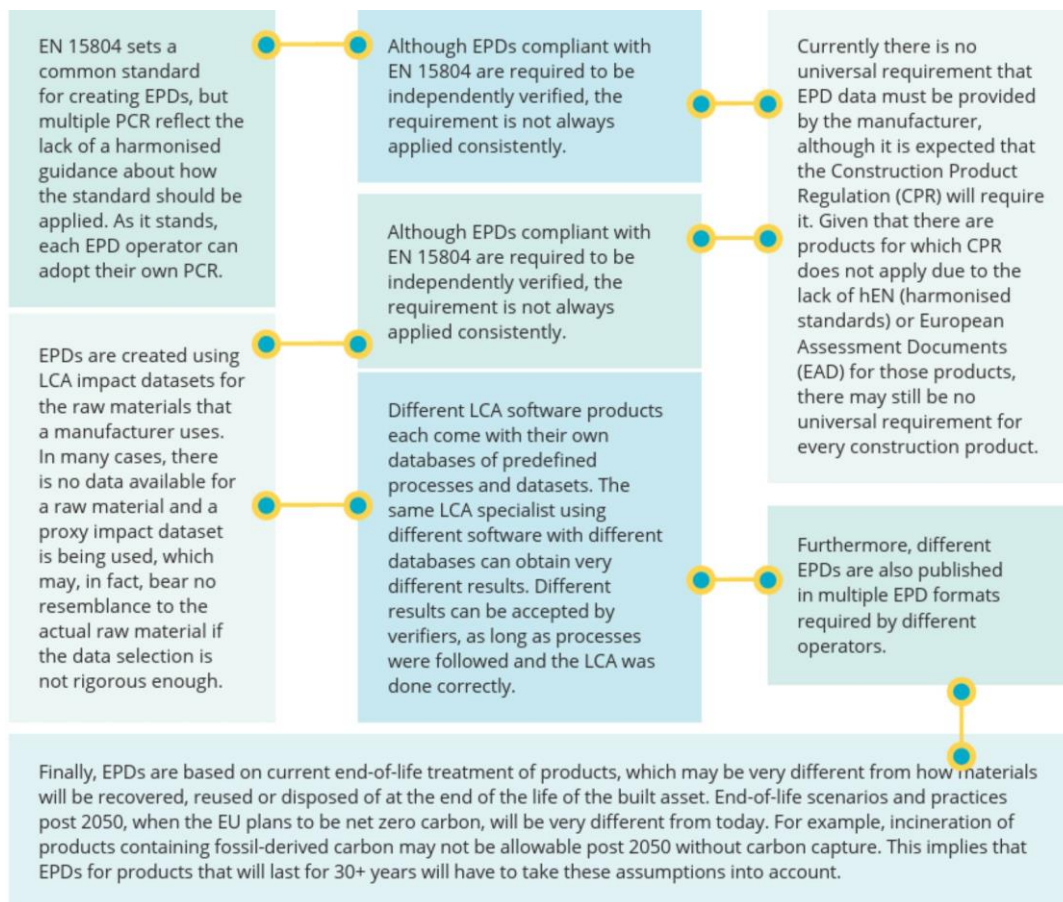
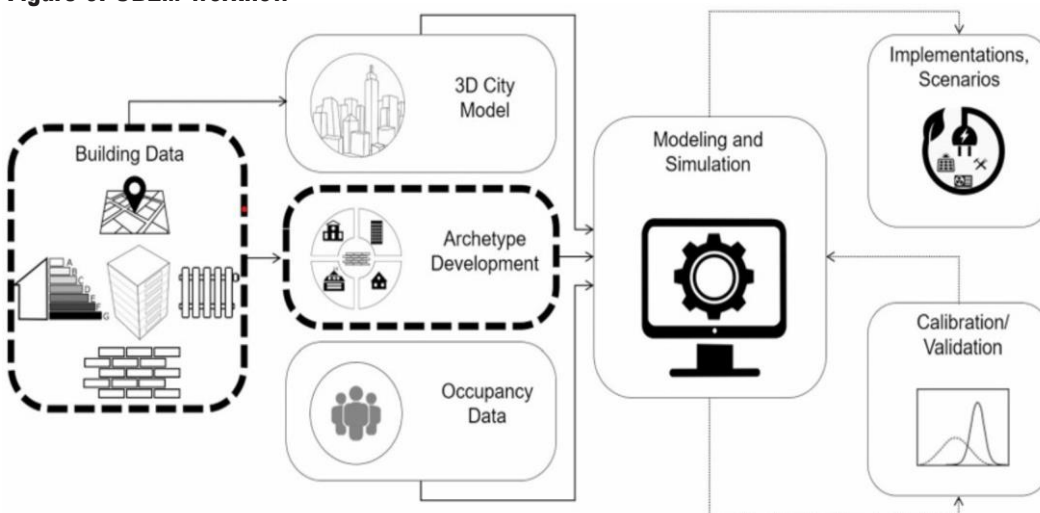


Figure 9. UBEW workflow

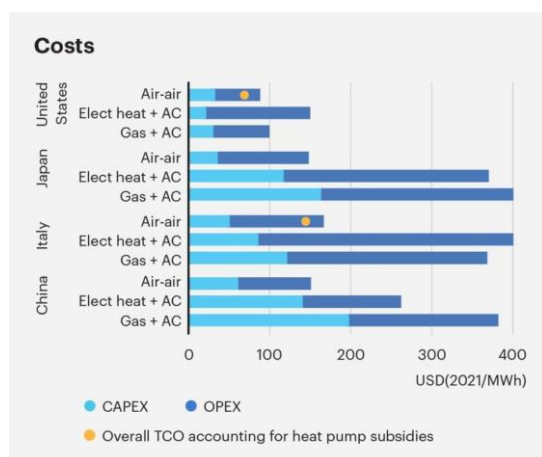


3.2.3 GLOBAL FINANCE ENVIRONMENT

In most markets, low carbon appliances, such as heat pumps, entail higher upfront costs than conventional fossil fuel heating equipment but benefit from lower running costs over their lifetime due to their much higher energy efficiency, as exemplified in Figure 10.¹⁴⁴

As such, funding is required to cover this additional capital expenditure.

Figure 10. Cost comparison



According to a survey by Dodge Data and Analytics, three of the five most substantial obstacles to sustainable buildings are related to finance, most often cited in North American and South Asian Markets.¹⁴⁶ The 2022 RICS Sustainability report found that a third of Europe-based respondents noted a significant increase in investor demand, while around 45% report a modest increase. In comparison, a significant increase in investor demand for green/sustainable buildings is noted by just over 10% of respondents in APAC and MEA, and around 8% in the Americas. Just over a third of respondents globally suggested that they have seen no change in occupier and investor interest green/ sustainable buildings over the past year. Under 10% of respondents globally note a fall in occupier and investor demand for green buildings.¹⁴⁷ This presents a challenge

to create demand in the markets where it will most be needed in terms of growth in floor area.

3.2.4 SUSTAINABLE COOLING AND HEATING

Innovation and widespread implementation of equipment for sustainable, clean heating and cooling is a major concern for the building and construction industry between now and 2050. The global stock of air conditioners in buildings is expected to grow to 5.6bn by 2050, 5 billion more than the current number.¹⁴⁸ Even if passive cooling design is implemented, with rising temperatures there is still likely to be a growing demand for ACs. Making cooling more efficient – for example through dual function heat pumps which provide both warmth in winter and coolth in summer - would also yield multiple benefits, making it more affordable, more secure, and more sustainable.

The Global Cooling Pledge launched at COP28 aims to raise ambition and international cooperation through collective global targets to reduce cooling related emissions by 68% from today by 2050, significantly increase access to sustainable cooling by 2030, and increase the global average efficiency of new air conditioners by 50%.¹⁴⁹

3.2.5 MATURING THE SUPPLY CHAIN FOR LOW-CARBON MATERIALS

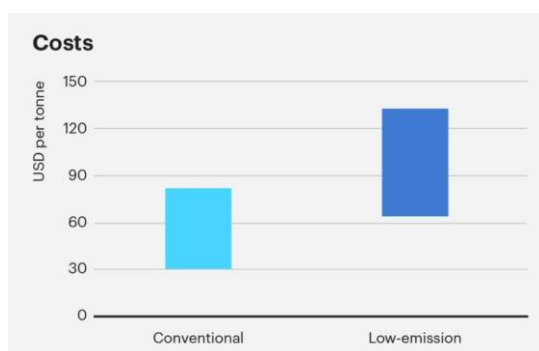
Across the world, already initiatives are seeking to unlock the importance- and value- of developing supply chains that can reduce costs and remove barriers to low carbon material deployment. The Clean Construction Accelerator from C40 Cities currently has eight signatories; Budapest, Los Angeles, London, New York City, Mexico City, Milan, Oslo, San Francisco, exhibiting the power of promoting change from a local level. It states “clean construction values our existing stock, prioritising building retrofits, and ensures

that new buildings and infrastructure embed circular economy principles in their design, material and construction choices.” Increasing the support of such initiatives will increase synergies across the construction sector, expanding and improving supply chains for a quicker delivery of net zero buildings.¹⁵⁰

Yet there is still much more to do. The 2023 Breakthrough Agenda Report states “the cement sector is not on track to meet net zero by mid-century, with total emissions rising since 2015. A significant number of new high-emission cement plants are anticipated, with relatively few announcements for new near-zero emission cement projects.” The figures for the industry currently do not provide a positive outlook:¹⁵¹

- Total CO2 emissions from the cement sector have been rising since 2015.
- Emissions intensity of cement production has risen by nearly 10% since 2015, largely due to an increase in the clinker-to-cement ratio in China.
- By 2030, total emissions need to fall by around 20%, enabled in part by an increase in CCUS.
- During the 2020s, costs of producing near-zero emission cement are likely to remain significantly higher than conventional cement, shown in Figure 11.

Figure 11. Cost comparison of conventional and low-emission cement



While a range of different low-emission technologies are under development, current estimates put low-emission cement at a 75% premium versus conventional cement production, on average.

The outlook for the steel sector is also currently not positive to reach net-zero by 2050, with emissions rising since 2015, stabilising since 2019. Over 100 Mt of near-zero emission ironmaking production is required by 2030, representing a gap of nearly 50 Mt, assuming all capable projects move to near-zero emissions in the near future. Therefore, rapidly accelerated action will be required to achieve this.¹⁵² Additionally, equipment fitted in buildings holds embodied carbon through reliance on steel and other metals such as aluminium and copper. As such, this impact needs to be considered and accounted for when developing a route forward to net zero buildings.

Furthermore, the use of biobased materials, including timber, agricultural straws, hemp, flax, cotton stalks, and cork, as construction materials will significantly reduce embodied carbon.¹⁵³ Nevertheless, the use of such materials will require addressing a number of obstacles including:

- For the production of mass timber, bigger trees take longer to grow, meaning firms that own and manage forests, and manufacture mass timber could be waiting 40 - 80 years after planting to get a return on their investment¹⁵⁴
- Upscaling and supplying materials in the quantities required for construction on an industrial scale
- Effectively marketing to increase awareness of the long-term positive aspects of specifying bio-based materials
- Bio-based construction is the initial higher material cost. Initial client costs range from 10% to 25% higher to construct using bio-based materials in comparison

- to a conventional steel build when also considering extra design costs
- Economic viability needs to extend throughout the supply chain
 - Contractual issues include methods of tendering and procurement and risk – who shoulders the burden, and how much risk they are willing to accept?¹⁵⁵

The end-of-life impacts of timber must also not be overlooked, since burning releases CO2 back into the atmosphere, requiring standards for the treatment of timber throughout its lifecycle.

For the Buildings Breakthrough, accelerating the use of timber as a low-carbon building material will require a thorough analysis of the resulting increase in demand for

wood globally and collaboration with forest management and the supply chain of the timber industry to address meeting this demand in a sustainable fashion. In regions where domestic timber supply is lacking, support should be provided to develop roadmaps and resilient supply chains of locally available resources, fostering innovation using these materials simultaneously. For example, Africa is rich in local construction techniques and materials such as adobe, laterite, termite, stone, bamboo, sand and a variety of dry vegetation.¹⁵⁶

Given the challenges presented here for both the UK and internationally, the following section presents a framework for new buildings and lessons to be adopted within the upcoming Buildings Breakthrough agreement.

Part Four

MOVING FORWARD: LESSONS FOR A BUILDINGS BREAKTHROUGH

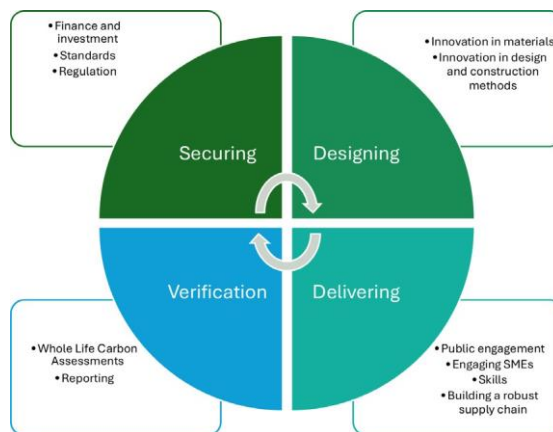
Ensuring all new buildings and homes are designed and built with the aim of being net zero will be instrumental in reaching the UK's and global net zero targets. These buildings of the future will also be cheaper to operate, provide a more comfortable living environment and be adaptable to a changing climate. However, the path to achieving this requires coordination of value chain actors for investment and innovation, importantly underlined by policy clarity and certainty.

The opportunities and challenges are nuanced in each country and region, nonetheless international commitments and collaboration is imperative to accelerating progress. The Buildings Breakthrough has already taken a huge step in this, with the Buildings and Climate Forum due to take place in Paris in March 2024.

While there is much work to be achieved to deliver and provide the detailed policy frameworks and delivery mechanisms to achieve the stated outcome of the breakthrough, for near-zero emission and resilient buildings to be the new normal by 2030, there is an opportunity to accelerate progress by adopting practices and approaches that already exist and have the chance to be scaled rapidly.

This can only be achieved, however, if policies and frameworks are developed in a holistic manner. A buildings breakthrough will only occur, as this report has already set out, if an approach is taken that recognises the importance of clarity and consistency across the entire construction sector, from legislation, regulation, standards and planning, to finance, design, modern methods of construction, supply chains and skills, through then the delivering, assessment and monitoring of buildings. Each of these processes are interlocked and interdependent on one another, however, they can be simplified in the following approach of a 'New Buildings delivery wheel':

Figure 12. New buildings delivery wheel



The following policy framework highlights the importance of taking a whole sector approach to new buildings, that does not place undue emphasis on one solution to delivering net zero buildings. Each part of the framework must be considered, not in turn, but in its entirety, with the opportunity for continuous development and refinement, as future lessons are learnt. The wheel can only turn and move forwards, if each part is given the correct momentum:

- 1. SECURING:** in order to secure the right conditions for deploying new low carbon, net zero buildings, we must secure the foundations needed for them to dominate the construction market, replacing older methods of construction. This requires not only government support for clear and consistent standards, a continuity of regulation and legislation, but also private sector support for finance and investment.
- 2. DESIGNING:** new designs for buildings, both in the innovation and research for new materials, the reuse of materials, and innovation in design and construction methods need to be accelerated, taking best practice examples of success at the same time as supporting future R&D.

3. DELIVERING: new net zero and low emissions buildings can only be built, delivered and ultimately sold if there are effective engagement strategies in place, to engage and inform the public, but also work alongside and upskill SMEs and supply chains, and building out robust material supply chains that can support the rapid growth in low carbon materials, goods and a skilled labour force.

4. VERIFYING: design and future innovation and materials should be held to account by effective and high integrity whole life carbon assessments, with effective reporting mechanisms in place, underpinned by legislation and regulation.

Without each of these parts in place, the wheel cannot move forward: in a similar analogy, the Buildings Breakthrough will not move forward at pace, unless all these policy considerations are given equal and due weight.

At the same time, in order to ensure that the Buildings Breakthrough can move forward at

pace, it is necessary not to entirely re-invent the wheel, but to seek to find immediate, ready made, solutions that can be adopted in real time, today.

The Buildings Mission Zero Network has identified some key examples of best practice that can be potentially used as future frameworks for the Buildings Breakthrough. The following section lays out 'Lessons for a Buildings Breakthrough' that provide the real-world examples of the various aspects of design and construction of buildings that have minimised emissions across their whole lifecycle and are resilient to a volatile climate.

Rather than make specific policy recommendations, for the Buildings Breakthrough, these examples can be taken as lessons for the Breakthrough that can be learnt from and either adopted or adapted as part of the Buildings Breakthrough final agreement.

This report identifies seven lessons that can be adopted:

4.1 LESSON ONE: NET ZERO CARBON BUILDINGS STANDARD

Long-Term success requires consistent and uniform buildings standards that can deliver net zero buildings. There must be a single standard to which the Breakthrough sets its ambition, for without effective and widely adopted standards, a clear definition of low carbon and net zero homes is meaningless. This lesson can be learnt by the Buildings Breakthrough adopting and scaling the work of the **Net Zero Carbon Buildings Standard**.

UK Net Zero Carbon Buildings Standard

The UK's first cross- industry Net Zero Carbon Buildings Standard that brings together Net-Zero Carbon requirements for all major building types, based on a 1.5°C trajectory. Leading organisations BBP, BRE, the Carbon Trust, CIBSE, IStructE, LETI, RIBA, RICS, and UKGBC have joined forces to champion this initiative.

What will it cover?

The Standard will set out metrics by which net zero carbon performance is evaluated, as well as performance targets, or limits, that need to be met. These are likely to include energy use, upfront embodied carbon, and lifecycle embodied carbon, with other metrics – such as space heating/cooling demand and peak load – also to be considered. It will also cover the approach to carbon accounting, procuring renewable energy, and the treatment of residual emissions, including carbon 'offsetting'. However, the scope and output of the Standard may evolve throughout the development process.

Who is it for?

The output will be for developers, contractors, asset owners and managers, occupiers, investors, financiers and funders, consultants, building industry professionals, building managers and product/material manufacturers, suppliers, and distributors. It is for anyone who wants to either fund, procure, design, or specify a Net Zero Carbon Building and anyone wanting to demonstrate that their building is 'Net Zero'-aligned with an industry-agreed Standard.

Will it be science-based?

Performance targets will align with science-based trajectories needed to achieve net zero by 2050 and a 78% reduction by 2035 in the UK, i.e. what is known to be required to stand a reasonable chance of mitigating global warming to 1.5°C. It will also align with the energy demand reductions projected to be required to enable a net zero carbon energy supply sector.

What building types will it apply to?

The approach will be applicable to both existing and new buildings (e.g. Homes, Offices, Education, Industry, Retail, Hotels, Healthcare etc.). To start, the focus will be on the most common building typologies, especially those for which industry stakeholders have already robust performance data available to inform the setting of performance targets. The Standard will not apply to infrastructure.

4.2 LESSON TWO: PHOENIX GROUP'S SUSTAINABLE FINANCE CLASSIFICATION FRAMEWORK

Strong and Stable financial support packages from the private sector and from the finance industry are essential to deliver the Buildings Breakthrough, which cannot rely on government support alone. An example to learn from is **The Phoenix Group's Sustainable Finance Classification Framework**.

Phoenix Group is a purpose-led investor, it is the UK's largest long-term savings and retirement business with c.£270bn assets under administration and c.12 million customers. Phoenix believes that to deliver on their purpose of helping people secure a life of possibilities, it is crucial to put sustainability at the heart of their business.

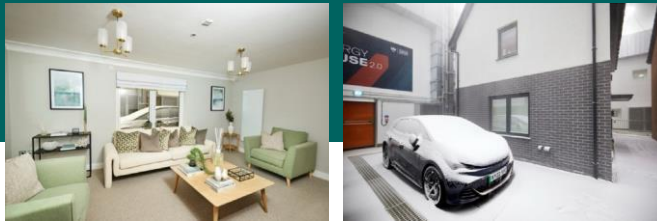
Within the Responsible Investment pillar, it has committed to include sustainability considerations within the investment decision making process. As providers of pension and savings solutions, its primary focus is to deliver good financial outcomes for its members and retail customers.

Other key objectives include:

- To increase its investment in sustainable assets within the shareholder and policyholder funds.
- To fund opportunities, which support the transition to a low-carbon economy.
- To expand its investment across all regions of the UK and aim to help the Government's objective to 'Build Back Better' and 'Levelling up'.

Its Sustainable Finance Classification Framework for Private Markets identifies eligible activities/themes which could be classed as Sustainable. It is intended to serve as a guide for investments across the Phoenix Group. Within that it includes Green Buildings as a theme which is then broke down into three sub-categories of Green Building Financing, Construction and Building Renovation. The eligible activities are Finance and/or refinance the acquisition of new buildings and/or existing buildings (or a portfolio of properties) achieving the following levels of environmental performance. The thresholds are outline below and certification looks back three years:

- Buildings certified to an acceptable level under any of the following internationally recognised green building certification schemes: BREEAM12 ("Very Good" 13 or above), LEED14 ("Gold" or above), Home Quality Mark (4 Stars or higher), EDGE, Energy Performance Certificate (EPC) "B" or above in UK, "A" or above in Europe.
- **USA:**
- 2020 Green Communities Criteria – Multifamily High Rise or Meeting Near Zero or Zero Energy Criteria
- EarthCraft (any level) with 20-30% improvement over ASHRAE 90.1
- ENERGY STAR® for New Homes Standard (8% improvement from Energy Star Certified Homes, Version 3.1 Revision 08
- OR 9% improvement from Energy Star Certified Homes, Version 3.1 Revision 09)
- ENERGY STAR for Buildings (85 or above Score for commercial buildings only)
- GreenPoint Rated (California Single Family/Multifamily: Home Outperforms California's 2019 energy code, Title 24 Part 6 or National (Non-CA) Multifamily certification with 20-30% improvement over ASHRAE 90.1)



4.3 LESSON THREE: EHOME2 AT ENERGY HOUSE 2.0 – BARRATT DEVELOPMENTS PLC AND UNIVERSITY OF SALFORD

Good design is key to delivering future low carbon and net zero buildings, however to deliver this better support must be given to research and innovation. The lesson that can be learnt by the Buildings Breakthrough is to emulate the approach taken by **Barratt's Energy House 2.0**.

Energy House 2.0 is a £16 million project, in-part funded by the European Regional Development Fund. It is a unique research centre at the University of Salford, in partnership with Barratt Developments' and Bellway Homes, consisting of two chambers that are each large enough to fit two detached houses. These chambers are special due to their ability to replicate the climate in 95% of the earth's environments. Their purpose? To research and experiment with new ways of powering, heating and insulating homes to reduce emissions from the construction of and living within new homes from 2025, using Barratt's eHome2 as a prototype.

Modern Methods of Construction (MMC) approaches have been adopted by Barratt to improve speed of build and mitigate shortages seen in both materials and skilled trades.^a New Product Introduction (NPI) testing and analysis is employed by the housing developer before the roll-out of innovative technologies. As such, they are confident in the tangible benefits of MMC. This is confirmed by the commitment to build 30% of their homes using MMC by 2025, and the opening of a new £45m timber frame factory in Derby. Using this approach, the superstructure at eHome2 can be built in 2 to 3 weeks from slab to finished roof, including windows and cladding.

Further, the fabric of a home's shell can determine how much heat is lost; thus it is important to consider this in design. Barratt's house is constructed of a timber frame, using I-shaped beams allowing more room for non-combustible insulation. Additionally, the embodied carbon of the building is also significantly reduced through the use of a Weber-designed brick slip system, which has a fraction of the weight of traditional brick. This brick system also lowers the whole life carbon impact in areas such as transport and waste.

Testing innovative technologies also aims to inform how running costs can be reduced.^b The eHome2 constructed within the chamber exhibits a strong case for the economic benefits, with the current energy costs of the home being £85 per month, compared to £187 per month for Barratt house sold today and £315 per month for a typical Victorian house.^c

Additionally, control of the environment rapidly increases the speed at which data can be collected, providing a much clearer understanding of how homes in the future will perform against the changing climate and, hence, resilient housing.

The findings are intended to influence homebuilding in both the UK and internationally. The technologies tested, including solar panels and systems to recover heat from wastewater in all new homes, will be integrated into the Future Homes Standard according to Richard Fitton, a professor of buildings physics at the University of Salford.^d The performance gap between design and post-construction is 3.9%. Considering it is a prototype, while a lot of work is required to scale up product availability and develop the necessary skills, the results strongly suggest that these houses can be built.^e

- a. <https://www.barrattddevelopments.co.uk/building-sustainably/taking-action/case-studies/innovating-to-improve-build-efficiency>
- b. <https://www.barrattddevelopments.co.uk/show-case/energy-house2>
- c. <https://barratt-ehome2.hybridplus.co.uk/reduce-consumer-bills/>
- d. <https://www.thetimes.co.uk/article/how-energy-efficient-are-the-next-generation-of-homes-dcx52g2s7>
- e. <https://www.thetimes.co.uk/article/how-energy-efficient-are-the-next-generation-of-homes-dcx52g2s7>



4.4 LESSON FOUR: LANDSEC'S TIMBER SQUARE

Materials of the Future and Modern Methods of Construction will be integral for delivering low carbon homes, yet greater support and emphasis needs to be placed on how to deliver these effectively into buildings. Pioneering examples of the use of timber, for instance, are important lessons for the Buildings Breakthrough, such as the award-winning **Timber Square by Landsec**.

At Landsec, we work to enhance the health of our environment and improve the quality of life for our people, customers and communities. Our sustainability strategy – Build Well, Live Well, Act Well – sets out our commitments to tackle climate change, enable our communities to thrive and ensure sustainability is embedded in everything that we do.

We've set an ambitious target of achieving net zero by 2040. Like many in our industry, we've got a long way to go. To succeed, we're working at pace to decarbonise our existing portfolio, as well as designing and developing all our new schemes to be net zero in operation and construction.

Timber Square, one of our landmark projects, exemplifies this commitment – an ambitious new 380,000 ft² campus in Bankside comprising of two office-led buildings. By volume, Timber Square will be the largest cross-laminated timber building in Europe.

One building, Print, was previously home to a printworks with strong existing foundations and generous floor-to-ceiling height. This means we've been able to retain 85% of the existing structure, dramatically reducing the project's upfront embodied carbon intensity. Given the structural retention, we're adding four floors to the building using a lightweight hybrid steel and cross laminated timber (CLT) solution.

The other building, Ink, was a smaller structure with little retention potential and needed to be replaced; however, it's also being constructed with sustainability at its heart. The building is designed with a repetitive structural module, which is extremely efficient with CLT, resulting in about half the number of steel beams than if built with steel and concrete. We are also procuring 120 tonnes of reused steel, which saves around 288 tonnes of carbon.

Overall, the development is estimated to be around 20-25% lighter than if built with traditional building materials. This means less pressure on the buildings' foundations, which themselves are carbon intensive. All of this means that Timber Square is on track to achieve an upfront embodied carbon intensity 50% less than a 'typical' office building, without accounting for any of the carbon stored in the timber.

To ensure that the building operates efficiently once completed, the development is the UK's first Design for Performance project to complete its Independent Design Review with a targeted 5* NABERS UK energy rating. This means that it will be net zero in accordance with UK Green Building Council guidelines and powered by 100% renewable energy sources. Timber Square has been recognised as an exemplar case study by the WGBC New London Architecture (NLA) and the BBC too.



4.5 LESSON FIVE: GROSVENOR'S HOLBEIN GARDENS

New low carbon and low emissions buildings do not have to be entirely new. The reuse and recycling of materials is critical for reducing emissions and embodied carbon. The Buildings Breakthrough can learn an important lesson from redevelopment projects that have reused materials such as steel for instance **Grosvenor's Holbein Gardens.**

Grosvenor is setting a new benchmark for sustainable workplaces with its first net zero project, Holbein Gardens. This redevelopment of a 1980s office building, completed in 2023, is leading the charge on exemplifying reuse of steelwork, which contains a large amount of embodied carbon.

Although Holbein Gardens is a reuse of an existing structure, it exhibits an innovative practice and circular economy principles that can be transferred to new builds. The integration a total of 24 tonnes of salvaged steelwork avoided around 60 tonnes of carbon emissions from new steel production. Nine tonnes were recovered from a nearby demolition site within Grosvenor's portfolio, with an additional 15 tonnes sourced through a partnership with Cleveland Steel. Not only does this reduce embodied carbon of the project, it also supports the growth of the second-hand materials market in the construction industry.

The project addressed and resolved complex issues currently surrounding the reuse of structural steel such as the cost of salvaging, programme constraints and the availability of reusable stock. One challenge presented was the mismatch of sizes and strength grade of the steelwork to the original design, subsequently affecting the design time required.

Further, Grosvenor worked closely with Cleveland Steel, a leading fabricator within the reuse of steel market, to assess the reclaimed material to confirm surface condition, coating and end preps to understand the existing condition. Alongside structural material testing, this process enables the steelwork to be designated the same quality as newly fabricated steelwork, providing CE/UKCA marking. Assigning Cleveland Steel as the main fabricator, supplier and tester of the reused steel also simplified the process and provided a level of cost security for the tendering contractors who have the challenge of quantifying the impact reusing steel has on the programme. Moreover, accustoming demolition contractors to programme in the extraction of steels and main contractors to understand the procurement challenges is essential for the reclaimed market to expand.

Other materials included Cemfree concrete, which has 85% lower embodied carbon compared to traditional Portland cement, and cross-laminated timber floor slabs from Eurban, which stores carbon and matches the strength-to weight ratio of that of concrete.

4.6 LESSON SIX: NATWEST GROUP – SUPPORTING THE DELIVERY OF LOW-CARBON BUILDINGS

The existing construction workforce will need significant retraining in order to deliver upon new standards and new methods of construction. Taking the supply chain on this important journey will be vital. Projects such as the **Supply Chain Sustainability School**, of which Natwest Group is a partner, is a key lesson for the Buildings Breakthrough to adopt.

As one of the largest lenders in the UK, we have a key role to play in supporting consumers and businesses in transitioning to more energy efficient homes and buildings that are warmer, cheaper to heat, and generate lower emissions.

Our strategy comprises of:

- Customer engagement: Providing educational information, building credibility and understanding with customers to support them in making their homes more sustainable.
- Product choices: Rewarding and incentivising customers to purchase and refinance the most energy efficient homes and upgrade the energy efficiency of their current homes.
- Sector engagement: Engaging with wider stakeholders within the sector to help influence change.
- Manage risk and data: Maintaining and developing the appropriate controls to manage the climate-related risk of our portfolio.

NatWest Group has joined forces with the Supply Chain Sustainability School to become their first partner within the finance sector, with a shared ambition of addressing climate change through building the skills the construction industry needs. Launched in 2012, the Supply Chain Sustainability School is a free virtual learning platform around sustainability, with the aim to upskill those working within, or aspiring to work within, the built environment sector. Their learning covers the three core pillars of Sustainability – environmental, social and economic – looking at key issues ranging from carbon management through to combatting modern slavery. The Supply Chain Sustainability School retrofit programme, sponsored by NatWest, was unveiled through a virtual conference on November 7th, 2023. This introduced CPD-accredited virtual training encompassing e-learning modules, online assessments, conferences, workshops and webinars running until Autumn 2024. These valuable resources will be freely accessible to professionals in the built environment, including NatWest Group's clients and School members. The Supply Chain Sustainability School also provides resources on construction, including MMC, DfMA and solutions to decarbonise cement.^a

^a. Resources
(supplychain-school.co.uk)

4.7 LESSON SEVEN: PROBLEM – CONSISTENT EMBODIED CARBON REPORTING

While it is essential that a common standard for low carbon and net zero buildings be adopted, it is equally important that this standard be enforced and effectively assessed if it is to be fit for purpose. **The work of Construction Carbon and CIBSE in establishing and accrediting a Life Cycle Assessment (LCA)** that can train, verify and accredit the low carbon buildings of the future is an essential lesson that can be deployed by the Buildings Breakthrough.

Construction Carbon was founded to tackle the construction industry's hidden emissions: embodied carbon from material manufacture, transport, and assembly. Even though the embodied carbon of construction accounts for as much as 11% of global emissions, industry understanding is poor and there is little relevant legislation in place. As a result, embodied carbon assessments are often unreliable, incomplete, and unverified. Consistent embodied carbon reporting at a real-estate portfolio level is consequently almost non-existent, and related metrics are rarely used to quantify the sustainability performance of built assets. Construction Carbon provides an all-in-one solution to these problems through our software platform, training, and industry partnerships.

Training

To improve the quality and accessibility of carbon assessments, we have developed an LCA (lifecycle assessment) training programme alongside leading experts and delivered with CIBSE (The Chartered Institution of Building Services Engineers) and the Supply Chain Sustainability School. This training will be free to attend for any consultants, developers or other professionals who wish to expand their understanding of whole-life carbon. A more in-depth and formally accredited training is currently under development.

Verification

At the core of this process is the verification service. 3rd party verification of whole life carbon assessments is recommended by the RICS (Royal Institution of Chartered Surveyors), the UKGBC (UK Green Building Council) and the GLA (Greater London Authority), as it provides essential accuracy, consistency, and credibility when the assessment forms the basis for any external carbon claims. Construction Carbon offers a unique technology enabled verification service in-line with the principles of ISO-14064-3, the international standard for validation and verification of greenhouse gas statements. This allows us to provide important insights into data quality and the potential for future improvement.

Reporting

Following project-level assessment, Construction Carbon facilitates straightforward reporting of a developer's portfolio-level embodied carbon performance. This reporting is not currently mandated but given the significance of embodied carbon's contribution to global emissions this is sure to change. Organisations such as GRESB (Global Real Estate Sustainability Benchmark) have already highlighted embodied carbon as an area for reporting scope expansion.

These otherwise piecemeal processes of assessment, verification and reporting are combined in our software platform, designed specifically to accelerate real estate developers towards decarbonised construction.

Part Five

CONCLUSION

This report, *Building the Future*, has been the product of several months of roundtable evidence sessions as part of the Buildings Network of the Mission Zero Coalition. Since the Buildings Network was formed, the Buildings Breakthrough Mission was established at COP28 in Dubai, led by France and Morocco, and signed up to by 28 nations, representing a third of all buildings emissions. It is an important moment for change, with the potential to establish a new low carbon future for new buildings across the world. The meeting of the Buildings Breakthrough in Paris this month (March 2024) represents also an important moment to ensure that the level of ambition and the right policy workstreams for the Buildings Breakthrough are agreed and committed to. This report is intended to highlight the opportunity that decarbonising new buildings can present, and to suggest lessons for the future, pioneering examples of best practice, and work already undertaken that could be adopted as part of the mission.

This report has been prepared both with the challenges faced by the UK, and those faced by the construction industry globally. These challenges are common ones, relating to the necessary regulations and standards needed to establish low carbon buildings, how to both benchmark and assess these standards in the future, and how to forge a low carbon construction industry and workforce that will be able to design, to create and build the buildings of the future.

This challenge is too important to get wrong: the buildings constructed from today and into tomorrow should be built to last; and built to have a lasting impact on reducing carbon dioxide emissions. Yet the challenge is also a vast opportunity, in particular for the UK, to demonstrate leadership and innovation, to scale up and deploy further faster the new building codes, designs, materials and methods of construction that can be not only pioneered, but be adopted by the rest of the world.

The Buildings Breakthrough is a unique moment to ensure that this deployment and scale up, the ability to standardise and to create common approaches that can be adopted by member countries. If this is successfully delivered, the environmental benefits of such an approach, as well the economic value of delivering economies of scale and efficiencies in emerging low carbon supply chains, the export of low carbon materials and construction goods, and the ability for companies that seize the net zero opportunity with both hands to then secure business and investment abroad will be realised.

The Buildings Network of the Mission Zero Coalition has been formed with some of the leading UK construction companies and property developers, all of whom are committed to designing and building the homes and commercial property of the future that must deliver the emissions reductions needed, not only in their operation, but in their entire life cycle.

The UK construction and design industry has been leading not only on the work needed to establish a net Zero Carbon Homes and Buildings standard, but also how to assess and enforce these standards in the future, so that they are fit for purpose. Life Cycle Assessments will be as important as the standards themselves, so developing the correct means to assess, to monitor and to hold to account the construction industry in all countries will be vital for the success of new homes and buildings being truly net zero. The lessons that this report has set out includes a number of pioneering approaches that can be expanded rapidly, given that the work has already been completed, or is near completion, in developing the standards and assessment criteria for the future. This report is intended to signal to the Buildings Breakthrough the importance of not seeking to create additional work, but to implement and adopt lessons that can be learnt today, from the best practice that already exists.

In turn, there is a separate lesson for the UK government and policy makers that should be learnt. With the rest of the world, at the very least the 28 countries represented in the Buildings Breakthrough, now awake to the opportunity that low carbon buildings and the industry that will need to be developed, can bring to their own countries, both in terms of job creation and inward investment. Now is not the moment to turn away from the progress that can or should be made.

The Future Homes and Buildings Standard consultation is a last chance for the UK to demonstrate that from 2025, new homes and buildings will be truly net zero homes and offices, rather than compromise and once again delay the necessary reforms that are needed to ensure that the buildings of the future will not have to be retrofitted ever in the future. For too long, new homes have been built and still being connected to the gas grid, still being powered by gas boilers that will need to be retrofitted at far greater cost to the householder. For too long, measures such as rooftop solar, or the ability to fit heat pumps near a home, have been stymied by the restrictions in planning or regulation. The Future Homes and Buildings Standard is an opportunity to finally get right a world leading standard that delivers the decarbonisation, but above all the comfort and lower energy costs that householders deserve in the third decade of the twenty first century.

The Future Homes and Building Standard, if done correctly, is also an opportunity for the UK to lead the rest of the world in demonstrating what a successful low carbon, net zero performance standard should look like. In doing so, the UK can demonstrate a climate leadership position in the Buildings Breakthrough that can have significant impact by helping other nations to achieve their own net zero new buildings ambitions, to make the construction of new low carbon buildings the 'new normal' as the Buildings Breakthrough aims to achieve.

This report presents in its conclusions the vital importance that new buildings, new homes and offices, new public buildings and commercial property, will have on our future. Not merely for the future of our environment and our emissions, but the future of our construction industry that will continue to grow. Indeed there is no alternative but to grow, but with a growth that works towards, and not against, our essential climate commitments. A Buildings Breakthrough is just around the corner; through further collaboration and commitment, and by quickly learning the lessons that are already there to be learnt, it can be delivered by 2030.

Rt Hon Chris Skidmore OBE

Appendix A

PROGRESS SUMMARY FOR BUILDINGS, CEMENT AND STEEL SECTORS FROM THE BREAKTHROUGH AGENDA REPORT 2023

Sector	Area	What progress has been made?	What more needs to be done?
Buildings	Standards and certification	<p>Whole-life carbon assessments exist in many countries, mostly voluntary. There is a limited availability of resilience assessments frameworks.</p> <p>Some limited collaboration among developed countries and some private sector organisations to advance compliance with standards and associated certification.</p>	<p>Governments to harmonise and upgrade definitions of near-zero and resilient buildings, defining and using a common set of concepts and nomenclature.</p> <p>Governments to align frameworks for whole-life carbon assessments and data collection and define resilience assessments.</p>
Buildings	Demand creation	<p>Strong aggregated procurement campaigns and policy commitments focused on building appliances and materials, albeit not for heating and cooling and whole building or-project-level.</p>	<p>Governments to work in partnership with existing forums to aggregate and amplify the demand signal for net zero and resilient buildings, expanding public sector participation and commitment.</p>
Buildings	Finance and investment	<p>Investment in energy efficiency and electrification for buildings at an all-time high, but not yet on track for net zero emissions by mid-century, and already showing early signs of slowdown.</p> <p>Some engagement of IFIs and business in unlocking private sector investment through several forums, although it is still challenging to match requests for support with the right funding and technical partners.</p>	<p>Governments should increase the scale of financial and technical assistance made available for developing countries.</p> <p>Improved co-ordination of IFIs and private sector investments to target flagship projects which can then unlock major pipelines of projects in emerging and developing economies in particular.</p>

Buildings	Research and innovation	Several well-established collaborative R&D forums already exist – with success in major technologies, such as heat pumping technologies, superinsulation and ventilative cooling. Current forums can be strengthened and expanded to increase and accelerate the impact of research and innovation.	Governments to co-ordinate on research, development and demonstration priorities to understand knowledge gaps, which can be overcome via joint working. Accelerate the creation of joint programmes to test and demonstrate new technologies, supporting developing country involvement.
Buildings	Capability and skills	Several collaborative forums deliver successful training programmes for construction and engineering roles that will be vital for the buildings sector and can be strengthened to build capacity and skills to deliver net zero and resilient buildings.	Countries and companies should jointly define training and capacity-building priorities, strengthening the role of existing networks to provide guidance, tools and resources for curriculum design, as well as international accreditation for education and training. Countries should focus on delivering technical capacity for the implementation and upgrade of building energy codes in countries where most growth in floor area is forecast.
Cement	Standards and certification	Strong alignment between international organisations on production level emissions accounting. Countries and companies increasingly looking to define low and near-zero emission cement and concrete.	Countries should agree a timeline for developing and adopting 1.5 C aligned low and near-zero emission definitions, as well as guidelines for efficient use and reuse of building material.
Cement	Demand Creation	Several, relatively new public and private sector forums for aggregating demand side commitments.	Further scale-up of high-quality commitments, which should be multi-year and backed by offtake agreements and or policy support.

Cement	Research and innovation	<p>Successful private sector collaborations are well-established, focused on both pre-competitive and applied innovation.</p> <p>Recent launch of MI NZIM to support country-level collaboration.</p>	<p>Accelerate the pace of learning among a wider set of countries, linking efforts to available financial and technical assistance.</p> <p>Support the delivery of pilot and demonstration scale projects for deep decarbonisation technologies.</p>
Cement	Finance and investment	<p>Several IFIs have programmes in place which can support cement decarbonisation projects.</p> <p>A growing focus from countries to improve the financial and technical assistance offer for developing countries, including under the Climate Club and LeadIT.</p>	<p>Develop an improved matchmaking function focused on industry decarbonisation to better respond to developing country requests and mobilise private sector investment.</p>
Steel	Standards and definitions	<p>Increase in membership of and co-ordination between key public and private sector initiatives.</p> <p>Emerging consensus on emissions accounting methodologies.</p> <p>Growing convergence on definitions for 'near-zero emission steel'.</p>	<p>Achieve broad consensus on methodologies by end 2024.</p> <p>Agree process for verifying 'near-zero emission' claims.</p> <p>Accelerate adoption of standards in national policy through collaboration between countries.</p>
Steel	Demand creation	<p>Increase in membership of key public and private sector initiatives, with CEM IDDI growing from countries representing 9% to 20% of global steel production.</p> <p>Increased efforts to engage regions outside Europe and North America.</p>	<p>Move from commitments and pledges to contracts and policies.</p> <p>Agree to share procurement data to strengthen demand signal.</p>

Steel	Research and innovation	<p>Growing number of successful private sector collaboration models for steel.</p> <p>Initial bilateral country partnerships being established under Mission Innovation NZIM.</p>	<p>Scale up country-level collaboration, making best use of private sector models where possible.</p> <p>Work closely with climate finance funds to build engagement with developing countries.</p>
Steel	Trade Conditions	<p>Some initial progress within new and existing forums and agreements, such as the WTO, OECD, Climate Club and GASSA.</p>	<p>Establish a dialogue on steel decarbonisation policies and trade, involving all major steel producing and consuming countries.</p>
Steel		<p>Launch of new funds, such as CIF Industry (USD 80 million out of USD 500 million capitalised).</p> <p>Initial interest to improve the effectiveness of delivery, including from LeadIT and the Climate Club.</p>	<p>Establish a matchmaking platform to link supply and demand for assistance and build sectoral expertise among major IFIs.</p> <p>Donor countries to further increase commitments for industry decarbonisation funds.</p>

Source: Breakthrough Agenda Report 2023. Available at: <https://www.iea.org/reports/breakthrough-agenda-report-2023>

Appendix B

ACHIEVING NET ZERO CARBON BY 2040

Amazon is making progress towards our 2040 net-zero carbon goal, with a near-term target of being 100% powered by electricity attributable to renewable electricity sources across our operations by 2025. As part of these ambitions, we are moving towards fully electric buildings services, reducing energy demand, and installing solar PV systems and battery storage at our buildings. We use our size and scale to support businesses and supply chains in the development of low-carbon products and services; working with partners, including governments is critical to deliver decarbonisation across business operations.

Buildings emissions challenge

Embodied carbon is our biggest challenge in reducing emissions associated with buildings, primarily those associated with the concrete and steel used in construction. We are looking to address this through innovating in materials development, along with improving data and reducing materials demand for future builds.

- We use the Embodied Carbon in Construction Calculator (EC3) tool to track embodied carbon in our building projects, and in 2022, we tracked embodied carbon from more than 400 building projects worldwide through EC3.
- We are working with cement suppliers – responsible for 90% of embodied carbon – to help develop lower carbon materials, through testing the mixture to ensure strength and performance standards.
- In 2021, we began purchasing steel from electric-arc furnaces, which use scrap steel and can be powered by renewable electricity, and which commonly results in half of the embodied carbon compared to fossil fuel steel production.



Amazon's Tilbury fulfilment centre: The building has 2 million sq. ft. of operating space and has been fitted with more than 11,500 modular solar panels, which generate the equivalent amount of electricity required to power UK 700 homes for one year.

Investing in innovation

Amazon is also investing in lower-carbon concrete and steel technologies globally through the Climate Pledge Fund, a \$2 billion program supporting the development of sustainable technologies and services. We've invested in Brimstone, a start-up developing the first carbon negative process for cement manufacturing, which uses carbon-free calcium silicate rock, and Electra, which produces iron at lower temperatures using low-grade iron ores and renewable energy.

Developing guidance for carbon reduction

Standards and guidance will be essential to establish a level playing field for business, and drive a higher bar for progress towards decarbonisation. In 2023 we worked with the Chartered Institution of Building Services Engineers (CIBSE) to develop guidance on how to reduce the embodied carbon of the equipment within Logistics Buildings. This approach helps logistics operators and their supply chains quantify the embodied carbon of their products by appraising the type and quantity of the materials and components making up the product. In turn, they can decrease carbon by either reducing the amount of materials and/or switching to lower carbon alternatives.

Recommendations

SUMMARY OF RECOMMENDATIONS SPECIFIC TO THE UK GOVERNMENT

#	Area	Recommendation
1	Standards and Regulation	Whilst Government has separately committed to review Part G (water efficiency) of building regulations, and a call for evidence on Part O (overheating) was included in the recent consultation, much greater ambition, and thorough consideration, is required to ensure key adaptation and resilience considerations are addressed on a par with carbon emissions.
2	Standards and Regulation	Part C of Building Regulations should require all properties at risk of flooding to include property flood resilience measures, prioritising nature-based solutions, specified and installed in accordance with the CIRIA Code of Practice for property flood resilience.
3	Standards and Regulation	To ensure buildings constructed using materials such as cross-laminated timber and reused steel are sufficiently insured and certified, Government needs to show these will be crucial in creating a net zero building stock, signalling through their inclusion in future standards consultations and setting targets for the proportion of such materials used in new domestic and non-domestic buildings, based on rigorous discussions with industry and stakeholders. Government can lead through their own procurement processes in relation to the public estate.
4	Standards and Regulation	The establishment of an industry-government FHS Implementation Board should be imminent.
5	Standards and Regulation	The government should add a mandatory timeframe for monitoring the building in order to incentivise a reduction in the performance gap between design and operation and explore the menu of options to encourage continuous improvements, such as tax breaks.
6	Standards and Regulation	To ensure a shift to operational performance metrics, monitoring and assessment, the government must introduce the planned performance-based rating system for large office buildings (>1,000m ²) by May 2022, including mandatory energy performance disclosure. This must be followed by introducing minimum standards and fiscal incentives for large office buildings by 2025, including separate minimum standards for new buildings (with suitable transitional arrangements).
7	Standards and Regulation	By 2028, established performance-based rating systems should be rolled out in remaining non-domestic sectors

8	Standards and Regulation	To ensure performance monitoring is reflected and embedded in regulation, the government must revise the National Calculation Methodology (NCM, as underpinned by SAP) and the EPC methodology to create a fit-for-purpose predictive methodology for energy performance of dwellings that better reflects in-use energy performance.
9	Standards and Regulation	Interim amendments to Building Regulations Part L should introduce EUI target compliance approach for additional sectors, aligned with mandatory energy performance disclosure dates. From 2027 amendments should include Offices <1,000m ² , Hotels, Retail, Warehouses, Higher Education. From 2029, amendments should cover remaining sectors. From 2030, Building Regulations should also include peak load limits demand limits (W/m ²) for different building typologies.
10	Standards and Regulation	Whilst Government has separately committed to review Part G (water efficiency) of building regulations, and a call for evidence on Part O (overheating) was included in the recent consultation, much greater ambition, and thorough consideration, is required to ensure key adaptation and resilience considerations are addressed on a par with carbon emissions
11	Standards and Regulation	Interim amendments to Building Regulations Part L should introduce EUI target compliance approach for additional sectors, aligned with mandatory energy performance disclosure dates. From 2027 amendments should include Offices <1,000m ² , Hotels, Retail, Warehouses, Higher Education. From 2029, amendments should cover remaining sectors. From 2030, Building Regulations should also include peak load limits demand limits (W/m ²) for different building typologies.
12	Standards and Regulation	The Government should consult on its approach to measuring and reducing embodied carbon in new buildings as soon as possible, and certainly in the first half of 2024, to ensure embodied carbon is incorporated into the Future Homes and Buildings Standard.
13	Standards and Regulation	The government should seek to adopt the a Net Zero Carbon Buildings Standard when completed, accompanied by an assessment process that validates the life cycle embodied carbon in buildings.
14	Standards and Regulation	The promised review of the NPPF, to better incorporate climate concerns, should include proposals to consult on introducing mandatory whole life carbon assessment through planning, following the approach of the London Plan.

15	Standards and Regulation	Further key actions the government should take include updating the Government Buying Standard for new-build construction and major refurbishments, which has not been updated since 2011, to include up to date net zero and whole life carbon targets.
16	Standards and Regulation	The above should be accompanied by extending the Public Sector Decarbonisation Scheme – beyond 2025 – to set out a longer-term programme for supporting public sector investment into carbon saving measures to at least 2030.
17	Design	The Government should conduct a review the planning system to address any key barriers to relevant technologies and innovations. It must update the NPPF to ensure it actively supports key technologies and design interventions. This should include clear guidance to address arbitrary barriers to key technologies, such as character constraints on rooftop solar, and presumptions in favour of key, low/no regret interventions, similar to current wording on street trees. For example, external wooden shutters to combat overheating.
18	Design	The Government appears to have made limited effort to understand and address these challenges. This should be addressed moving forward, with a response to the inquiry on modern methods of construction required as soon as possible.
19	Design	The Government should make clear its support for MMC and DfMA, which are shown to provide clear benefits for the industry that will increase with the maturity of the market. Through continued funding, for example extending the transforming construction challenge, which was funded under the UKRI Challenge Fund, and clear objectives from the government, these techniques can be integrated into the design of new buildings on a wider scale.
20	Financing	The Government should consider a programme of funding to encourage the use of clean energy for heating and cooling in buildings. A leading example is the Powering Affordable Clean Energy (PACE) program in the US, implemented as part of the Inflation Reduction Act to makes it more affordable for rural areas.
21	Financing	An energy adjustment of the SDLT calculation could catalyse and drive the market to deliver both energy efficiency improvements and low carbon heat and power. It would also be revenue neutral to HM Treasury

22	Skills	The Government should carry out a skills gap analysis on the buildings and construction industry and work with industry actors to identify where apprenticeships and training courses can be enhanced, especially in terms of data tools and analysis.
23	Skills	The UK Government should produce a national 'Net Zero Skills Strategy', similar to the Welsh Net Zero Skills Action plan, proposals and timelines for boosting skills in the relevant areas.
24	Innovation	The Government must consult on its current Procurement Act and revise it to create demand for sustainable building materials, thus growing local supply chains in a managed fashion and fostering an ecosystem for green buildings.
25	Innovation	The Government can further support expanding the market through integrating procurement of reclaimed steel for use in the construction of new public buildings.

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