# Retrofit First, Not Retrofit Only

## A focus on the retrofit and redevelopment of 20th century buildings

JLL

London Property Alliance
WPA | CPA
Westminster Property Association | City Property Association

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## About the London Property Alliance (LPA)

London Property Alliance WPA | CPA

London Property Alliance brings together the Westminster Property Association (WPA) and the City Property Association (CPA). It is the not-for-profit membership body and advocacy group representing the leading owners, investors, professional advisors, and developers of real estate operating in the Cities of Westminster and City of London.

The Alliance provides a unified voice for the real estate sector across central London.

This research paper has been authored by real estate consultancy JLL and produced with support from BentallGreenOak, British Land, Derwent London, GPE and Landsec.

# Foreword

Central London is a major driver of economic growth and prosperity. But success comes at a cost in the form of elevated greenhouse gas (GHG) emissions. Our buildings, and particularly how we use them, are major contributors.

Tackling climate change has rightly risen to the top of the political agenda, and the property sector, like many others, is grappling to play its part in reducing its carbon footprint.

Whilst the capital has the lowest level of emissions per capita of any UK city due to its high population density and wide use of public transport[1], the core commercial districts of Westminster and the City of London have some of the highest emissions by local authority area in the country, at 2.6million and 676,000 tonnes respectively.

Both governing authorities have pledged to achieve either net zero carbon (the City) or carbon neutrality (Westminster) by 2040. The Mayor of London Sadiq Khan has gone even further, targeting 2030 for London to be a net zero carbon city.

Reducing energy use in buildings is a fundamental component in central London's carbon reduction strategy, and new development is able to adhere to the stringent energy and carbon requirements of the Mayor's London Plan.

But 80% of London's 2050 stock is likely to be comprised of buildings already standing today, highlighting the need for substantial improvements on a massive scale. Around 74% of office buildings in Westminster and the City of London will need to be upgraded before 2030.

This is a huge challenge, which many property companies, including those featured in this report as case studies, are rising to. But buildings are not all created equally, and retrofit is not always feasible or viable for those with poor architectural quality, inflexible layouts, limited accessibility and insufficient load-bearing capacity.

The industry is firmly behind a retrofit-first approach. However, a combination of gaps in national policy, under resourced planning departments, lack of expertise, and an increasing presumption of retrofit-only in decision making risks undermining collective efforts to decarbonise our built environment.

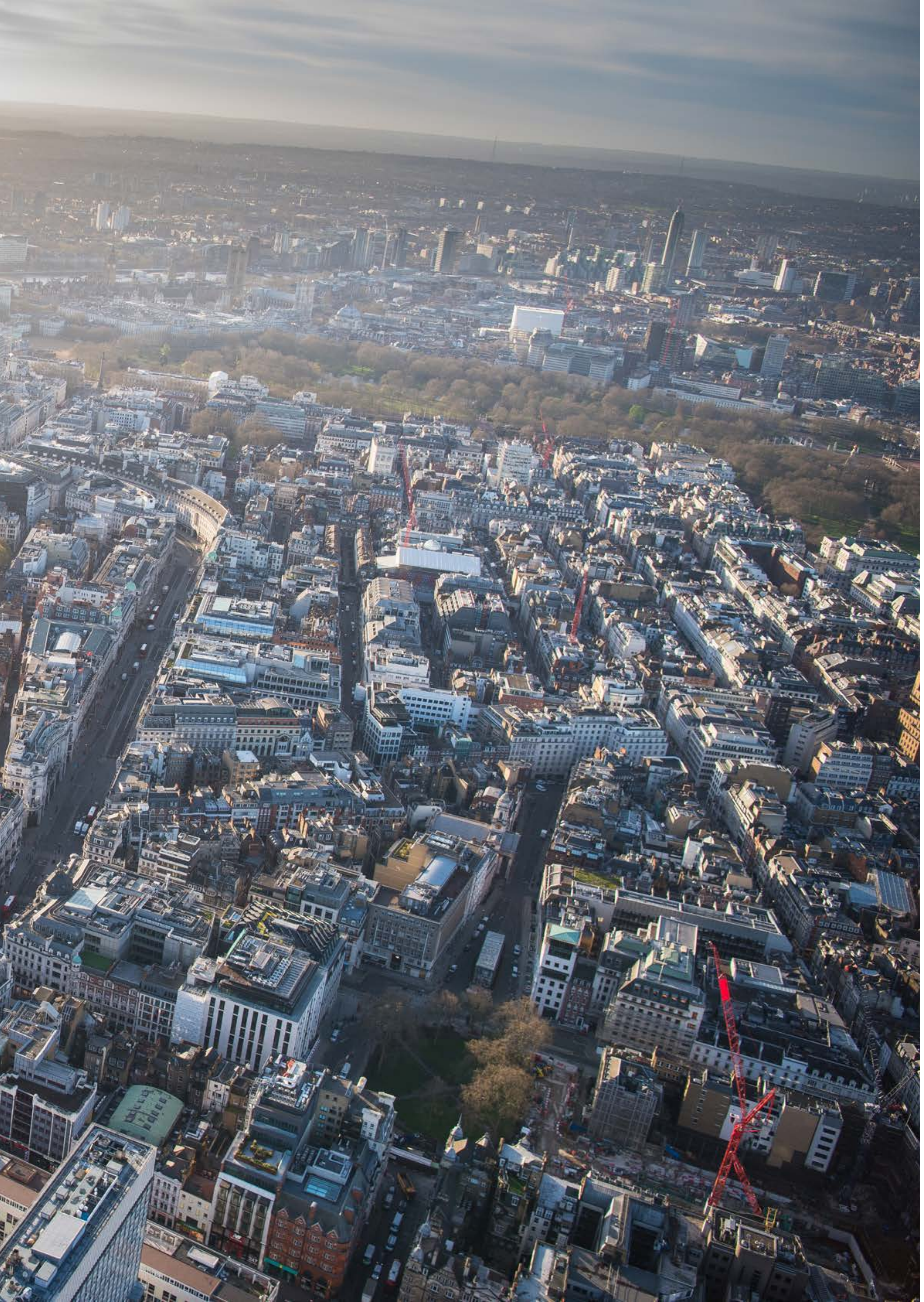
The National Planning Policy Framework (NPPF) features four pillars of sustainability; human, social, economic and environmental. But it contains little guidance on how these can be assessed and balanced in the context of local decision making. This is contributing to an increasingly fragmented system with policymakers unsure of how to grapple the issue as they come under increased pressure to adopt a 'retrofit only' approach during the planning process.

This report is a timely intervention to help navigate the complexity of decarbonising our built environment. It aims to bring greater clarity to planning and investment criteria, which ultimately underpin future development, pinpointing key considerations in determining the best approach taken from case studies and real-world experience.

Whilst we all agree on the need to tackle climate change, the path we take to reach our net zero carbon ambitions is not straightforward. We can only achieve these by working together. We hope that the analysis and recommendations presented serve to accelerate the transition towards a zero-carbon built environment in central London.

I would like to thank our members that have dedicated considerable insight into the development of this paper, those that have submitted case studies and all our partners and contributors.

**Charles Begley**
Chief Executive
London Property Alliance



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## Net zero carbon: challenges and opportunities for commercial building stock

Buildings account for around 78% of greenhouse gas (GHG) emissions generated in London[2]. As the need to address global climate change becomes more pressing, regulatory and policy drivers for commercial building retrofit are being pushed forward by UK Government, the Greater London Authority and an increasing number of London's borough councils. For example, most stock with an EPC rating below 'C' - will need to be upgraded before 2027 to continue to be lettable. To meet the UK's 2050 net zero emissions goal, buildings will need to be almost completely decarbonised through energy efficiency improvements, the phasing out of fossil fuel-based heating systems and the integration of smart technologies.
Demand for low and/or zero carbon assets is rising at pace across key UK office markets, driven by both occupiers and investors. Whilst corporates are aligning leasing strategy with their carbon reduction commitments and seeking to occupy buildings that support greater employee wellbeing and productivity, a significant majority of global real estate investors report that sustainability is a key consideration for investment decision-making.

Upgrading the commercial building stock to achieve NZC standards presents both challenges and opportunities for developers, and each building presents a unique set of location-based, physical and historical characteristics. NZC retrofit is far more likely to be technically viable and commercially attractive for buildings which present good overall architectural quality; foundations and structure that meet modern robustness requirements, and height expectations, and a floorplate configuration that allows for flexibility for extension and modernisation. Conversely, for buildings with poor quality design, construction and materials; sub-optimal floor to ceiling heights, poor accessibility and/or inflexible layouts, redevelopment may prove to be a more effective approach to meet carbon reduction goals and create an attractive product that is more likely to maintain its market value over time. Furthermore, a stock of attractive buildings is crucial to the overall attractiveness and competitive positioning of London as a place to employ people and invest.

## Retrofit first, not retrofit only

We consider that both retrofit and redevelopment can be valid approaches to delivering NZC buildings, and that a 'retrofit first', rather than 'retrofit only' stance should be adopted by property owners and policymakers.
To illustrate the spectrum of NZC projects undertaken to date across 20th century commercial buildings of different ages and styles, we analysed case studies submitted by members of Westminster Property Association and City Property Association in May - June 2022. The case studies demonstrate the importance of allowing for flexibility to deliver NZC through both retrofit and redevelopment approaches. They provide useful examples of the typical challenges and opportunities associated with converting the 20th century commercial building stock to NZC standards, the types of interventions - including the use of innovative design and construction methods - that can be effectively deployed, and key learnings for future projects. Combined with our wider knowledge of NZC projects completed or underway in central London, the case studies enable us to draw out key findings on the drivers, decision-making processes and outcomes for NZC retrofit and redevelopment schemes, as summarised below.

## Key findings from retrofit and redevelopment case studies

1. **NZC is being delivered through both retrofit and rebuild approaches, and whole life carbon assessment (WLCA) is being used to determine and/or validate the approach pursued.** Buildings that are NZC in construction and operation are being delivered through both retrofit and redevelopment of central London's 20th century commercial stock, as is demonstrated by schemes such as Holbein Gardens; Timber Square; 100 Liverpool Street; Edenica and 105 Victoria Street. The use of WLCA enables developers to identify and/ or confirm which is the most effective retrofit approach from a NZC perspective.

2. **Developers are increasingly adopting a 'retrofit first' approach and only pursuing other strategies where retrofit is not viable.** Schemes which involve full or partial redevelopment such as 105 Victoria Street, Edenica and 100 Liverpool Street, tend to do so after exploring retrofit first.

3. **Retrofit is most often viable for buildings which present a specific set of characteristics, whilst redevelopment is most often pursued when these characteristics are not present.** Retrofit is most often viable for buildings which present overall good architectural quality, with a robust structure and foundations with sufficient load bearing capacity to support extensions. Buildings which are of poorer quality construction, have an insufficiently robust structure and/or

### Defining net zero carbon

We consider a net zero carbon building to be one where the embodied and operational carbon emissions have been assessed and reduced to the greatest extent possible, considering the whole building life cycle, and where the residual emissions associated with at least the construction works and operational energy use have been offset.

unadaptable layouts present greater technical difficulties and less potential to unlock additional commercial value through retrofit, but can effectively achieve NZC (in addition to economic and social benefits) through a redevelopment approach.

4. **Retrofit and redevelopment projects employ a plethora of measures to reduce whole life carbon, from the reuse of existing structures to specifying all-electric, renewables-based energy systems.** Retention of existing foundations and structures, façade refurbishment and building systems and equipment upgrades are most important for retrofit. On redevelopment schemes, reusing demolition materials and other low carbon products along with modern methods of construction reduces upfront embodied carbon, and there is generally flexibility to explore a wider range of passive and active design measures to reduce operational energy demand and adapt for future climatic conditions. Developers are pioneering innovative techniques to deliver NZC and other sustainability goals, helping project teams to acquire new skills and experience and share learnings, with mutual benefits for organisations along the real estate value chain.

5. **Retrofit and redevelopment are driven by other factors besides NZC and deliver a wider range of positive sustainability outcomes.** The primary driver for commercial building retrofit or redevelopment is to unlock the potential of economically and/or environmentally stranded assets and maximise their value. NZC is generally approached within the context of a holistic asset sustainability strategy and is one of a wider range of positive outcomes delivered, such as additional lettable space with lower operational costs, increased occupier health and wellbeing, enhanced public realm, climate change resilience, biodiversity gain and air quality improvements.

6. **The delivery of NZC buildings presents common challenges including costs, skills shortages, information gaps and tenant engagement to maintain target energy performance.** These challenges are common to both retrofit and redevelopment approaches, and specifically include a lack of internal capacity and external availability of specialist skills, additional costs associated with lower embodied carbon materials and NZC infrastructure and the practical difficulties of obtaining reliable information about existing buildings and building products.



7. **NZC is most effectively delivered via a strategy that is tailored to the individual asset, both its physical attributes and long-term commercial proposition.** Retrofit, redevelopment and hybrid approaches can each be effective, and there is no 'one size fits all' solution. NZC buildings are also more likely to create and sustain additional value when developed according to holistic sustainability principles, with due consideration to climatic changes and evolving societal and market trends.

## Ten recommendations for property owners and policymakers

### For property owners

1. Develop a portfolio strategy for NZC transition
2. Develop asset sustainability strategies with consideration to economic, environmental and social aspects
3. When the opportunity for asset intervention is identified, engage all key stakeholders to set the initial project brief
4. Undertake a whole life carbon assessment (WLCA) based on a robust methodology
5. Assess a range of options to deliver NZC within the context of the asset's sustainability strategy, applying a robust methodology to quantify and compare the likely costs, impacts and benefits of each option.

### For policy makers

1. Improve consistency in national, regional and local planning policy and application, especially between the London boroughs and the GLA
2. Consistently promote a 'retrofit first' rather than 'retrofit only' approach to delivering NZC buildings and ensure that this is communicated clearly to all stakeholders
3. Request evidence of the assessment of NZC approaches and the decision-making process followed by planning applicants at an early stage, as part of pre-application discussions
4. Provide robust and consistent guidance on WLCA at national, local and regional level
5. Ensure that there is sufficient sustainability expertise within their planning departments to enable planning applications to be appropriately assessed from a NZC and wider sustainability perspective.

02

# Introduction and context

# Introduction & context

In April 2022 the Intergovernmental Panel on Climate Change (IPCC) finalised the third part of its Sixth Assessment Report[3], which identified that global emissions must peak by 2025 at the very latest to effectively limit global temperature rise to 1.5°C (in line with the Paris Agreement[4]). We only have a narrow and fast-closing window to deliver transformative change. In the built environment sector, urgent action is needed to deliver carbon reduction by reducing energy demand, increasing energy efficiency and implementing renewable energy systems. Reducing buildings' impact on and vulnerability to climate change has the potential to contribute positively to human health and wellbeing by improving indoor air quality and thermal comfort, reducing operating costs and increasing productivity.

## Carbon reduction pathways for the UK built environment

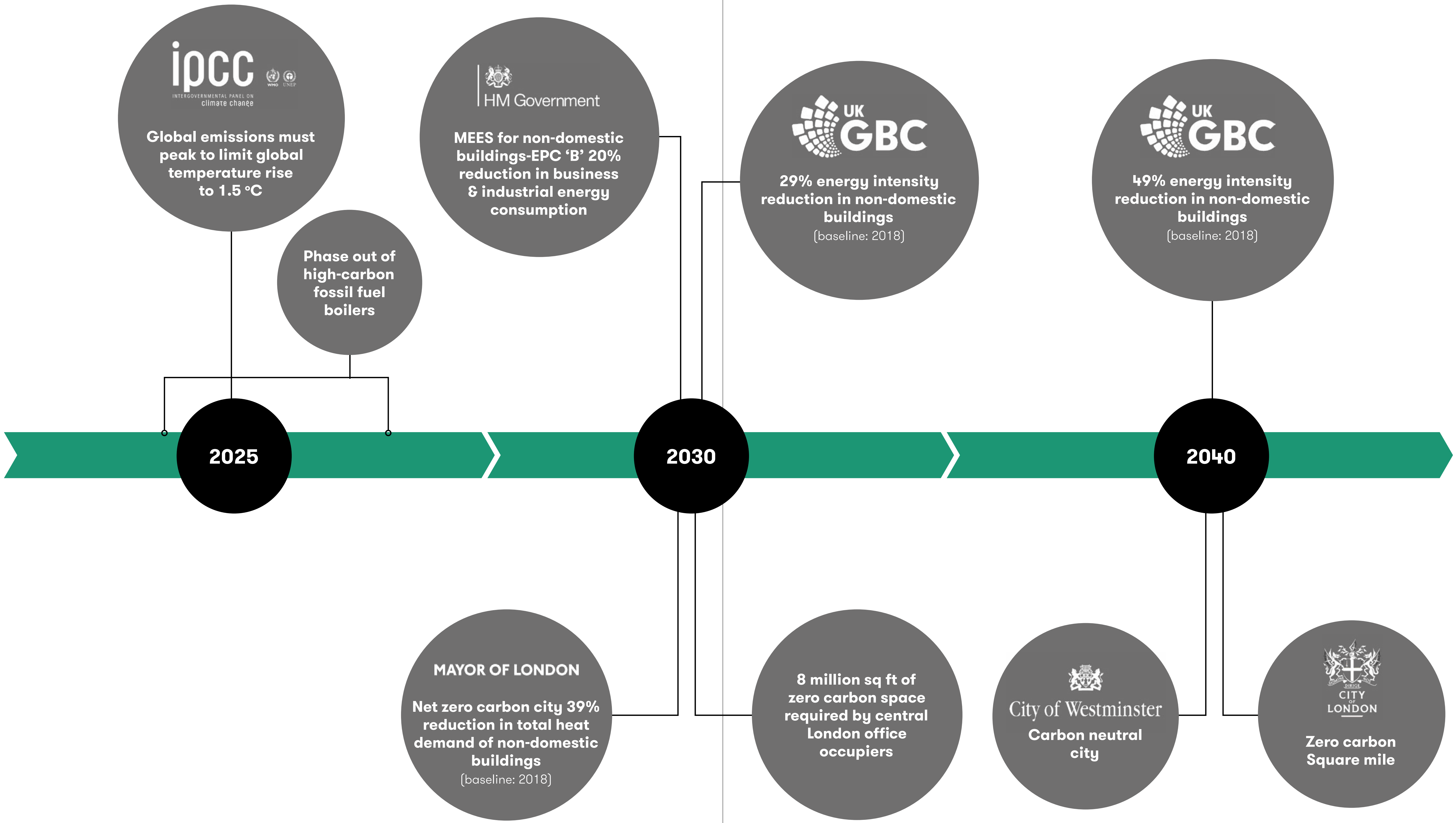
Overall, the UK's built environment is responsible for 25% of the nation's GHG emissions[5]. In keeping with the UK's 2050 net zero emissions goal[6], new and existing buildings will need to be almost completely decarbonised through energy efficiency improvements, the phasing out of fossil fuel-based heating systems and the integration of smart technologies[7]. Apart from operational energy consumption, the impact of constructing new buildings will need to be considered with the whole life embodied carbon emissions of buildings reduced though innovative construction methods, resource efficiency and circularity. The UK Green Building Council (UK-GBC)'s Whole Life Carbon Roadmap, published in November 2021, establishes a built environment emissions budget to 2050, consistent with the wider UK carbon budget and with lowest possible residual emissions. For non-residential buildings, this equates to a requirement of an average 29% energy intensity reduction by 2030 against a 2018 baseline, and a 49% reduction by 2040, to align with a 2050 net zero carbon pathway[8].

Pathways modelled by the Climate Change Committee (CCC) identify that high-carbon fossil fuel boilers should be phased out by 2026 at the latest (2024 for large non-residential properties under the UK Heat & Buildings Strategy), and gas boilers by 2033. All new buildings should be operationally zero-carbon by 2025, and all commercial energy efficiency renovations should be completed by 2030 to meet the Government's target of reducing business and industrial energy consumption by 20%[9]. Carbon Risk Real Estate Monitor (CRREM), the leading global standard and initiative for operational decarbonisation of real estate assets, has also developed asset type-specific decarbonisation pathways for the UK informed by the global carbon emissions reduction requirements needed to accelerate the decarbonisation of the EU building stock to "1.5-degree-readiness" by 2050. Following CREEM Global Pathways, office and retail-high street buildings in the UK should demonstrate a 38% reduction in energy consumption by 2030, and an 89% reduction by 2050, against a 2018 baseline.

## Regulatory and policy drivers

Regulatory and policy drivers for commercial building retrofit ahead of the 2030 milestone are being pushed forward by national government and City Hall. The UK's 2020 Energy white paper confirmed that the future trajectory for the non-residential minimum energy efficiency standards (MEES) will be EPC 'B' by 2030[10] (EPC 'C' by 2027), creating a clear regulatory driver for commercial building retrofits. The Mayor of London has committed to bring forward London's net zero target from 2050 to 2030, with key policies including a 39% reduction in total heat demand of non-domestic buildings, to be delivered through retrofit programmes[11]. At national and GLA levels, political appetite for change appears to be accelerating at a faster pace, but recent controversy over the planned demolition of Marks & Spencer flagship Oxford Street illustrates the challenge of managing conflicting analyses on the best approach to delivering a more sustainable built environment and the complex interaction between embodied carbon, and heritage policy[12]. Indeed, there is currently some inconsistency – and hence confusion – between policy makers at a local level and built environment industry stakeholders as to whether a 'retrofit first' or 'retrofit only' stance should be adopted.

# The Net Zero landscape



Both retrofit and redevelopment schemes also have the potential to deliver a wider range of economic, social and environmental co-benefits in addition to NZC. Considered within the context of the UK's National Planning Policy Framework definition of sustainable development*, this includes:

- Creating new commercial space and upgrading existing commercial space
- Improving resource productivity
- Enhancing the public realm and providing spaces for community benefit
- Protecting the natural environment by implementing nature-based solutions to improve biodiversity and climate resilience, and minimusing waste and pollution.

More extensive planning benefits and contributions to a local area are likely to be realised from proposals that lead to the more efficient use of land, perhaps through intensification and appropriate growth and densification, which may be more easily realised in redevelopment schemes that lead to floorspace growth than in retrofit-only schemes.

*The purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development is summarised as "meeting the needs of the present without compromising the ability of future generations to meet their own needs". The planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways: an economic objective to help build a strong, responsive and competitive economy; a social objective to support strong, vibrant and healthy communities and an environmental objective to protect and enhance our natural, built and historic environment. (National Planning Policy Framework, HM Government, valid as at August 2022)

### Defining retrofit and redevelopment

**Retrofit** involves modifying the building's systems and/or structure after its initial construction and occupation, generally to improve amenities and comfort for building occupiers and/or increase operational efficiency by reducing utilities consumption. A low or net zero carbon retrofit involves the retrospective upgrading of a building to enable it to respond to the imperative of climate change by maximising energy efficiency and phasing out fossil fuel use to deliver low or zero operational carbon emissions.

**Redevelopment** involves new construction on at site that has pre-existing uses. It typically involves the full or partial demolition of the existing building to deliver a new building of a higher quality standard to meet modern occupancy requirements and, in the context of this research paper, to deliver high operational energy efficiency and low or zero operational carbon emissions.



# Unlocking market opportunities

## Occupier demand for sustainable corporate real estate

Demand for sustainable assets is already rising exponentially across key UK office markets as occupiers seek to align corporate real estate strategy with climate change commitments. Demand for sustainable assets is already rising exponentially across key UK office markets as occupiers seek to align corporate real estate strategy with climate change commitments. At the same time, they are looking to support greater employee wellbeing and productivity, satisfaction, and retention through the procurement of high quality, dynamic workspace. Feedback from 1,095 corporate real estate decision-makers partaking in JLL's Future of Work Survey 2022 revealed that over 43% are embedding NZC requirements in new location selection and over 46% plan to accelerate investment to operate facilities in a carbon-efficient manner. 74% stated that they are likely to pay a premium to occupy a building with green credentials, and 56% among them plan to do so by 2025. Anecdotal evidence suggests that whilst up to now occupiers' sustainable leasing criteria typically focused on building certifications and ratings, greater attention is beginning to be placed on wellness factors as well as real operational energy and carbon.

As of July 2022, 613 central London occupiers had signed up to Science-Based Targets (SBTs) for carbon emissions reduction, representing a collective 3.36 million square metres (36.2 million square feet) of office space. Nonetheless, there is a mismatch between demand and delivery. JLL has looked forward to the next wave of office development and has calculated that the next wave of office development and major refurbishment will need to accommodate at least 1.5 million square metres (16.3 million square feet) of highly sustainable demand from occupiers across central London by 2030.

## Investor interest in sustainable products

78% of respondents to JLL's 2022 UK investor survey selected sustainability and climate change as the long-term trend which will have the greatest impact on UK real estate. 62% stated that ESG-focused regulations such as the EU Taxonomy has already pivoted their investment strategies towards demonstrably sustainable products, and a further 23% expected this shift to take place soon[13]. Globally, JLL has found that nearly three quarters of 'leading' investors plan to invest in NZC assets in the next three years[14].

Sustainable offices tend to achieve higher rents, quicker leasing and better longer-term performance than less sustainable offices. In central London the average premium of all rated buildings above non-rated buildings is around 8%, and central London BREEAM Outstanding/Excellent offices achieved rents 10% higher than non-rated buildings[15].

## Property owners' perspectives on NZC portfolio drivers

Direct feedback from WPA and CPA members and a high-level review of their published portfolio-level NZC pathways indicates that drivers for NZC retrofit and/or redevelopment include:

- Aspiring towards market leadership and demonstrating the business case to push the market forwards in tackling climate change
- Attracting and retaining high calibre tenants through NZC alignment and by improving buildings' indoor environmental quality
- Reducing operational costs for landlord and tenants
- Preparing for stringent future regulations (such as evolving MEES requirements)
- Future-proofing assets for long-term resilience – particularly relevant for investors with long-term holdings
- Delivering on corporate NZC commitments, which are in turn supported by investors who are increasingly focused on climate change risks and opportunities.

Some landlords report that they are already working in collaboration with forward-thinking customers who are demanding higher sustainability credentials for their occupied space and want to reduce their carbon emissions. Such occupiers are actively seeking operators who demonstrate leadership in this area.



**86%**

**Westminster's carbon attributed to buildings**

**80%**

**Proportion of London's existing buildings likely to be standing in 2050**

**74%**

**Proportion of Westminster and City office buildings with EPC rating below 'B'**

**>18Mm²**

**Approximate supply of commercial office space in Westminster and the City of London**

**1.5Mm²**

**Estimated net increase in office space required *by* 2040**

**3.36Mm²**

**Central London office space occupied by companies with science-based targets**

Altogether, these data demonstrate that there is a compelling business case for upgrading assets to meet high sustainability standards, including zero carbon.

# The state of the 20th century commercial stock

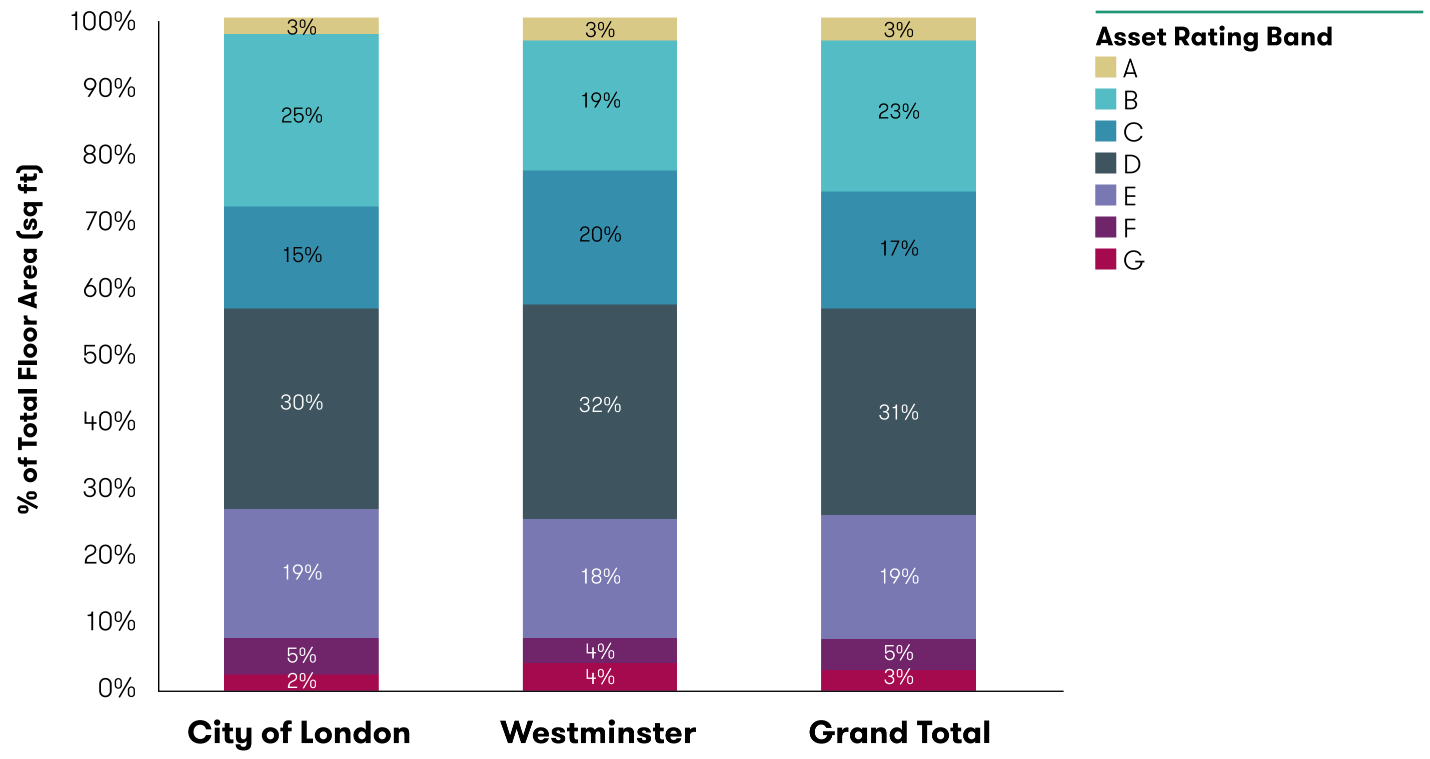
## The energy performance handicap

The absence of regulation on building energy performance prior to 2006, coupled with the use of older technology and fossil-fuel based heating systems, means that the large part of the UK 20th century building stock has a poor energy performance profile.

One of the key challenges we face is assessing the actual performance of the 20th century building stock in terms of energy usage intensity, carbon intensity and other indicators of sustainability performance. EPC data is based on theoretical modelling[16] using regulated energy use only, rather than actual metered energy consumption data for both regulated and unregulated energy uses[17]. It has been widely documented that in practice, there is a "performance gap": buildings do not typically perform as anticipated by design[18].

Nonetheless, the EPC profile of Westminster and the City of London's commercial buildings is useful as an indicator of the scale of retrofit works that will need to be carried out prior to 2030, to meet with evolving MEES regulations. The following chart indicates that this is approximately 74% of the office building stock[19]. Around 50% of buildings – those which have EPC ratings 'D' and 'E' - will need to be upgraded before 2026, whilst the 8% currently listed as having 'F' and 'G' ratings require immediate works to render them legally lettable (on existing leases) from 1 April 2023, unless the landlord has registered an exemption.

**EPC ratings of office buildings (% in each EPC band, by floor area): City of London, Westminster and Total**




Actual operational energy performance data will become more widely available for commercial buildings in future through the use of NABERS UK (launched for offices in 2020)[20] and the proposed government performance-based rating scheme for large commercial and industrial buildings[21]. In London specifically, energy performance monitoring, verification and reporting will be mandatory for new developments for at least five years post-construction[22], and the GLA's post-construction monitoring platform is being developed to collect and display the reported data.

For the time being though, we do not have specific benchmarks available for central London. At a national level, the 2021 REEB benchmark indicates that despite sustained year-on-year improvements in energy performance, 97% of participating offices currently fall short of the UKGBC Energy Use Intensity (EUI) targets for 2035-50[23], further highlighting the scale of the retrofit and redevelopment challenge.

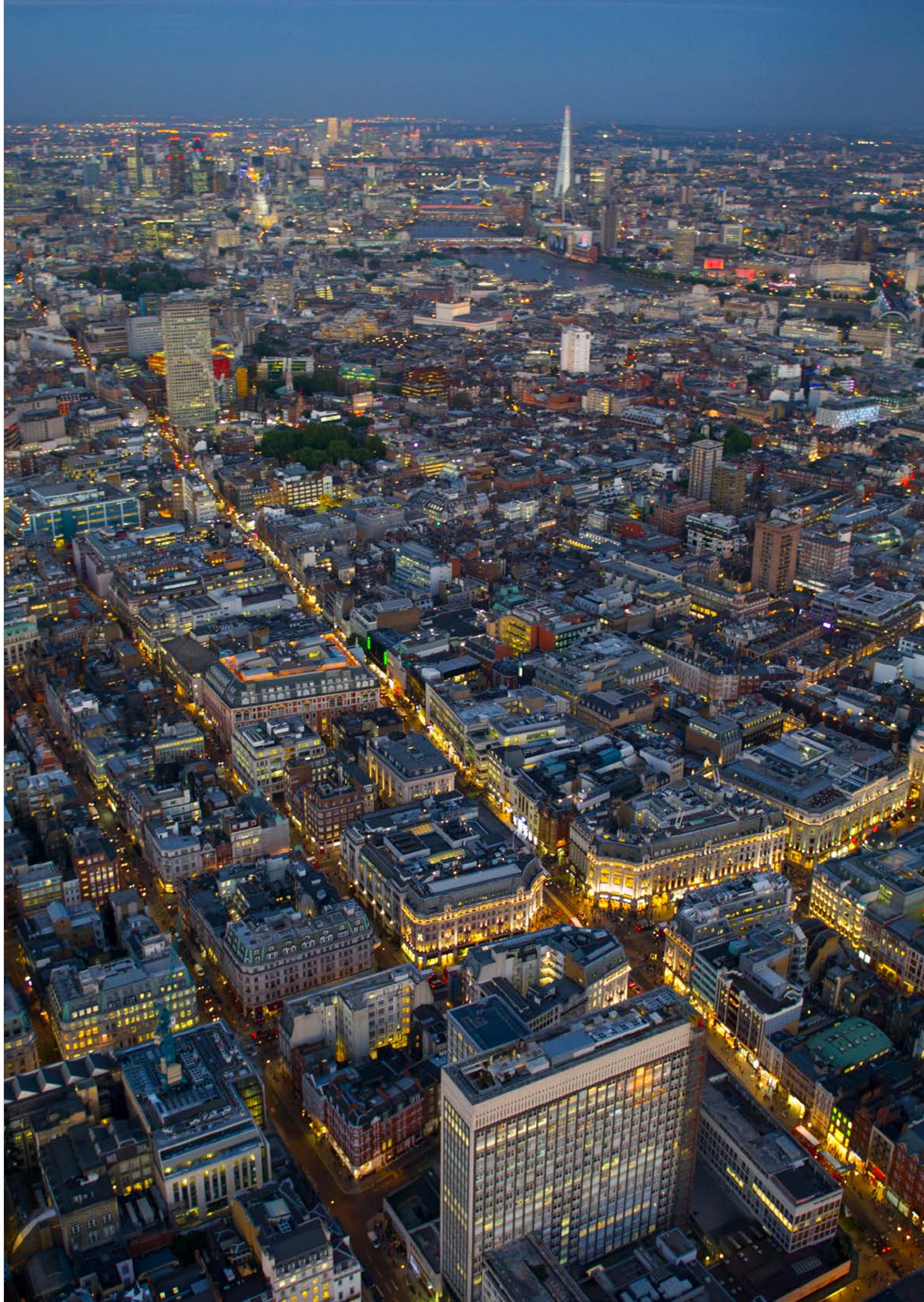
## Age and style matters

The 20th century commercial building stock spans a hugely diverse range of architectural typologies, from the neoclassical, Portland stone facades of the West End's Edwardian department stores and hotels to post-war modern concrete tower blocks and the introduction of the post-modern high-tech steel and glass office towers which now dominate the City of London's skyline.

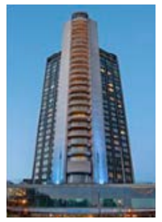
The quality of the existing structure and materials of a building has a significant bearing on its NZC retrofit potential. Poorly constructed or poorly preserved structures may require many lifecycle interventions to maintain their integrity, rendering their retention unfeasible. Low floor to ceiling heights and compromised floor plates can limit the extent to which existing structures and services can be modified or adapted to meet modern occupancy requirements, and windows with poor thermal performance may need to be fully replaced to achieve target energy efficiency values. The presence of corrosion-related damage[24], or toxic materials such as asbestos[25], may also require the removal and replacement of some existing building elements, rendering a 'light touch' retrofit approach unviable.

An analysis of different typologies provides some generic insights into the quality of the 20th century central commercial building stock in Westminster and the City of London, thereby allowing us to identify some common challenges and solutions for delivering zero carbon retrofits based on the characteristics of age, architectural style and construction materials.





1910 | 1920 | 1930 | 1940 | 1950 | 1960 | 1970 | 1980 | 1990

| | | | | | |
|---|---|---|---|---|---|
| **Epoch** | **Edwardian** | **Art deco & interwar** | **Post war** | **Modernism** | **Post-modernism & start of high-tech post modernism** |
| **Design trends** | • Neoclassical styles<br>• Chicago influence – large façades and columns<br>• Department stores & hotels in West End<br>• Introduction of concrete & steel frames makes taller buildings possible<br>• Use of glazed ceramic tiles & Portland stone | • Pastiche of styles with exuberant characteristics and Egyptologist influence<br>• Classical composition & traditional styles in protected city centre districts (e.g., buildings designed by E. L. Lutyens)<br>• Portland stone with complex details and decorative elements<br>• Introduction of radical modern styles (e.g., Daily Express – concrete structure concealed by glass curtain wall) | • Portland stone or brick cladding<br>• Vertical window proportions<br>• Classical style elements<br>• Trend towards open plan office layouts | • Commercial building boom, (mid-50s to early 70s)<br>• Office towers with structural frames of steel or reinforce concrete with highly-glazed curtain walls<br>• Office floors raised over ground-floor shops; lifts and vertical services<br>• Cubicle workstations (1980s)<br>• Variety of cladding materials (plate glass, steel, aluminium, brick, reinforced concrete) | • Diverse approaches; eccentricity & playfulness<br>• 'Ground scrapers' – deep floor plates, perimeter service cores and central atrium<br>• Adaptations of historic buildings<br>• Flexible workspaces with more streamlined services<br>• Predominant use of glass, steel & high-tech production processes<br>• Exposed structures & flexible interiors |
| **Example buildings** | • British Medical Association, 1907-08<br>• Selfridges, 1906-09 (pictured)<br> | • Britannic House, 1924-27<br>• Daily Express, 1932<br>• Daily Telegraph, 1928<br>• Dorchester Hotel, 1930<br>• Midland Bank Head Office, 1924<br>• Palladium House, 1928<br>• Vigo House, 1920-25 (pictured)<br> | • 18-20 Savile Row, (1950s) (pictured)<br>• Time and Life Building, 1951-53<br>• Lloyds Bank Pall Mall, 1956-58<br> | • BT Tower, 1964<br>• Centre Point, 1959-62 (pic.)<br>• Economist Building, 1964<br>• London Hilton, 1963 (pic.)<br>• New Zealand House, 1959-63<br>  | • Embankment Place, 1988-91 (pictured)<br>• Channel 4, 1990-94<br>• Lloyds Building, 1981-86 (pictured)<br>• NatWest Tower, 1980<br>• No. 1 Poultry, 1997<br>• Richmond House, 1982-84<br>  |
| **Common challenges** | • Heritage protections<br>• Historic uses which may affect loading capacity and flexibility<br>• Lack of information about loading capacity and structural integrity<br>• Poor thermal insulation<br>• Poor window performance<br>• Regent Street's Disease<br>• Outdated heating and electrical systems<br>• Inability to retrofit renewable energy generation<br>• Need to be adapted to meet with current accessibility standards | | • Deteriorating / poorly maintained building fabric<br>• Poor overall structural integrity<br>• Poor thermal performance<br>• Low floor to ceiling heights<br>• Inflexible floor plates<br>• Antiquated building services<br>• Presence of asbestos<br>• Lack of active frontages<br>• Inflexible and unattractive interior layout and design<br>• Poor climate adaptation and prone to solar gain and overheating<br>• Lack of passive design features<br>• Poor consideration of adjacent buildings and local character | | • Deteriorating / poorly maintained building fabric<br>• Inefficient layouts<br>• Poor thermal performance<br>• Lack of active frontages |
| **Common opportunities** | • Retention of existing foundations, structure and façade<br>• Retention / enhancement of original aesthetic and heritage features<br>• Use of cross-laminated timber (CLT) and other natural materials for new structural elements<br>• Reuse of existing materials and/or reused materials sourced from other sites, where possible in keeping with original aesthetic<br>• Insulation improvements<br>• Window upgrade or replacement<br>• Natural / mixed mode ventilation<br>• Low energy lighting installation<br>• Air or ground source heat pumps for heating<br>• Integration of flexible open floorplatesrds | | • Retention of structural elements where feasible, and/or reuse of pre-existing material in new construction<br>• Extensive refurbishment or replacement of façade<br>• Use of cross-laminated timber (CLT) and other natural materials for new structural elements<br>• Thermal performance improvements<br>• Window upgrade or replacement<br>• Natural / mixed mode ventilation<br>• Electrification of building systems<br>• Low energy lighting installation<br>• Renewable energy systems installation (e.g., solar PV, air or ground source heat pumps)<br>• Activation of frontages<br>• Activation of roof space<br>• Green infrastructure additions | | • Good floor to ceiling heights (e.g., 'big bang' typology)<br>• Retention of existing façade and structure<br>• Refurbishment of façade<br>• Reuse of pre-existing material in retrofit<br>• Thermal performance improvements<br>• Natural / mixed mode ventilation<br>• Electrification of building systems<br>• Low energy lighting installation<br>• Renewable energy systems installation (e.g., solar PV, air or ground source heat pumps)<br>• Activation of frontages<br>• Activation of roof space<br>• Landscaping improvements and green infrastructure additions |

03

# Delivering Net Zero Carbon

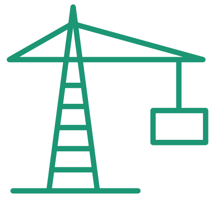
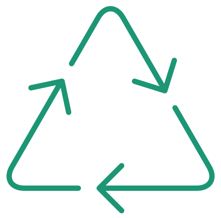
## Delivering Net Zero Carbon

Whilst we await the preparation of the anticipated UK Net Zero Carbon Buildings Standard[26], we refer to the definitions and principles for net zero carbon in construction, operational energy and whole life established by the UK-GBC's net zero carbon buildings framework[27], which have been endorsed by the Mayor of London in his call to action on net zero carbon retrofit.



## Defining net zero carbon buildings

Source: adapted from UK-GBC, 'Net Zero Carbon Buildings: A Framework Definition' (April 2019)

| Scope | Definition | Principles |
|---|---|---|
| **Net Zero carbon construction**<br> | "When the amount of carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy" | 1. Whole life carbon assessment undertaken (module A)<br>2. Strategy and plan to reduce carbon emissions as far as possible<br>3. Embodied carbon impacts from product and construction stages measured and offset at practical completion, using a recognised framework and disclosing the amount of offsets. |
| **Net zero carbon operational energy**<br> | "When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset" | 1. Reductions in energy demand and consumption prioritised overall other measures<br>2. In-use energy consumption calculated and disclosed<br>3. On-site renewable energy source prioritised<br>4. Off-site renewable energy source should demonstrate additionality<br>5. Remaining carbon should be offset using a recognised framework and disclosing the amount of offsets. |
| **Net zero carbon whole life**<br> | "When the amount of carbon emissions associated with a building's embodied and operational impacts over the life of the building, including its disposal, are zero or negative" | 1. Whole life carbon assessment undertaken covering life cycle modules A-D<br>2. Strategy and plan to reduce carbon emissions as far as possible, considering all stages A-D<br>3. Application of NZC construction principle 3 and NZC operational energy principles 1-5 as listed above. Due to current limitations in measuring the carbon emissions associated with a buildings' maintenance, repair, end-of-life stages and beyond, it is not proposed to report and offset of carbon for all life cycle modules. |

With reference to the definitions outlined on the previous page, we consider a net zero carbon building to be one where the embodied and operational carbon emissions have been assessed and reduced to the greatest extent possible, considering the whole building life cycle, and where the residual emissions associated with at least the construction works and operational energy use, have been offset.

To achieve net zero carbon in construction, an upfront embodied carbon assessment should be undertaken to inform strategies which can be implemented to minimise emissions. Upfront embodied carbon impacts associated with building materials and construction should be then measured and offset at practical completion.

Net zero operational energy should be achieved in keeping with the hierarchy of reducing energy demand, supplying energy efficiently, supplying energy through on-site renewable sources, procuring off-site sources that demonstrate additionality and lastly by offsetting any residual emissions.

Under a whole life net zero carbon approach, embodied carbon emissions associated with activities which occur through the full building life cycle (as explained on the next page) would also need to be minimised and the remainder offset.



# Understanding whole life carbon (WLC)

Buildings generate carbon emissions throughout their entire lifetime. These are generally split into two categories: operational carbon emissions and embodied carbon emissions.

## Embodied carbon emissions

Net emissions associated with all the non-operational aspects of a building across its lifetime, including emissions associated with:

- energy consumption and chemical processes during the extraction, manufacture and assembly of materials and components
- transportation of materials to a building site
- resource consumption of construction activities
- maintenance, repair and replacement of components during the operations phase
- demolition and disposal at end of life, and,
- reuse, recovery and recycling of components beyond the building life cycle

## Operational carbon emissions

Emissions associated with the energy required to run a building, such as the energy used to provide lighting, power, heating, cooling, and ventilation.

Equivalent carbon emissions associated with water services and consumption in buildings would also be included as part of operational carbon emissions under WLC assessment.

The embodied carbon impact of a product or element is calculated by carrying out a life cycle assessment (LCA) study which provides an overview of the carbon footprint related to each of the product or element's life cycle stages and is reported in $KgCO^2e$ per unit or per measurement type (volume or weight of material). Embodied carbon is usually associated with the initial phases of a product's life cycle (A1-A3: extraction and manufacturing). However, the embodied carbon produced over the life cycle also includes the carbon emissions from the transportation of the materials on site (A4), the construction processes (A5), any replacement, repair or maintenance of the product or material (B1-B5) and the emissions associated with the end of life, recycling, reusing or disposal (C1-C4).

# Whole life carbon and the building life cycle

**Product**
- A1 Raw materials supply
- A2 Transport
- A3 Manufacturing

**Construction**
- A4 Transport
- A5 Construction & installation process

**Use**
- B1 Use
- B2 Maintenance
- B3 Repair
- B4 Replacement
- B5 Refurbishment
- Operational energy use
- Operational water use

**End of life**
- C1 Deconstruction & demolition
- C2 Transport
- C3 Waste processing
- C4 Disposal

**Beyond building life cycle**
- Benefits & loads
- Reuse
  Recovery
  Recycling

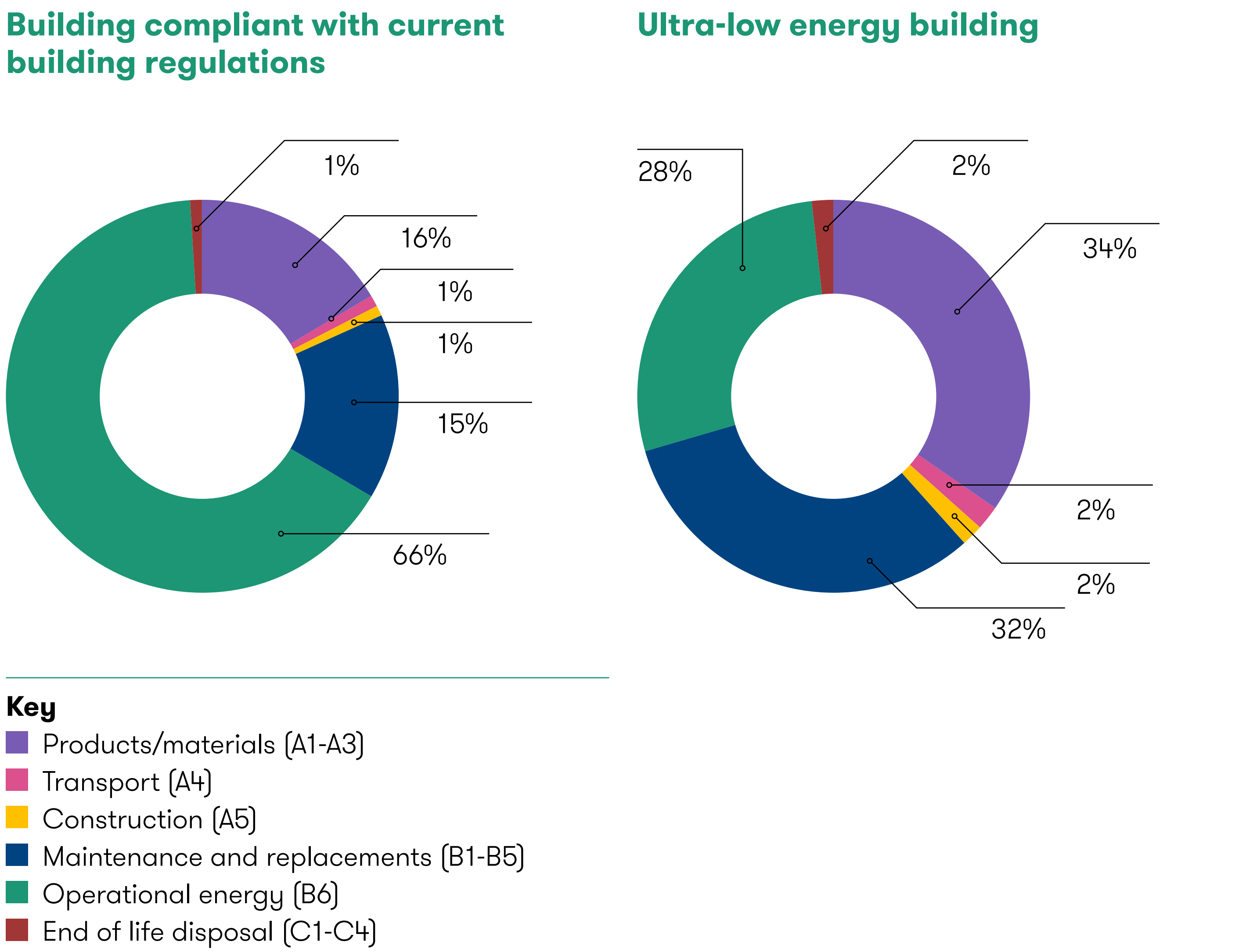
**Legend**
- Embodied carbon
- Operational carbon

Adapted from BSI “Modular information for the assessment as per EN 15978 including typical system boundaries” and WLCN, LETI & RIBA “Improving Consistency in Whole Life Carbon Assessment and Reporting

Around 50% of the world's raw materials are consumed in the development of buildings, hence it can be argued that "the greenest building is the one that's already built"[28]. The construction of new buildings using current techniques and materials typically results in significantly higher upfront embodied carbon emissions, although it can deliver buildings with much lower operational carbon emissions (and potentially lower in-use embodied carbon emissions) when compared with typical practice benchmarks across the existing stock.

The proportions of embodied and operational carbon across a typical building's lifecycle can vary significantly depending on the scope of construction works; the actual level of energy usage intensity achieved and the longevity and maintenance requirements of the asset. Data from RICS[29] and the London Energy Transformation Initiative (LETI)[30] suggest that for a typical new office building, embodied carbon accounts for approximately 33-34% of WLC emissions (with embodied carbon including maintenance, repair and replacement of components during the in-use phase). For an ultra-low energy office building, LETI estimates embodied carbon accounts for 72% of WLC emissions.

Source: LETI Embodied Carbon Primer (January 2020 edition)




A whole life carbon assessment (WLCA) can help to inform both the overall approach (retrofit, redevelopment or hybrid) and potential solutions for minimising emissions through design and materials specifications. It is important that a consistent WLCA methodology is used: the City of London Corporation has noted that recent planning applications have reported WLCA in different ways, with the scope of WLCA differing between industry standards. The London Plan guidance[31], which is recognised as industry-leading, provides comprehensive information for each lifecycle stages A1-D and stages beyond the lifecycle (D). All new major development proposals within the GLA area are required to undertake a WLCA based on the London Plan guidance (Policy SI 2). The City of London Corporation's recent Planning Advice Note also supports the use of the London Plan WLCA guidance[32].

# Asset sustainability strategy and whole life carbon reduction

LETI's Embodied Carbon Primer highlights the significance of both the upfront and in-use embodied carbon emissions, which are more substantially material for all assets regardless of whether they have low or high operational intensity.

A holistic asset sustainability strategy can be synergistic with WLC reduction goals[33]. For example, designing for longevity and climate change resilience reduces the likelihood of future refurbishment. Favouring the use of 'nature-positive' materials and creating green infrastructure can deliver improvements in air quality, occupier health and wellbeing, whilst contributing to upfront embodied carbon reduction. Using construction techniques and specifying materials and equipment to avoid or minimise interventions for maintenance, repair and replacement can reduce resource consumption and disruption to occupiers and reduces embodied carbon during the in-use phase.

In brief, buildings which optimise resource use; increase green space; integrate climate change resilience measures and minimise the extraction of raw materials, the emission of pollutants and waste, will contribute positively to global sustainability goals (as defined by the UN SDGs), national and local sustainability guidance and requirements, along with the benefit of producing lower carbon emissions.

Conversely, buildings that are not designed to support occupier health; be resilient to the physical impacts of climate change or adaptable to evolving changes in stakeholder expectations, run the risk of requiring more intensive interventions over time to attract and retain tenants and sustain their operational performance. This results in additional costs, as well as higher embodied carbon emissions. Occupiers are demonstrating a preference for healthy workplaces that adhere to 'inclusive' and 'circular' design principles. An analysis of responses received via JLL's 2022 Future of Work Survey, demonstrated over 46% of corporate occupiers interviewed expressed plans to accelerate investment in workplace design to improve employee engagement and wellbeing. Whilst there may be potential trade-offs with regards to daylight levels and ventilation enhancements[34], design strategies that promote health and wellbeing are likely to be beneficial from a WLC perspective, by increasing occupier productivity and tenant satisfaction, thereby reducing the frequency and scale of future interventions[35].

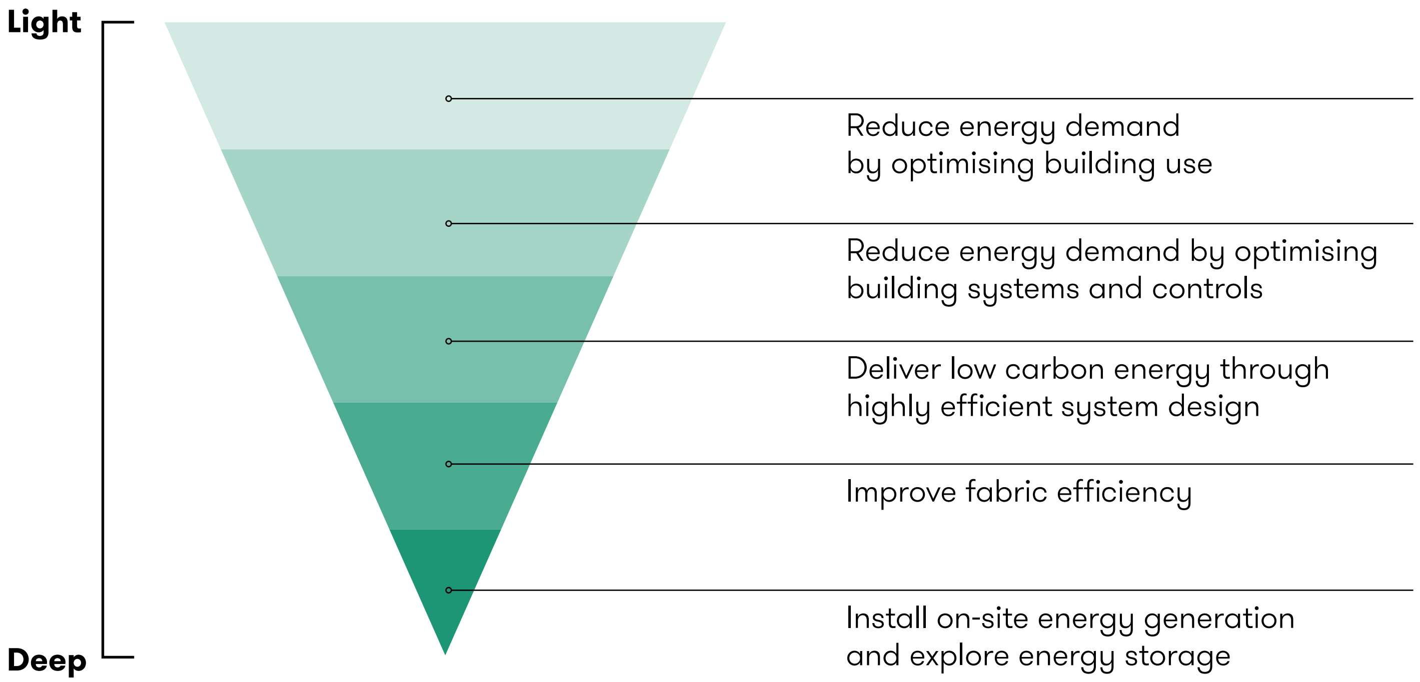


# Operational carbon reduction

**Design approaches to reduce operational carbon emissions in new buildings focus on reducing building energy demand first,** by implementing a range of passive design measures such as optimising building orientation, from factor and glazing ratio, high thermal envelope performance and harnessing natural ventilation. Following the passive design measures, efficient active design measures are then considered, which include highly efficient all electric mechanical systems that can efficiently deliver the building's energy demand. On-site and/or off-site renewable energy generation is then maximised to address any residual operational carbon emissions.

**Retrofitting an existing building to NZC involves a bespoke approach, tailored to the existing building's physical characteristics and current and/or intended uses.** A range of interventions may be deployed, typically grouped as 'light' and 'deep' interventions. We visualise these as a combined hierarchy of interventions, as shown below.

## Figure 1: Hierarchy of retrofit interventions for commercial buildings




'Light retrofit' interventions, with reference to the UK-GBC definition[36], focus on performance optimisation through basic remodelling, replacement, or adaptation of existing building elements. They are often introduced in conjunction with stakeholder engagement to affect behaviour change, further increase the efficiency or maintain good performance of a building that is already performing well, and/or as the first phase of a deeper retrofit as cost effective 'quick wins' which are less disruptive to building operations. 'Light retrofit' interventions are explored in more detail in the WPA's 2021 Zero Carbon Westminster research paper, 'A Focus on Retrofit in Historic Buildings', pages 23 – 27.

'Deep retrofit' interventions are more intrusive and costly, resulting in a significant reduction of energy consumption and carbon emissions. The UK-GBC defines these as "significant works of size or scale that result in a fundamental change to the building structure and/or services"[37]. An extensive range of interventions can be considered including building envelope insulation, façade thermal upgrades, and central mechanical, electrical and plumbing (MEP) upgrades. Such interventions, including the extent of their impact on building energy and carbon intensity and ease of installation and cost implications, are discussed in Appendix A.

Many schemes also consider a hybrid approach to retrofit, where works to the building go beyond extensive refurbishment and upgrade of existing structural elements and/or services, usually involving some demolition and new build as well. Such an approach can include stripping the building back to its structural frame, potentially re-coring it, maintaining substructure (foundations/basement floors) and superstructure (columns/beams) elements, and adding new façade and additional floors. Hybrid approaches are significantly more intrusive and carbon intensive than deep retrofits but can still deliver significant carbon savings compared to complete demolition and rebuild.

As discussed in section 2.4 above, available EPC data from the UK Government and real performance data from REEB suggest that the energy performance of the current commercial building stock falls significantly short of UK-GBC's Paris Proof targets. For most assets, delivering the levels of energy and carbon efficiency required for operational net zero will warrant 'deep retrofit' interventions or, in cases where retrofit is not feasible, a redevelopment approach. Compared to a 'light retrofit', these approaches are more costly and intrusive in the short-term, but they will typically deliver greater added value in the long-term.

Appendix A provides high level guidance on how to approach a 'deep retrofit' for NZC and a table of key interventions assessed against various factors, including practicalities and cost considerations as well as carbon reduction potential.

04

# Retrofit & redevelopment in practice

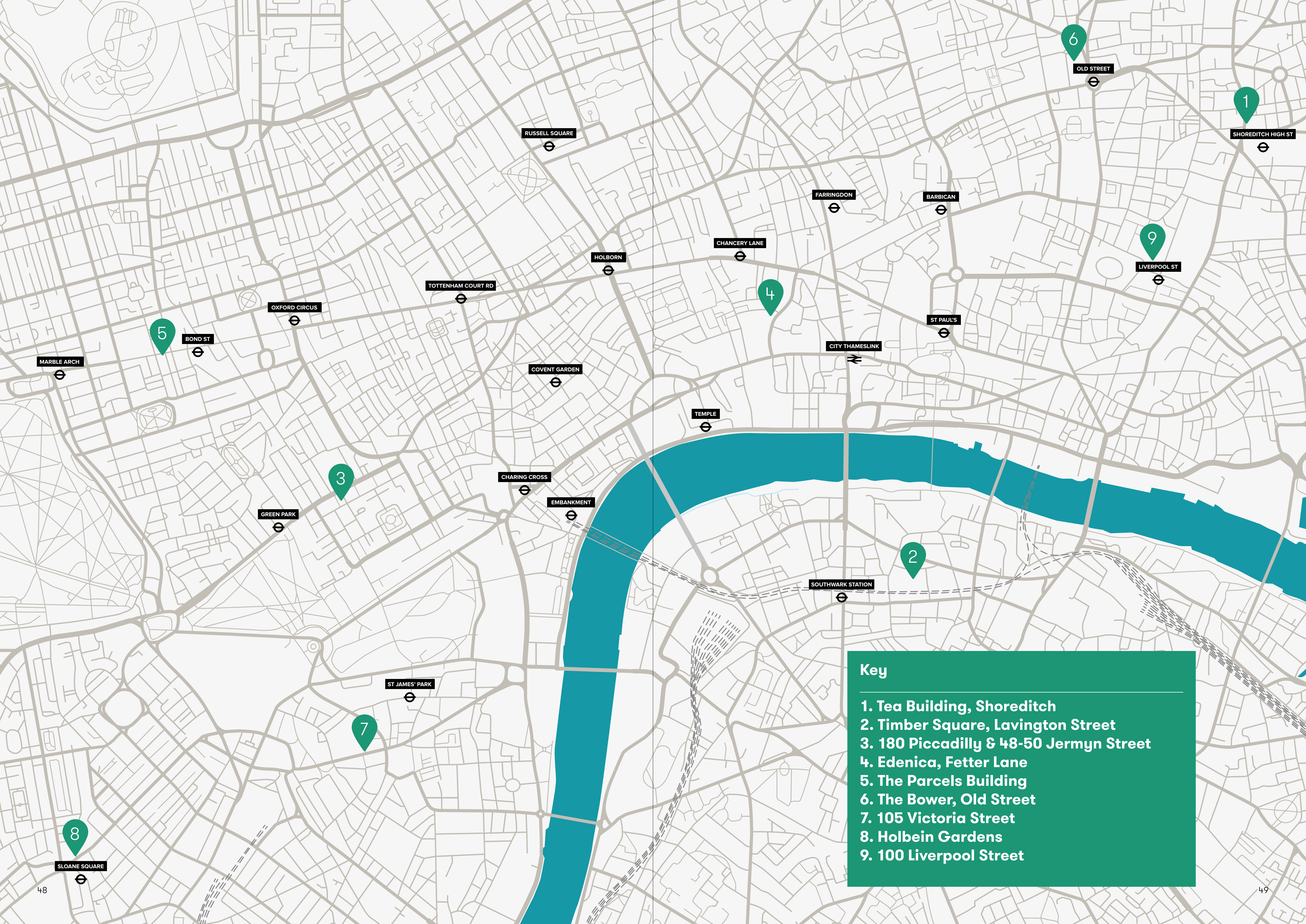
# Overview

To illustrate the spectrum of NZC retrofit approaches undertaken to date across different 20th century commercial building typologies, in April 2022 we issued a request for case studies from WPA and CPA members.

Case studies submitted were reviewed for their suitability with regards to the level of quantitative and qualitative data available and the desire to strike a balance between examples of retrofit, redevelopment and hybrid 'partial retention and rebuild' approaches, whilst including a diverse set of buildings of different ages and styles. This process enabled us to identify a total of nine case studies which are presented in summary below and in detail in Appendix B of this report.

The case studies are intended to provide useful examples of the typical challenges and opportunities associated with retrofitting the 20th century commercial building stock to NZC standards, the types of interventions that can be effectively deployed and key learnings for future projects. Combined with our wider knowledge of NZC retrofit projects completed or underway in central London, the case studies provide the basis of our key findings on retrofit drivers, decision-making and outcomes.

It should be noted that the case study projects presented were initiated between 2014[38] and 2022. During this period the decision maker and policy focus on whole life carbon has sharpened considerably, and policy requirements to consider embodied carbon and undertake WLCA being introduced.


RUSSELL SQUARE
OLD STREET
SHOREDITCH HIGH ST
FARRINGDON
BARBICAN
CHANCERY LANE
HOLBORN
LIVERPOOL ST
TOTTENHAM COURT RD
OXFORD CIRCUS
BOND ST
MARBLE ARCH
ST PAUL'S
CITY THAMESLINK
COVENT GARDEN
TEMPLE
CHARING CROSS
EMBANKMENT
GREEN PARK
SOUTHWARK STATION
ST JAMES' PARK
SLOANE SQUARE
1
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Key
1. Tea Building, Shoreditch
2. Timber Square, Lavington Street
3. 180 Piccadilly & 48-50 Jermyn Street
4. Edenica, Fetter Lane
5. The Parcels Building
6. The Bower, Old Street
7. 105 Victoria Street
8. Holbein Gardens
9. 100 Liverpool Street


# Tea Building, Shoreditch
## Derwent London

**Planning authority:** London Borough of Hackney
**Current/ planned use:** Offices, plus Shoreditch House Members Club and restaurants
**Size:** 25,180 m$^2$
**Typology:** 1930s warehouse
**Project type:** Phased retrofit
**Project timeline:** 2001 (first phase); 2004 (second phase); 2009 – 2011 (improvement works); 2014 – present (Green Tea)

### Context
- Former Lipton bacon-curing plant and tea packing warehouse acquired by Derwent London in 2001.
- Tailored for storage, with open floorplates, four lightwells and a single tenant.
- Constructed to provide light industrial space without environmental cost considerations.

### Drivers for retrofit
1) To create a range of office and studio units of flexible sizes and configurations to attract a diverse mix of occupiers.
2) Upgrade the assets' environmental credentials through a series of passive, active and comprehensive measures.

### Retrofit strategy & key measures
- Provided flexible unit sizes and configurations for office and studio spaces.
- Maintained the building's industrial character and heritage.
- High specification main entrance, circulation upgrade and addition of 'shop fronts'.
- High performance insulation .
- Window replacement.
- LED lighting installation with PIR sensors.
- Hybrid cooling/heating via high efficiency rooftop heat exchanger and hot and cold-water thermal loop.

### Outcomes
- Hub for creative industries with an emphasis on community values and shared amenities.
- 1,500+ people work in and visit the building each day today compared to 5-6 in 2001.
- Energy intensity aligned to UK-GBC 2025-30 targets.
- On pathway to achieve NZC by 2030.

### Challenges, opportunities & lessons learned
The building presented an inherently poor energy performance. Through engagement with architects, and structural engineers Derwent London identified a series of measures which could be implemented in the building to significantly improve its energy performance and deliver a better level of comfort for tenants. One creative example is the A/C system that shares solar gain accumulated via the building's significant thermal mass around the building through a six-storey thermal loop.

Tea Building offers a good template on what can be done with older buildings to give them a new lease of life. Clear and considerate planning and having a long-term masterplan meant that the building could be upgraded on an iterative and flexible process.

Investigating the natural characteristics of the building meant the space was able to be utilised in what otherwise could have been deemed challenging infrastructure, highlighting the importance of case by case assessment when it comes to retrofits.


# Timber Square, Lavington Street

## Landsec

**Planning authority:** London Borough of Southwark
**Current/ planned use:** Offices plus retail
**Size:** 34,374 m$^2$
**Typology:** 1950s industrial, repurposed to offices
**Project type:** Part redevelopment, part retain and extend
**Project timeline:** 2022 – 2025
**Planning approval:** 2020

### Context

- Two linked buildings
- Former printworks, 1980s extension and retrofit works converted to offices.
- Approx. 9,300 m$^2$ 'Print Building' (six storeys, unevenly stacked) with structural frame good condition and generous slab to slab heights.
- Approx. 3,250 m$^2$ Smaller 'Ink Building' (three storeys) with inefficient floor plate, fronted by large unused car park.

### Drivers for retrofit / redevelopment

1) Create a 'sustainable ecosystem' where global corporates sit alongside local start-ups, linked by their desire to make a difference.
2) Deliver characterful, flexible, next generation 'healthy' workspace to attract and retain diverse occupiers.
3) Be one of the UK's first large-scale NZC buildings.

### Retrofit strategy & key measures

### Print Building

- Retention of 85% of the existing structure, with introduction of lightweight hybrid steel and CLT extension.
- Comprehensive retrofit with 'human centric' design approach.

### Ink Building

- Demolition to make way for new 15-storey asset.
- Design for Manufacture and Assembly (DfMA) approach including MMC.
- Flexible workspace built around a central core with good daylight and views, enlivened with terraces and balconies.

### Both buildings

- 'Fabric first' approach to energy and carbon reduction with optimised façade design.
- High-efficiency mechanical ventilation with heat recovery.
- Air Source Heat Pumps proposed as primary heat source.

### Anticipated outcomes

- Vibrant destination with enhanced public realm.
- Targeting £205 million social and local economic value generated during the project lifecycle.
- Embodied carbon intensity of whole development 50% lower than typical office.
- Predicted 5* NABERS rating, BREEAM 'Excellent' and WELL Core.
- UK GBC interim Paris Proof targets for operational carbon; energy intensity below 125 kWh/m$^2$.

### Challenges, opportunities & lessons learned

Retaining the majority of the Print Building reduced the carbon footprint of the redevelopment, the construction period and cost and enabled the retention of the building's heritage aspects. But retaining the Ink Building would have impeded the redevelopment of the site and public realm and access improvements. The use of CLT and steel delivers a solution that is around 20-25% lighter than a conventional structure and provides greater opportunities to create additional space when investigating extensions. CLT is also considered a carbon negative material when carbon sequestration is considered.

# 180 Piccadilly & 48-50 Jermyn Street GPE

**Planning authority:** Westminster City Council
**Current/ planned use:** Offices plus retail and F&B
**Size:** 4,634 $m^2$
**Typology:** Post war modern office building
**Project type:** Redevelopment
**Project timeline:** 2024 – 2026
**Planning approval:** 2021

## Context

- Two buildings constructed in the 1950s and 1960s following WWII bomb damage.
- Internal spaces and layouts are compromised, inflexible and do not meet the requirements of modern office occupiers.
- Energy performance is also poor and the mechanical plant old and outdated.

## Drivers for retrofit / redevelopment

1) Maximise the potential of the site for a larger building providing high quality space.
2) Create an adaptable building that meets modern needs and is resilient for future change.
3) Create a more vibrant, richly modelled building to enhance the architectural character of the area.
4) Meet the highest standards of energy efficiency, embodied carbon and circular economy principles.

## Retrofit strategy & key measures

- Contemporary contextual building to fit with neighbouring listed buildings.
- Proposed massing of six storeys, plus two mansard floors, plus rooftop plant enclosure/ lift overruns.
- Adoption of circular economy principles to reduce WLC, including reuse of foundations; use of reused steel and project to investigate reuse of other existing building elements.
- Flexible open-plan floorplates that can be subdivided to offer different tenancy sizes.
- Highly efficient Mechanical & Electrical services.
- Openable windows for all elevations.

## Anticipated outcomes

- Enhanced architectural character of the conservation area with improved active frontages.
- Flexible space to adapt to future needs.
- NABERS 5* rating; BREEAM 'Excellent' and WELL-enabled.
- 46.6% reduction in $CO^2$ emissions beyond the Part L, 2013 'Gas boiler baseline'.

## Challenges, opportunities & lessons learned

Both buildings present inflexible spaces with low floor to floor heights; cladding which does not meet thermal performance requirements; M&E plant beyond economic life and levels and circulation which do not meet accessibility requirements.

The lack of alignment between storey heights makes it impossible to unify the buildings to deliver the floorplate adjustments required for contemporary workplaces.

It was determined that redevelopment of the existing site presented the best approach to unlock additional commercial space and deliver high quality workplaces to meet identified need within Westminster. Constructing a new building with flexible open-plan floorplates can accommodate for different tenancy sizes and letting arrangements and allow for adaptability to meet evolving market needs. A carefully crafted design can enhance the architectural character of the conservation area, bringing additional benefits to the public realm. Reusing material from both existing buildings and a structural frame consisting of reused steel reduces the embodied carbon of the redevelopment.

N.B. As the freeholder final consent for the scheme is required from The Crown Estate.

# **Edenica, Fetter Lane,** BauMont Real Estate Capital / YardNine

**Planning authority:** City of London Corporation
**Current/ planned use:** Offices plus retail
**Size:** 8,826 m$^2$
**Typology:** Post-war modern, light industrial & offices
**Project type:** Redevelopment
**Project timeline:** 2022 – 2024
**Planning approval:** 2021

## Context

- Unattractive, unoccupied building which did not meet modern occupation standards.
- Originally constructed as a single building with steel and concrete frame for use as printworks and storage.
- Split into two distinct self-contained units and substantially altered in 1970s.
- Poor quality structure and façade; building services no longer fit for purpose.

## Drivers for redevelopment

Create an intelligently designed, high quality workspace with sustainability and user experience at its core.

*"Our intention was to remove the shackles of conventional design so that the team could take a truly un-fettered and holistic approach to the sustainability strategy"* - Maxwell Shand, YardNine

## Retrofit strategy & key measures

- Demolition of existing buildings on site.
- Replacement 12-storey new build office building with a flexible commercial unit and extensive rooftop gardens.
- 'Fabric first' approach to reduce project operational energy use to be reduced to far below regulatory requirements.
- Structural design for flexibility and longevity (e.g., expanded floor to ceiling floor heights; variety of floor plate sizes; use of material passports in the main frame, prefabricated façade elements and other flexible construction techniques).

## Anticipated outcomes

- All-electric building with abundant daylight and natural ventilation; planted terraces and mix of amenities to attract and retain tenants.
- 40% lower upfront embodied carbon intensity compared to typical office development.
- UK-GBC NZC for construction and operation.
- Overall annual estimated energy intensity of 77 kWh/m$^2$, outperforming UK-GBC 2030 target.
- BREEAM 'Outstanding' and WELL 'Platinum-Enabled'.

## Challenges, opportunities & lessons learned

The retrofit of the existing building was considered as the first option from both a cost and sustainability perspective, but proved unviable due to a gamut of factors, including variable and unreliable construction type and materials in the pre-existing building.

WLCA has been undertaken and a range of strategies identified to reduce WLC on the new build scheme. The development is meeting the GLA embodied carbon benchmark for all modules A1-A5 and B-C and also has a lower impact than the Aspirational WLC Benchmark for the Modules B-C. WLC is targeted to be 30% lower than a 'typical' office and operational energy intensity anticipated to be 65% lower.


# **The Parcels Building,** 1a 388-396 Oxford Street, Duke Street Property Ltd, formerly Selfridges Group

**Planning authority:** Westminster City Council
**Current/ planned use:** Offices plus retail
**Size:** 5,450 m$^2$
**Typology:** Post-war modern
**Project type:** Retrofit, including part demolition and extension
**Project timeline:** 2018 - 2022
**Planning approval:** 2019

## Context

- 1957 building of L-shaped on plan with seen storeys along the Oxford Street side and four storeys along Duke Street, connected with neighbouring buildings in the block.
- Existing facade was in need of modernization.
- Reinforced concrete frame with mixture of concrete, stone and brick cladding infill.
- Existing structure presented challenges once stripped out.

## Drivers for retrofit

1) Add value to the asset through a series of extensions to the superstructure, including single storey extensions to seventh and fourth storey wings.
2) Improve building energy performance and occupier comfort and wellbeing.
3) Deliver a more attractive building and enhanced public realm.

## Retrofit strategy & key measures

- New stone façade designed to establish clear relationship to the neighbouring buildings and deliver enhanced thermal performance.
- Remodelling of cores and stairways to improve circulation.
- New extensions with CLT floor panels and steel frame construction to keep increased loads to a minimum and reduce embodied carbon.
- Enhanced fabric insulation and improved U-values of opening, external walls, floor/ ceilings, exposed-roof and ground floor.
- Double-glazed windows to reduce heat loss, and optimised glazing g-value to reduce the risk of summer overheating.
- Energy efficient, electric-led building systems.

## Anticipated outcomes

- Embodied Carbon predicted to meet RIBA 2030 target and the UKGBC / LETI up-front embodied carbon stretch target for 2030.
- Operational Energy Consumption predicted at 99kWh/m2 (NLA) pa which betters 2025-2030 UKGBC target.
- Targeting BREEAM 'Outstanding' for base build and office fit out and targeting 'Excellent' for retail shell.
- Targeting Net Zero Carbon – Construction and Net Zero Carbon – Operational Energy against the UKGBC Framework.

## Challenges, opportunities & lessons learned

Whilst the existing facade and structure were in need of modernisation, the existing building presented optimal internal layouts. The retrofit works undertaken have extended the buildings' useful life with a lower impact in terms of embodied carbon compared to a redevelopment approach. What is more, a demolition and rebuild approach would have presented significant challenges due to the physical structure and site layout.


# The Bower, Old Street
## Helical

**Planning authority:** London Borough of Islington
**Current/ planned use:** Offices, plus retail and restaurants
**Size:** 30,937 m$^2$
**Typology:** 1960s Brutalist office towers
**Project type:** Deep retrofit, including part demolition and extensions of two buildings plus 1,719 m$^2$ new build element
**Project timeline:** 2014 – 2018
**Planning approval:** 2013

### Context:
- Disparate collection of under-performing and overclad but well-constructed buildings dating from 1967 which offered substantial office accommodation.
- One building (207 Old Street) refurbished and reclad in 1984 for British Telecom.

### Drivers for retrofit
1) Create best in class accommodation for future tenants.
2) Connect the buildings to their surroundings and improve public realm quality for occupiers and visitors.
3) Deliver the best outcomes for environmental sustainability and heritage protection.

### Retrofit strategy & key measures
- 'Retrofit first' approach, reusing existing structure and foundations in their entirety.
- Phased approach starting with lighter touch retrofit of the rear building ('The Warehouse') and new low rise construction in unused car park ('The Studio').
- Retrofit and extension of the front building ('The Tower'), adding light weight "wings" on both principal elevations to provide each floor with enhanced daylight and double height volume.

### Outcomes
- Delivered improved connectivity, enhanced building systems with ample tenant plant and service space, and adaptable floorplates.
- Enlivened previously landlocked site with new thoroughfares, piazza and ground level retail.
- Energy intensity below the UKGBC's 2030-25 target and 50% better than current BBP REEB
- BREEAM 'Excellent' certification.
- Attracted occupiers with shared passions and values; launched "The Pledge" programme to support joint activities for social and environmental benefit.

### Challenges, opportunities & lessons learned
The partly landlocked site presented some inherent complexities, meaning that it would likely have been easier logistically to have cleared the site to facilitate a new build. However, in keeping with its 'retrofit first' approach, Helical wanted to extract financial and environmental value from the existing structures.

*"This has been a successful project and were we presented with a similar opportunity today, aside from changes due to advances that have taken place in the intervening period in terms of both technology and sustainability, we would adopt a very similar approach. Carrying out the scheme on a phased basis, maintaining occupation throughout was challenging but necessary in order to manage this large scheme financially"*

– Nikki Dibley, Senior Development Executive, Helical

# 105 Victoria Street
## BentallGreenOak / Welput

**Planning authority:** Westminster City Council
**Current/ planned use:** Offices plus retail
**Size:** 46,450 $m^2$
**Typology:** 1970s department store and offices
**Project type:** Redevelopment
**Project timeline:** 2022 – 2026
**Planning approval:** 2021

### Context
- Current House of Fraser building comprising. two basement, ground and 12 upper storeys
- Concrete beam and slab construction with aluminium, glass and stone façade.
- EPC 'E' rating with antiquated building services.

### Drivers for redevelopment
1) Create best-in-class office accomodation designed to be flexible and future-fit for rapidly evolving ways of working.
2) Deliver the most sustainable new development in Westminster with a building that is all-electric, NZC in operation and minimises WLC, to attract businesses with the highest ESG ambitions.

### Retrofit strategy & key measures
- Demolition of existing department store.
- New build construction with two basement levels, ground floor "Village Square" and mezzanine I plus up to 14-storeys.
- Design and materials selection to manage heat gains and maximise natural ventilation.
- Around 2,787 $m^2$ of greenspace and terracing including rooftop urban farm.
- All electric systems.
- Bespoke combination of spatial qualities, building services, amenities and materials to ensure durability of fabric, functionality and adaptability to create an armature to ensure a long life span.

### Anticipated outcomes
- Multi-tenanted, community focused building with inclusive wellness programme and public amenities including community allotments.
- Highest level sustainability ratings/ certifications: NABERS 5.5* rating; BREEAM 'Outstanding'; WELL 'Platinum'; Active Score 'Platinum 100'.
- Energy intensity aligned to RIBA 2030 targets.
- Embodied carbon below 750 kg $CO^2e/m^2$ (A-C).
- Social Impact Charter for community engagement and upskilling.

### Challenges, opportunities & lessons learned
The project team considered the option to retrofit and extend the existing building, however due to the layout; column density and low floor to ceiling height within a large floor plate, retrofit was discounted as a viable option. Moreover, the WLCA conformed that the new build option would be more carbon efficient. The highly sustainable new build product is forecast to repay the embodied carbon spent within six years due to its substantially lower operational carbon intensity.

*"Sustainability is not just about environmental considerations, it needs to respond to the social influence of the development; the social interaction with the building user and the interface with the surrounding area"*
– Alexander Morris, Bentall Green Oak


# Holbein Gardens

## Grosvenor

**Planning authority:** Royal Borough of Kensington & Chelsea
**Current/ planned use:** Offices
**Size:** 2,399 m$^2$
**Typology:** 1980s brick office block
**Project type:** Retrofit and one story extension
**Project timeline:** 2021 – 2022
**Planning approval:** 2021

**Context:**
- Concrete structure with brick façade (new floors comprise reclaimed steel).
- Low thermal performing fabric with large cavities.

**Drivers for retrofit**
1) Create a leading NZC office development, providing best in class office space with exemplar sustainable design, and
2) Prove the potential for transforming outdated offices into exemplary NZC workspaces, targeting innovative ways in which the environmental impact of retrofitting buildings can be minimised.

**Retrofit strategy & key measures**
- Retention of existing building with façade interventions and new roof extension.
- Building fabric upgrade to improve thermal efficiency (new mineral wool insulation within cavities and high performance insulation to the internal wall linings).
- Façade refurbishment and installation of new openable windows linked to the BMS.
- All-electric with efficient lighting and equipment.
- Use of low embodied carbon products.
- Significant landscaping improvements and green infrastructure to improve public realm.

**Anticipated outcomes**
- Occupier to save 50% on energy compared to typical London offices.
- Embodied carbon circa 300 kgCO$^2$/m$^2$ (modules A1-5), exceeding LETI Pioneer Project target.
- High/ highest level sustainability ratings/ certifications (NABERS 4.5, BREEAM 'Outstanding' and WELL 'Platinum').
- NZC in line with UK-GBC framework, target energy intensity 91 kWh/m$^2$/year.
- 200% biodiversity net gain.
- Estimated 50 local jobs created through circular economy building strategy.

**Challenges, opportunities & lessons learned**
The goal to deliver maximum possible WLC reduction tested the project team's capabilities, leading to acquisition of experience and know-how that will enable more efficient delivery of NZC projects going forwards. Specific challenges encountered included the lack of quality assurance for some recovered building products, inconsistent availability of EPDs and higher cost of reused steel. On the other hand, the reuse of the building's orignial steel frame enabled cost savings. The retrofit approach implied some compromise on flexibility, but as a more carbon efficient option, it enables Grosvenor to market the scheme as a WLC pioneer.

# 100 Liverpool Street
## British Land

**Planning authority:** City of London Corporation
**Current/ planned use:** Offices plus retail and F&B
**Size:** 50,539 m$^2$
**Typology:** 1980s finance industry building
**Project type:** Combined retrofit and redevelopment (50% of existing structure retained)
**Project timeline:** 2017 – 2020
**Planning approval:** 2015

### Context:
- Existing 'Big Bang'-era buildings designed by Arup were successful in their time but needed modernistation.
- Presented awkward layouts and poor energy performance but offered generous floor to ceiling heights, a large structural grid and detailed architectural and engineering records.

### Drivers for redevelopment
1) Redefine existing buildings to meet occupier demand for high quality, flexible, sustainable space.
2) Deliver improvements to the public realm.

### Retrofit strategy & key measures
- Combined approach of 50:50 reuse and new build.
- Combined two separate structures, 100 Liverpool Street and 8-12 Broadgate, into one single building.
- Extensive retrofit works including full services replacement, full façade replacement and reconfiguration of the floor plates.
- Use of low embodied carbon products.
- Addition of three new floors above the existing building plus 2,415 m$^2$ of terraces and 450 m$^2$ PV installation.

### Outcomes
- Fully let, tenants include several international finance firms.
- British Land's first NZC development.
- Embodied carbon of 389 kgCO$^2$e/m$^2$ (A1-A5).
- Energy intensity 89 kWhe/m$^2$ (TM54 calculation).
- BREEAM 'Outstanding' and WELL 'Gold'.
- Improved accessibility, increased asset flexibility and enhanced retail offer.

### Challenges, opportunities & lessons learned
The redevelopment process presented some significant challenges due to the buildings' location above and adjacent to three major transport hubs and the Broadgate Circle public space.

From the outset, ambitious goals were set for sustainability performance and embedded into the early contractual obligations. The project team had to constantly monitor and work with all parties involved in the project, to ensure that these standards were understood and implemented.

Tackling these and other specific technical and logistical complexities required a high degree of skill from the architectural, engineering and project management teams, raising standards and honing skills and experience for future retrofit projects.

The quality of data on the existing building was key. To make the right decisions, project teams need access to the right information. British Land is taking care to ensure that developments designed now are rigorously documented to facilitate future adaptations and reuse.

# Key findings

## 1) NZC is being delivered through both retrofit and rebuild approaches, and Whole Life Carbon Assessment (WLCA) is used to determine and/or validate the approach pursued

Buildings that are (or are targeting) NZC in construction and operation are being delivered through both retrofit and redevelopment of central London's 20th century commercial stock, as is demonstrated by schemes such as Holbein Gardens; Timber Square; 100 Liverpool Street; Edenica and 105 Victoria Street. The use of WLCA enables developers to identify and/ or confirm which is the most effective retrofit approach from a NZC perspective.

At Holbein Gardens, a retrofit approach was pursued and WLC updates were repeated during the design phase to confirm that the project's upfront carbon was on track to meet targets. At The Bower, where Helical deployed a 'retrofit first' approach, assessment demonstrated that a retrofit and remodelling strategy was more carbon efficient than demolishing and rebuilding. By contrast, at 105 Victoria Street, the WLCA concluded that a redevelopment approach would be more efficient from a WLC perspective compared to retrofitting the poorly constructed 1970s building.

In cases where the retrofit of an existing building is deemed unviable, WLCA is being used to identify means to minimise the lifecycle carbon emissions of the redevelopment. At 100 Fetter Lane (Edenica), where NZC for construction is targeted in line with the UKGBC definition, WLCA was undertaken and a procurement strategy devised to support embodied carbon reduction. At 180 Piccadilly, 48-50 Jermyn Street, 2 Aldermanbury Square & and 4 Basinghall Street[39], circular economy principles have been embedded into design and procurement to support carbon reduction objectives. This has led to the re-use and reconditioning of 1,200 tonnes of structural steel from the demolition of the existing building at the latter site to complete the structural frame of 180 Piccadilly & 48-50 Jermyn Street. At British Land's 1 Broadgate (not featured as a case study), opportunities to reduce embodied carbon were comprehensively explored. Consequently, 200 tonnes of façade material from the demolished building have been repurposed for the flooring of the new building, and the façade of the new building has been designed as a "kit of parts" to adapt and respond to future needs. Long-span steel beams and bolted connections have been used to facilitate deconstruction.



## 2) Developers are increasingly adopting a 'retrofit first' approach and only pursuing other strategies where retrofit is not viable

Schemes which involve full or partial redevelopment tend to do so after exploring retrofit first. At 105 Victoria Street, the option to retrofit and extend the existing building was considered but was deemed unviable for structural reasons. At 180 Piccadilly, 48-50 Jermyn Street and 100 Fetter Lane (Edenica), the retrofit of the existing buildings was analysed as the first option from both a cost and sustainability perspective but proved unfeasible principally due to problems presented by the buildings' structures and layouts.

At 100 Liverpool Street, studies carried out at the start of the design process to investigate both new build and retrofit options concluded that whilst site and land ownership constraints rendered full demolition impractical, the configuration of the existing building meant that a 'light touch' retrofit would not deliver the desired outcomes. Consequently, a combined approach of reuse and redevelopment was implemented to achieve the developer's objectives of creating high-quality, flexible, sustainable space.

At 1 Marble Arch and 1 Great Cumberland Place (a 1920s building not featured as a stand-alone case study), the project team investigated a 'retrofit first' approach to reduce upfront carbon and preserve the building's historical character. However, it quickly became clear that a 'light touch' retrofit would not deliver a product with a sufficient lifespan to meet the investor's long-term ambitions, and it subsequently proved unfeasible to retain the existing structure due to the constraints of the existing structural grid. As such, it was determined to rebuild and extend the structure whilst preserving the historical façade. However, in retrospect, redevelopment of the façade would have in fact resulted in lower upfront carbon than façade refurbishment, which required the use of temporary steels[40].

Image: 1 Marble Arch and 1 Great Cumberland Place, The Portman Estate

## 3) Retrofit is most often viable for buildings which present a specific set of characteristics. Redevelopment is most often pursued when these characteristics are not present.

As is to be expected, retrofit is most often viable for buildings which present overall good architectural quality, with a robust structure and foundations. Integral to this is an ability to attest to the robustness of foundations and structural frame via detailed architectural and engineering records and/or deep site investigation. Specific characteristics which are consistently identified in the case studies as being critical for retrofit viability include:

- Sufficient load bearing capacity to support extensions
- Generous floor to ceiling heights
- Large floor plates
- Flexibility to adapt internal layouts
- Sufficient space to allow for the retrofitting of new plant
- Ability to make the building accessibility-compliant
- Access to architectural and engineering records
- Feasibly to carry out deep site investigation as/where required

Altogether, the presence of these characteristics increases the likelihood that the retrofit will deliver a building that is viable for long-term use, being carbon-efficient and of high quality and flexible design and build. They can also be considered as key features which should be integrated into the design of new developments to facilitate their future adaptability and longevity. By contrast, the absence of these characteristics is likely to weigh in favour of a demolition and redevelopment approach: buildings which are of poorer quality design and construction, have an insufficiently robust structure and/or unadaptable layouts present greater technical difficulties and less potential to unlock additional commercial value[41].

The Tea Building, a 1930s warehouse, had a robust structure and open floorplates, allowing for the possibility to create a range of office and studio units of flexible sizes and configurations whilst maintaining the original aesthetic. The East Building at Timber Square (1959) had been originally developed for industrial use, which meant that (like the Tea Building) it had good structural capacity and could accommodate increased loads without foundation strengthening. At 207 and 211 Old Street (The Bower), the 1967 Brutalist style blocks were in a dilapidated condition but the structure and foundations, which were of robust construction,



could be used in their entirety in the new scheme. The Angel Building (1980s; not featured as a stand-alone case study) had an inefficient layout and deteriorating fabric, but it was viable to reuse the building frame due to the good floor to ceiling heights of the in-situ frame and the potential to obtain additional space by utilising the open central courtyard to increase floor area.

The Parcels Building (1957) presented a structure and facade in need of modernisation, but favourable layouts, and constraints around the site, made deep retrofit a better option. Post-retrofit, the building boasts substantially improved energy performance, attractiveness and longevity.

By contrast, at 105 Victoria Street, retrofit was discounted as a viable option due to the layout; column intensity and the floor to ceiling configuration within a large floor plate in the department store / office building (constructed 1976), and at 100 Fetter Lane (Edenica), a wide range of barriers to retrofit were encountered, including concerns over the building's structural integrity; outdated and inflexible building services and a structure and layout that could not be adapted to meet accessibility standards without substantial demolition.

At 100 Liverpool Street (1989), generous floor to ceiling heights, a large structural grid and detailed architectural and engineering records facilitated the retention of the structural frame, basement and foundations. However, inefficient and inflexible layouts, along with poor energy and sustainability performance, drove the decision to demolish the remaining 50% of the building in order to deliver full services replacement, full façade replacement and floor plate reconfiguration in addition to the three-storey extension.

**4) Retrofit and redevelopment projects employ a plethora of measures to reduce whole life carbon. Retention of existing foundations and structures, façade refurbishment and building systems and equipment upgrades are most important for retrofit. On redevelopment schemes, reusing demolition materials and other low carbon products along with modern methods of construction reduces upfront embodied carbon, and there is generally flexibility to explore a wider range of passive and active design measures to reduce operational energy demand.**

Drawing from the case studies analysed for this report and wider industry insights, we can highlight the most common strategies deployed to deliver WLC reduction in retrofits and redevelopments (see Table 1 on the following page). Many of these also deliver co-benefits such as cost reduction, occupier health promotion, heritage preservation and public realm enhancement. We also see that developers are pioneering new approaches and innovative techniques to deliver NZC and other sustainability goals, such as:

- the reuse of strip out or demolition materials from the same or other project sites;
- the use of lightweight cross-laminated timber (CLT) and steel extensions
- the use of prefabricated façade
- efficient design approaches including DfMA and DfD/A and the use of building materials passports

This is helping project teams to acquire new skills and experience and share learnings, with mutual benefits for organisations along the real estate value chain.

For most retrofit projects, the retention of existing structure, foundations and façade deliver the greatest reductions in upfront carbon emissions (WLCA modules A1-A5), whilst highly efficient building systems' upgrades tend to contribute most to lowering operational carbon intensity. To deliver NZC in operational energy, the most important and the most significant intervention is the replacement of the fossil fuel (mains gas) powered systems with systems that use mains electricity.



On redevelopment projects, where upfront carbon emissions are inevitably likely to be higher in comparison with a retrofit approach, project teams are making efforts to reuse demolition materials and source repurposed or recycled input materials to bring emissions below benchmark levels (and it is hoped further innovations will continue to help these reductions). Redevelopments on the other hand do tend to offer greater scope for operational carbon intensity reduction by means of both passive and active design measures, including the integration of renewable energy systems.

Whilst many of the NZC interventions listed in Table 1 above are common in both retrofit and redevelopment projects, redevelopments apply the energy hierarchy starting with the "fabric first" (passive design) approach, followed by active measures to optimise energy demand; opportunities to supply energy efficiently and integrate renewable energy systems. Circular economy design approaches, such as modular and dry construction methods, the selection of durable materials that can be repurposed at end of life and use of building materials passports contribute to comparatively lower 'end of life' and 'beyond building life cycle' carbon emissions (WLCA modules C + D).

**Table 1: Common strategies deployed in retrofit and redevelopment to reduce WLC, based on case study review**

It should be noted that a hybrid approach could include a mix of all these measures

| Strategies | Most common application | Retrofit | Redevelopment |
|---|---|---|---|
| **Embodied carbon** | | | |
| **Structure and building fabric** | Retention of existing foundations and structure as far as possible | | |
| | Lightweight extensions including the use of cross-laminated timber (CLT) and lightweight steel to allow for the retention of existing structures with lower load bearing capacity | | |
| | Refurbishment of façade, to improve thermal performance, often maintaining the original aesthetic | | |
| | Window replacement or refurbishment, optimising glazing performance | | |
| | Other building fabric improvements (improved insulation and airtightness levels) | | |

| Strategies | Most common application | Retrofit | Redevelopment |
|---|---|---|---|
| | Heat recovery and 'night purging' strategies to increase thermal efficiency | ■ | |
| | New, passive design measures to minimise winter heat losses and summer heat gains | | ■ |
| | New high performance building envelope and glazed façades | | ■ |
| | Cross-laminated timber (CLT) and steel hybrid structures | | ■ |
| | Expanded floor to ceiling heights and variety of floor plate sizes to support flexibility and longevity | | ■ |
| **Materials** | Reuse/ repurposing of existing materials in situ where feasible, and reused materials sourced from other sites | ■ | ■ |
| | Use of (other) low carbon materials; e.g., concrete mixes with low or no cement, CLT, recycled steel | ■ | ■ |
| | Procurement of timber from certified sustainable sources | ■ | ■ |
| | Use of modern methods of construction (MMC) | | ■ |
| | Use of building materials passport scheme | | ■ |
| | Design for Manufacture and Assemble (DfMA) | | ■ |
| **Building services** | All electric HVAC systems, i.e Heat Pumps | ■ | ■ |
| | Mixed mode ventilation through operable windows | ■ | ■ |
| | Installation of LED lighting and occupancy/daylight controls | ■ | ■ |
| | Rooftop solar PV installations | ■ | ■ |
| | Installation of smart metering systems and BMS | ■ | ■ |
| **Layouts** | Remodelling of cores to improve circulation and connectivity | ■ | ■ |
| | Creation of flexible workspaces | ■ | ■ |
| | Maximisation of lettable area | ■ | ■ |
| | Design for adaptability | ■ | ■ |
| | Increased plant and service spaces | ■ | ■ |



## 5) Retrofit and redevelopment projects are driven by other factors besides NZC, and deliver a wider range of positive sustainability outcomes

Our research identified that the primary driver for commercial building retrofit is to unlock the potential of economically and/or environmentally stranded assets and maximise their value. This may involve repurposing their use (e.g., from industrial to office and retail) and increasing their lettable floor space; and it almost always involves creating adaptable and inspiring spaces that will appeal to office occupiers.

Sustainability is integral to these goals and is being driven by occupier expectations, investment market demand, regulatory and planning requirements, and developers' own sustainability commitments, including science-based targets, NZC pathways, targets linked to standards and ratings such as BREEAM, NABERS and WELL and ambitions to generate positive social impact and enhance the public realm. As such, NZC is generally approached within the context of a holistic asset sustainability strategy and is one of a wider range of positive outcomes delivered.

**Most notable among the case studies presented and other projects reviewed were:**

### Green infrastructure and biodiversity gain

Examples:
- Planted façades and green walls, terraces, balconies and ground-level spaces, prioritising native species and pollinator plants
- Biodiversity net gain

### Climate change resilience

Examples:
- Façade design to reduce overheating risk
- SUDs with best practice surface water run-off rate
- Green infrastructure
- On-site urban agriculture
- Water conservation measures like rainwater harvesting

### Circular economy

Examples:
- Design and construction for flexibility and longevity and durability
- Design for disassembly
- Use of 'waste' demolition materials in situ and/or from other projects
- Revitalisation of previously un- or underused space

### Health and wellbeing

-Biophilic design elements (patterns, colours, natural materials, 'green' features and views)
- Optimal daylight levels
- Natural ventilation
- Outdoor break-out spaces
- On-site gym/ exercise spaces
- Active travel facilities

### Socio-economic value

Examples:
- Creation of public spaces and pedestrian routes
- Accessibility for people with different needs
- Space target to or ringfenced for SMEs
- Procurement strategy including Living Wage commitment, local suppliers and SMEs
- Youth employment and training programmes

### Commercial value

Examples:
- Successful leasing to high calibre tenants
- Tenant satisfaction, retention and engagement with strong relationships built on shared ethos
- Attractive, active frontages and pedestrian routes/ public spaces to increase footfall and dwell time
- Operational cost reductions



## 6) The delivery of NZC buildings presents common challenges to developers regardless of the approach they pursue, including costs and budget constraints, skills shortages, lack of reliable building information and occupier engagement to maintain target energy performance.

One of the most common challenges cited is the lack of internal capacity and external availability of specialist skills, both for NZC development and retrofit and the operation and maintenance of the systems and equipment inherent to NZC buildings. Developers also highlight the additional costs associated with lower embodied carbon materials and NZC infrastructure; the practical difficulties of obtaining reliable information about the embodied carbon of building products and the ability to attest to the quality and reliability of materials repurposed or reused from other sites.

For all schemes exploring a 'retrofit first' approach, the lack of availability of historical data, structural drawings, engineering records and survey information that attest to the structural robustness, construction methods and materials used in existing buildings can significantly hinder informed decision-making and entails additional risks. Indeed, we are aware of three projects where unanticipated defects were uncovered in the structure or facade. On one of these, the project team is confident that deep retrofit was the right approach, but on the other , analysis suggested that retention of complex structures may have resulted in higher upfront carbon emissions compared to a new build approach[42].

Unsurprisingly, occupier behaviour continues to pose a challenge in ensuring that operational energy performance is maintained at target levels. Landlords are actively addressing this through occupier engagement and advanced energy monitoring systems. For example, Derwent London is collaborating with occupiers to set targets and benchmarks to reduce emissions associated with energy use in the spaces they occupy, and Grosvenor's Circular Neighbourhoods programme has brought together businesses, residents and retailers to identify opportunities to reduce building energy use. British Land has introduced BL:Connect, an occupancy based smart building management tool which collects data from thousands of energy consuming and monitoring devices to provide data on how spaces are being used and in what conditions, to identify opportunities to increase efficiency.

**7) NZC is most effectively delivered via a strategy that is tailored to the individual asset, both its physical attributes and long-term commercial proposition. Retrofit, redevelopment and hybrid approaches can each be effective, and there is no 'one size fits all' solution.**

Retrofits typically result in lower upfront carbon; less resource use and entail lower costs in comparison with redevelopment. They are also likely to be the most viable – or indeed only viable – solution for listed heritage assets and buildings which present physical constraints preventing demolition and redevelopment. However, reusing an existing structure can compromise the level of structural flexibility in comparison with a redevelopment, meaning that whilst the upfront embodied carbon balance of a retrofit is lower, the in-use and end of life embodied carbon may be higher compared to a redevelopment approach.

Redevelopments tend to have much higher upfront carbon – in the examples we have reviewed it is typically two to three times higher, even though this can be somewhat reduced through the reuse of some existing elements; a procurement strategy that favours locally sourced, re-used and lower carbon input materials (including CLT, low carbon concrete and steel) and the use of MMC. On the other hand, greater design flexibility allows for the development of a structure and sub-structure that is durable and adaptable to future uses, construction techniques that allow for easier maintenance, disassembly, and reuse to reduce embodied carbon emissions through the in-use phase and beyond.

With regards to operational carbon intensity, the case studies suggest that for buildings which present favourable characteristics, it is possible to achieve levels of performance in line with best practice benchmarks through retrofit, even though this tends to be easier with redevelopment schemes. There are examples of deep retrofit, hybrid and redevelopment schemes which are delivering – or are forecast to deliver – annual operational energy intensity that is aligned to the UK-GBC's 2030 targets; EPA 'A' ratings and NABERS UK 4.5 – 5* ratings.

Observations from the case studies suggest that NZC is most effectively delivered via a strategy that is tailored to the individual asset, both its physical attributes and long-term commercial proposition.

05

# Unlocking delivery through cultural, market and planning policy shifts

# Recommendations for property owners

Drawing on our research, experience, engagement with WPA and CPA members and key findings from the case studies presented, we propose a succinct set of step-by-step recommendations and tools for property owners seeking to deliver NZC buildings.

## Recommendation 1: Develop a portfolio strategy for NZC transition

- All buildings in the UK will need to be net zero carbon by 2050.
- Developing a portfolio level NZC pathway and action plan with support from experienced sustainability professionals can enable you to integrate NZC into decision-making at each stage of the investment lifecycle to meet evolving regulatory and industry standards and customer demand and protect and enhance value.
- A portfolio-level NZC pathway provides a framework that informs policies and procedures for acquisitions, developments, and asset management to enable NZC transition.
- Continued professional development on the topic of NZC should be promoted to support investment, development, asset and property managers in implementing NZC policies.
- As such, it should help to ensure that NZC is fully embedded into asset level strategies, ensuring that any planned retrofits and other interventions from the outset follow a ‘retrofit-first’ principle but include an assessment of options to deliver NZC in the context of an holistic asset sustainability strategy (see Recommendations 2 and 4).



## Recommendation 2: Develop asset sustainability strategies with consideration to economic, environmental and social aspects

- Asset level sustainability should include consideration of economic, environmental, and social aspects, with the objective of sustaining long-term asset values.
- To identify material (most significant) sustainability aspects, property owners should draw on sustainability expertise within their internal teams and external advisors, and be informed about –
  - o Priorities of the local council area in which the asset is situated
  - o Policies, objectives, and feedback from existing or target occupiers
  - o Anticipated market trends
  - o Investors’ portfolio strategy and goals, including NZC transition plan (as per Recommendation 1).
- The infographic below provides an illustration of the thematic areas and specific factors which may be considered, and materiality analyses that should be applied.
- Asset sustainability strategies should include an action plan and budget for achieving NZC within an appropriate timeframe taking into account key leasing events to identify the best moment for intervention.

## Sustainability aspects

### Protecting the earth

- Climate change
- Biodiversity
- Freshwater use
- Pollution to air, land & water

### Improving quality of life

- Health & wellbeing
- Education & employment
- Inclusivity & social equity
- Cultural & natural heritage
- Climate change adaptation
- Resource optimisation
- Direct & indirect economic value creation

## Materiality analysis

### 1. Investors' strategy & objectives

- Commercial strategy & financial targets
- Sustainability strategy & objectives
- Alignment with industry standards (eg UK-GBC pathway, NABERS, RIBA targets)

### 2. Institutional stakeholders & communities

- Regulatory requirements (eg Building Regulations, MEES, Heat & Building strategy
- London Plan requirements & guidance
- Local Authority Planning requirements & guidance
- Local Authority engagement
- Local community engagement

### 3. Market trends & occupier demands

- Market analysis (occupier demand, 'green premium')
- Occupier sustainability policies & targets
- Occupier engagement

### 4. Site-specific risks & opportunities

- Climate change risk analysis
- Physical site investigation
- NZC & sustainability appraisal including best available tools & techniques

## Asset sustainability strategy

- Material sustainability aspects
- SMART targets
- Performance indicators & scorecards

## Recommendation 3: When the opportunity for asset intervention is identified, engage all key stakeholders to set the initial project brief

- Each project is likely to have a unique set of key stakeholders, including property owners, investors, planning authorities, design teams, construction teams and others, who will each bring their own principles and priorities.
- Identifying and engaging these stakeholders from the outset of the project means that the project can be administered based on a customised, shared set of principles and objectives.
- Stakeholders should be informed about the portfolio level NZC pathway and asset level sustainability strategy and use these documents to help guide decision-making.
- The LETI Climate Emergency Design Guide[43] provides a reference guide for actions than should be taken at each RIBA stage to facilitate the delivery of a NZC building, including actions for the designer and for the Life Cycle Assessment (LCA) specialist.

## Recommendation 4: Undertake a whole life carbon assessment (WLCA) based on a robust methodology

- At the point at which the opportunity for asset intervention is first identified, property owners should undertake the first WLCA based on a robust methodology[44] that covers the entirety of modules A to D.
- The WLCA should demonstrate the most effective approach to reducing carbon emissions across the whole building lifecycle, and the quantitative results should feed into the NZC options assessment (see Recommendation 5).
- The WLCA should be updated at the end of each RIBA project design stage up to practical completion (PC) and at key intervals during the course of the project.



## Recommendation 5: Assess a range of options to deliver NZC within the context of the asset's sustainability strategy. Apply a robust methodology to quantify and compare the likely costs, impacts and benefits of each option.

- Consider a range of options that includes retrofit first, but also including hybrid and full-scale redevelopment approaches and weigh up the likely outcomes, advantages and disadvantages of each approach.
- Use a quantitative assessment method that encompasses cost, ROI, NZC and other sustainability factors linked to the asset sustainability strategy. This should include:
  - o Key performance indicators (KPIs) to assess these factors; both "objective KPIs" linked to industry standards (e.g., operational carbon intensity, embodied carbon intensity) and "subjective KPIs" linked to key stakeholders' aspirations (e.g., low energy bills, reduced carbon emissions associated, enhanced health & wellbeing, inclusivity, access to biophilic elements, etc.).
  - o Specific metrics that the scheme should deliver to (e.g., UK-GBC Paris-proof energy performance targets for offices; LETI pioneer project embodied carbon target; NABERS UK Design for Performance rating).
- Undertake consultation with all key project stakeholders to ensure that the selected KPIs cover all their requirements and discuss and agree the level of priority ("weighting") which should be assigned to each metric.
- Test each option; review and calibrate the findings and incorporate the final assessment into decision-making.
- Ensure that a documented record of this assessment is available throughout the duration of the project to ensure that all stakeholders – including current and future personnel within project and planning teams – have a clear understanding of how the NZC approach was determined.

The NZC project decision-making tool developed by JLL provides a freely accessible template for project teams to do this, along with further guidance on the process described above.

# Recommendations for policymakers

Our recommendations for policymakers are aligned to those for property owners. Their overarching purpose is to ensure that property owners and developers apply a robust process to assess NZC options and to facilitate the availability of transparent and reliable data on NZC buildings.

## Recommendation 1: Improve consistency in national, regional and local planning policy and application, especially between the London boroughs and the GLA

The case study projects reviewed in this report were prepared at different times and in response to local and regional policy contexts that varied considerably. Consequently, the approach taken to evaluating the options available for the re-use, or redevelopment of the sites, and to communicating and justifying this to regulators and other stakeholders, also differed from asset to asset.

In summary:
- Planning policy on NZC and WLCA approaches is currently fragmented. It exists mainly at a regional (London) level and is not addressed by national policy
- Climate change mitigation is a strategic national objective and needs to be addressed through a portfolio-based approach
- There is currently a misalignment and inconsistency in approach between London boroughs and the GLA. A more standardised approach, with consistent regulation at least across London, and an agreed framework for analysing and disclosing NZC strategies, should lead to improved outcomes by providing greater clarity and clearer direction to developers and their project teams.

National policy makers should:
- Review and update National Planning Policy Framework to include clear guidance for all local authorities on how to assess the relative merits of retrofit and redevelopment.

The GLA and local authorities should:
- Continue to develop a uniform approach to the evidence requirements for WLCA, on a cross-London basis
- Expand on the role of the GLA's WLCA Guidance and, potentially, the City of London's current draft Whole Lifecycle Carbon Optioneering Planning Advice Note
- Work with Government to develop national policy and guidance to align the approach to NZC and WLCA with the presumption in favour of sustainable development and its support for growth, innovation and improved productivity.

## Recommendation 2: Consistently promote a 'retrofit first' rather than 'retrofit only' approach to delivering NZC buildings and ensure that this is communicated clearly to all stakeholders.

- The extent to which individual development proposals can achieve NZC and their whole life carbon effects, should be weighed alongside the other planning and wider public benefits of the proposal.

Physical change in the built environment should lead to a range of social, economic and environmental benefits. These benefits should be taken into account and assessed, alongside the WLC effects of proposals, rather than WLC being treated as a 'gateway' issue. The GLA and local authorities should:

- Set a clear strategy for delivering NZC buildings that is aligned to long-term, local built environment strategy, the London Plan and encompassing the need for weighting and balance between WLC and other sustainability aspects.
- Engage with Government to ensure a balanced approach to evaluating WLC considerations alongside the other social, economic and environmental aspects of development is embedded within forthcoming reviews of the National Planning Policy Framework.
- As such, allow flexibility for decision-making on a case-by-case basis to deliver buildings that will maintain NZC status for operational and embodied carbon and sustain their commercial value in the long-term whilst contributing to other desirable socio-economic and environmental outcomes, including securing the long-term attractiveness of central London as a place to do work.

Support the industry and incentivise SMEs in their efforts to decarbonise as part of this approach. At national and/or local level this should include:

- Make green investment more commercially viable by removing VAT to retrofit projects
- Consider fiscal incentives to encourage enhanced energy efficiency, and research and development into sustainable technologies and construction materials such as regulated timber construction[45].

## Recommendation 3: Request evidence of the assessment of NZC approaches and the decision-making process followed by planning applicants at an early stage, as part of pre-application discussions. The NZC approach should be discussed alongside the evolution of potential options for the proposed development.

Local authorities (and for major developments, the GLA) should:

- Request to see the NZC assessment, including KPIs, alongside contextual information detailing how the assessment was carried out and how the outcomes informed project decision-making.
- Request that NZC assessments apply a consistent methodology and metrics to determine the most favourable approach to delivering NZC for the asset in question, whilst allowing flexibility for bespoke methodologies to be used by different planning cases.
- Be willing to enter into discussions on the potential form of the proposed development alongside evaluation of the NZC approach. The form, environmental design and other benefits of the proposed development will be essential in undertaking a balanced evaluation of the WLCA and NZC approach.



## Recommendation 4: Provide robust and consistent guidance on WLCA

There remains a lack of clarity and consistency over the requirement and methodology of Whole-Life Carbon Assessments and both the industry and local policy makers would benefit from robust guidance at a national level. The Government should consider how the Building Regulations 2010 could be amended to require and standardise the reporting of whole life carbon emissions of buildings. Such a move could help to depoliticise the issue, create greater certainty and provide better support to businesses decarbonising their stock.

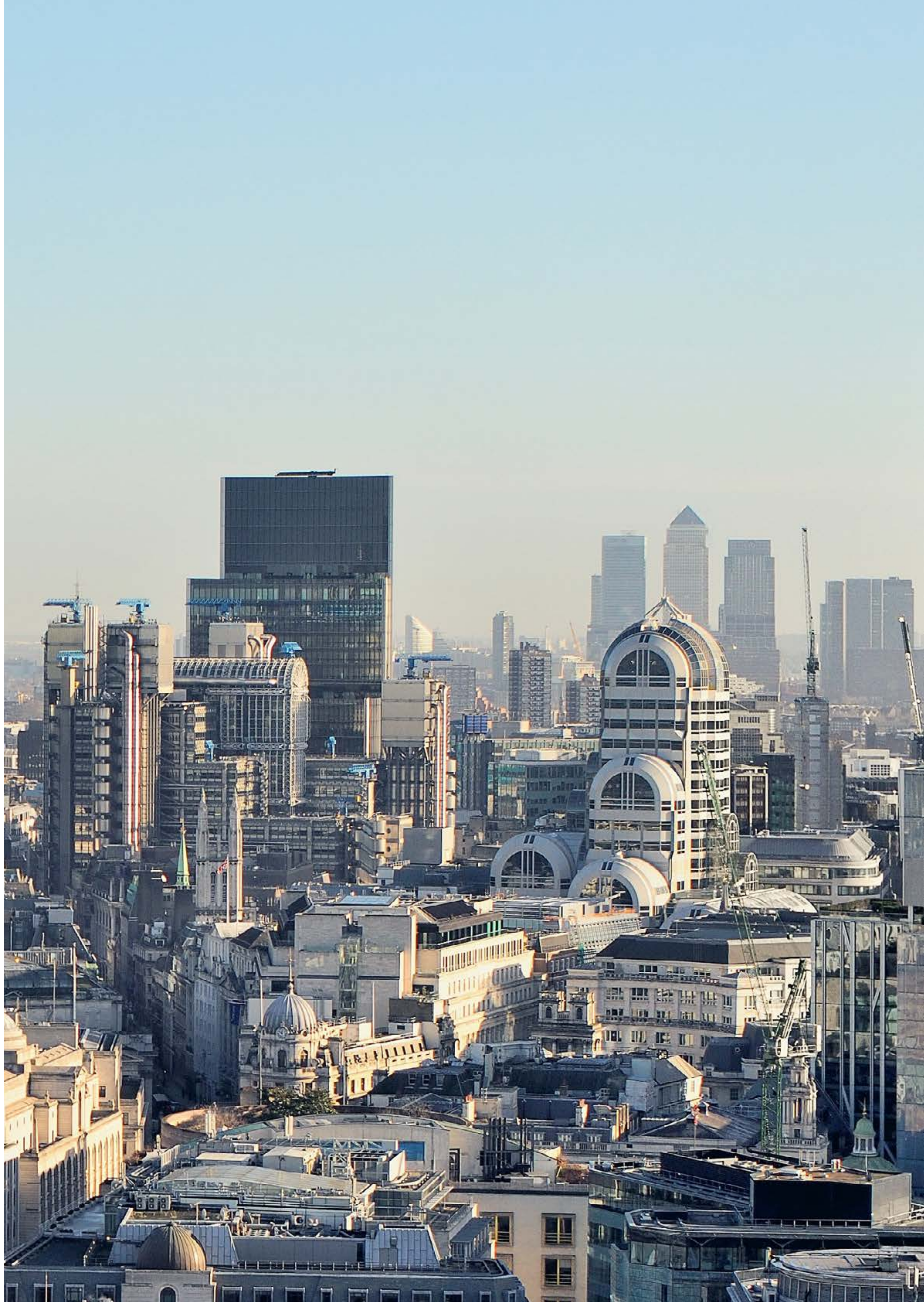
The London Plan has published guidance on Whole-Life Carbon Assessments (March 2022). However, application of the guidance is not currently a pre-requisite for most retrofit and redevelopment projects. Furthermore, the guidance acknowledges the fact that at the planning and early design stages of a project, the embodied carbon of certain types and/or quantities of materials and construction techniques may be difficult to calculate or maybe unknown to the project teams. As such it requests clear statements of exclusions. Whilst this is considered a fair approach at planning stage, it may lead to situations where a comparison of total life cycle emissions of different projects is not necessarily achievable. Furthermore, the guidance does not specifically require the inclusion of embodied carbon calculations associated with materials and techniques utilised pre- and post-operational phases of the building, e.g. support structures and hoardings required during construction.

- The GLA should consider providing minimum mandatory LCA calculations and reporting. Local authorities should adopt uniform guidance aligned to the GLA's.
- Benchmark figures should be provided for detailed LCA calculations when materials and construction types are unknown at planning stages and should be developed to be included in planning reports.
- This would create the opportunity for reports and developments to be fairly compared with each other, whilst it would further incentivise to bring forward the detailed forecasting of material quantities in every project with the view to allow for more and bespoke calculations in projects.
- Given that benchmark figures would most likely allow for worst case scenarios, the latter bespoke calculations, when possible, is envisaged to be the preferrable option for developers moving forward.

## Recommendation 5: Ensure that there is sufficient sustainability expertise within planning departments to enable planning applications to be appropriately assessed from a NZC and wider sustainability perspective

Local authorities should:

- Provide training and CDP opportunities for all planning staff to develop competencies in sustainability aspects.
- Appoint a sustainability champion within the planning department who can provide consistent oversight on all relevant schemes submitted.
- Create and/or participate in forums for knowledge-sharing and networking with the GLA, other LA and industry organisations to build mutual capacity and understanding of NZC and sustainability in the built environment context.



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# Conclusions and further recommendations

Urgent action needs to be taken across the UK built environment if we are to remain on track to achieving national carbon reduction goals. Delivering NZC poses a challenge for London's commercial building stock, which spans a range of typologies presenting specific complexities and a mostly poor energy profile. Corporate occupiers are already demanding NZC buildings to support their climate change commitments and promote employee engagement. Essential to retaining the attractiveness of central London as an employment hub and continue to maximise the efficiencies of that population density and public transport system, proactive landlords are already delivering NZC buildings, driven by the desire to push the industry forward; attract and retain high calibre tenants; and reduce costs and future proof their assets. NZC retrofit and redevelopment has the potential to deliver a range of economic, social, and environmental co-benefits for landlords, tenants and communities alike, and NZC buildings are more likely to create and sustain additional value when developed according to holistic sustainability principles, with due consideration to climatic changes and evolving societal and market trends.

Assessing the best approach to delivering NZC commercial buildings is a complex task which needs to be carried out on a case-by-case basis, taking account of each building's unique characteristics, its current and intended uses, and with due consideration to a set of financial and non-financial indicators. A whole life carbon assessment (WLCA) should be used to inform both the overall approach and potential solutions for minimising emissions through design and materials specifications. Policy makers and property owners should aim for the optimal approach to delivering NZC on an individual building basis, taking account of the asset building lifecycle and assessing carbon reduction potential in balance with other sustainability outcomes. As such, they should adopt a 'retrofit first' approach, but consider other options (i.e., partial or full-scale redevelopment) where retrofit is deemed unfeasible.

A range of interventions may be deployed to deliver NZC in operational energy, but for most assets adopting a retrofit approach, delivering required levels of energy and carbon efficiency will warrant 'deep retrofit' interventions such as extensive building services upgrades to remove on-site fossil fuel combustion, implement fabric efficiency improvements and install on-site energy generation systems. In redevelopment projects, the reuse of demolition materials, specification of low carbon products, use of MMC and design for future disassembly and adaptability (DfD/A) can help to reduce the likely higher levels of embodied carbon associated with this option.

## Innovation

Looking to the future, we envisage the uptake of NABERS UK as a tool to assess and compare the actual, in-use energy performance of commercial buildings will prompt building owners to implement investment and management measures to improve the efficiency of their assets, as has been the case in Australia (where assets with higher NABERS ratings have been documented as commanding higher values). Rising costs and shortages of construction materials are adding impetus to embed circular economy principles into building design and construction, and cities like Amsterdam and Paris are leading the way in providing a supportive policy environment for 'circular building'. Together with the introduction of carbon-negative building materials into the market, such as mycelium insulation and cement and plasterboard products manufactured using innovative techniques to capture and store carbon, this points towards a future scenario where low embodied carbon strategies are more cost efficient and straightforward to implement. The adoption of building materials passports and DfD/A principles – already used by some of the case study buildings featured in this report – also create a market incentive for the manufacture and specification of durable, easily repairable, and recyclable materials; promote circular economy models and whole life carbon reduction.

All industry stakeholders have a role to play in expediting these trends, and tackling remaining barriers, to facilitate a swift transition to a low- or zero-carbon built environment.

## Circular economy and embodied carbon

- Property owners and developers, advisors, contractors and product manufacturers should investigate, trial and/or direct research and development budgets towards low or zero carbon building products. Materials passports should be adopted on a voluntary basis, and their widespread use advocated.
- National and local governments should research and develop policies to support a circular economy approach to building retrofit and redevelopment, including –
  - o Quality control standards for reused materials
  - o Allocation of funds for research and development into low or zero carbon building products
  - o Regulation of embodied carbon through the proposed amendment to Part Z, with target-setting and disclosure requirements
  - o Mandating the use of building materials passports.

## Operational energy and carbon

- Property owners should roll out the use of the NABERS energy performance rating system across their assets on a voluntary basis, and advocate for mandatory in-use energy performance disclosure (with a shift away from certification based on theoretical energy use). They should include 'green' clauses in tenant leases as standard practice to promote efficient use of energy in tenant-demised areas and the sharing of data between landlord and tenant.
- Occupiers should request evidence of actual energy and carbon performance to inform corporate real estate decision-making; set targets for energy use within leased space (ideally aligned to whole building performance targets) and agree to share data with landlords.
- The UK government and the GLA should consider aligning policies on mandatory operational energy disclosure with the adoption of NABERS UK to allow for a consistent and comparable approach to energy performance measurement and make mandatory the exchange of energy and carbon data between landlord and tenant. The UK Government should consider reducing legal barriers for pooled Power Purchase Agreement (PPA) capacity to support investment in additional off-site, renewable energy.
- Property owners and policy makers should investigate potential solutions for assets at risk of becoming economically stranded, either because they have a layout and structure which disallows retrofit from a commercial and/or technical viability perspective, and/or because their rental value is not sufficient to allow for the additional costs of NZC upgrades to be recovered through higher rents or service charge.

## Green skills gap

- People should be able to acquire and refine the skills needed to design, develop, manage, and maintain NZC buildings. Adult education budgets should be used to direct funds towards practical 'green skills' development, and businesses along the property value chain should seek opportunities to engage with training providers to promote the creation of appropriate training programmes and modules to facilitate skills acquisition among students and professionals, and use employee training and community investment budgets to support this learning.

Image:
Future City skyline.
Didier Madoc Jones
of GMJ and City of
London Corporation

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# Appendix

# Appendix A: 'Deep Retrofit' interventions for NZC

For most assets, delivering the levels of energy and carbon efficiency required for operational net zero will warrant 'deep retrofit' interventions or, in cases where retrofit is not feasible, a redevelopment approach. Compare to a 'light retrofit', these approaches are more costly and intrusive in the short-term, but they will typically deliver greater added value in the long-term.

To achieve NZC operational energy, the most significant intervention is the replacement of the fossil fuel (mains gas) powered systems with systems that use mains electricity. Such systems have higher efficiency rates compared to gas boilers and due to grid decarbonisation deliver lower carbon intense heat. Unfortunately, there is no single solution for electrical replacement in buildings that utilise gas boilers for space heating and hot water. The electrification process requires extensive understanding of buildings physical structure and use, and such intervention can involve a complete re-design of building services, from main plant to end systems.

Fabric upgrades should be carried out if the analysis shows that significant improvements will be delivered, and if the façade performance is very poor that it is causing other problems like corrosive windows etc, in which case instead of retrofitting on a like-for-like basis, a more environmentally friendly approach should be considered. Prior to any intervention applied the performance of the façade should be accurately established through a thermographic survey across the fabric elements.

Finally, renewable energy generation as outlined within UKGBC's Renewable Energy Procurement & Carbon Offsetting guidance, should be a key focus to support net zero aspirations. The best approach to generating renewable on-site again is relevant to the individual building, considering whether there is a high electricity or hot water demand after the retrofit interventions, as well as any limitations of the building structure, roof space or view disruption. On-site energy storage (thermal or electrical) is important to balance the discrepancies between demand and supply of renewable technology such as solar photovoltaics and solar thermal. Additionally, it can be beneficial when considering the electricity price fluctuations across the day and night.

Table 2 provides a breakdown of key interventions and a high-level assessment of their potential impacts and implications across six criteria: (a) their potential positive impact on building energy performance and (b) occupier comfort; (c)their level of favourability in terms of ease of installation/ level of disruption; (d) cost; € return on investment (ROI), and (f) upfront embodied



carbon. It should be noted that for criteria (a) and (b) the table indicates whether an intervention is simply expected to have positive impact or not on (a) the building's energy and carbon performance and (b) the building occupants, without assessing the level of impact, as this can vary significantly depending on the type of asset and the scope and quality of the intervention. For all other criteria (c to f) a 'traffic light' ranking systems has been used to indicate the potential level of favourability of the intervention.

## High level assessment of deep retrofit interventions for NZC

**Key**
Impact | No impact

**Traffic light code**
High | Moderate | Good/Favourable/Low

| Key Interventions | Brief description | A. Impact on building energy and carbon performance | B. Impact on building occupants | C. Ease of installation/ building disruption | D. Construction cost | E. Return on Investment | F. Upfront embodied carbon |
|---|---|---|---|---|---|---|---|
| **Service upgrades** | | | | | | | |
| **Electrification of building systems and services** | Removal of on-site combustion systems (oil/gas fired boilers, Combined Heat & Power etc) and upgrade with all-electric building services systems in order to support the decarbonisation of heating and hot water generation, through the decarbonisation of the UK grid. | Significant reduction on building's carbon performance due to UK gid's decarbonisation. | | **High Building Disruption** The electrification process can be very intrusive, involving complete strip out of existing building services and installation of new systems, from main plant to end systems. | **High Cost** The cost of complete building systems' electrification can be quite high, depending on the extend of system upgrade required. | **Favourable ROI** due to higher energy efficiency rates expected, therefore reduced energy bills. Increase in rental income is also expected after achieving a better environmental performance for the asset and avoiding the asset being stranded. | **High Upfront Embodied Carbon** Depending on the extent of service upgrade, the proportion of embodied carbon related to building services upgrade can be considerably high. |
| **Installation of low carbon technology (Heat Pumps)** | Heat Pumps offer a low carbon solution to heating and cooling by using electricity to operate and due to their higher efficiency rates than traditional heating systems. Various types of heat Pumps are available, such as air-source, water source or ground source, and the applicability of each type is specific to site characteristics and requirements. | Higher efficiency rates compared to traditional systems and delivering of lower carbon intense heat due to grid decarbonisation. | | **Moderate Building Disruption** Due to heat pumps operating at lower temperatures than traditional gas heating, further site adaptations might be required, such as resizing of heat distribution network and heat emitters. | **High Cost** The cost of installing heat pumps is higher than traditional heating technology (gas boilers). Also, adaptation works to pipework and heat emitters can be an additional cost. | **Favourable ROI** due to higher energy efficiency rates, therefore reduced energy bills. Increase in rental income is also expected after achieving a better environmental performance for the asset and avoiding the asset being stranded. | **High Upfront Embodied Carbon** Depending on the type of heat pump installation and the extent of additional works the embodied carbon can be considerably high. |
| **Energy efficient ventilation system** | Mechanical (or mixed mode) ventilation systems with heat recovery offer an energy efficient solution to building ventilation. | Reduced energy demand resulting from heat losses and gains associated with air movement. | Provision of sufficient air supply rates, humidity levels and filtration that enhance occupants' comfort and health. The provision of natural ventilation should also be considered where appropriate and practical, considering any site constraints and technical viability. | **Moderate Building Disruption** Such intervention can involve a complete re-design of ventilation systems and building services, including dusting and end systems. | **High Cost** The cost of ventilation system upgrade can be considerably high, depending on the extend of upgrades required. | **Favourable ROI** due to reduced energy demand and higher efficiency rates, therefore reduced energy bills. Increase in rental income is also expected after achieving a better environmental performance for the asset and avoiding the asset being stranded. | **Moderate Upfront Embodied Carbon** Depending on the extend of upgrades required the ventilation system upgrade can be moderate to high. |
| **Fabric upgrades** | | | | | | | |
| **Fabric thermal insulation** | Insulation of external wall and roof elements, with necessary thickness to reach specified U-values, to reduce heat losses across the building envelope. Such intervention should be happening following a thermal survey to identify the areas with higher heat losses. | Reduced energy demand resulting from heat losses and gains associated with fabric performance. | Improved occupant thermal comfort through effectively regulating the internal temperature. | **High Building Disruption** Such intervention requires vacant building to be carried out. | **High cost** The cost of installing fabric insulation can be considered moderate to high, depending on the extend of insulation and thickness required, as well as the overall disruption to the building fabric. | **Moderate ROI** due to high cost and low overall impact on building's energy demand reduction. | **High Upfront Embodied Carbon** Embodied carbon of fabric insulation can be considered high, depending on the insulation material specified and the thickness required. |

## High level assessment of deep retrofit interventions for NZC (continued)

| Key Interventions | Brief description | A. Impact on building energy and carbon performance | B. Impact on building occupants | C. Ease of installation/ building disruption | D. Construction cost | E. Return on Investment | F. Upfront embodied carbon |
|---|---|---|---|---|---|---|---|
| **Sealing for improved envelope airtightness** | Sealing of windows and building envelope to reduce infiltration rates can significantly reduce the heat losses of the building. Such intervention should be happening following a thermal survey to identify the areas with higher infiltration rates. It is also considered very important in order to maintain minimal performance gap. | Reduced energy demand resulting from heat losses and gains associated with reduced air infiltration. | Improved occupant thermal comfort through avoiding air leaks and cold drafts near the floor perimeter. | **Moderate building disruption** Such intervention can have moderate to low building disruption (considering basic airtightness through good workmanship and attention to detail e.g., filling holes and sealing gaps in the fabric). | **Moderate cost** Moderate to low cost for improving building's airtightness. | **Favourable ROI** due to reduced heat loss and energy use in buildings with poor draughtproofing and airtightness. | **Moderate Upfront** Embodied Carbon Embodied carbon of sealants can be moderate. |
| **Glazing upgrade** | Reduction of heat losses and gains solar gains through glazing upgrade and solar shading. | Reduced energy demand resulting from heat losses and gains associated with fabric airtightness. | Improved occupant thermal and visual comfort due to reduced solar gains, insulated glazing panels and avoidance of glare discomfort through shading provision. | **High building disruption** Such intervention can require vacant building to be carried out, depending on the extend of glazed façade replacement (curtain walling vs individual windows). | **High cost** The cost for glazing system upgrade can be considerably high depending on the extend of glazed façade replacement (curtain walling vs individual windows). | **Moderate ROI** due to high cost and low overall impact on building's energy demand reduction. | **High upfront embodied carbon** Embodied carbon of glazing systems upgrade is considerably high, including the contribution of the insulating glass units (IGU), aluminium, and steel in glazing assemblies of curtain walling systems. |
| **On-site energy Generation and Storage** | | | | | | | |
| **Solar PV** | Installation of solar photovoltaic system on-site to produce renewable electricity and reduce building's carbon emissions. | Significantly reduced building carbon emissions. | | **Moderate building disruption** Moderate to low disruption to building operation (it may be possible to carry out the majority of the works whilst keeping the building running on the existing system until final connections). | **High cost** Roof mounted PV usually comes with high cost to install. | **Favourable ROI** ROI is expected to be favourable depending on the extent of PV system installation and the contribution to overall grid electricity demand. | **High upfront embodied carbon** The embodied carbon of such intervention is considered to be very high. |
| **Solar thermal** | Installation of solar thermal system to buildings with high demand for hot water. | Solar thermal panels can deliver significant carbon savings to a building with a high demand for hot water. | | **Moderate building disruption** Moderate to low disruption to building operation (it may be possible to carry out the majority of the works whilst keeping the building running on the existing system until final connections). | **Moderate cost** The cost of installing solar thermal can be considered moderate to high. | **Favourable ROI** ROI is expected to be favourable depending on the extent of solar thermal installation and building's hot water demand. | **High Upfront embodied carbon** The embodied carbon of such intervention is considered to be very high. |
| **Energy storage** | On-site energy storage (thermal or electrical) is important to balance the discrepancies between demand and supply of renewable technology such as solar photovoltaics and solar thermal. Additionally, it can be beneficial when considering the electricity price fluctuations across the day and night. | Significantly reduced building carbon emissions. | | **Moderate building disruption** Moderate to low disruption to building operation (it may be possible to carry out the majority of the works whilst keeping the building running on the existing system until final connections). | **High cost** **Energy storage** installation comes with high cost (thermal storage is significantly cheaper than batteries). | **Favourable ROI** ROI is expected to be favourable. | **High upfront embodied carbon** The embodied carbon of such intervention is considered to be very high. |

# Appendix B: Case studies


# **Tea Building,** 5-13 Bethnal Green Road, Shoreditch. Derwent London

**Current/ planned use:** Offices, plus Shoreditch House Members Club and restaurants
**Size:** 25,180 $m^2$ (271,100 sq ft)
**Typology:** 1930s warehouse
**Project type:** Phased retrofit
**Investor:** Derwent London
**Developer:** Derwent London
**Architect:** Allford Hall Monaghan Morris
**Project manager:** Rougemont
**Main contractor:** The Thornton Partnership (TTP)
**Structural engineer:** David Akera
**M&E engineer:** Peter Deer and Associates / Watts
**Project timeline:** 2001 (first phase); 2004 (second phase); 2009 – 2011 (improvement works); 2014 – present (Green Tea)

**Summary:**
The Tea Building is a robust and striking 1930s warehouse which dominates the junction of Shoreditch High Street and Bethnal Green Road. In the early 2000s, Derwent London completed a phased retrofit, maintaining the 1930s design aesthetic to create a range of office and studio units of flexible sizes and configurations to attract a diverse mix of occupiers. The Tea Building became a hub for creative industries, as well as a home to restaurants and Shoreditch House, a private members club.

Aware of the building's inherently poor sustainability performance, and wanting to preserve its character, in 2014 Derwent London launched the 'Green Tea' project, identifying ways to upgrade the assets' environmental credentials. Through a series of passive, active and comprehensive measures, operational energy intensity is on average 90-100 kWh/$m^2$, which is largely in line with UKGBC operational energy targets for 2025-2030.

**Pre-retrofit building profile**

**Construction date:** 1933

**Previous uses:**
- Originally used by Lipton as a bacon-curing plant and subsequently a tea packing warehouse
- Vacated by Allied and Lipton during the 1970s
- Used as a warehouse and storage facility with the name 'Centric House' prior to acquisition by Derwent London in 2001

**Design and construction:**
- Tailored for storage, with open floorplates, four lightwells and a single tenant.
- Constructed to provide light industrial space without environmental cost considerations.
- Walls with no thermal insulation, windows single glazed and the roof of solid concrete construction.

**Drivers for retrofit:**
1) To create a range of office and studio units of flexible sizes and configurations to attract a diverse mix of occupiers.

2) Upgrade the assets' environmental credentials through a series of passive, active and comprehensive measures.

**Whole Life Carbon Assessment**
To further understand the sustainability credentials of the building, Derwent London undertook an embodied carbon assessment on recent 'Green Tea' fit outs. The findings show that the whole life carbon assessment is 1,128kg$CO^2$e/$m^2$ over a 60-year lifecycle, with upfront carbon being 111kg$CO^2$e/$m^2$ (A1-A5).

**Retrofit strategy & key measures**
- Worked with existing structure to minimise cost.
- First phase light touch retrofit executed 2001 – 2003, involving the split of the Tea Building from the adjacent Biscuit Building, which had formerly been interconnected.
- Site split into 16 units of varying sizes. Incorporation of lightwells into usable floor plates, creation of two new central lift cores, two new atria and new communal service cores.
- Second phase retrofit executed in 2004 on the second to fifth floors.
- Entrance moved from the side door to the larger opening onto the 'internal street' in 2007. Opening of Shoreditch House.
- New high specification glazed main entrance completed in 2009; circulation upgrade adding 'shop fronts' to the corridors and new lighting in 2011.
- Design strategy focused on the provision of inherently flexible unit sizes and configurations to attract a diverse mix of tenants, with nearly 50 office and studio spaces of different sizes created alongside with galleries and communal areas.
- Maintained the building's industrial character and heritage, and many of the original structural detail and features, including exposed brick, concrete columns, cobbled loading bay floors, and timber lift doors.
- Reception area designed to convey a strong industrial feel, and a blend of roughness and craftsmanship; along with new concrete steps; redecorated lift lobby and feature staircase.
- 'Green Tea' project commenced in 2014 to improve the building's environmental performance, involving:
  - o Replacement of original steel framed single glazed windows with Critall-style W20 section windows with

operable vents and solar thermal glazing
  o High performance roof insulation
  o LED lighting system with PIR sensors
  o Hybrid cooling/heating via installation of a high efficiency rooftop heat exchanger providing a hot and cold-water thermal loop through the building to provide heating and cooling (or both) to any indoor unit
  o Renewable electricity and gas tariffs
  o Retrofitted smart metering to enable accurate monitoring of each occupier unit's power and gas consumption, facilitating tenant engagement and reduction of occupancy costs.
- Tenant engagement to accelerate NZC transition:
  o First NZC Occupier Survey in 2021 to identify challenges that occupiers face in delivering carbon reductions and opportunities for greater collaboration.
  o Engagement with occupiers to support them in sharing best practice, setting targets and benchmarking performance to reduce carbon emissions associated with tenant-demised areas.
- Hub for creative industries with an emphasis on community values and shared amenities
- Revitlisation of the commercial built environment
- Energy intensity aligned to UK-GBC 2025-30 targets
- On pathway to achieve NZC by 2030; residual emissions to be offset using certified carbon offsetting schemes
- Social value creation via Community Fund as well as facilitation of youth engagement days.

When the property was acquired by Derwent London in 2001, only 5-6 people were employed in it. Today, over 1,500 people work in and visit the building each day.

Over the years Derwent London's Tech Belt Community Fund has provided support to St. Hilda's East Community Centre, which is sited within two minutes walking distance from the Tea Building. This has included support for their food co-op which offers fresh fruit and vegetables at affordable prices to local residents.

## Outcomes

### Pre- and post-retrofit comparison

| | Pre retrofit | Post retrofit |
|---|---|---|
| **Energy intensity** | - | 2019: 104 kWh/m$^2$<br>2021: 83 kWh/m$^2$ |
| **Operational carbon** | - | 70 kgCO$^2$/m$^2$/ year |
| **Embodied carbon** | - | 'Green Tea' scope of works per unit:<br>111kgCO$^2$e/m$^2$ (A1-A5) |
| **EPC rating** | - | 'B' |
| **NABERS rating** | - | - |
| **Building services** | • No central heating infrastructure<br>• Ad hoc flat panel electric radiators Single-glazed Crittall style windows and natural ventilation<br>• LG2 fluorescent lighting<br>• Basic metering | • High efficiency rooftop heat exchanger providing a hot and cold-water thermal loop (units attached to thermal loop when available)<br>• Modular gas boilers<br>• Natural ventilation through operable, double-glazed windows<br>• LED lighting with PIR sensors<br>• Smart metering system |
| **Certificates** | - | - |



### Challenges, opportunities & lessons learned

1) The building presented an inherently poor energy performance. Through engagement with architects and structural engineers Derwent London identified a series of measures which could be implemented in the building to significantly improve its energy performance and deliver a better level of comfort for tenants. One creative example is the A/C system that shares solar gain accumulated via the building's significant thermal mass around the building through a six-storey thermal loop. The infrastructure for this ambient thermal loop was installed such that as and when units become availableavailable, they can be upgraded and connected to the loop.

2) Tea Building offers a good template on what can be done with older buildings to give them a new lease of life. Clear and considerate planning and having a long-term masterplan meant that the building could be upgraded on an iterative and flexible process. Investigating the natural characteristics of the building meant the space was able to be utilised in what otherwise could have been deemed challenging infrastructure, highlighting the importance of case by case assessment when it comes to retrofits. Given the time of retrofit, the building is currently supplied by gas. The next phase of life for the building will be considering its route to an all-electric strategy.


# **Timber Square,** 25 Lavington Street, Southwark. Landsec

**Current/ planned use:** Offices, plus retail
**Size:** 34,374 m² (370,000 sq ft)
**Typology:** 1950s industrial, repurposed to offices
**Project type:** Part redevelopment, part retain and extend
**Investor:** Landsec
**Developer:** Landsec
**Architect:** Bennetts Associates
**Project manager:** Opera
**Main contractor:** Laing O'Rourke
**Structural engineer:** Heyne Tillett Steel
**M&E engineer:** Hoare Lea
**Project timeline:** 2022 – 2025
**Planning approval:** 2020

**Summary:**
Timber Square is a landmark development in the heart of London's South Bank, located on the site of the former timber storage yard and print works. It will deliver two main buildings – The Ink Building and The Print Building – with a design approach that prioritises customer health and wellbeing and an accommodation offer tailored to a diverse mix of office and retail tenants, with 10% of the new space ringfenced as affordable space for SMEs.

Timber Square is the UK's first Design for Performance project to complete its Independent Design Review with 5* NABERS UK Energy rating and operational energy performance of the all-electric buildings will align to the UKGBC's 2025-2030 targets for commercial offices. Operational carbon is expected to be 50% lower than a 'typical' office building. By retaining 85% of the existing structure of the Print Building and introducing a hybrid steel and Cross Laminated Timber (CLT) extension for the new development component, the embodied carbon intensity of the whole development will also be around 50% compared to that of a typical office development. The scheme has been recognised as exemplar case study by the World Green Business Council (WGBC) and New London Architecture (NLA) and the BBC.

**Pre-retrofit building profile**

**Construction date:** 1959

**Previous uses:**
- Originally constructed as a printworks
- Extended and adapted in the 1980s for use as commercial offices by TSB Bank.

**Design and construction:**
- Two linked buildings referred to as the 'East Building' (c. 100,000 sq ft) and 'West Building' (c. 35,000 sq ft).
- The East Building was six storeys at its highest point but not evenly stacked.
- Tall ground and basement spaces, with a steel encased concrete structural frame in good condition; generous slab to slab heights on other floors between 3.9 and 4.5 metres.
- The West Building comprised three floors of office space and one level of basement, with a large unused car park to the front of it included within the site boundary.

**Drivers for retrofit/redevelopment:**
1) Create a 'sustainable ecosystem' where global corporates site alongside local start-ups, linked by their desire to make a difference.
2) Deliver characterful, flexible, next generation 'healthy' workspace to attract and retain diverse occupiers.
3) Be one of the UK's first large-scale NZC buildings.

**Whole Life Carbon Assessment**
An embodied and whole-life carbon assessment was undertaken from early design stage and regularly updated to ensure that the project remained on target. In construction, it will be updated every 6 months with as-built information as it becomes available, and a final report will be produced at practical completion. The project is targeting an embodied carbon intensity for RICS Modules A1-A5 535kg$CO^2$/m² GIA (448kg$CO^2$/m² with sequestration) for the whole development.

**Retrofit strategy & key measures**
- Design brief is informed by three overlapping themes of sustainability, evolving workplace design and efficient construction technique (DfMA – Design for Manufacture and Assembly).
- Official Better Buildings Partnership Pioneer of the 'Design for Performance' (DfP) approach to operational energy with advanced energy simulation process conducted during design stages and enhanced commissioning, aftercare and post-occupancy verification to ensure the building is built and operated to perform as intended.
- Public realm carefully considered to promote routes through the site and connectivity to existing infrastructure and established interventions such as the Low Line; new public route and provision of public and green space; diverse mix of retail and leisure at ground floor levels.

**Print Building**
- Retention of 85% of the existing structure, made possible because the building was designed for heavy loads associated with printing, meaning that the existing foundations can accommodate the increased loads

without requiring foundation strengthening.
- Working with the existing 6m x 10.5 -14m column grid, and aiming to reuse much of the existing structure, the retained lower portion will be extended with an interlocking lightweight extension.
- Extension created using an efficient, lightweight truss steel frame, with cross laminated timber (CLT) floor panels spanning 6m.
- Four complete new floors stacked at 4.1m floor to floor, achieving 2.8m clear to the underside of the truss, and a perceived height of 3.7m to the exposed CLT soffit.
- Comprehensive retrofit through a human-centric design approach to deliver characterful, flexible, next generation 'healthy' workspace.

### Ink Building

- Demolition to make way for new 15-storey asset. The decision to redevelop was due to the building's inefficient floor plate and the presence of the car park.
- New build design will maximise Design for Manufacture and Assembly (DfMA) potential being composed of a single efficient repetitive structural module.
- Use of an innovative hybrid steel frame with CLT floor slabs[46].
- M&E services will be modularised and exposed to give a characterful and flexible workspace built around a central core with good daylight and views around the perimeter, which will itself be enlivened with terraces and balconies.

### Anticipated outcomes

- Vibrant destination with enhanced public realm
- 10% of new space created as affordable workspace for SMEs
- Embodied carbon intensity of whole development 50% lower than typical office
- DfP certified predicted 5* NABERS rating, BREEAM 'Excellent' and WELL Core
- Operational carbon intensity 50% lower than typical London office
- UK GBC interim Paris Proof targets for operational carbon; energy intensity below 125 kWh/m$^2$
- NZC building in line with UK-GBC framework definition; residual emissions associated with manufacturing and construction to be offset at the completion of the project
- 125% uplift in biodiversity units for both area and linear based habitats

Landsec is targeting a minimum of £205 million social and local economic value generated during the project lifecycle (construction / management / occupation) with a potential of £420 million.

3-5% of the total workforce during construction will be from underemployed groups (long-term unemployed, ex-offenders and young people not in education, employment or training (NEETS)), and 10% of total construction spend dedicated to local suppliers (with preference for SMEs).

Landsec will deploy a wide range of measures to foster local growth and offer training and upskilling development opportunities, including apprenticeships, paid and unpaid work placements during the operational phase, as part of a commitment to help retail tenants prioritise local employment.

### Pre- and post-retrofit comparison

| | Pre retrofit | Post retrofit |
|---|---|---|
| **Energy intensity** | - | Both buildings projected to sit below the baseline energy performance of 125 kWh/m$^2$ per year |
| **Operational carbon** | - | UK-GBC interim Paris Proof targets |
| **Embodied carbon** | - | East Building, modules A1 – A5:<br>434 kgCO$^2$/m$^2$ GIA<br>• 369 kgCO$^2$/m$^2$ (including sequestration)<br>West Building, modules A1 – A5:<br>• 623kgCO$^2$/m$^2$ GIA<br>• 518 kgCO$^2$/m$^2$ (including sequestration)<br>WHOLE DEVELOPMENT modules A1-A5<br>• 535 kgCO$^2$/m$^2$ GIA<br>• 448 kgCO$^2$/m$^2$ GIA (including sequestration) |
| **EPC rating** | - | 'B' |
| **NABERS rating** | - | DfP certified predicted 5* Energy rating |
| **Building services** | - | • All electric heating and cooling through ASHPs; 4 pipe fan coil units; min COP 2.8, min SEER 4.7<br>• Mechanical ventilation with heat recovery<br>• Lighting power density average 1.4 W/m$^2$/100lux in office areas; absence detection sensors; daylight dimming<br>• Metering strategy designed to enable NABERS UK monitoring in operation<br>• BMS control methodologies reviewed in line with modelled strategies in Design for Performance |
| **Certificates** | - | Targeting BREEAM 'Excellent' and WELL Core certifications |

### Challenges, opportunities & lessons learned

1) It was clear that the printworks (East Building) had a long term viable future due to its inherent structural capacity, the volume of the lower floors and the size of floorplates. This building was capable of being extended upwards with little strengthening of the existing structure and could provide best in class workspace for years to come. Retaining the majority of the Print Building reduced the carbon footprint of the redevelopment, the construction period and cost and enabled the retention of the building's heritage aspects.

2) The West building, on the other hand, had compromised floor plates and a large car park to the front of the site. The retention of this building would have impeded the redevelopment of the site and the improved public realm and access to the Grande Vitesse railway viaduct and arches that the redevelopment has provided.

3) The deconstruction of the East Building took longer than demolition and was more expensive. However, since around 25% of the overall development structure will be built when construction commences this will reduce construction time. The retention of the building also led to a higher value floorplate.

4) The use of CLT and steel delivers a solution that is around 20-25% lighter than a conventional structure and provides greater opportunities to create additional space when investigating extensions. While a hybrid steel and CLT frame typically requires a slightly larger floor to floor height, the local authority were more receptive to a discussion around height due to the sustainable benefits that arose from this hybrid structure. However, Landsec had to undertake extensive fire testing at its own cost to be able to proof the fire safety of the proposed design.

5) The need to store materials and building products for later reuse presented a logistical challenge. Consequently, it was decided to share some materials, like the raised access floor tiles, for reuse on other sites with the intention to source reused items in turn when needed in the build. This aside, embedding a reuse at an early stage helped to prevent unforeseen challenges later in the project.

# **180 Piccadilly** & 48-50 Jermyn Street, Westminster. GPE

**Please note GPE's proposals will be subject to consent by The Crown Estate**

**Current/ planned use:** Offices plus retail and F&B)
**Size:** 4,634 m² (49,879 sq ft)
**Typology:** Post-war modern office building
**Project type:** Redevelopment
**Investor:** GPE
**Developer:** GPE
**Architect:** Make
**Project manager:** -
**Main contractor:** -
**Structural engineer:** Elliott Wood
**M&E engineer:** Hoare Lea
**Project timeline:** 2024 – 2026
**Planning approval:** 2021

**Summary:**

GPE will redevelop the existing site at 180 Piccadilly and 48-50 Jermyn Street to create a high-quality office building with two flexible commercial units at ground floor. The design and materiality will reflect a contemporary interpretation of the rich architectural context of the St James's Conservation Area, enhancing the characters of Piccadilly, Duke Street St James's, and Jermyn Street.

The new building will offer high-specification, flexible floor space, meeting current demands and being adaptable over time to meet changing future needs. Wellness is a priority of the design, with south-facing terraces at the upper levels offering outdoor amenity to the building occupants, with views over St James's. Opening windows bring fresh air into the large, open, well-lit floorplates.

The project takes an holistic approach to sustainability, reusing elements of the existing buildings to reduce embodied carbon and operating as efficiently as possible to create commercial space that works well for people, place and planet. This is a DfP Pioneer Project targeting a 5* NABERS UK rating along with minimum BREEAM 'Excellent' and operational energy intensity aligned with UK-GBC Paris Proof targets.

**Pre-redevelopment building profile**

**Construction date:**
- 1953-1958 (48-50 Jermyn Street)
- 1962 (180 Piccadilly, French Railways House)

**Previous uses:**
- Offices and retail

**Design and construction:**
- Both buildings are of post-war modern typology. 180 Piccadilly is an 8-storey office building; 48-50 Jermyn Street is a 5-storey building. Both have retail units at ground and basement levels.
- The architecture of 180 Piccadilly is in contrast to that of the wider streetscape, with a gridded facade, shallow reveals, high proportion of glazing and flat roof.
- 48-50 Jermyn Street is a local Building of Merit. French Railways House has no designation.
- Both buildings have Portland stone in their façades.

**Drivers for redevelopment:**
1) Maximise the potential of the site for a larger building providing high quality space
2) Create an adaptable building that meets modern needs but is resilient in the context of future change
3) Create a more vibrant, richly modelled building to enhance the architectural character of the conservation area
4) Deliver a building that performs to the highest standards of energy efficiency, embodied carbon and circular economy principles

**Whole Life Carbon Assessment**

A WLC assessment has been undertaken (modules A-D) and a decarbonisation project developed targeting a reduction of 12,209 tonnes $CO^2$e. This encompasses the reuse of the existing buildings' foundations and reused steel for the structural frame, among other measures.

**Redevelopment strategy & key measures**
- Designed as a contemporary contextual building reflecting the proportions and materiality of the neighbouring listed buildings.
- Adoption of circular economy principles to reduce WLC, including reuse of foundations and potentially other elements of the existing buildings (see below).
- Proposed massing is six storeys, plus two mansard floors, plus a rooftop plant enclosure/lift overruns.
- Flexible open-plan floorplates that can be subdivided to offer different tenancy sizes and letting arrangements.
- Roof terraces for staff working in the building, including communal roof terrace.
- Prominent retail frontages and flexibility for various ground floor uses to meet changing future market needs.
- Welcoming office reception on Jermyn Street that contributing active frontage to the streetscape.

**Energy optimisation**
- Passive design and energy efficiency measures are key to reducing the energy demand and $CO^2$ emissions:

o Anticipated to achieve up to 17.7% reduction in

operational $CO^2$ emissions prior to the consideration of any Low or Zero Carbon (LZC) technologies.
- Air Source Heat Pump technology to provide space heating, cooling and a proportion of domestic hot water.
- Highly efficient Mechanical & Electrical services to support ambitious operational carbon targets.
- New efficient vertical transportation systems which are based on latest BCO guidance.
- Solar PV panels ($80m^2$) proposed at roof level.
- Extensive energy metering throughout the building to analyse and manage energy usage.
- DfP feasibility appraisal and preliminary energy performance and DfP rating targets established for the with reference also to the UKGBC Net Zero Energy intensity targets and GPE's corporate targets.

## Embodied carbon reduction & circular economy

- Structural steel columns and beams from two other GPE demolition sites identified as suitable for reuse, with plans to use them to complete the structural frame at 180 Piccadilly following testing and recertification.
- Structural design has optimised the loading capacities of the reused steel to maximise embodied carbon saving – comparing EPD values of the reused and primary steel demonstrates the carbon emissions of the reuse steel is reduced by 98% before refabrication.
- Reuse of the basement void, with minimal dig to unify the levels, reducing embodied carbon, waste, lorry journeys, construction time and disruption to neighbours.
- Investigating reuse of basement columns and slabs, Portland stone, lightwell brick, glass and aluminium window frames.
- Storey height allows for a CLT and steel hybrid structure (to be developed in future stages).
- Developing off-site manufacture, e.g. for cladding and plant, to minimise waste.

## Climate change resilience & biodiversity

- Increasing biodiversity on the site with a green wall and biodiverse roofing.
- 'Blue roof' system for responsible water management.
- Investigating rainwater harvesting and greywater recycling.

## Occupier health & wellbeing

- Terraces on levels 5, 6 & 7 offer amenity to occupants on those floors and a shared roof terrace provides amenity space to all occupants of the building.
- Openable windows for all elevations of the building for occupant control, wellness and connection to the weather and seasons.

## Anticipated outcomes

- Enhanced architectural character of the conservation area with improved active frontages.
- Flexible space to adapt to future needs, such as various sized and interconnecting ground floor spaces.
- NABERS 5* rating; BREEAM 'Excellent' and WELL-enabled.
- 46.6% reduction in $CO^2$ emissions beyond the Part L, 2013 'Gas boiler baseline' including consideration of Low or Zero Carbon (LZC) technologies.

GPE aims to be intrinsically involved with the communities in which their developments are built and operated. Once the project is completed, interviews will be conducted with a variety of stakeholders to ensure that the approaches designed to address social issues in the locality continue to be implemented and that local stakeholders are benefiting from the changes. Regular engagement with occupiers will also ensure that the development is still being operated in the way that it was initially designed which delivers sustainable social value.

## Pre- and post-retrofit comparison

| | Pre retrofit | Post retrofit |
|---|---|---|
| **Energy intensity** | - | Stretch target (subject to detailed operational energy monitoring):<br>• $90kWh/m^2$/year |
| **Operational carbon** | - | (subject to confirmation of grid decarbonisation factor) |
| **Embodied carbon** | - | Target with structural frame of reused steel:<br>• 409 $kgCO^2e$ |
| **EPC rating** | - | Minimum 'B' |
| **NABERS rating** | - | 5* |
| **Building services** | • Variable refrigerant flow systems<br>• HWS electric for domestic hot water<br>• Natural ventilation via openable windows with some mechanical ventilation retrofitted<br>• Mostly fluorescent lighting with some LEDs in landlord-controlled areas<br>• All tenants sub-metered | • Variable refrigerant flow systems<br>• Air source heat pump<br>• Mixed mode ventilation<br>• Efficient LED lighting with PIRs and daylight- linked controls<br>• Metering in accordance with NABERs, connected to the BMS. |
| **Certificates** | - | BREEAM Excellent (minimum target)<br>• BREEAM Outstanding (aspiration)<br>• WELL-enabled |

## Challenges, opportunities & lessons learned

1) Both buildings are failing to meet current occupier needs. They have narrow, inflexible office space, cladding which does not meet thermal performance requirements, M&E plant beyond economic life; levels and circulation which does not meet accessibility requirements. Both have floor to floor heights of approximately 3.1m which is not adequate to bring in better services or improve the daylighting.

2) The storey heights across the two existing buildings do not align, which makes it impossible to unify the buildings to offer larger, more flexible, accessible floorplates, as demanded for contemporary workplaces.

   In plan, both buildings are relatively thin with a central lightwell. The stairs, lifts and WCs are arranged across the floorplate, rather than in a central core, which further limits the creation of open, flexible workspace. Furthermore, 48-50 Jermyn Street is a lower building than the surrounding streetscape and it did not maximise the potential of the site.

3) On this basis, it was determined that redevelopment of the existing site presented the best approach to unlock additional commercial space and deliver high quality workplaces to meet identified need within Westminster. Constructing a new building with flexible open-plan floorplates can accommodate for different tenancy sizes and letting arrangements and allow for adaptability to meet evolving market needs. A carefully crafted design can enhance the architectural character of
the conservation area, bringing additional benefits to the public realm.

4) Reusing material from both existing buildings and a structural frame consisting of reused steel reduces the embodied carbon of the redevelopment.

# **Edenica,** 100 Fetter Lane, City of London. BauMont Real Estate Capital / YardNine

**Current/ planned use:** Offices plus retail
**Size:** 8,826 m$^2$ (97,000 sq ft)
**Typology:** Post-war modern, light industrial & offices
**Project type:** Redevelopment
**Investor:** BauMont Real Estate Capital
**Developer:** YardNine
**Architect:** Fletcher Priest Architects
**Project manager:** Third Wall London
**Main contractor:** -
**Structural engineer:** Waterman
**Project timeline:** 2022 - 2024
**Planning approval:** 2021


### Summary:
The project encompasses the demolition of 100 Fetter Lane and construction of a new building ('Edenica') for office use with a flexible retail unit. Upon completion, Edenica will comprise basement level, ground, mezzanine and 12 upper storeys plus roof level, creating 93,000 sq ft of high-quality workspace that benefits from natural ventilation, abundant natural daylight and a mix of amenities including extensive rooftop gardens. Edenica will be an all-electric building, designed to high energy performance standards. Upfront embodied carbon is predicted to be 40% lower than current GLA benchmarks and aligned to LETI targets. The project is targeting BREEAM Outstanding, EPC A Rating, WiredScore Platinum, SmartScore Platinum and WELL Platinum enabled certifications.


### Pre-redevelopment building profile

**Construction date:** Early post-war

### Previous uses:
- 96-108 Fetter Lane originally constructed as a single building in the early post-war years for use as a printing works, print storage and offices.
- Substantial alterations in the 1970s split the building into two distinct self-contained units which fell under separate ownership. The site previously included two pubs; but only one remained.

### Design and construction:
- Steel and concrete frame designed for original use as a print and storage works, with signs of heavy modifications over its lifetime.
- Brick and glass cladding to three elevations and punched windows in leadwork to the upper storeys.
- Poor quality structure and façade; building services no longer fit for purpose.

### Drivers for redevelopment:
Transform an unattractive, unoccupied building which did not meet modern occupation standards, creating in its place an intelligently designed, high quality workspace with sustainability and user experience at its core.

*"Our intention was to remove the shackles of conventional design so that the team could take a truly un-fettered and holistic approach to the sustainability strategy"*
- Maxwell Shand, YardNine

### Whole Life Carbon Assessment
A WLCA was undertaken in accordance with the London Plan Policy. The development is meeting the GLA embodied carbon benchmark for all modules A1-A5 and B-C, and furthermore has lower impact than the Aspirational WLC Benchmark for the Modules B-C.

Upfront carbon is expected to be 40% lower than a 'typical' office building, and whole life carbon 30% lower. Embodied carbon is targeted to align to LETI benchmarks and the project team aims to meet the UKGBC definition for Net Zero in construction.

### Redevelopment strategy & key measures
- Demolition of existing buildings on site.
- Replacement 12-storey new build office with flexible commercial unit and extensive rooftop gardens.
- 'Fabric first' approach to reduce operational energy use to far below regulatory requirements.
- Structural design for flexibility and longevity (e.g., expanded floor to ceiling floor heights; variety of floor plate sizes; use of material passports in the main frame, prefabricated façade elements and other flexible construction techniques).
- Main frame designed with beams at 4.5m centres which offer greater future flexibility for cutting in stairs, whilst significantly reducing the overall weight of steel to yield substantial embodied carbon savings.
- Prefabricated 4.5m span pre-cast concrete planks will provide the thermal mass essential for extending the natural ventilation periods, whilst reducing concrete waste and embodied carbon.

### Embodied carbon reduction
- Targeting NZC in construction; strategies to deliver target include use of prefabricated elements; use of structural steel with high recycled content (avoiding over 238 tonnes of CO$^2$) and use of high percentage of concrete replacement in the structure.
- First project within the City of London to participate in pioneer building materials passport scheme, with

all materials data stored in a 'bank' to facilitate future disassembly and reuse.
• Underfloor air system to significantly reduce the amount of ductwork required, which in turn allows for a whole life carbon saving by minimising components that need to be maintained, repaired and altered in fit outs.

### Energy optimisation / operational carbon reduction

• Designed to be NZC in operation, with energy performance 65% better than 'typical' office building based on the Building Regulations Part L1A SAP (BRUKL) energy model. Reduction of energy demand and integration of renewable energy systems:
  o High-performance glazed façade and high-performance envelope, with deep reveals and solar fins to reduce solar gains.
  o 'Mixed mode' ventilation to reduce reliance on air-conditioning.
  o 'Night purge' strategy to cool concrete soffits to absorb heat during the day, reducing peak cooling loads supplying energy efficiently.
  o Discreet PV arrays provided on plant screen.
  o High efficiency air source heat pumps for heating, cooling & hot water generation.

### Climate change resilience & biodiversity

• Urban green factor (UGF) score of 0.34 and a 555.43% net increase in biodiversity:
o Gardens and planted terraces amount to near 9,000 sq ft of green space, encompassing a range of habitat types, including green roofs, shrubs, grassland, climbers and trees.
o Provision of foraging opportunities and nesting boxes for bees, bats and birds.
• 'Greenfield' run-off attenuation, via a blue roof and basement storage, to minimise impact of landscaping on water resources.
• Smart tank technology to recycle rainwater and grey water from the building's showers, with recovered water used to feed 'low flow' WC cisterns and irrigation.

### Occupier health and wellbeing

• Optimal building user comfort:
o Temperature control through underfloor air-based heating and cooling system or natural ventilation via openable windows, both manual and automatic.
o 3.4m floor to soffit height for optimised natural ventilation and increased natural daylight.
o Abundant fresh air from openable windows and night purging system.
o Access to amenities including onsite café, Edenic gardens, nearby St. Dunstan's Gardens and ancillary cycle parking with 230+ cycle spaces and 22 showers to encourage active travel.

### Anticipated outcomes

• All-electric building with abundant daylight and natural ventilation; planted terraces and mix of amenities to attract and retain tenants
• 40% lower upfront embodied carbon intensity compared to typical office development
• UK-GBC NZC for construction and operation
• Overall annual estimated Operational energy intensity of 77 kWh/m², outperforming the UK-GBC 2030 target
• BREEAM 'Outstanding' and WELL 'Platinum-Enabled'

Inclusion of an environmental and social charter as part of the Building User Guide to ensure the building will be operated sustainably going forward.

Targeting 100% compliance with London Living Wage (best practice) and 25% of labour force to be sourced locally (best practice from a number of London Council's e.g Hackney and Lambeth).

### Pre- and post-retrofit comparison

| | Pre retrofit | Post retrofi |
|---|---|---|
| **Energy intensity** | - | Estimated annual energy usage for office spaces[47]:<br>• 55kWh/m² (regulated)<br>• 23kWh/m² (unregulated)<br>• 77kWh/m² (overall) |
| **Operational carbon** | - | 142,157 kgCO²e (based on the Building Regulations Part L1A electricity carbon factor) |
| **Embodied carbon** | - | Overall:<br>• 10,626 tonnes CO²e<br>• 783 kgCO²e/m² GIA<br>Module A only:<br>• 594 kgCO²e/m² |
| **EPC rating** | 'D' rating | 'A' rating |
| **NABERS rating** | - | Predicted '5' |
| **Building services** | • Electrical and gas plant<br>• Four pipe fan coil air-conditioning in the office areas with VAV air conditioning serving the ground and lower ground floor areas. | • All electric plant<br>• Mixed mode cooling; openable windows<br>• Underfloor air-based heating and cooling<br>• 300 LUX lighting<br>• BMS and sub-metering<br>• SMART-enabled building facilitates use of SMART App Technologies to control and monitor all aspects of the workspace. |
| **Certificates** | - | BREEAM 'Outstanding'<br>WELL 'Platinum Enabled'<br>WiredScore 'Platinum'<br>SmartScore 'Platinum' Enabled |

### Challenges, opportunities & lessons learned

1) The retrofit of the existing building was considered as the first option from both a cost and sustainability perspective, but proved unviable due to a gamut of factors, including variable and unreliable construction type and materials in the pre-existing building, including:
• Floor-to-floor heights were not suitable for BCO Grade 'A' or 'B' workspaces.
• Building services, including lifts, were in need of replacement, and lift shafts were not of sufficient size to allow for replacement with regulatory and BCO-standard lift cars.
• Building structure and layout could not be adapted to meet accessibility standards without substantial demolition.
• Building structure presented several concerns; columns and beams would need to be either part replaced or enlarged to prevent corrosion, did not comply with robustness requirements codified for at least 20 years and could not be warranted by the structural engineer or the fire engineer.
• Foundations could not be reused due to the variability and unreliability of construction type and materials in the original construction.
• Basement space did not meet current standards to prevent water ingress and was not large enough to provide the plant space required.
• Façade was poorly insulated and thermally highly inefficient and would require substantial interventions to meet modern standards; especially when considering that the external fabric (brick and concrete walls) were likely to be integral with the structure.

The design team, including Fletcher Priest and Waterman, were involved in the redevelopment of 98 Fetter Lane in 2017 and had extensive knowledge of the existing building, its structure and foundations as detailed above. During this project attempts were made to retrofit the building by retaining elements of the existing structure and foundations and intrusive surveys into the capabilities of the existing structure were carried out. This experience was used to justify the assumptions made about the existing 100 Fetter Lane Building and structure, and the decision to pursue a demolition and new development approach.

2) An holistic approach to sustainability has been embedded throughout the buildings design, with operational and embodied carbon minimised, and future adaptability and flexibility built-in to the scheme. Reflecting this ethos, a BREEAM 'Outstanding' rating is targeted, whilst the design's 'fabric first' approach to reducing energy use will yield an operational energy consumption level which is far lower than regulatory requirements. In achieving this a key lesson learned has been to challenge conventional design throughout, the 'fabric first' approach has been testimony to this and has allowed the project team to deliver a scheme that sets a precedent in sustainable development.

3) WLCA has been undertaken and a range of strategies identified to reduce WLC on the new build scheme. The development is meeting the GLA embodied carbon benchmark for all modules A1-A5 and B-C and also has a lower impact than the Aspirational WLC Benchmark for the Modules B-C. WLC is targeted to be 30% lower than a 'typical' office and operational energy intensity anticipated to be 65% lower.


# **The Parcels Building,** 1a 388-396 Oxford Street. Duke Street Property Ltd, formerly Selfridges Group

**Planning authority:** Westminster City Council
**Current/ planned use:** Offices plus retail
**Size:** 5,450 $m^2$
**Typology:** Post-war modern
**Project type:** Retrofit, including part demolition and extension
**Project timeline:** 2018 - 2022
**Planning approval:** 2019

**Summary:**
Selfridges Group undertook the retrofit of an existing building on the corner of Oxford Street and Duke Street, directly opposite the Grade II listed Selfridges store, to deliver renewed retail and office accommodation across existing basement, ground and upper floor levels and additional single-storey extension on both wings.
The retrofit involved the removal and replacement of all facades visible from the street, and the modification of building cores to meet current standards.

Energy modelling anticipates that regulated carbon emissions will be reduced by 32% in the retrofitted building and 58% in the new build extension, against a 2013 Building Regulations Part L baseline. Operational carbon in the retrofitted element will be 66% lower compared to a pre-retrofit baseline. The scheme has obtained a BREEAM 'Excellent' certification.

**Pre-retrofit building profile**

**Construction date:** 1957

**Previous uses:**
- Commercial offices plus retail

**Design and construction:**
- Building of L-shaped on plan with seen storeys along the Oxford Street side and four storeys along Duke Street, connected with neighbouring buildings in the block.
- Reinforced concrete frame with mixture of concrete, stone and brick cladding infill.
- Strip glazing is positioned flush with the cladding, resulting in a flat façade with very little depth or variation, and little or no protection from the solar gains from the south.
- Existing structure presented challenges once stripped out..

**Drivers for retrofit:**
1) Add value to the asset through a series of extensions to the superstructure, including single storey extensions to seventh and fourth storey wings.
2) Improve building energy performance and occupier comfort and wellbeing.
3) Deliver a more attractive building and enhanced public realm.

**Whole Life Carbon Assessment**
-

**Retrofit strategy & key measures**
- Series of extensions to the superstructure, including single storey extensions to seventh and fourth storey wings.
- New stone façade designed to establish clear relationship to the neighbouring buildings and deliver enhanced thermal performance.
- Stone piers profiled to provide solar shading, and deep horizontal lintels and beams protect the floorplates from the south sun.
- Double height retail 'base' for ground and first floor aligns to the height of Selfridges shop windows.
- Four storey 'middle' divided into two distinct but equivalent layers, where windows are paired over two floors to give a double order to the façade.
- Attic space that ties sixth floor level and the terrace to the new set-back level together, relating to the upper level of Selfridges.
- New extensions with CLT floor panels and steel frame construction to keep increased loads to a minimum and reduce embodied carbon.
- Remodelling of cores to improve circulation; stair openings within the main floor plate infilled and substituted with new stairways cut in preferred locations.
- Enhanced fabric insulation and improved U-values of opening, external walls, floor/ceilings, exposed-roof and ground floor.

**Energy optimisation / operational carbon reduction**
- Enhanced building fabric insulation and improved U-values of opening, external walls, floor/ceilings, exposed-roof and ground floor.
- Double-glazed windows to reduce heat loss, and optimised glazing g-value to reduce the risk of summer overheating.
- Energy efficient, electric-led building systems; upgrade

of heating and cooling systems and AHUs; upgrade of lighting to higher efficiency specification.
• Photovoltaic panels (PV) on the roof of the new-built extension.
• New build extension designed to comply with the London Plan 35% carbon reduction target even though it does not meet the threshold for 'major development'.

## Occupier health and wellbeing

• Passive design measures to reduce energy demand (detailed above) also intended to promote occupier health and wellbeing
• Access to roof garden at fifth floor level overlooking Duke Street with a mix of planting and hard landscaping, in addition to a roof terrace at the s eventh level.

## Anticipated outcomes

• Embodied Carbon meets RIBA 2030 target.
• Operational Energy Consumption predicted at 99kWh/m² pa which betters 2025-2030 UKGBC target.
• Predicted BREEAM 'Excellent' certification for Base build & Retail shell.
• Minimum predicted BREEAM 'Excellent', but targeting a potential BREEAM 'Outstanding' for Base build & Office Fit-out.
• Advised predicted NABERS UK 4.5-star rating (note: the assessment has not been formally commissioned for the project).
• Targeting Net Zero Carbon.

Hugo Boss is set to become the lead retail occupier after signing for a new 8,000 sq ft (740m²) space.

25,000 sq ft (2,320m²) across six stories of the upper floors of the building will be transformed into premium flexible workspace operated by flexible workspace company Fora.



## Pre- and post-retrofit comparison

| | Pre retrofit | Post retrofit |
|---|---|---|
| **Energy intensity** | - | Space heating, hot water, regulated and unregulated electricity, retrofitted offices:<br>• 64.15 kWh/m²/year<br>New build offices:<br>• 59.66 kWh/m²/year<br>Retail:<br>• 71.83 kWh/m²/year |
| **Operational carbon** | - | Retrofitted offices:<br>• 14.6 kg CO²/m²/year<br>New build offices:<br>• 8.9 kg CO²/m²/year<br>Retail:<br>• 23 kg CO²/m²/year |
| **Embodied carbon** | - | - |
| **EPC rating** | - | - |
| **NABERS rating** | - | - |
| **Building services** | • Heating & cooling: Heat pump via local fan cooler SCoP 2.0<br>• DHW: Instantaneous electric, 140l storage, 0.05 losses (offices); 20l storage, 0.05 losses (retail)<br>• Ventilation: Natural ventilation (offices); Heat exchanged 65% efficiency. SCoP 2.0. SFP 1.0 (retail)<br>• Internal lighting: Lamp – 60 lm/W (offices); Display Lighting 15 lm | • Heating & cooling: Air source heat pump<br>• DHW: Instantaneous electric, 20l storage, 0.05 losses<br>• Ventilation: MVHR 75% efficiency<br>• Internal lighting: Lamp – 100 lm/W (offices) – 80 lm/w (rest of spaces); Display Lighting 85 lm |
| **Certificates** | - | BREEAM 'Excellent' |

## Challenges, opportunities & lessons learned

1) Whilst the existing facade and structure were in need of modernisation, the existing building presented optimal internal layouts. The retrofit works undertaken have extended the buildings' useful life with a lower impact in terms of embodied carbon compared to a redevelopment approach. What is more, a demolition and rebuild approach would have presented significant challenges due to the physical structure and site layout.

3) The differing heights and massing along Oxford Street to the east raised the opportunity of having varied heights in the retrofit and extension proposal. It allowed for a new floor extension, set back from the street frontage. The projection of the Dr. Martens' facade past the existing building façade line presented an opportunity for the new facade to have an increased depth and to have projecting elements which would relate to its neighbour. The strong solar gains from the south could therefore be mitigated thanks to increased shading.


# **The Bower,** 207, 211, Old Street, Islington Helical

**Current/ planned use:** Offices plus retail and restaurants
**Size:** 30,937 m² (333,000 sq ft)
**Typology:** 1960s Brutalist office towers
**Project type:** Deep retrofit, including part demolition and extensions of two buildings, plus 1,719 m² new build element
**Investor:** Helical
**Developer:** Helical
**Architect:** Allford Hall Monaghan Morris
**Project manager:** Avison Young
**Main contractor:** Phase 1 – Sisk; Phase 2 - Skanska
**Structural engineer:** Waterman
**Project timeline:** 2014 - 2018
**Planning approval:** 2013

**Summary:**
The Bower is a large scale, mixed use retrofit and remodelling scheme located adjacent to Old Street Roundabout. Designed with the existing local tech community in mind, the scheme offers a range of spaces over a collection of three buildings, The Tower, The Warehouse and The Studio, each with a distinct character, linked by new public facing elements and walkway at ground floor level.

The retrofit respects the original buildings' heritage whilst enabling significant carbon savings through an innovative design approach.

The Bower has been recognised by three awards for its substantive improvement to the public realm and excellent example of retrofit: 'Best Old and New Building' (World Architecture Festival); 'Best Refurbishment or Regeneration (City)' (OAS Awards) and 'Office Refurbishment of the Year' (The Building Awards).

**Pre-retrofit building profile**

**Construction date:** 1967

**Previous uses:**
- 207 and 211 Old Street built in 1967 as a speculative office development, by CH Elsom & Partners.
- 207 Old Street refurbished and re-clad in 1984 for British Telecom. Planned refurbishment and re-clad of 211 Old Street was not executed.

**Design and construction:**
- The two buildings were designed with a shared language and material palette, with brickwork and sculptural precast concrete cladding.
- 207 Old Street re-clad in mirrored glass.
- Buildings acquired by Helical were under-performing and overclad but well-constructed, offering substantial office accommodation.

**Drivers for retrofit:**
1) Create best in class accommodation for future tenants.
2) Connect the buildings to their surroundings and improve public realm quality for occupiers and visitors.
3) Deliver the best outcomes for environmental sustainability and heritage protection.

**Whole Life Carbon Assessment**
By adopting a retrofit and remodelling strategy rather than demolishing and rebuilding, it was calculated that 12,493 tonnes of carbon were avoided.

**Retrofit strategy & key measures**
- 'Retrofit first' approach, reusing existing structure and foundations in their entirety.
- Phased approach starting with lighter touch retrofit of the rear building ('The Warehouse') and new low-rise construction in unused car park ('The Studio').
- Location of the primary entrance in the heart of the scheme rather than on Old Street, to link the two principal buildings and encourage footfall through the scheme.
- Introduction of retail units at ground floor level, with a mix of sizes to create a diverse and dynamic mix for occupiers and community.

**The Tower**
- Retention of structure and foundations; three additional floors included at roof level with minimal additional strengthening to the retained structure.
- Removal of original 1960's heavy cladding and screeded floors to help balance loads.
- Added light weight "wings" on both principal elevations to provide each floor with enhanced daylight and double height volume.
- Retention of brutalist concrete panels and bare faced internal concrete columns, preserving historical integrity and avoiding additional material use and waste.

**The Warehouse**
- Completely retrofitted and stripped back to expose the existing structure.
- Floorspace increased to 122,000 sq ft across 11 storeys with the addition of side and rooftop extensions and private roof terraces on three floors.

- Steel frame and hollow-core precast planks used to minimise the building's weight and an exposed concrete finish was chosen to match the existing frame.

### The Studio
- New build construction of 18,500 sq ft across two storeys with a rooftop terrace.
- Connected to the scheme's other buildings via a ramped pedestrian walkway.

### Embodied carbon reduction and circular resource use
- Reuse of existing structure and foundations.
- 100% of timber procured from sustainable sources.
- 2,000 tonnes of construction waste diverted from landfill.

### Energy optimisation / operational carbon reduction
- Energy performance over 50% better than the current BBP Real Estate Environmental Benchmarks and exceeds the UKGBC's target energy consumption rating for 2030-35.
- Glass wrapped façade with opening windows and extensive natural light.
- LED lighting upgrade.

### Climate change resilience & biodiversity
- Green and brown roofs.

### Occupier health and wellbeing
- Openable windows and enhancements to existing ventilation systems to achieve an air circulation rate of 10 times per hour.
- Rooftop terrace accessible by all occupants.
- Access to common facilities including new double-height reception, communal Hub café and lounge.
- Landscaped, pedestrianised outside spaces plus a variety of on-estate cafes, restaurants and bars.
- High ratio of cycle facilities per occupier (430+ cycle storage spaces plus locker/shower rooms).

### Outcomes
- Across all buildings, delivered improved connectivity, enhanced building systems with ample tenant plant and service space, and adaptable floorplates.
- Attracted a variety of occupiers from a range of sectors with shared passions and values
- Energy intensity below the UKGBC's 2030-25 target and 50% better than current BBP REEB
- BREEAM 'Excellent'
- Enlivened previously landlocked site with new thoroughfares, piazza and ground level retail

Created a successful destination for tenants and community through a carefully curated retail and restaurant tenant mix including kiosks targeted to small, start up occupiers.

Launched "The Pledge" programme with building management team to support joint activities to reduce environmental impact, engage with local charities and communities, improve health and wellbeing and share achievements with stakeholders.



## Pre- and post-retrofit comparison

| | Pre retrofit | Post retrofit |
|---|---|---|
| **Energy intensity** | - | The Tower<br>• 84.2 kWhe/m² NLA/year<br>The Warehouse<br>• 119.8 kWhe/m² NLA/year |
| **Operational carbon** | - | - |
| **Embodied carbon** | - | - |
| **EPC rating** | - | 'B' |
| **NABERS rating** | - | - |
| **Building services** | • Old and tired fan coil units<br>• Several levels of plant on the roof<br>• Fluorescent strip lights | • Fully automated natural ventilation system<br>• Plant largely relocated to basement and space reclaimed for NIA<br>• High quality LED lighting system<br>• Advanced BMS trialled at The Warehouse |
| **Certificates** | - | BREEAM 'Excellent' for offices<br>BREEAM 'Very Good' for retail |

### Challenges, opportunities & lessons learned
1) The partly landlocked site presented some inherent complexities, meaning that it would likely have been easier logistically to have cleared the site to facilitate a new build. However, in keeping with its 'retrofit first' approach, Helical wanted to extract financial and environmental value from the existing structures.

2) The existing site presented a disparate collection of dilapidated buildings which nonetheless offered considerable potential and embedded value. The developer set itself the challenge to create best in class accommodation for future tenants and curate a place that would connect to its surroundings, improve the quality of the public realm for occupiers and visitors.

*"This has been a successful project and were we presented with a similar opportunity today, aside from changes due to advances that have taken place in the intervening period in terms of both technology and sustainability, we would adopt a very similar approach. Carrying out the scheme on a phased basis, maintaining occupation throughout was challenging but necessary in order to manage this large scheme financially"*
– Nikki Dibley, Senior Development Executive, Helical

# **105 Victoria Street,** Westminster
## BentallGreenOak / Welput

**Current/ planned use:** Offices plus retail
**Size:** 46,450 m² (500,000 sq ft)
**Typology:** 1970s department store and offices
**Project type:** Redevelopment
**Investor:** Welput (specialist office fund managed by Bentall Green Oak)
**Developer:** Bentall Green Oak
**Architect:** Kohn Pederson Fox Associates
**Project manager:** Avison Young
**Main contractor:** Skanska
**Structural engineer:** AKT II
**Project timeline:** 2022 - 2026
**Planning approval:** 2021

### Summary:
The redevelopment of the existing House of Fraser department store in Victoria Street, SW1E, will deliver a multi-tenanted, community-focused office building that will become the UK's largest fully electric net zero emissions building. The new 105 Victoria Street will be net zero operational carbon and net zero embodied carbon harnessing ultra-low carbon construction methods to minimise development carbon intensity. The building will be fully supplied by renewable energy sources with no gas supply or on-site diesel generator. Boasting a wide range of sustainability features, it will be the UK's first office building to target a combined BREEAM 'Outstanding' and 5.5* NABERS rating, as well as a WELL 'Platinum' certification. 105 Victoria Street is the largest speculative West End office scheme ever to come forward, and secured Westminster City Council's single largest commercial building consent in April 2021.

### Pre-redevelopment building profile

**Construction date:** 1976

### Previous uses:
• House of Fraser department store with offices

### Design and construction:
• Building comprised of two basement, ground and 12 upper storeys and incorporates a covered colonnade along Victoria Street.
• Concrete beam and slab construction with aluminium, glass and stone façade.

### Drivers for redevelopment:
1) Create best-in-class office accomodation designed to be flexible and future-fit for rapidly evolving ways of working
2) Deliver the most sustainable new development in Westminster with a building that is all-electric, NZC in operation and minimises WLC, to attract businesses with the highest
ESG ambitions.

### Whole Life Carbon Assessment
A comprehensive WLCA undertaken by SWECO found the whole life sustainability benefits of new build on the site would outweigh that of retrofitting the existing, energy-inefficient 1970s constructed building. Carbon emitted will be offset within six years of the new building's operations.

### Redevelopment strategy & key measures
• Demolition of existing department store (a lease break option to terminate the existing lease will be exercised in July 2022 to start the construction of the new building).
• New build construction with two basement levels, ground floor "Village Square" and mezzanine plus up to 14-storeys.
• Design and materials selection to manage heat gains and maximise natural ventilation.
• Around 2,787 m² of greenspace and terracing including rooftop urban farm.
• Bespoke combination of spatial qualities, building services, amenities and materials to ensure durability of fabric, functionality and adaptability to create an armature to ensure a long life span.

### Carbon reduction
• Design approach and materials selection to manage heat gains and at the same time maximise natural ventilation to lower energy use by 45% when compared to a traditional office building.
• Design to enable retrofit, repurposing and recycling at the end of its own lifespan.
• All electric systems supplied by renewable energy sources with no gas supply or on-site diesel generator.
• Electricity to be purchased from green energy provider with a 'Renewable Energy Guarantee of Origin' (REGO) certificate and commitment to a 15-year renewable energy power purchase agreement (PPA).
• Will encourage tenants to take up "Green Fit-out" and monitor and review landlord performance via Post Occupancy Evaluation.

### Climate change resilience & biodiversity
• Living green walls and green roof space.
• On-site urban farming to provide fresh food and enable composting of organic waste generated within the building.

### Occupier health and wellbeing

- 2.8m theoretical floor-to-ceiling heights and façade design create abundance of natural light.
- Openable windows for mixed-mode and natural ventilation.
- Almost 30,000 sq ft of greenspace and terracing.
- Programme of 'inclusive wellness' with 200m 'walk and talk' track with views across London.
- Multi-purpose room for hosting indoor sports, games and gatherings.
- Activity zone for the arrival of pedestrians and cyclists; shower and locker rooms.

### Anticipated outcomes

- Multi-tenanted, community focused building with inclusive wellness programme and positive social impact via public amenities and engagement
- 400,000 sq ft of office space including 5,500 sq ft of incubator and affordable space
- Highest level sustainability ratings/ certifications: (NABERS 5.5* rating; BREEAM 'Outstanding'; WELL 'Platinum'; Active Score 'Platinum 100')
- Energy intensity aligned to RIBA 2030 targets
- Embodied carbon below 750 kg $CO^2e/m^2$ (A-C)

105 Victoria Street will operate a Social Impact Charter with a programme for school engagement, volunteering, and upskilling.

The redevelopment will create 90,000 sq ft public space with a central Village Square at street level with community-focused retail offer, and an urban farm with community allotments.

### Pre- and post-retrofit comparison

| | Pre retrofit | Post retrofit |
|---|---|---|
| **Energy intensity** | - | Alignment with RIBA 2030 targets |
| **Operational carbon** | - | Target base-build energy use intensity:<br>• <90 kWh/m² (NLA)/year |
| **Embodied carbon** | - | Target based on EN 15978 modules A-C:<br>• <750kg $CO^2e/m^2$ (GIA) |
| **EPC rating** | 'E' rating | 'A' rating |
| **NABERS rating** | - | 5.5* |
| **Building services** | • Heating and hot water by gas boiler<br>• Cooling by rooftop chillers<br>• Electrical power provided by existing on site substation.<br>• Fluorescent lighting in grids with power sensors.<br>• Traditional air intake and extract with onsite filtration. | • Roof mounted Air Source Heat Pumps, providing 4 pipe heating and cooling with heat recovery.<br>• Alternate mains secondary power supply.<br>• Water source heat pump for basement. showers; electric POU heaters to other areas<br>• High efficiency LED light fixtures with fully addressable lighting control system.<br>• Landlord's AHU to serve basement levels.<br>• Tenant provision for installation of local ventilation units, with connections to façade provided. Natural ventilation provision to all CAT A offices and at Village Square level. |
| **Certificates** | - | BREEAM 'Outstanding'<br>WELL 'Platinum'<br>Active Score 'Platinum 100' |



### Challenges, opportunities & lessons learned

The project team considered the option to retrofit and extend the existing building, however due to the layout; column intensity and the floor to ceiling height within a large floor plate, retrofit was discounted as a viable option. Moreover, the WLCA conformed that the new build option would be more carbon efficient. The highly sustainable new build product is forecast to repay the embodied carbon spent within six years due to its substantially lower operational carbon intensity. It is also anticipated to deliver greter socio-economic benefits.

*"Sustainability is not just about environmental considerations, it needs to respond to the social influence of the development; the social interaction with the building user and the interface with the surrounding area"*
– Alexander Morris, Bentall Green Oak


# **Holbein Gardens,** 7 Holbein Place, Chelsea. Grosvenor

**Current/ planned use:** Offices
**Size:** 2,399 m$^2$ (25,800 sq ft)
**Typology:** 1980s brick office block
**Project type:** Retrofit and one storey extension
**Investor:** Grosvenor
**Developer:** Grosvenor
**Architect:** Barr Gazetas
**Project manager:** Capital and Provincial
**Main contractor:** Blenheim House Construction
**Structural engineer:** Heyne Tillett Steel
**Project timeline:** 2021 - 2022
**Planning approval:** 2021

**Summary:**
Grosvenor's first net zero carbon office project, Holbein Gardens comprises the retrofit and one storey extension of a 1980s office building off Sloane Square, creating a 25,800 sq ft modern workplace.

The retrofitted building will be all-electric, with in-use energy optimisation through efficient lighting and mechanical equipment, on-site renewable energy generation, blue roofs and sustainable urban drainage systems. The scheme will align to the UK-GBC net zero carbon buildings framework and NABERS energy rating methodology. As a LETI Pioneer Project, it aims to exceed the LETI Pioneer Project target for embodied carbon. Grosvenor is also targeting BREEAM Outstanding, WELL Gold Platinum and Wired Score Gold certifications for the scheme.

**Pre-retrofit building profile**

**Construction date:** 1987

**Previous uses:**
• Office block

**Design and construction:**
• Concrete structure with brick façade (new comprise new floors are constructed of reclaimed steel and CLT)
• External fabric of low thermal performance with large cavities
• Aluminium windows also with low thermal performance
• Small terrace facing the rear courtyard on the fourth floor, with a lead mansard covering the roof

**Drivers for retrofit:**
1) Create a leading NZC office development, providing best in class office space with exemplar sustainable design, and
2) Prove the potential for transforming outdated offices into exemplary NZC workspaces, targeting innovative ways in which the environmental impact of retrofitting buildings can be minimised

**Whole Life Carbon Assessment**
Early WLC assessment undertaken by OneClick LCA) followed by updates through the design phase, confirming that the project's upfront carbon (modules A1-A5) is on track to achieve circa 300 kgCO$^2$e/m$^2$ GIA, surpassing the LETI 2030 Upfront Carbon Design target of 350 kgCO$^2$e/m$^2$ GIA. This is achieved due to multiple interventions, as described below.

**Retrofit strategy & key measures**
• Retention of existing four-storey structure, façade and steelwork.
• Removal of existing roof structures and fourth floor level, and creation of a single storey (fifth floor) extension set back from Holbein Place.
• Partial sixth floor for access to the roof terrace for office occupiers; roof extension extended in masonry to retain the character and performance.
• Building fabric upgrade to improve thermal efficiency (new mineral wool insulation within cavities and high-performance insulation to the internal wall linings).
• Façade refurbishment along Holbein Place and at the rear of the building; refreshing existing brick work and installing new windows, juliet balconies, terraces, green walls and planted window boxes.
• New landscaping and planting along Holbein Place to improve pedestrian experience; enhance public realm and enable wheelchair access to the building for the first time.

**Embodied carbon reduction and circular resource use**
• Retention of existing four-storey concrete structure, brick façade and steelwork, with retention the latter two components enabling a combined 119 tonnes of CO$^2$e to be avoided.
• Replacement materials selected to minimise embodied carbon:
  o Use of CLT in extension, also allows flexibility to adapt floorplates in future
  o CEMFREE Concrete
  o Celcon and Lignacite blockwork
  o Reclaimed raised access flooring
  o Reused steel (with some reused steel sourced from Grosvenor's Bermondsey site)
• Estimated 29% of materials procured from a reused, recycled or renewable source.

- Standardisation through raising of access floors to allow for services configuration, and installation of prefabricated kitchen units.
- New brickwork assembled with lime-based mortar for improved disassembly.
- Mechanical fixings on steelwork, and bolted connections on steel frame and CLT floor panels to enable deconstruction at end of life.
- Exposed finishes to allow easy access for maintenance, as well as adaptation and flexibility to zone future space in multiple configurations.
- 99.95% of strip out waste diverted from landfill (doors traded by re-use marketplace Globe Chain, timber reused by St Albans wood recycling charity, a proportion of carpet tiles reused on another site).

### Energy optimisation / operational carbon reduction

- All-electric heating and cooling with 100% green energy procurement.
- Exposed concrete slabs to improve thermal mass and passive design performance.
- Natural daylight optimisation.
- Efficient lighting and mechanical equipment.
- Openable windows linked to the BMS.
- Mechanical, Electrical, Plumbing & Heating (MEPH) plant replacement plus planned preventative maintenance (PPM) programme to extend the plan lifetime.
- On-site renewable energy generation (PV panels predicted to offset approximately 1.5% of the building's maximum demand).

### Climate change resilience & biodiversity

- Biodiversity significantly enhanced through extensive landscaping and greening of over 16% of the building's gross area, estimated to deliver 200% biodiversity net gain.
- Supports the Wild West End initiative and Urban Greening Factor (UGF) of 0.26.
- Extensive landscaping contributes to improved local air quality.
- Blue roof and permeable paving, designed for the retention of rainwater above the roof and at ground, to reduce surface water discharge from site to 11.3 litres per second under a worst case 1 in 100 year storm (+climate change consideration).

### Occupier health and wellbeing

- Optimal natural daylight levels and smart ventilation strategy to balance energy performance with occupier comfort.
- Accessible terrace areas and extensive landscaping at ground floor level.
- Multiple green walls to improve internal air quality.

### Anticipated outcomes

- Occupier to save 50% on energy compared to typical London offices
- Embodied carbon circa 300 $kgCO^2/m^2$ (modules A1-5), exceeding LETI Pioneer Project target
- High/highest level sustainability ratings/ certifications (NABERS 4.5, BREEAM 'Outstanding' and WELL 'Platinum')
- NZC in line with UK-GBC framework, target energy intensity 91 $kWh/m^2/year$
- 200% biodiversity net gain
- Estimated 50 local jobs created through the implementation of a circular economy building strategy

Anticipating 100% compliance with the Grosvenor Supply Chain Charter, meaning that all suppliers are expected to pay the Living Wage to all employees (including apprentices) engaged on project contracts; exclude zero hours contracts unless requested and exclude unpaid hours; use best available guidance to safeguard against modern slavery and provide training and development opportunities for staff.

### Pre- and post-retrofit comparison

| | Pre retrofit | Post retrofit |
|---|---|---|
| **Energy intensity** | - | • 91 $kWh/m^2/year$ |
| **Operational carbon** | - | • 43,762 kg $CO^2$/ year (using Part L 2021 electricity carbon factor of 0.136) |
| **Embodied carbon** | - | Upfront embodied carbon (modules A1-5):<br>• c. 300 $kgCO^2/m^2$ (on track) |
| **EPC rating** | 72 C | 'A' (targeted) |
| **NABERS rating** | - | 4.5 |
| **Building services** | • Gas-fired boilers and air-cooled chillers<br>• Centralised Air Handling Unit<br>• Fluorescent lighting<br>• Utility meters | • All-electric<br>• Photovoltaic panels supply 17% of demand<br>• Openable windows & smart ventilation system<br>• Smart meters linked to BMS |
| **Certificates** | - | BREEAM 'Outstanding'<br>WELL 'Platinum'<br>Wired Score 'Gold' |

### Challenges, opportunities & lessons learned

1) The project team reviewed options for retaining the existing building as well as new build; with the conclusion that a retrofit approach would align to Grosvenor's goal of delivering the maximum possible WLC reduction.
2) The drive to reduce WLC to the greatest extent possible tested the project team's capabilities, leading to acquisition of experience and know-how that will enable more efficient delivery of NZC projects going forwards.
3) Specific challenges encountered included the lack of quality assurance for some recovered building products, inconsistent availability of EPDs and higher cost of reused steel. On the other hand, the reuse of the building's original steel frame enabled cost savings.
4) The retrofit approach implied some compromise on flexibility, but as a more carbon efficient option, it enables Grosvenor to market the scheme as a WLC pioneer.

# **100 Liverpool Street,** City of London British Land

**Current/planned use:** Offices plus retail and F&B
**Size:** 50,539 m$^2$ (544,000 sq ft)
**Typology:** Modernist, 1980s finance industry
**Project type:** Combined retrofit and redevelopment (50% of existing structure retained)
**Investor:** British Land
**Developer:** British Land & GIC
**Architect:** Hopkins Architects Limited
**Project manager:** M3 Consulting
**Main contractor:** Sir Robert McAlpine
**Structural engineer:** AKT II
**MEP engineer:** ChapmanBDSP
**Project timeline:** 2017 - 2020
**Planning approval:** 2015

**Summary:**
Built directly above the entrance to one of the UK's busiest train stations, 100 Liverpool Street is a flagship first net zero carbon development for British Land. It offers mixed-use space of the highest standards in sustainability and wellbeing, curated through the transformation of the former 1980s office building with a high degree of technical and logistical skill.

50% of the existing structure was retained, including foundations and a large proportion of the original steelwork, whilst the original cladding was replaced with a glazed façade. Three new office floors and terraces and rooftop gardens were added on the upper levels. The presence of three major transport hubs adjacent to the site, and retail outlets in the station below the building presented specific challenges which were effectively tackled through the architectural project, engineering, and project management teams.

**Pre-redevelopment building profile:**

**Construction date:** 1989

**Previous uses:**
- Offices

**Design and construction:**
- Designed for banking industry 'Big Bang' with deep floor plans for trading floors
- Presented awkward layouts and poor energy performance but offered generous floor to ceiling heights, a large structural grid and detailed architectural and engineering records.

**Drivers for redevelopment:**
1) Redefine existing buildings to meet occupier demand for high quality, flexible, sustainable space
2) Deliver improvements to the public realm

**Whole Life Carbon Assessment**
Use of One Click LCA and RICS framework to assess WLC and implementation of a process to quantify, track and report as built embodied carbon emissions. Embodied carbon intensity of 389 kgCO$^2$e/m$^2$ (A1-A5) achieved, with 11,000 tonnes of embodied carbon avoided.

**Redevelopment strategy & key measures**
- Combined approach of 50:50 reuse and new build
- Combined two separate structures, 100 Liverpool Street and 8-12 Broadgate, into one single building
- 50% of the existing structure was reused: 32% of the existing steel frame was retained as the base for the new development, and 49% of the concrete was retained and reused, including 100% of the foundations
- New steel frame was then constructed, and three additional floors added above the existing building plus 2,415 m$^2$ of terraces
- Extensive retrofit works including full services replacement, full façade replacement and reconfiguration of the floor plates
- A dramatic atrium and feature staircase constructed, transforming the interior of the building.

**Embodied carbon reduction**
- Reuse of 50% of the existing structure (steel frame, concrete and foundations) allowed for the most significant embodied carbon saving.
- New materials selected for lower carbon content, including 51% secondary aggregates and 44% cement replacement (GGBS) in concrete mixes.
- After embodied carbon is minimised as far as possible, all upfront carbon to be offset through verified, nature-based solutions to achieve net zero.

**Energy optimisation / operational carbon reduction**
- Improvement in U-Values beyond the minimum levels required for building regulations.
- Research and incorporation of appropriate efficient building services design.
- PV installation of approximately 450m$^2$ on unshaded areas of the roof providing to provide 74,590 kWh/annum.
- 100% REGO renewable electricity.
- Use of BL: connect, an occupancy based smart building management tool which collects data from thousands of assets – including lightbulbs, lifts, fan coil units,

escalators, sensors and valves – to provide data on how spaces are being used and in what conditions, enabling British Land to identify opportunities to increase efficiency and occupier comfort.

## Climate change resilience & biodiversity

- 10% net gain in biodiversity.
- Third party verified project FSC® certification, providing assurance that all timber used on site is responsibly sourced.
- Greywater reuse and rainwater harvesting with extra filtration use for the air conditioning system.

## Occupier health and wellbeing

- Trialled alternative construction materials including paints, adhesives, flooring and insulation with low volatile organic compounds to improve internal air quality.
- Use of BL: Connect to enable optimisation of indoor environmental conditions.

## Outcomes

- Fully let, tenants include several international finance firms
- Repositioned cores and atrium increased flexibility, improved accessibility and enhanced the retail offer
- British Land's first NZC development
- Embodied carbon of 389 $kgCO^2e/m^2$ (A1-A5)
- Energy intensity 89 $kWhe/m^2$ (TM54 calculation)
- BREEAM 'Outstanding' and WELL 'Gold'
- Recognition as 'Green Building of the Year' in the BusinessGreen Leaders Awards 2021.

British Land has established the Broadgate Community Fund to providing funding for charities and community partnerships in and around the area.

The Fund has launched the New Diorama Theatre Broadgate, one of the biggest free rehearsal and artist support spaces in the UK, providing 20,000 sq ft of space free of charge for independent and freelance artists.

## Pre- and post-retrofit comparison

| | Pre retrofit | Post retrofit |
|---|---|---|
| **Energy intensity** | - | • 89 kWhe/ $m^2$ (TM54 calculation) |
| **Operational carbon** | - | |
| **Embodied carbon** | - | • 389 kg $CO^2e/\ m^2$ (stages A1-A5) |
| **EPC rating** | - | 'B' |
| **NABERS rating** | - | - |
| **Building services** | - | - |
| **Certificates** | - | BREEAM 'Outstanding'<br>WELL 'Gold'<br>Wired Score 'Platinum' |

## Challenges, opportunities & lessons learned

1) The redevelopment process presented some significant challenges due to the buildings' location above and adjacent to three major transport hubs and the Broadgate Circle public space.

2) From the outset, ambitious goals were set for sustainability performance and embedded into the early contractual obligations. The project team had to constantly monitor and work with all parties involved in the project, to ensure that these standards were understood and implemented.

3) Tackling these and other specific technical and logistical complexities required a high degree of skill from the architectural, engineering and project management teams, raising standards and honing skills and experience for future retrofit projects.

4) The quality of data on the existing building was key. To make the right decisions, project teams need access to the right information. British Land is taking care to ensure that developments designed now are rigorously documented to facilitate future adaptations and reuse.

# Glossary

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| **BBP** | **Better Buildings Partnership**<br>A collaboration of the UK's leading commercial property owners who are working together to improve the sustainability of the existing commercial building stock. |
| **BREEAM** | **Building Research Establishment Environmental Assessment Method**<br>The world's leading science-based suite of validation and certification systems for a sustainable built environment. |
| **BSI** | **British Standards Institute** |
| **Building materials passport** | **Building materials passports** are sets of data which describe the characteristics of all materials and (sub)products included in a product or construction, thereby giving them value for recovery, reuse and recycling. |
| **Carbon or GHG intensity** | **Carbon or greenhouse gas intensity** refers to the total amount of direct and indirect GHG emissions (kg$CO^2$) generated from energy consumption in a building over a full reporting year, normalised by an appropriate denominator (e.g., $m^2$ floor area). |
| **Circular economy** | **Circular economy** refers to an economy based on the principles of eliminating waste and pollution, circulating products and materials (at their highest value) and regenerating nature. A building may be considered 'circular' if at each stage of the lifecycle it is supporting a continuous, closed loop of resources where resource is not lost or wasted. |
| **CCC** | **Climate Change Committee**<br>The UK's independent adviser on tackling climate change, a statutory body established under the Climate Change Act 2008. |
| **CLT** | **Cross-laminated timber**<br>A wood panel product made from gluing together layers of solid-sawn lumber, i.e., lumber cut from a single log. Because the timber acts as a carbon store, a steel framed CLT building has significantly lower whole life carbon emissions compared to a reinforced concrete one. |
| **CPA** | **City Property Association** |
| **DfD/A** | **Design for disassembly and adaptability**<br>A design approach that facilitates the ability to change or modify a building during its useful life and the ability to disassemble it at the end of its useful life, in a way that enables components and parts to be recovered, reused and recycled. |
| **DfMA** | **Design for manufacture and assembly**<br>A design approach that focuses on simplification to make manufacture and assembly as efficient as possible. |
| **Embodied carbon** | **Embodied carbon** emissions are the total GHG emissions and removals associated with materials and construction processes throughout the whole life cycle of an asset (Modules A1-A5, B1-B5, C1-C4). |
| **Energy intensity** | **Energy intensity** refers to the total amount of direct and indirect energy used (kWh) by renewable and non-renewable sources in a building over a full reporting year, normalised by an appropriate denominator (e.g., $m^2$ floor area). |



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| **EPC** | **Energy performance certificate**, a legally valid document in the UK which provides an energy efficiency rating of a property (displayed on an A-G scale). |
| **GHG** | **Greenhouse Gases** are constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. Carbon-related definitions refer to GHGs with Global Warming Potentials, i.e., carbon dioxide ($CO^2$), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFC's), perfluorocarbons (PFC's), and sulphur hexafluoride (SF6). |
| **GLA** | **Greater London Authority** |
| **IPCC** | **Intergovernmental Panel on Climate Change**<br>The United Nations body for assessing the science related to climate change. |
| **LCA** | **Life cycle assessment**<br>A methodology for assessing environmental impacts associated with all the stages of the life cycle of a commercial product, process, or service. |
| **LETI** | A network of built environment professionals that are working together to put the UK on the path to a zero-carbon future. Originally known as the 'London Energy Transformation Initiative'. |
| **MEES** | **Minimum Energy Efficiency Standards**<br>Regulations introduced for private rental properties in the UK in 2015. The UK Government has indicated that all non-domestic rented buildings will be required to meet an Energy Performance Certificate ("EPC") level B by 2030 (currently the minimum requirement is an E). |
| **MMC** | **Modern methods of construction**<br>A range of construction approaches which spans off-site, near site and on-site pre-manufacturing, process improvements and technology applications. |
| **NABERS** | **National Australian Built Environment Rating System**<br>An energy performance rating system for operational buildings based on actual impact measurement. NABERS UK currently offers two products, Design for Performance (DfP) to drive energy-efficient new buildings, and NABERS Energy ratings to measure how energy-efficient existing buildings are. |
| **NZC building** | **Net zero carbon building**<br>A building for which the embodied and operational carbon emissions have been assessed and reduced to the greatest extent possible, considering the whole building life cycle, and where the residual emissions associated with at least the construction works and operational energy use have been offset. |
| **NZC construction** | **Net zero carbon in relation to construction**<br>When the amount of carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy (UK-GBC). |

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| **NZC operational energy** | **Net zero carbon in relation to operational energy**<br>When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset (UK-GBC). |
| **NZC whole life** | **Net zero carbon in relation to the whole building life cycle**<br>When the amount of carbon emissions associated with a building's embodied and operational impacts over the life of the building, including its disposal, are zero or negative (UK-GBC). |
| **Operational carbon** | **Operational carbon** emissions are the GHG emissions arising from all energy consumed by an asset in-use, over its life cycle. |
| **Paris Proof target** | The **'Paris Proof'** methodology establishes the amount of energy reduction required for the UK economy to be fully powered by zero carbon energy in 2050. Through consultation and direct engagement with stakeholders, UKGBC asserts a need for 60% reduction in energy use from offices which translates to the Paris Proof targets. These targets offer an outcome-based approach, setting a trajectory for tightening performance targets over the next fifteen years. |
| **PPA** | **Power Purchase Agreement**<br>A contract between two parties, one which generates electricity (the seller) and one which is looking to purchase electricity (the buyer). Usually used to refer to a long-term renewable energy contract which provides a reliable way to decarbonise the buyers' electricity consumption. |
| **REEB** | **Real Estate Environment Benchmark**<br>A publicly available operational benchmark of environmental performance for commercial property in the UK. |
| **Redevelopment** | **Redevelopment** involves new construction on at site that has pre-existing uses. It typically involves the full or partial demolition of the existing building to deliver a new building of a higher quality standard to meet modern occupancy requirements and, in the context of this research paper, to deliver high operational energy efficiency and low or zero operational carbon emissions. |
| **Retrofit** | A building **retrofit** involves modifying the building's systems and/or structure after its initial construction and occupation, generally to improve amenities and comfort for building occupiers and/or increase operational efficiency by reducing utilities consumption. A low or net zero carbon retrofit involves the retrospective upgrading of a building to enable it to respond to the imperative of climate change by maximising energy efficiency and phasing out fossil fuel use to deliver low or zero operational carbon emissions. |
| **RIBA** | **Royal Institute of British Architects** |
| **RICS** | **Royal Institute of Chartered Surveyors** |
| **SBTs** | **Science-based targets** |
| **SMEs** | **Small and medium enterprises** |



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| **SUDS** | **Sustainable urban drainage systems** |
| **Sustainability** | **Sustainability** or **Sustainable Development** is an integrated approach that takes into consideration environmental and social concerns along with economic development. In 1987, the United Nations Brundtland Commission defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." |
| **Upfront carbon** | **Upfront carbon** emissions are the GHG emissions associated with materials and construction processes up to practical completion (Modules A1-A5). |
| **UK-GBC** | **UK Green Building Council** |
| **WELL** | **WELL Building Standard®**<br>A performance-based system created by the International WELL Building Institute™ for measuring, certifying, and monitoring features of the built environment that impact human health and well-being, through air, water, nourishment, light, fitness, comfort and mind. |
| **WLC** | **Whole life carbon emissions**<br>The sum total of all asset-related GHG emissions and removals, both operational and embodied over the life cycle of an asset including its disposal (Modules: A1-A5; B1-B7; C1-C4). Overall Whole Life Carbon asset performance includes separately reporting the potential benefit from future energy recovery, reuse, and recycling (Module D). With reference to definitions provided by LETI, RIBA, and the UK-GBC. |
| **WLCA** | **Whole life carbon assessment**<br>The assessment of whole life carbon emissions based on the Life Cycle Modules adapted from BS EN 15978: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method. |
| **WPA** | **Westminster Property Association** |

# References


1 Department for Business, Energy and Industrial Strategy, June 2022: https://www.gov.uk/government/statistics/uk-local-authority-and-regional-greenhouse-gas-emissions-national-statistics-2005-to-2020
2 'Decarbonizing Cities and Real Estate', JLL, May 2022. London has the highest proportion of emissions from buildings out of all 15 major global cities assessed by JLL.
3 Climate Change 2022: Mitigation of Climate Change, Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change' (IPCC WG III, WMO & UNEP, April 2022).
4 The Paris Agreement is a legally binding international treaty on climate change, with a goal to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016 (United Nations Framework on Climate Change, 2022).
5 UK-GBC (2021); UK Parliament (2022).
6 The UK Climate Change Act (amended 2019) enshrined in law a target of net zero emissions by 2050. In April 2021 the UK Government enshrined in law a target to cut emissions by 78% by 2035 compared to 1990 levels. In line with the recommendation from the independent Climate Change Committee, this sixth Carbon Budget limits the volume of greenhouse gases emitted over a 5-year period from 2033 to 2037, taking the UK more than three-quarters of the way to reaching net zero by 2050. The Carbon Budget will ensure Britain remains on track to end its contribution to climate change while remaining consistent with the Paris Agreement temperature goal to limit global warming to well below 2°C and pursue efforts towards 1.5°C (UK Government, April 2021).
7 'Net Zero Strategy: Build Back Greener' – section 3iv, Heat & Buildings, HM Government (October 2021). Note that according to the UK-GBC, the UK Built Environment is currently responsible for (i.e., has direct control over), 25% of total UK greenhouse gas emissions (buildings and infrastructure). If surface transport (vehicle emissions) is included within the scope of the built environment, the total share of UK emissions increases to 42%.
8 Net Zero Whole Life Carbon Roadmap, A Pathway to Net Zero for the UK Built Environment', UK-GBC (2021)
9 'The Sixth Carbon Budget – Buildings', CCC (December 2020). As part of its Advice Report for the UK's Sixth Carbon Budget, the UK's independent adviser on tackling climate change, the Climate Change Committee (CCC), established pathways to reduce emissions in buildings to zero by 2050 at the latest, whilst adapting to a changing climate.
10 'The Non-Domestic Private Rented Sector Minimum Energy Efficiency Standards Implementation of the EPC B Future Target', UK Government Consultation (March 2021)
11 'Analysis of a Net Zero 2030 Target for Greater London Final report for Greater London Authority', Element Energy Limited (January 2022)
12 In April 2022 Communities Secretary Michael Gove blocked Pilbrow & Partners' plans to demolish and rebuild Marks & Spencer flagship Oxford Street store due to concerns over embodied carbon emissions, highlighted in a report by Sturgis, commissioned by SAVE Britain's Heritage. The London Mayor argues that the scheme is compatible with the London Plan, and that the lifecycle carbon impact assessment undertaken by Arup concludes that in this case, new build offers advantages over retrofit.
13 JLL UK Capital Markets Review & Outlook, JLL (March 2022)
14 'Responsible Real Estate: Decarbonizing the Built Environment', JLL (2021)
15 'The Impact of Sustainability on Value: Developing the business case for net zero carbon buildings in central London', JLL (2020). Also, M&G Real Estate's research on certified assets across its European portfolio found that whilst implementing sophisticated technologies to deliver sustainable buildings had increased costs (+31bps), they were able to make up for this with significantly higher rental income (+53bps), ultimately leading to higher cash flows for distribution (+19bps) and compensation for the premium costs of a green building (Auxadi, 'ESG for Real Estate: small changes have a big impact', October 2021)
16 Theoretical modelling is based on the national calculation methodology, with assumptions regarding occupancy levels and regulated energy use patterns. Actual buildings use is very much influenced by factors such as the commissioning and control of building management system and occupier activities which are not captured within design-based ratings.
17 'Regulated energy' is energy consumed by controlled, fixed building services and fittings, including heating and cooling, hot water, ventilation, fans, pumps and lighting. 'Unregulated energy' refers to energy consumed by all other equipment, including ICT equipment, lifts, refrigeration systems, external lighting and appliances.
18 Indeed, the 2021 results of the Real Estate Environmental Benchmark (REEB) concluded that "there remains little evidence of a clear relationship between Energy Performance Certificates (EPCs) and performance in use". ('Latest Real Estate Environmental Benchmarks Reveal Sustained Improvements in Energy Performance', Press Release, Better Buildings Partnership, August 2021)
19 In the City of London, 89% of commercial buildings have an EPC rating of B or below. In Westminster, this rises to 91%. Source: Energy Performance of Buildings Data: England and Wales, Department for Levelling Up, Housing & Communities (based on data for Property types - A1 - A5, B1, C1; offices, retail, F&B and hotels, downloaded in May 2022)
20 NABERS UK measures and rates the actual energy use of offices, helping building owners to accurately track and communicate the energy performance of their buildings. It is an adaptation of the highly successful rating programme NABERS that operates in Australia. In the UK it is run by BRE.
21 In 2021 the UK government issued a consultation on proposals to introduce a national performance-based policy framework for rating the energy and carbon performance of commercial and industrial buildings above 1,000m² in England and Wales, with annual ratings and mandatory disclosure as the first step.
22 In accordance with London Plan Policy SI 2 ('be seen' element of the London Plan energy hierarchy).
23 'Latest Real Estate Environmental Benchmarks Reveal Sustained Improvements in Energy Performance', Press Release, Better Buildings Partnership, August 2021
24 Also known as 'Regent Street's disease', corrosion-related damage affecting early 20th Century steel-framed, masonry-clad buildings is common among Regent Street buildings.
25 More likely to be found in steel-framed buildings built or refurbished between 1950 and 1980 and in the roofing of older 20th century buildings.
26 In May 2022 a coalition of UK industry bodies launched a cross-sector steering group to develop a standard for net zero carbon building standards. The UK Net Zero Carbon Buildings Standard will provide built environment stakeholders with a standard to verify that new and existing UK buildings are 'net zero carbon'. The Standard will cover both new and existing buildings and will set out performance targets addressing operational energy and embodied carbon emissions to align with the UK's 2035 and 2050 emissions targets - 78% reduction and net zero respectively. (Coalition of leading industry bodies join forces to develop UK Net Zero Carbon Buildings Standard', News Release, Better Buildings Partnership, May 2022)
27 'Net Zero Carbon Buildings: A Framework Definition', UK Green Building Council, April 2019
28 'Decarbonizing Cites and Real Estate', JLL Global Research (May 2022)
29 'Whole Life Carbon Assessment for the Built Environment', RICS (1st Edition, November 2017)
30 'LETI Embodied Carbon Primer – Supplementary guidance to the Climate Emergency Design Guide, LETI (January 2020)
31 Whole Life-Cycle Carbon Assessments, London Plan Guidance (Mayor of London), March 2022. The London Plan Guidance recommends the use of the RICS Professional Statement: Whole Life Carbon assessment for the built environment (the RICS PS) as a guide for the practical implementation of the BS EN 15978 principles.
32 Whole Lifecycle Carbon Optioneering - Planning Advice Note, City of London/ Hilson Moran, (May 2022). The Planning Advice Note establishes the minimum WLCA data required at the pre-planning and planning stages, and the level of transparency to be disclosed to City of London Corporation. The proposal aligns with the GLA's new guidance on Whole Lifecycle Carbon Assessment reporting (March 2022).
33 The London Plan WLCA guidance establishes principles for WLC reduction, which include designing for durability and flexibility using efficient construction techniques to allow for future adaptations and mitigate obsolescence risk; pursuing a circular economy approach to maximise the use and reuse of structures and materials and consideration for regenerative design approaches, such as the use of materials and vegetation to absorb carbon.
34 See 'People versus planet: Is there ever a trade-off in green building design?' World Green Building Council Blog for discussion on this topic.
35 By way of example, JLL's Sustainable Workplace Strategy demonstrates how sustainability aspects are embedded within corporate real estate decision-making. Its core pillars include 'Health First' (biophilic design; optimal air quality; active workplace, etc.); 'Sustainable & Circular' (reduced embodied carbon; fully electric; circular design, etc.); 'Inclusive Design' and 'Collaboration First Design', among others.
36 In its paper 'Delivering Net Zero: Key Considerations for Commercial Retrofit' the UK-GBC establishes definitions for 'light' and 'deep' retrofits to provide clarity to assist in establishing best practice approaches. ('Delivering Net Zero: Key Considerations for Commercial Retrofit', UK Green Building Council, Advancing Net Zero, May 2022).
37 Idem.
38 Whilst the first phase of the Tea Building retrofit actually commenced in 2001, 'Green Tea', the energy and carbon reduction-focused project, was commenced in 2014.
39 A City of London redevelopment project by GPE, not featured as a stand along case study. The project team at 2 Aldermanbury Square & 40 Basinghall Street was challenged to design a building that would be net zero carbon in operation and would challenge industry embodied carbon norms for a new build development, and all opportunities to reduce carbon have been assessed in the most comprehensive and collaborative way. The completed project

is expected to deliver a 49.7% reduction in $CO^2$ emissions relative to Part L2A 2013 Building Regulations, with embodied carbon outperforming the LETI 'C' performance band for new development. NZC status will be achieved through the annual voluntary offset of operational carbon through GPE's internal fund, and the purchase of Gold Star approved offsets for embodied carbon.

40 1 Marble Arch and 1 Great Cumberland Place is owned and managed by The Portman Estate. The redevelopment of the corner site was planned and implemented between 2013 and 2022 with architects Allford Hall Monaghan Morris, to offer high-end retail and office space. The initial solution for which the scheme first received planning approval in 2016 was to retain as much of the existing structure as possible whilst extending the building vertically with the introduction of new floors. However, since the core configuration of the existing building was inadequate for contemporary uses, a new core had to be introduced to meet the needs of a modern building. However, the constraints of the existing structural grid meant that almost half of the floor plate would need to be rebuilt. The complexity of this structural intervention, as well as the lack of survey information, led the team to change their approach to a façade retention scheme. The existing structure was demolished, and a new steel frame structure was constructed. Retrospectively, the project team believes that a full redevelopment approach, without the façade retention, would have resulted in lower upfront carbon emissions. This is due to defects found in the façade as works progressed, which added significant complexity, additional material, detailing and workmanship to the façade retention element and the extensive and complex structural steel support system to prop the retained façade, (Source: 'The nuts and bolds of regenerative design: 1 – 4 Marble Arch" (AKT II, Consulting Structural and Civil Engineers, August 2022)

41 E.g., by delivering additional lettable area, tenant amenity and quality, and retaining asset value over time.

42 See note 40 above.

43 'LETI Climate Emergency Design Guide: How new buildings can meet UK climate change targets', Appendix A0.2, Actions by RIBA Stage (pages 114-118), https://www.leti.uk/_files/ugd/252d09_3b0f2acf2bb24c019f5ed9173fc5d9f4.pdf

44 The current approach recommended by the GLA is to follow the RICS Professional Statement: Whole Life Carbon assessment for the built environment (the RICS PS) as a practical implementation guide based BS EN 15978 principles.

45 Arup, Rethinking timber buildings, 2019: https://www.arup.com/perspectives/publications/research/section/rethinking-timber-buildings

46 The overall weight of steel and CLT buildings is about 20-25% lighter than a conventional structure (Landsec).

47 The energy intensity of the development has been estimated based on the Building Regulations Part L1A SAP (BRUKL). The operational energy calculations were undertaken using the IESVE simulation software. The operational energy consumption has been calculated for a life-cycle of 60-years, assuming that the annual operation energy consumption remains identical throughout the reference period.

London Property Alliance

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