Embodied Carbon in Central London

ARUP

London Property Alliance
WPA Westminster Property Association
CPA City Property Association

About London Property Alliance

London Property Alliance (LPA) brings together the Westminster Property Association (WPA) and City Property Association (CPA) to provide a unified voice for the leading owners, developers, investors and professional advisors of real estate across central London.

Combined we represent over 400 members, ranging from FTSE 100 companies and the Great Estates to affordable housing providers and boutique architectural practices. We are not-for-profit, and the only property industry body which represents London's Central Activities Zone (CAZ). The Alliance delivers informative events, publishes innovative research and represents our members' interests to politicians and policymakers.

Project contributors

BGO
Berkeley Estate Asset Management
BNP Paribas
British Land
Brookfield Properties
CO—RE
Derwent London
Endurance Land, A Member of Nan Fung Group
GPE.
Grosvenor
Helical
Landsec
OPLM Old Park Lane Management
Royal London Asset Management
Sellar
Stanhope
The Crown Estate

With acknowledgement to

Hilson Moran, part of the Tyréns Group
W—B Woods Bagot

Content

Holbein Gardens | *Grosvenor Property UK*

Foreword

Climate change is the defining risk of our generation. For the built environment sector, meeting this challenge demands far more than incremental improvement. It requires a fundamental shift in how we plan, design, deliver and operate buildings, and in how the property sector works across the supply chain to reduce carbon and build long-term resilience. I have made collective action on embodied carbon reduction central to my agenda during my tenure as WPA Chair, because no single organisation can deliver this transition alone.

This study draws on that collective effort. Authored by Arup, it brings together data from 76 central London projects submitted by developers operating across the Central Activities Zones (CAZ) under the WPA and CPA's joint banner of the London Property Alliance. This breadth of insight reflects the leadership of Alliance members, who are at the forefront of delivering sustainable development. It also reflects London's widespread adoption of lifecycle carbon analysis, which sets the capital apart, not just from the rest of the UK, but from most international peers.

Our members understand first hand the realities of creating a low carbon built environment and the findings of this analysis show both how far the sector has already come and the scale of innovation and investment underpinning that progress.

There is much to celebrate, but of course, progress does not stand still. However, to support this continued transition to a net zero future, change must be matched by an enabling policy environment. This includes planning and sustainability policies, as well as certification schemes such as the UK Net Zero Carbon Building Standard.

To genuinely drive progress, these policies and initiatives must be grounded in evidence and responsive to how development is financed, designed and delivered in practice, acknowledging the many and varied constraints already in existence. They need to reflect the realities of carbon performance today and set out a credible, phased roadmap that shows how the industry can decarbonise over time.

However, this analysis highlights the significant gap between what is currently achievable and the embodied carbon targets proposed within the UK Net Zero Carbon Building Standard. This gap is particularly stark for new build office schemes and tall buildings across dense city centres, where the dramatic year-on-year target reductions will soon exclude a majority of projects.

If this disconnect is not addressed, we risk creating a benchmark that rapidly becomes obsolete. Effective certification should incentivise an ever-increasing proportion of the sector to aspire and take part in best practice, by demonstrating that the additional investment required is worthwhile. By creating targets that are unachievable for so many, the UK Net Zero Carbon Building Standard is missing this opportunity. Getting it right would be the most effective means to delivering our shared ambition of a low carbon built environment; getting it wrong risks further stalling development and diverting investment at precisely the time it is needed to fund the innovation required to decarbonise.

As we push to deliver a new generation of low carbon buildings, we must also remember why we build in the first place: to create high quality places for people, and to support the capital's essential economic and social functions.

I am confident that through our continued innovation and collaborative actions our industry can deliver a resilient, low carbon future.

James Raynor
WPA Chair and Chief Executive
Grosvenor Property

Introduction

The central London commercial sector is the beating heart of the UK economy, generating significant economic output and supporting millions of jobs. High-quality commercial buildings are fundamental to this success, providing the workplaces that enable businesses to innovate, collaborate and grow. London's density, agglomeration benefits and unrivalled access to public transport make it the most efficient location for offices, helping to reduce car dependency and supporting lower-carbon patterns of living and working. When viewed at the scale of the city, rather than through the carbon profile of a single building or sector, central London is one of the most sustainable places in the country to concentrate economic activity. At the same time, our sector recognises the need to align with a 1.5°C decarbonisation pathway and this starts with individual projects and sector collaboration. For the first time, this report provides a clear picture of the embodied carbon associated with commercial development delivery today. Understanding our current position is essential: only with robust, transparent data can we chart a credible route to a decarbonised commercial property sector while continuing to deliver the workplaces that underpin London's economic and social success.

Embodied carbon is typically 70-80% of a commercial building's total lifecycle carbon impact. And as buildings transition to all electric in operation, and electricity decarbonises, that proportion will rise over time. The building data collected for this report totals 1.7 million tonnes of CO_2e, which is a substantial proportion of London's total carbon footprint and emphasises the importance of taking action to reduce our embodied carbon impacts.

Over the last 10 years we have transformed our approach to embodied carbon in commercial developments. 10 years ago, even measuring embodied carbon was the preserve of a few leading developers, and there was very little understanding across the market of the scale of the carbon impact associated with construction. The first RICS Professional Statement in 2017 standardised the approach and broadened the uptake to some extent. But it was the 2021 London Plan and the requirements for all referrable developments to complete whole life carbon assessments that have really been transformational. The rapid expansion in uptake since that point has driven increased focus and rapid improvements in measurement practice, resulting in the 2023 update to the RICS Professional Statement. This report is essentially the culmination of that process - the first wave of projects to achieve planning following the adoption of the new London Plan are now in construction or approaching completion. As a result now, for the first time, we are able to bring together a substantial dataset of upfront embodied carbon outcomes based largely on in-construction assessments. Therefore, this dataset paints a much clearer picture than we have had to date of what is achievable now in terms of upfront embodied carbon intensity.

There is a strong sense that the increased focus on embodied carbon, and competition among leading developers, has driven substantial reductions in embodied carbon intensity. This is difficult to substantiate due to improvements in measurement practices, which make it difficult to rely on historic data. However, comparing the GLA dataset published in 2021 in support of the London Plan with our dataset in 2026, we see a 24% improvement in the average intensity over that period. If anything, this is likely to be an under-estimate of progress, as embodied carbon tended to be under-reported historically. As an industry we should be proud of this achievement, and we should take courage from it as we face the challenges going forwards. Whilst we have largely consumed the low hanging fruit, and future reductions will be harder to come by, it does show our capacity to innovate and change in response to changing demands.

It is also important to reflect on the broader impact of London's journey to embodied carbon maturity. The 2023 update to the RICS Professional Statement was a response in large part to the challenges demonstrated by the early whole life carbon assessments completed by London developers in response to the London Plan. The 2023 RICS Professional Statement is increasingly being used internationally, and has been referenced in industry guidance as far away as South Africa. In the UK we are seeing regional local planning authorities follow London's example in requiring whole life carbon assessments at planning stage, emboldened by the experience of the London market. Globally, experience in London, alongside Toronto and a handful of others, has inspired the adoption of whole life carbon assessments in the national regulations in Denmark, the Netherlands, Sweden and France. The proposed 2028 update to the European Performance of Buildings Directive will include embodied carbon and will be by far the largest scale roll-out seen globally to date.

This report brings together robust, project-level embodied carbon data from 76 office-led developments across central London. Submitted by 17 leading property organisations, the dataset reflects both new developments and a wide range of retrofit projects. The analysis provides insight into prevailing trends, the scale of variation between project types, and the contextual factors that shape embodied carbon outcomes.

This report demonstrates London's leadership in embodied carbon reporting, increasing transparency of performance and supporting the industry in moving beyond abstract targets to an evidence-based approach to managing embodied carbon performance. This publication contributes to that effort by establishing a transparent, data-driven view of embodied carbon intensities across central London offices and highlighting the benchmark ranges that represent today's best practice.

Our aim is simple: to help property owners, practitioners and policymakers in the UK and beyond understand what "good" looks like in central London today, and how the sector can continue to drive down embodied carbon while delivering the high-quality, resilient office buildings the city needs.

Stephen Hill
Associate Director
Arup

Tamanna Abul
Sustainability Consultant
Arup

Executive summary

What does good look like?

This publication brings together data from 76 commercial office-led projects being delivered by 17 of central London's top commercial developers, including new construction and retrofit projects across Shell & Core, Cat A and fully fitted (Whole Building) data.

This dataset captures the first wave of projects to achieve planning permission post the 2021 New London Plan. The requirement was introduced at that point for referrable projects to complete an embodied carbon assessment. Many of these projects are now on site, and as a result we now have a robust dataset based on upfront embodied carbon assessments at detailed design or construction stage. This provides us with a much clearer picture of what is achievable in the market now than has been previously available.

In total this dataset represents 1.7 million tonnes of construction CO_2e, and includes projects starting on site from 2019 to 2029. This compares to the total embodied impact of construction in central London of circa 6 million tonnes annually, so this dataset represents a significant proportion of the total.

Within this dataset the 10 high rise projects represent 46% of the total carbon impact.

The majority of the projects start on site in either 2025 or 2026, and hence this dataset does not give a strong sense of change over that time. However, the average in this dataset for Cat A New Build projects of 720 $kgCO_2e/m2$ GIA[1] can be compared to the GLA Benchmark of 950 $kgCO_2e/m^2$ GIA. This was calculated based on the average of a dataset collected by the GLA prior to the launch of its whole life carbon guidance in 2021. Whilst there has been significant change in measurement practice over that period, this comparison does give a broad indication of the progress to date.

76
office projects

1.7 million tCO_2e
total impact

Average performance (Shell & Core + Cat A New Build)

720
$kgCO_2e/m^2$ GIA

24%
improvement on the GLA Benchmark from 2021 (950 $kgCO_2e/m^2$ GIA)

[1] $kgCO_2e/m^2$ GIA = kg of carbon equivalent per m² of Gross Internal Area.

Market Best Practice (defined as the 25th percentile from the dataset)

<table>
<tr><th>PROJECT TYPE</th><th>SHELL & CORE</th><th>SHELL & CORE + CAT A</th><th>FULLY FITTED (WHOLE BUILDING)</th></tr>
<tr><td>23
NEW BUILD
100% NIA is New</td><td rowspan="2">495
kgCO₂e/m² GIA</td><td rowspan="2">590
kgCO₂e/m² GIA</td><td rowspan="2">760
kgCO₂e/m² GIA</td></tr>
<tr><td>22
NEW BUILD WITH RETENTION
<50% new NIA is retained (e.g. foundation, façade, etc.)</td></tr>
<tr><td>31
RETROFIT
>50% of New NIA is retained</td><td>255
kgCO₂e/m² GIA</td><td>295
kgCO₂e/m² GIA</td><td>415
kgCO₂e/m² GIA</td></tr>
</table>

Impact of High Rise (increase per additional storey)

SHELL & CORE	SHELL & CORE + CAT A	FULLY FITTED (WHOLE BUILDING)
~4 $kgCO_2e/m^2$ GIA per storey	~5 $kgCO_2e/m^2$ GIA per storey	~9 $kgCO_2e/m^2$ GIA per storey

This analysis is intended to provide a clear picture of what "good" looks like in the current market with respect to upfront embodied carbon intensity. We have taken the 25th percentile of the data in each category as being broadly representative of best practice. Embodied carbon outcomes are sensitive to the context of each individual project, and while this analysis gives a broad indication of best practice, individual project teams will need to follow the evidence to work out what is achievable in each case.

The dataset is dominated by low-to mid-rise projects, with most in the range eight to fifteen storeys. The best practice numbers are therefore broadly reflective of this massing. Our analysis shows that building height is a significant determinant of embodied carbon outcome, with additional storeys adding on average 5 $kgCO_2e/m^2$ for New Build projects delivering a Cat A scope.

Within the dataset there are fewer fully fitted or Whole Building data points. This reflects the fact that embodied carbon analysis is not yet as widespread in the fit-out market as it is in base build construction. Whilst base build embodied carbon has become mandatory through the London Plan, analysis of fit-outs remains voluntary. Measurement practice in fit-out as a result lags to some extent behind Shell & Core components due to that lack of data, and as a result, there remains the potential for some under-reporting in this sector.

Executive summary

What's next?

The analysis presented in this report clearly reflects the value of a robust evidence base in informing both policy and practice. We need to continue to work across industry to collect and synthesise this data. This will extend our understanding of the impact of embodied carbon and reveal trends over time in the office market, which are difficult to derive from this dataset alone. Similarly we need to extend this type of analysis to encompass other market sectors.

We have made significant strides in recent years in optimising embodied carbon outcomes, through a combination of lean design, re-use of existing materials and use of lower carbon products. Whilst many of the more straightforward opportunities have been taken, we need to continue to innovate in this space. Unlocking challenges such as the fire safety of bio-based materials and warranties for reused products will, in particular, require coordinated industry-wide research initiatives, as these issues cannot be resolved on a project-by-project basis.

In recent years we have started to see demand signals for low carbon materials have an impact, with the materials supply chain responding through innovation. Where the business case is clear, supply chains respond quickly, and re-used raised access floor tiles selling like hot cakes is one of the clearest examples of this. Other examples, such as re-use of structural steel, have more challenges associated with them, but that market is also starting to mature. It will be important going forwards that we are coordinated in our engagement with supply chains so that we provide clear signals of future demand for decarbonised materials. This will give supply chains the confidence to invest in developing and scaling new products.

The introduction of mandatory reporting of embodied carbon through the London Plan, as well as certification schemes such NABERS, have played a helpful role in benchmarking and encouraging industry best practice on decarbonisation. The launch of the UK Net Zero Carbon Building Standard (UKNZCBS) has the potential to support the sector in this transition. As it stands, the 2025 limits align well with our findings on best practice. However, the rate of year-on-year reduction means that going forwards the limits will be out of reach for the vast majority of New Build commercial development in central London. This is in part because they are designed to apply to only a small proportion of schemes, rather than to be applied by the market at large.

Regardless, it remains essential that the industry continues to take action to ensure it can be decarbonised by 2050, in alignment with the UK Climate Change Act and UK's 2050 Net Zero Target.

To move forward, we urgently need to understand the likely rate of material decarbonisation going forwards, from which we can better understand the gap between what we will be able to deliver and what will be required to reach net zero. Once we understand the gap we can then consider what we need to do to bridge it. This will no doubt include ongoing collaboration and dialogue across the industry and policy-makers, but as this body of work demonstrates, there is a clear desire among market leaders to deliver low carbon buildings and the will to innovate and share best practice and knowledge. We hope this analysis inspires better outcomes for our built environment.

Top four areas of action

The industry is by no means standing still in terms of embodied decarbonisation. Across the industry we are seeing continuing innovation to drive decarbonisation on projects. Going forward, involvement from a broad cross-section of industry stakeholders will be essential to ensure these initiatives succeed.

1 Innovation and use of low carbon materials

The industry is heavily invested in developing and trialling new, low carbon materials in major schemes. Many of London's top developers and engineers have formed the Accelerating Concrete Decarbonisation Group[2] to work together on developing a form of low carbon concrete, which if introduced, could be a real game changer. Others are working in hand-in-hand with the insurance industry to facilitate the use of timber, which, too often is difficult to insure and therefore use at scale.

2 Rolling out materials reuse

Materials reuse has come a long way in the last five years. Developers have become better at seeking opportunities for the reuse of materials across sites. GPE for example, reused its steel from 2 Aldermanbury Square at French Railways House in the West End. However, challenges remain, from storage, logistics and being able to procure large volumes of second-hand materials when you need them. Cracking this, with the creation of a thriving second-hand sector could be transformational.

3 Improvements in measurement

We are now only able to understand market performance because we are able to measure carbon accurately and consistently. Industry practice has come on in leaps and bounds in the last few years. Nevertheless, we need to continue to improve, with focus on areas such as MEP and fit-out, where industry practice is less mature. Continued improvements both in measurement and availability of supply chain data will be essential to support our journey to becoming truly net zero by 2050.

4 Measuring embodied carbon of fit-out

Measuring embodied carbon of fit-out remains less prevalent than for base build, largely because requirements are typically voluntary and data availability is limited. However, fit-out can be a significant contributor to a whole building's carbon. To drive meaningful progress, the measurement and reporting of fit-out embodied carbon should increasingly be established as good practice across the sector. A number of leading developers are already incorporating embodied carbon requirements for fit-out within tenant agreements and expanding this practice more widely would help to improve data quality, increase transparency and enable more effective carbon reduction across all parts of our projects.

[2] Accelerating Concrete Decarbonisation Group, https://acdg.london/

Context

Purpose of this publication

This publication presents the results of an analysis of the upfront embodied carbon performance of a total of 76 office-led developments from across the City of London and Westminster. The data used in the analysis has been provided by 17 leading property organisations, the majority of whom are members either of the Westminster Property Association (WPA) or City Property Association (CPA).

Through this analysis we aim to illustrate the range of upfront embodied carbon performance that is being achieved across these leading developments, and give a sense of the contextual factors in individual projects that influence the outcomes.

Understanding of and expectations for the upfront embodied carbon performance of developments have evolved rapidly over recent years as the prevalence of Lifecycle Carbon Analysis on major development projects has rapidly increased. From industry-led targets such as the Low Energy Transformation Initiative (LETI), the Royal Institute of British Architects (RIBA), and the now launched UKNZCBS to policy benchmarks set by the GLA and more recently Westminster City Council as part its Retrofit First policy, views on what "good" looks like are varied and evolving. This publication takes robust upfront embodied carbon data from recent and ongoing developments to provide an evidence-led basis for understanding what is achievable currently in terms of embodied carbon outcomes. This is intended to help to ensure that evolving standards accurately reflect what is achievable in the market.

The climate emergency

The climate emergency is accelerating at a pace that exceeds earlier scientific projections, the latest 2023 IPCC findings show that human induced warming has already reached approximately 1.1°C above pre industrial levels,[3] and in 2024 the 1.5°C limit was breached for the first time.[4] This rapid warming is already driving more frequent and severe climate impacts, from heatwaves and flooding to supply-chain disruption, placing cities like London under growing pressure to reduce emissions quickly and consistently across all sectors of the built environment. For the property and development industry, this means the window for small, incremental change has closed. Achieving a climate-aligned pathway now requires immediate action to reduce emissions embedded in materials and construction processes, alongside operational decarbonisation.

As London continues to grow, renew and adapt its commercial building stock, decisions taken today will significantly influence whether the city remains within a 1.5°C-aligned future.

Importance of embodied carbon

London's buildings generate approximately six million tCO_2e of embodied carbon emissions each year, representing around 15% of total building-related emissions and roughly 8% of the city's overall consumption-based footprint.[5]

This scale of impact reflects the fact that embodied carbon constitutes a substantial part of a building's whole lifecycle impact, encompassing both upfront emissions (A1–A5) from material extraction, transport and construction, and in-use emissions (B–C) associated with maintenance, repair, replacement and end-of-life processes.

As the UK electricity grid continues to decarbonise through increased deployment of renewable energy, the operational carbon emissions associated with building energy use will reduce significantly, even where overall energy consumption of the building remains unchanged. Consequently, embodied carbon is expected to dominate the whole life carbon footprint of buildings in the coming years, potentially exceeding 75% of a building's total whole life carbon footprint.[6]

Crucially, roughly three quarters of lifecycle embodied emissions are released upfront during material manufacture and construction, and these cannot be mitigated through future operational efficiencies. This places significant emphasis on early-stage design decisions, particularly those relating to design efficiency and material selection, as these represent the most effective and time-critical opportunities to reduce carbon. Concentrating on upfront embodied carbon is therefore essential to addressing near-term climate impacts and aligning building design with net zero objectives.

This study focuses exclusively on upfront embodied carbon (A1–A5) for the projects analysed.

2 Finsbury Avenue, Broadgate | *British Land*

[3] IPCC - AR6 Synthesis Report Climate Change 2023, https://www.ipcc.ch/report/ar6/syr/

[4] UN Climate Action – 1.5°C: what it means and why it matters, UN Climate Action, https://www.un.org/en/climatechange/science/climate-issues/degrees-matter

[5] Information on the carbon impact of buildings within London (GLA 2020) London's overall Carbon Footprint (London Councils, July 2024), https://www.london.gov.uk/who-we-are/what-london-assembly-does/questions-mayor/find-an-answer/emissions-buildings-1#:~:text=Answer,-Date:%20Friday%2018&text=Buildings%20account%20for%2074%25%20of%20London's%20direct%20emissions%20(emissions%20from,the%20forefront%20of%20climate%20action

[6] Based on a number of ARUP projects data, London council July 2024, https://www.londoncouncils.gov.uk/news-and-press-releases/2024/consumption-based-emissions-cbes-dataset-london#:~:text=Unlike%20territorial%20emissions%2C%20which%20account,to%2028.7%20million%20tonnes%20CO2e

Context

Progress in embodied carbon reporting

The evolution in the understanding and reporting of embodied carbon in construction has evolved incredibly quickly. The first comprehensive standard for measurement of embodied carbon in buildings was only published in 2017 (The RICS Professional Statement). Prior to this, whilst some leading developers were implementing embodied carbon analysis on projects, approaches were diverse and results generally not comparable.

In 2021 the London Plan introduced a requirement for all referrable developments to undertake a full Lifecycle Carbon Analysis, following the RICS Guidance. The impact of that change has been nothing short of transformational, taking embodied carbon from something only a minority of leading developers were engaging with to a mainstream activity with leading developers competing to achieve the lowest embodied carbon outcome.

This widespread adoption of Lifecycle Carbon Analysis is in sharp contrast not only to the remainder of the UK, but also to most other countries around the world. Research by Arup on behalf of the World Business Council for Sustainable Development in 2025 identified embodied carbon policies actively in place in Denmark, the Netherlands, Sweden and France. This picture is changing, with adoption becoming more widespread internationally. The next iteration of the European Union Energy Performance of Buildings Directive in 2028 will require member states to implement embodied carbon analysis for major developments, which will be a significant transformation.

So whilst it is important to look ahead and remain ambitious about further change to reduce emissions, it is essential to recognise the scale of positive change undertaken in the industry to date.

Accuracy of embodied carbon assessment

The 2017 RICS Professional Statement was one of the first attempts globally to define an industry standard process for evaluation of embodied carbon in building construction. Prior to this, assessments followed similar principles but with substantial differences in detail.

The rapid increase in uptake of Lifecycle Carbon Analysis assessments since 2017, particularly in London following the 2021 London Plan, has put the industry on a rapid learning curve. Further standards, including CIBSE's TM65[7] and the CWCT Standard,[8] and in 2023 the updated RICS Professional Statement Edition 2,[9] have seen significant steps forward in the comprehensiveness and consistency of embodied carbon calculation and reporting.

This rapid development has been hugely positive for the industry. However, it has revealed that data from analyses produced prior to 2023 tended to under-report the embodied impact to varying degrees compared to more recent assessments. This to some extent hampers the ability to identify trends in embodied carbon outcomes over time.

[7] CIBSE TM65 Embodied Carbon in Building Services, https://www.cibse.org/knowledge-research/knowledge-portal/embodied-carbon-in-building-services-a-calculation-methodology-tm65

[8] CWCT Embodied carbon methodologies for facades, https://www.cwct.co.uk/pages/embodied-carbon-methodology-for-facades

[9] RICS Whole Life Carbon Assessment (WLCA) for the built environment, https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/construction-standards/whole-life-carbon-assessment

100 New Bridge Street | *Helical*

Context

Embodied carbon standards and benchmarks

The main benchmarks, standards and certifications for upfront embodied carbon referenced in this report are described in the table opposite. These standards have evolved considerably since the groundbreaking LETI Climate Emergency Design Guide was published in 2020. This evolution is largely a reflection of the significant increase in both the quantity and quality of project data available over that time. The UKNZCBS has taken a significant step forward from previous standards, both in breadth (18 sectors covered) and in depth of analysis. Projects must meet a number of limits including upfront embodied carbon intensity. Sectoral limits are derived from a model that balances project level data from across those 18 sectors in order to achieve UK wide decarbonisation targets to 2050.

The impact of scope – Shell & Core, Cat A and Cat B

One issue that has contributed to the uncertainty around the interpretation of data on upfront embodied carbon is the extent of the scope of work to which the data relates. Specifically, whether the data represents construction to Shell & Core, Whole Building including a full tenant fit-out, or somewhere in between.

Historically most targets and benchmarks, including LETI, RIBA and GLA, have been understood to represent Shell & Core + Cat A, as this is the most prevalent scope of landlord construction works. However, whilst it is common, it is far from the only solution, with some developers preferring Shell & Core only, Shell & Floor (false floor installed but no ceilings or high level services), Cat A+ (where basic office furnishings are included) and many other permutations. The pilot version of the UKNZCBS differentiated between Shell & Core and Whole Building, with different approaches and limits for each. Version 1 of UKNZCBS goes further and includes Cat A limits for both new builds and retrofits.

[10] LETI Climate Emergency Design Guide, 2020, https://www.leti.uk/cedg

[11] RIBA 2030 Climate Challenge, (last updated 2021), https://www.riba.org/campaigns/climate-action/2030-climate-challenge/

[12] GLA Benchmarks, 2022, https://www.london.gov.uk/programmes-strategies/planning/implementing-london-plan/london-plan-guidance/whole-life-cycle-carbon-assessments-guidance

[13] UK Net Zero Carbon Building Standard (UKNZCBS), 2025 Version 1, https://www.nzcbuildings.co.uk/the-standard

Standard / benchmark	Upfront embodied carbon targets (A1-A5)
LETI Climate Emergency Design Guide, 2020 [10] LETI is a coalition of built environment professionals, established in 2017. Its 2020 design guide was the first comprehensive guide to address net zero buildings, and to include requirements for embodied carbon intensity.	Best Practice 2020: <600 kgCO_2e/m² GIA Best practice 2030: <350 kgCO_2e/m² GIA Targets applicable to year of design
RIBA 2030 Climate Challenge, (last updated 2021) [11] The Royal Institute of British Architects (RIBA) published its 2030 Climate Challenge in 2019, with Version 2 published in 2021. The Challenge was intended to focus the architectural community on the level of ambition needed to tackle the climate emergency.	2030 Built Target: <475 kgCO_2e/m² GIA 2021 targets were for whole life carbon but the subsequent LETI RIBA embodied carbon target alignment showed an equivalent upfront target (B rating)
GLA Benchmarks, 2022 [12] The GLA embodied carbon benchmarks were published in 2022 in the GLA's document "Whole Life Carbon Assessments – London Plan Guidance". It was in support of the 2021 London Plan requirement for all referrable developments to produce a Whole Life Carbon Statement (Policy SI2). Benchmarks were derived from a dataset collected from projects that had previously completed a Lifecycle Carbon Analysis assessment. The benchmark value was the average of that dataset for each use type, and the aspirational value applied a notional 40% improvement on that value.	Benchmark: 950 kgCO_2e/m² GIA Aspiration: 600 kgCO_2e/m² GIA
UK Net Zero Carbon Building Standard UKNZCBS, 2025 Version 1 [13] The UKNZCBS was the first standard in the UK to produce a comprehensive 1.5°C aligned set of decarbonisation targets for the UK property sector. Target limits reduce steeply every year from 2025 to 2050 following a 1.5°C trajectory and aligned with the UK national decarbonisation targets.	2025 Version 1 Limit (New Build offices): Shell & Core – 520 kgCO_2e/m² GIA Shell & Core + Cat A - 595 kgCO_2e/m² GIA Whole Building – 805 kgCO_2e/m² GIA.

Summary of data collected

Participating members

17 organisations have submitted a total of 76 projects that make up the dataset that has informed this publication. All contributors are members either of the Westminster Property Association or City Property Association.

These projects represent a significant proportion of the leading commercial office-led developments across Westminster and the City of London, the two biggest office markets in the capital. Taken together they give a clear picture of the art of the possible with regard to upfront embodied carbon. However, these schemes are developed by those at the forefront of sustainable development with experienced sustainability teams, who have invested hugely in this area. An element of caution should be applied when using this data as indicative about what is achievable more broadly across the sector and country.

The data is predominantly informed by measurement at RIBA 4 onwards and is based on the analysis of detailed designs and/or as-built information. The majority of projects started on site in 2025 or 2026, so measurements are to the latest industry standards, including RICS Edition 2 (2023). As such, we believe this to be a robust dataset sufficient on which to base broad conclusions as to what is achievable in today's market on upfront embodied carbon intensity.

76 office projects

17 participating members

One Leadenhall | *Brookfield Properties*

Data quantity, construction type & building height

The 76 London office projects assessed in this study collectively represent approximately 1.7 million tCO_2e of upfront carbon emissions, arising from the production of construction materials, associated transport, and on-site construction processes. Therefore this constitutes a dataset of sufficient scale to support robust sector-level observations regarding achievable embodied carbon performance.

Building height distribution within the sample is skewed towards lower-rise typologies: 57 out of the 76 projects are under 14 storeys, increasing confidence in the statistical reliability of results for this low-rise cohort, despite their contributing only 37% of the total dataset's upfront carbon. Data coverage decreases with increasing height, with only nine mid-rise buildings (14–29 storeys) and 10 high-rise buildings (≥30 storeys) represented. Consequently, results for mid- and high-rise buildings should be interpreted with caution due to limited sample size. However, this distribution broadly reflects the morphology of central London, where tall buildings are limited in number and primarily concentrated in the City of London, whilst they are comparatively scarce in Westminster. Despite their lower frequency, high-rise buildings account for 46% of total upfront emissions in this study, demonstrating the impact of both the scale and the carbon intensity associated with tall-building construction. Section 5 provides a detailed statistical examination of height/carbon correlations.

The dataset also captures a balanced spread of construction types, with roughly one-third of projects categorised as New Build, New Build with Retention and Retrofit respectively. This near-equal representation supports comparative analysis across intervention types. Definitions and boundaries for each category are outlined in the following section.

	HIGH-RISE ≥30 above ground storeys	**MID-RISE** ≤29 & ≥14 above ground storeys	**LOW-RISE** ≤13 above ground storeys	**TOTAL**
BREAKDOWN OF UPFRONT CARBON BY BUILDING HEIGHT	773,939 tCO_2e	290,776 tCO_2e	613,372 tCO_2e	1,678,087 tCO_2e
BREAKDOWN % OF UPFRONT CARBON BY BUILDING HEIGHT	46%	17%	37%	100%
NEW BUILD 100% NIA is new	2	4	17	23
NEW BUILD WITH RETENTION <50% new NIA is retained (e.g. foundation, façade, etc.)	7	3	12	22
RETROFIT >50% of new NIA is retained	1	2	28	31

Summary of data collected

Data categorisation

The dataset was classified into three categories informed by both the UKNZCBS and Westminster City Council's Retrofit First policy, which apply different criteria for defining project types. UKNZCBS differentiates between new works and retrofit works based on the proportion of new Net Internal Area (NIA) introduced, whereas Westminster categorises projects as New Build, Deep Retrofit or Retrofit, according to the extent of demolition undertaken.

Within the sample, 23 projects align unambiguously with both frameworks as full New Builds, and 31 projects align as Retrofits. A further 22 projects exhibit characteristics that fall between these two categories. These have almost fully new NIA, which classifies them as new works under UKNZCBS, yet they also retain significant existing elements, such as foundations or façades, resulting in only partial demolition and therefore a deep retrofit designation under Westminster criteria. For this study, these projects are designated with the label of "New Build with Retention."

Such hybrid configurations are prevalent in central London, where constraints such as heritage necessitate retaining structural or façade elements that may not contribute to NIA gains. These projects were therefore isolated as a distinct group to allow the study to observe the impact of even limited retention on the overall performance.

For the purposes of comparative analysis, projects classified as New Build with Retention will be benchmarked against the New Build industry limits (e.g., UKNZCBS New Works Limits) to ensure consistency in interpreting their embodied carbon outcomes against the current frameworks.

Definitions

New Build

Full demolition 100% & 100% full new NIA.

Retrofit

Minimal demolition (less than 10%) & less than 50% new NIA.

New Build with Retention

Partial demolition between 10% to 100% & more than 50% new NIA. Retention of significant existing elements such as foundations, façades or basements that may or may not contribute to NIA gains.

	UK Net Zero Carbon Buildings Standard	City of Westminster
23 **NEW BUILD** 100% NIA is new	**New Works** Either: • construction resulting in more than 50% of NIA being new (See UKNZCBS V1 Section 4.2.1 Table 5) or • building is single-storey and all elements above the ground floor slab are new.	**New Build** Substantial demolition (50% to 100%)
22 **NEW BUILD WITH RETENTION** <50% new NIA is retained (e.g. foundation, façade, etc.)		**New Build** Substantial demolition (50% to 100%) **Deep Retrofit with Extension** Partial demolition (10% to 50%)
31 **RETROFIT** >50% of new NIA is retained	**Retrofit Works** Not New Works, and either: • ≥10% of original area of thermal envelope is new, upgraded or replaced, or • ≥10% of original glazed area is new, upgraded or replaced.	**Retrofit with Extension** No or minor demolition (up to 10%) **Retrofit** No or minor demolition (up to 10%)

Data sources, analysis & accuracy

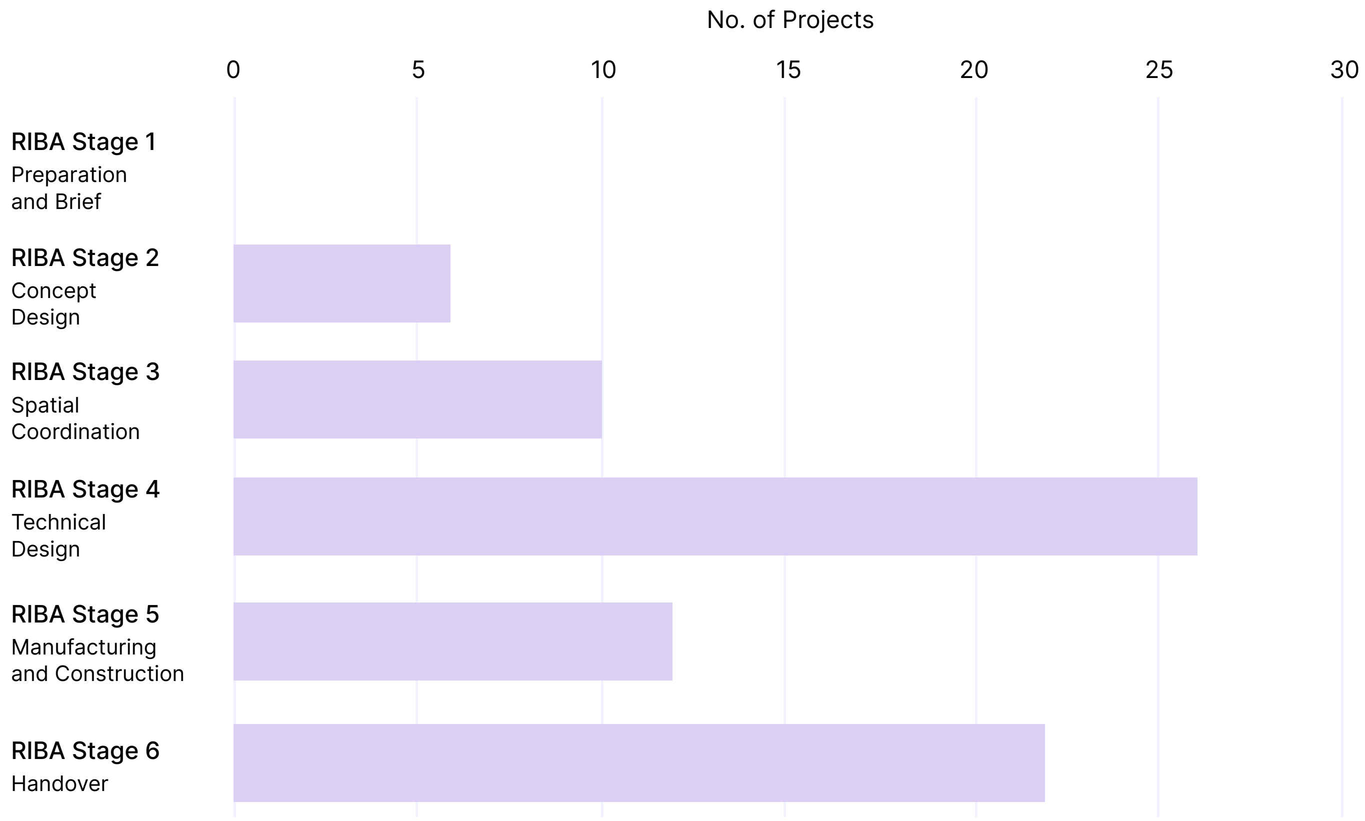
RIBA stages

The upper chart opposite illustrates the distribution of projects by the RIBA Stage at which the embodied carbon data was captured. Notably, about 80% of the dataset is derived from projects in technical design or construction (RIBA Stages 4, 5 and 6). This enhances the accuracy and reliability of this study's findings as later-stage carbon assessments rely on confirmed product selections and verified material quantities rather than early-stage benchmarks or indicative estimates.

Additionally, the lower matrix opposite shows the number of projects at each RIBA Stage across construction start years. As highlighted, the dataset is heavily concentrated around RIBA Stages 4-5 for projects starting construction in 2025-2026, meaning the analysis reflects the embodied carbon performance of schemes that are about to commence on-site works and therefore benefit from higher data certainty.

The dataset also contains a limited number of completed projects with construction start dates between 2019-2022 (shown in blue). These datapoints should be treated with an element of caution because they were undertaken before the most recent industry guidance was published and may therefore use less representative carbon factors or less comprehensive calculation approaches, making them less accurate.

Similarly, a few projects in early design stages appear in the dataset with future construction start years (shown in orange), and these are likely to feature estimates or benchmark values for elements where the design is unresolved (such as building services or internal finishes). While they represent only a small fraction of the dataset, these datapoints should also be interpreted carefully due to their inherently lower level of definition.




The Smith | *Old Park Lane Management*

CONSTRUCTION START YEAR	NO. OF PROJECTS RIBA STAGE 1	RIBA STAGE 2	RIBA STAGE 3	RIBA STAGE 4	RIBA STAGE 5	RIBA STAGE 6
2019	0	0	0	0	0	1
2020	0	0	0	0	0	5
2021	0	0	0	1	0	5
2022	0	0	0	2	0	4
2023	0	0	0	2	1	5
2024	0	1	0	7	2	1
2025	0	0	4	7	9	1
2026	0	2	4	5	0	0
2027	0	0	1	2	0	0
2028	0	2	1	0	0	0
2029	0	1	0	0	0	0

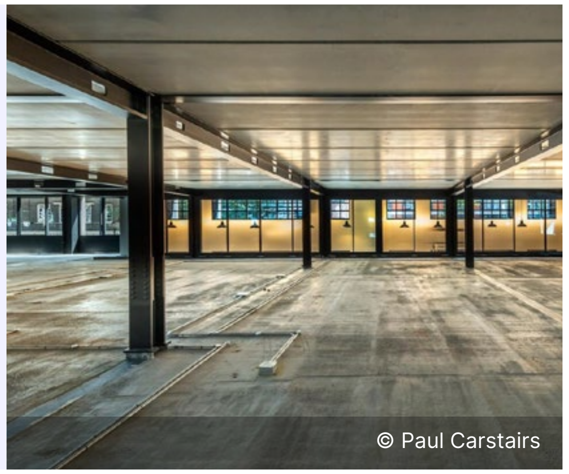
Data sources, analysis & accuracy

Scope of works

In this study, all projects were requested to submit upfront embodied carbon results for three defined scopes of work:

Shell & Core

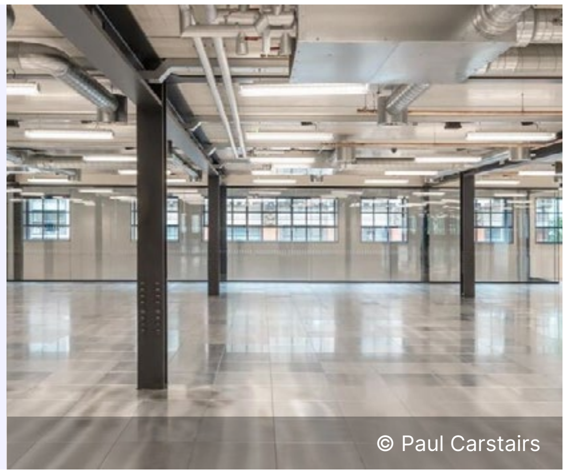
This scope includes the primary structural frame, building envelope (façades, roofs), cores, plant spaces and base building services required for statutory compliance and landlord operation. It excludes all internal finishes, tenant-specific services and all fit-out works.



© Paul Carstairs

Shell & Core + Cat A

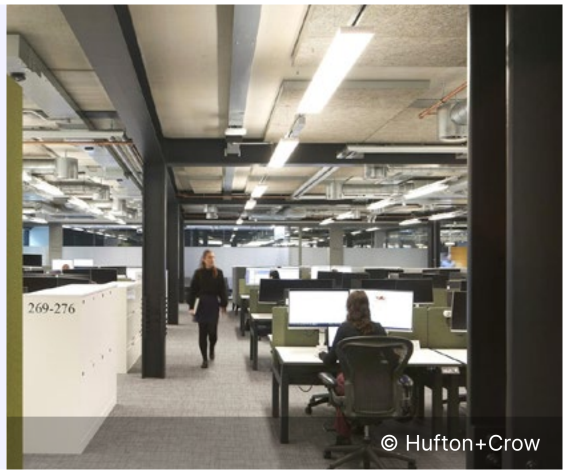
This expands upon the Shell & Core scope by incorporating landlord-provided internal works such as raised floors, suspended ceilings, basic internal partitions (where applicable), primary mechanical and electrical distribution within floors and other elements intended to provide a lettable, occupiable commercial space. It excludes tenant-specific Cat B fit-out.



© Paul Carstairs

Whole Building

This represents the complete building including Shell & Core, Cat A and Cat B fit-out. Cat B includes tenant-specific elements such as local MEP distribution, internal partitions, bespoke joinery, kitchen and tea-point equipment, furniture, fixtures and equipment (FF&E) and any other items required for operational occupation.



© Hufton+Crow

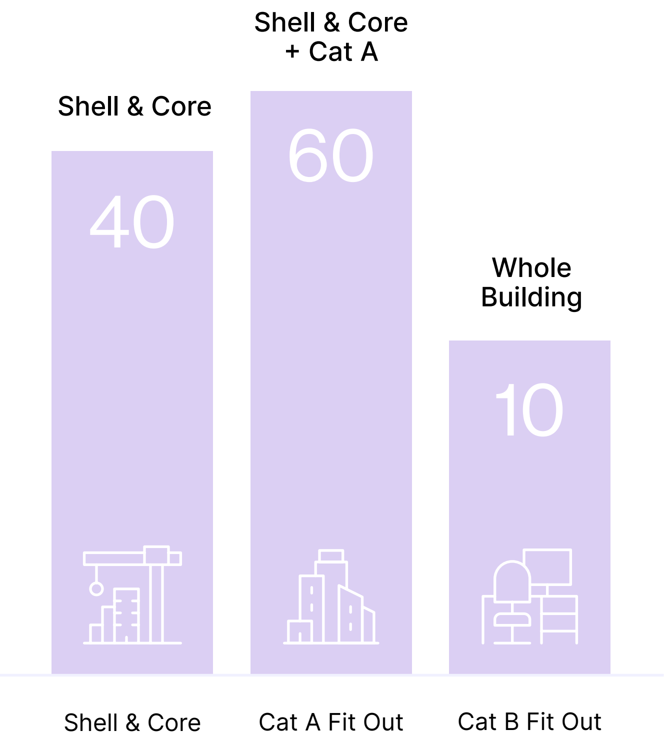
Due to limitations in available project information, only a minority of schemes were able to provide data for all three scopes.

Shell & Core + Cat A was the most commonly submitted scope, reflecting industry practice in developer-led commercial offices. Whole-building data was available for only a small subset of projects, as tenant fit-out is often unknown during design and remains highly variable until leases are agreed; as a result, findings based on Whole Building data should be interpreted with caution given the limited sample size and potentially low representativeness.

In some cases, projects estimated tenant fit-out impacts using published industry benchmarks where tenant information was unavailable. For example, some studies applied typical fit-out benchmarks from sources such as the Counting the Upfront Carbon in Cat B Offices by Overbury,[14] where tenant fit-outs are shown to vary between 164–214 $kgCO_2e/m^2$ GIA, depending on the extent and specification of the works. This approach represents a broad indication only of the embodied impact of the Cat B works, and this should be considered in interpreting Whole Building results.

A challenge that was noticed when separating the dataset by scope of works was the inconsistency in project boundaries. While some schemes report pure Shell & Core results, which are comparatively straightforward to interpret, the Shell & Core + Cat A submissions vary significantly, as Cat A can encompass a wide range of landlord-provided elements. For example, some projects may only provide Shell & Floor (raised floors installed but no ceilings or high-level services), others deliver Cat A+ (including basic furnishings), and many fall somewhere between these. This variability complicates cross-project comparability as well as comparability against industry standards.

Moreover, Lifecycle Carbon Analysis assessments do not always delineate Shell & Core and Cat A components cleanly; elements belonging to one scope may be inadvertently included in the other. Again, such boundary inconsistencies can introduce further uncertainty and hinder the accurate comparison of project results against industry limits.



[14] Part 1 | Counting the upfront carbon in Cat B office fit out, https://www.overbury.com/carbon-in-cat-b-fit-out

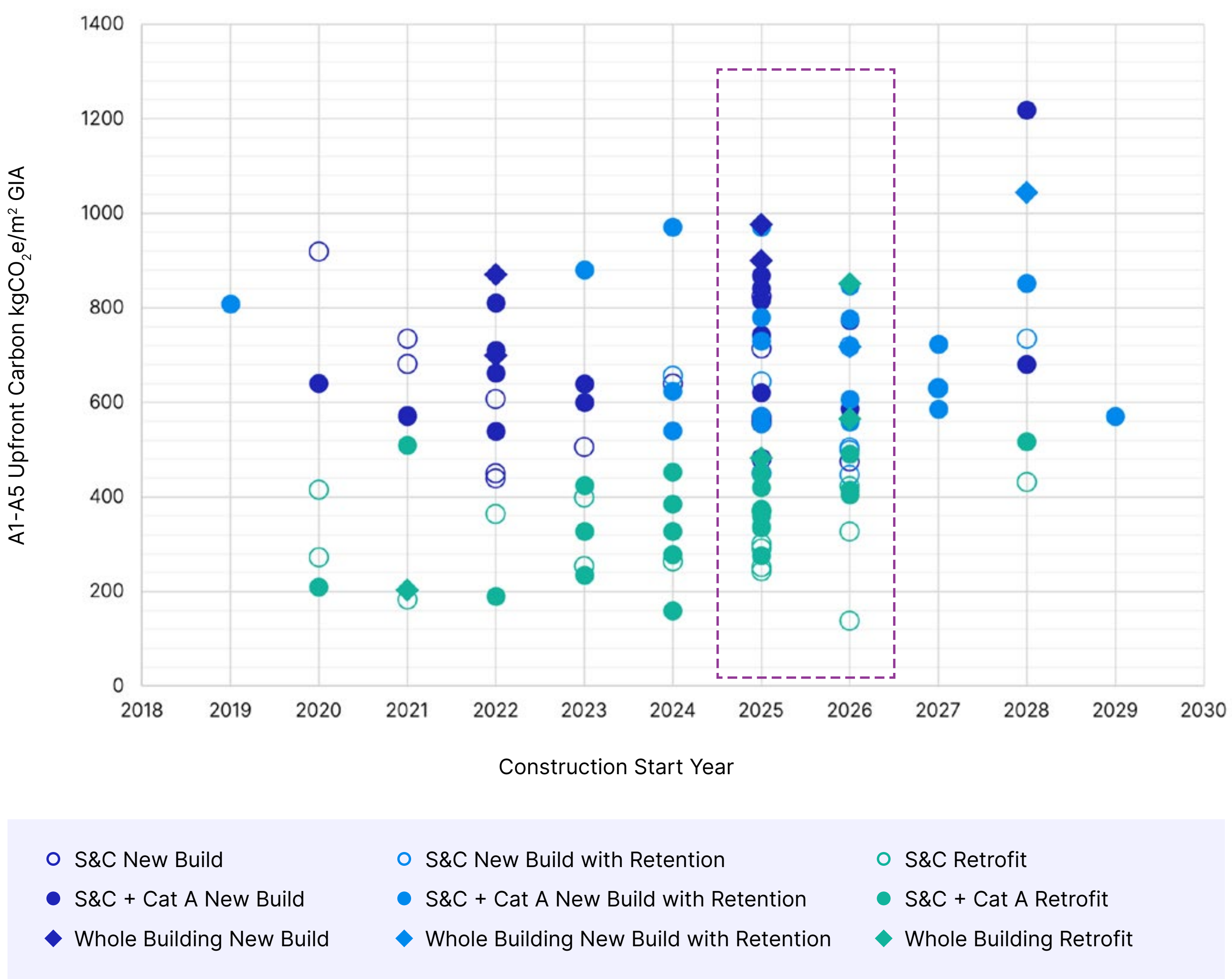
Overall results & data

24% reduction in average intensity in five years

Key findings

The graph below presents the full dataset, differentiating projects by scope of works - Shell & Core, Shell & Core + Cat A and Whole Building - through marker shapes, and by construction type - New Build, New Build with Retention and Retrofit - through colour coding. Plotted against construction start year on the x-axis, the dataset shows a significant concentration of projects commencing in 2025–2026, reflecting the rapid increase in industry-wide carbon assessment activity and the maturation of embodied carbon knowledge. This clustering establishes the robustness of the dataset, as most values are derived from projects at detailed-design stage or already entering construction, therefore providing a high degree of reliability in the findings that will be presented in the next sections.

A1-A5 Upfront Carbon for London Office Buildings - All Data



Source: Arup

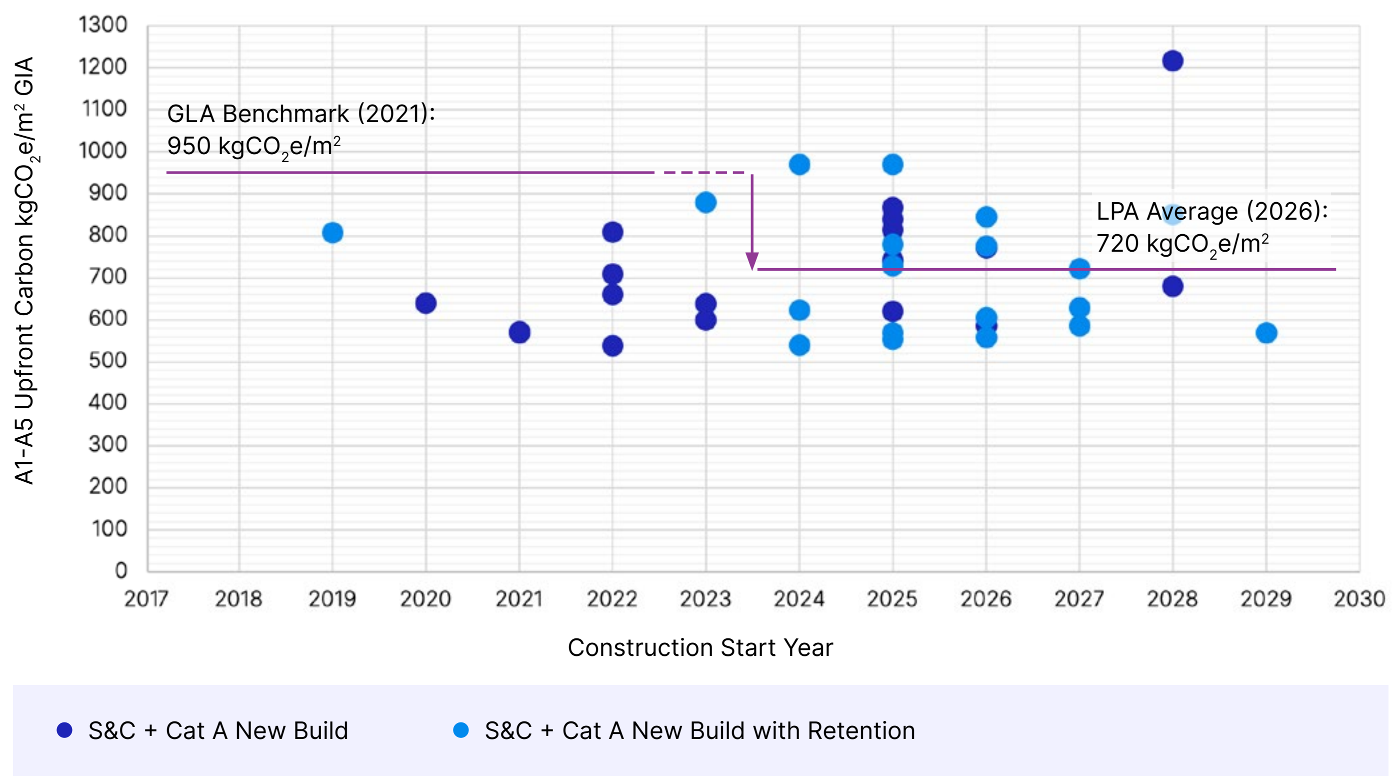
Looking backwards

The concentration of projects commencing on site in 2025-2026 means that this dataset alone cannot provide a definitive picture of long-term trends in embodied carbon. However, when set alongside the project information gathered for the GLA's 2022 London Plan Guidance on Whole Life Carbon Assessments - which reported an average upfront embodied carbon intensity of around 950 $kgCO_2e/m^2$ GIA - a clear progress narrative emerges.

The current dataset shows an average intensity of 720 $kgCO_2e/m^2$ GIA, representing a 24% reduction since the earlier GLA research. This equates to an almost 5% improvement per year, a pace of change that strongly suggests the industry-wide focus on embodied carbon is having a real impact. Design teams and supply chains appear to be reducing carbon through both design decisions and procurement practices, supported by the broader uptake of Whole Life Carbon Assessment methods since the London Plan guidance was introduced.

While these figures highlight how far the sector has come in a relatively short period, they also signal that the most easily achieved reductions may already have been captured. If improvements were to continue at the same rate, the trajectory towards net zero would be comfortably within reach. Yet the evidence suggests that achieving further reductions will be progressively more challenging, requiring more innovative design strategies, deeper material optimisation and systemic shifts in how projects are delivered. In addition, improvements in measurement may offset some of those reductions in the near to long term.

A1-A5 Upfront Carbon for London Office Buildings - All Data



Source: Arup

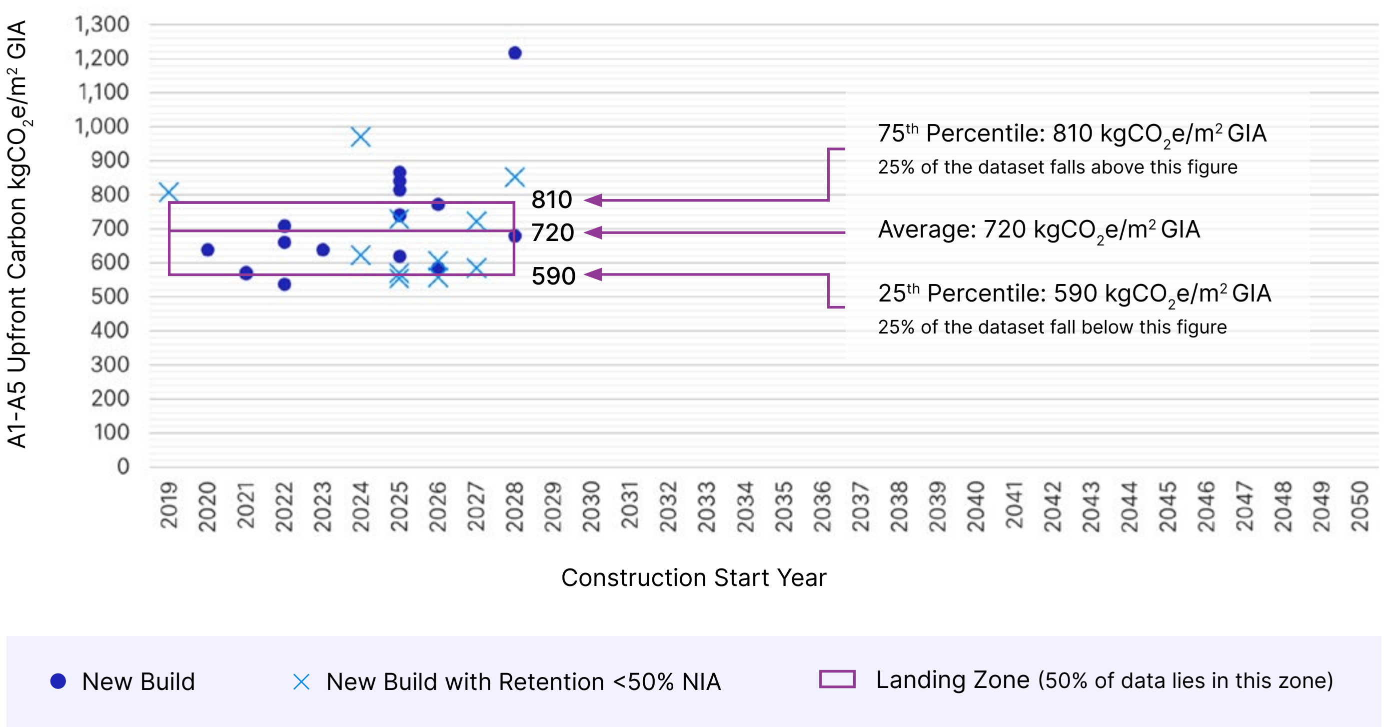
Overall results & data

How to Read the Graphs

On the following pages, data is presented by construction scope (Shell & Core, Shell & Core + Cat A, and Whole Building). In each instance, the box illustrates the mid-spread, indicating where 50% of the data resides. The bottom of the box shows the 25th percentile of the data, the top marks the 75th percentile, and the line in the middle indicates the average. The width of the box reflects the range of construction start dates. This is considered a reasonable representation of the expected "landing zone" for projects in this category. This approach is intended to remove outliers and focus in on the embodied carbon outcomes that should be within reach for the majority of projects. Within this it is important to recognise that embodied carbon outcomes do vary significantly based on the context of individual projects, and therefore what "good" looks like will be different from project to project. Whilst we have tried to isolate some of the main influencing factors (massing for example), there are many other factors that have an influence.

At the same time, it is important to consider that the current dataset is focused on central London and covers a particular group of developments delivered by property developers with strong sustainability commitments. These projects actively measured and addressed embodied carbon during the design stage - and, where relevant, during construction - using targeted reduction strategies and carbon management approaches. As such, the dataset reflects a group of comparatively high-performing projects and is likely to sit below the UK market-wide average, which includes a large proportion of developments where embodied carbon is not assessed at all. This context should be considered when interpreting quartiles, comparing performance, or referencing average values.

New Build Shell & Core + Cat A: A1-A5 Upfront Carbon for London Office Buildings



Source: Arup

New Build office

Shell & Core

The 25th to 75th percentile range for this dataset is 495 to 690 $kgCO_2e/m^2$ GIA

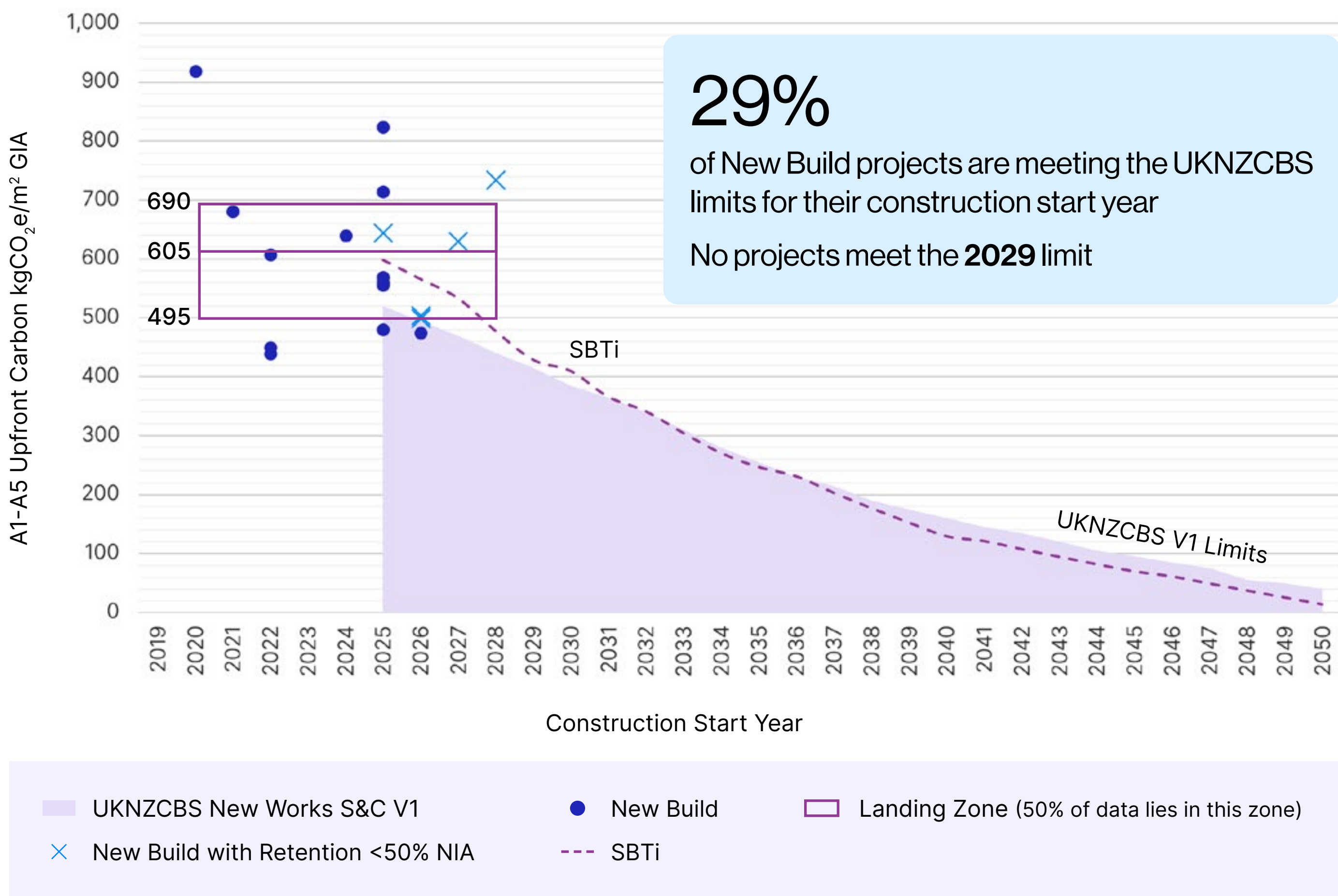
New Build Shell & Core projects are presented against the limits set by the various standards and guidance described on page 17.

While alignment with the SBTi buildings trajectory is reasonable in 2025, however the rapidly downward slope of the trajectory means that very few projects achieve alignment with the SBTi limits from 2028 onwards. It should be noted that the SBTi does not differentiate between scopes of construction, and so a comparison with Shell & Core only does paint a positive picture.

The UKNZCBS limit of 520 for 2025 is above the 25th percentile of the dataset, indicating good alignment with best practice. As with the SBTi trajectory, the limits reduce relatively rapidly year-on-year, and in this case no projects align with the UKNZCBS limits for 2029 or beyond.

This means that many projects in the early stages of design now, will not meet the UKNZCBS limits for their expected construction year (assumed to be 2030 or later).

New Build Shell & Core: A1-A5 Upfront Carbon for London Office Buildings



Source: Arup

New Build office

Shell & Core + Cat A

The 25th to 75th percentile range for this dataset is 590 to 810 $kgCO_2e/m^2$ GIA

Shell & Core + Cat A is the largest category within the dataset, as would be expected given the prevalence of Cat A fit-out by commercial landlords and developers.

Comparing this dataset with market benchmarks, the GLA aspirational target (600), LETI 2020 (600), SBTi (600) are all well aligned with the best practice value of 590 $kgCO_2e/m^2$ GIA. The Westminster Local Plan limit (650) is within the percentile range, with 45% of projects achieving this level. Only two projects meets the Westminster aspirational target (550).

The 2025 UKNZCBS limit of 595 is in line with the 25th percentile of 590 kgCO2e/m2 GIA, and therefore reasonably well aligned with current best practice. The SBTi and UKNZCBS targets reduce year-on-year, towards a net-zero target in 2050 which in the case of the UKNZCBS is aligned with the UK Government target for the economy as a whole.

A key finding of this research is that while a small proportion of buildings achieve the 2025 and 2026 UKNZCBS V1 limits, no buildings are able to achieve the limits from 2027 onwards. By 2030, the gap between the UKNZCBS V1 limit and the 25th percentile is 34%.

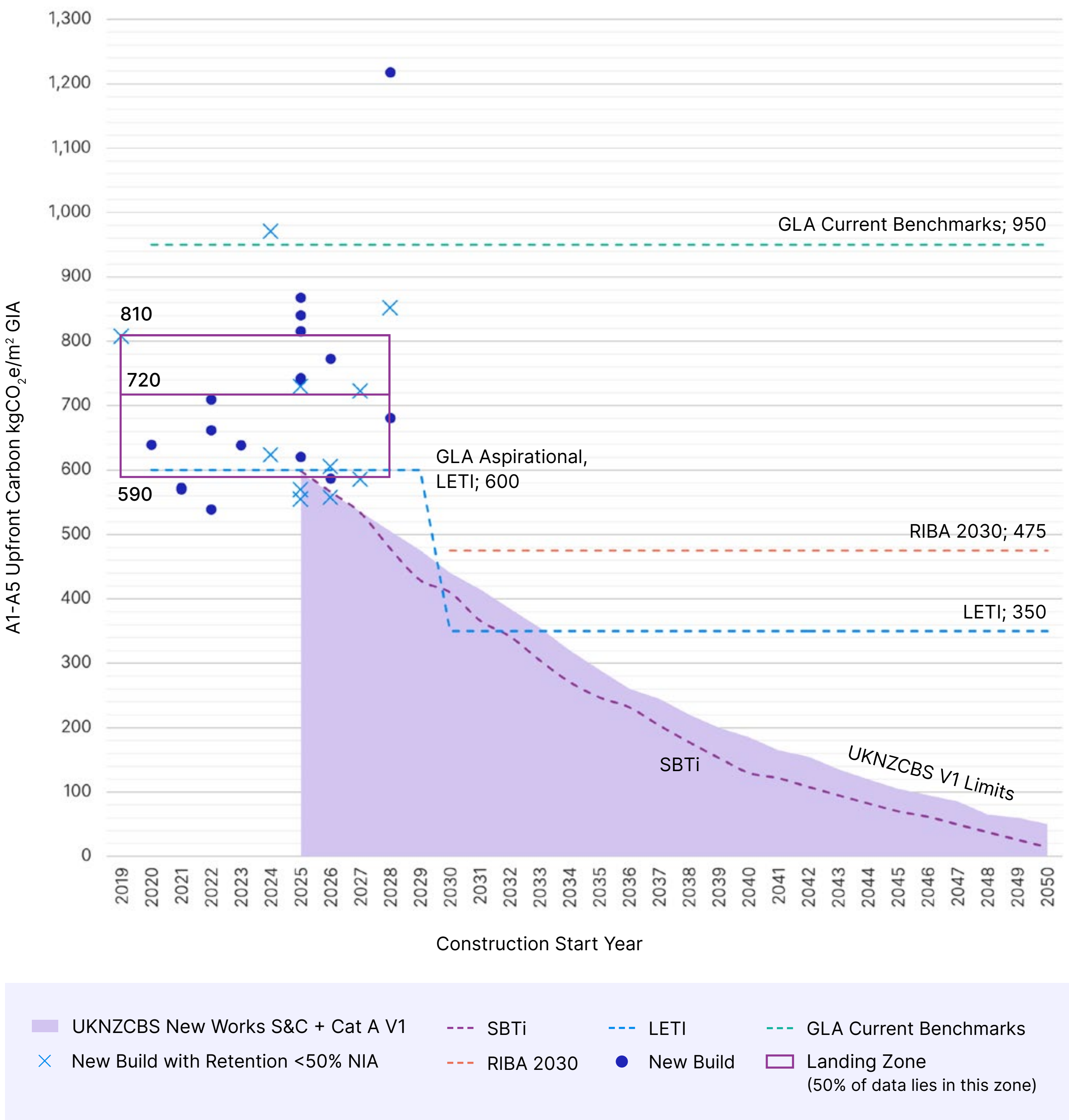
The majority of the data collected is for projects starting on site in 2025 or 2026. As a result, the dataset does not provide reliable evidence as to the rate of reduction of embodied carbon intensity year-on-year. Anecdotal evidence suggests that while progress continues to be made both in optimising design for embodied carbon outcomes, and in the decarbonisation of the materials supply chain, the rate of change is significantly less than that assumed in the UKNZCBS and SBTi trajectories. This means that most projects designed now, will not meet the UKNZCBS limits for their expected construction year (approx. 2031).

18%

of New Build projects are meeting the UKNZCBS limits for their construction start year

No projects meet the **2027** limit

New Build Shell & Core + Cat A: A1-A5 Upfront Carbon for London Office Buildings



Source: Arup

New Build office

Whole Building

The 25th to 75th percentile range for this dataset is 760 to 960 kgCO$_2$e/m² GIA

There is substantially less data for Whole Buildings, reflecting the lack of Cat B fit-out data in the industry generally. As a result, this graph should be interpreted with a degree of caution. That said, the uplift in the percentiles from Cat A to Whole Building does appear reasonable, and the comparison with UKNZCBS is very similar to previous categories – a small minority of projects able to comply in 2025, reducing to zero from 2028 onwards.

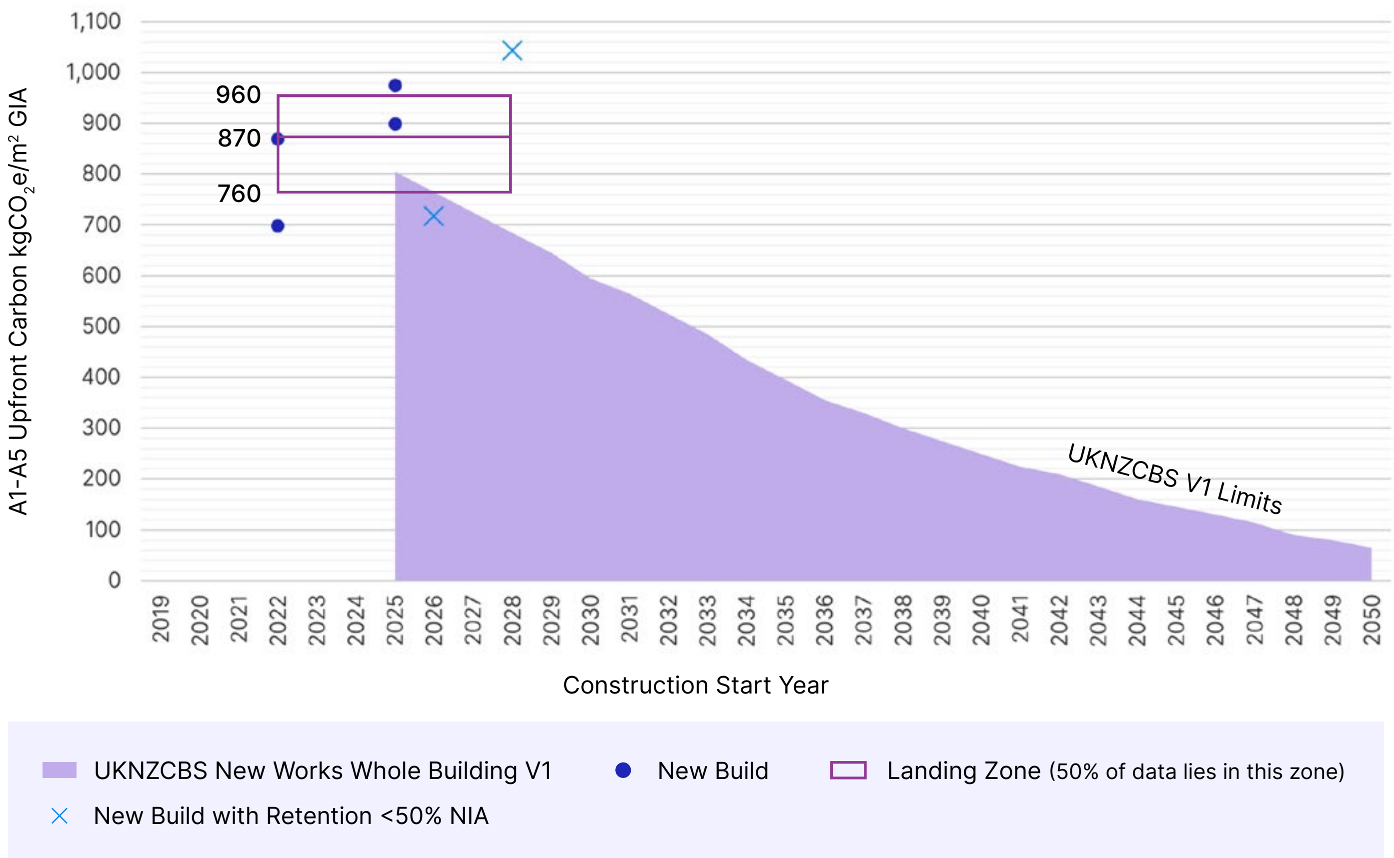
As with previous categories, this means that most projects in the early stages of design now, will not meet the UKNZCBS limits for their expected construction year.

33%

of New Build projects are meeting the UKNZCBS limits for their construction start year

No projects meet the **2028** limit

Whole Building: A1-A5 Upfront Carbon for London Office Buildings



Source: Arup

Retrofit office

Shell & Core

The 25th to 75th percentile range for this dataset is 255 to 380 kgCO$_2$e/m² GIA

The UKNZCBS is one of the first standards to set explicit upfront carbon limits for retrofit projects, an area that has historically been difficult to benchmark due to the wide variability in retrofit scope. By introducing limits, the UKNZCBS addresses an important gap and provides much-needed direction for the industry.

Compared with new-build results, the retrofit analysis shows a more favourable alignment with the applicable UKNZCBS limits. As presented in the adjacent chart, 75% of retrofit projects fall within the Shell & Core limit for their construction year, and alignment continues until 2038.

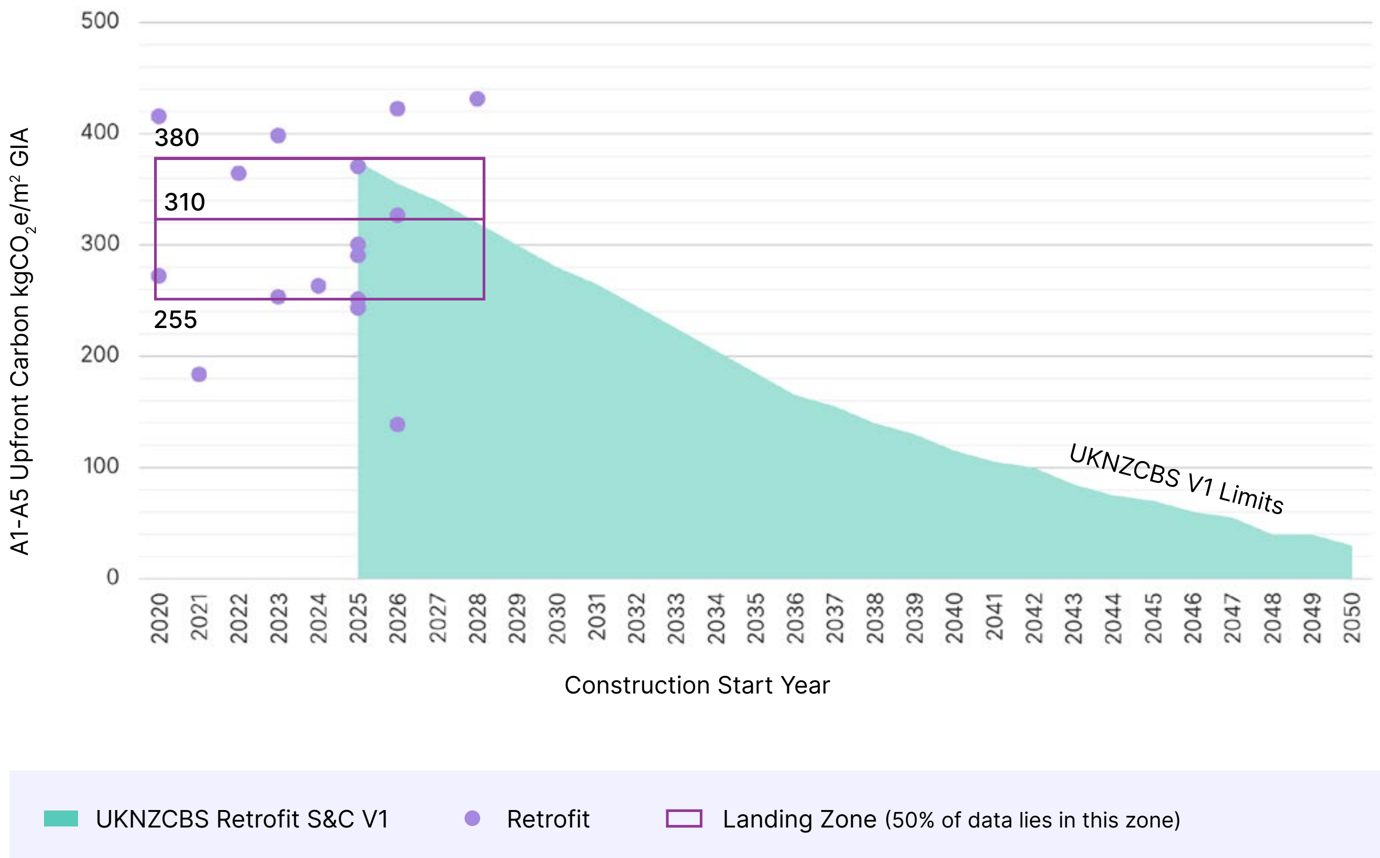
It is important to note, however, that retrofit scopes vary significantly in their intensity, from light-touch refurbishment to deep interventions, and this variability influences how individual projects perform.

75%

of Retrofit projects are meeting the UKNZCBS limits for their construction start year

Alignment extends to the **2038** limit

Retrofit Shell & Core: A1-A5 Upfront Carbon for London Office Buildings



Source: Arup

Retrofit office

Shell & Core + Cat A

The 25th to 75th percentile range for this dataset is 295 to 425 $kgCO_2e/m^2$ GIA

Similarly to new-build projects, Shell & Core + Cat A forms the largest subset of the retrofit dataset. The alignment of these projects with the UKNZCBS limits is particularly strong: over 82% of datapoints meet the limit for their construction year, and the landing zone fully overlaps with the UKNZCBS trajectory, with this alignment extending to 2035.

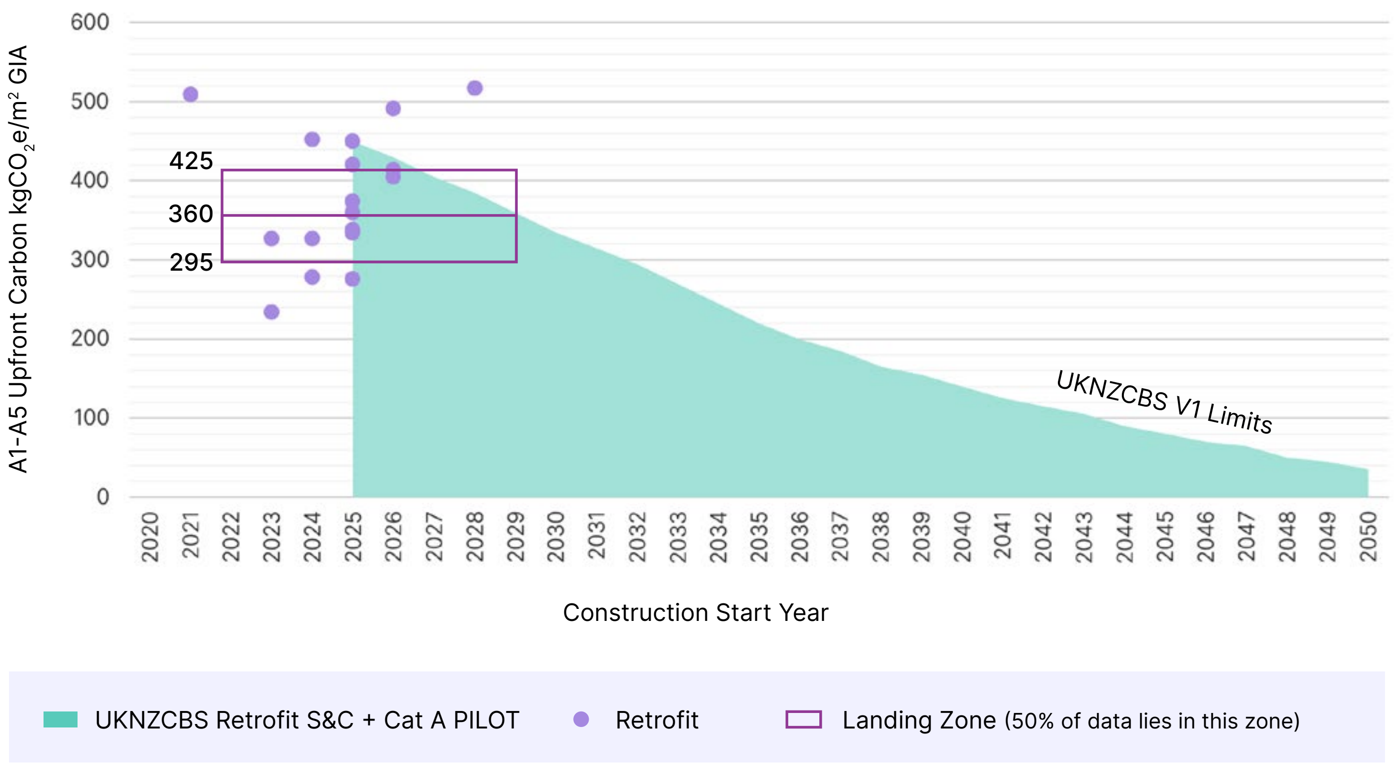
82%

of Retrofit projects are meeting the UKNZCBS limits for their construction start year

Alignment extends to the **2035** limit

However, although these projects are labelled as Cat A, it is not always clear whether all Cat A elements have been consistently included. Retrofit schemes often contain a greater proportion of fit-out-driven components (such as on-floor MEP items, kitchen equipment, and bespoke FF&E and joinery) compared to structural components, and these items can be difficult to quantify and may be under-represented in Lifecycle Carbon Analysis assessments. As this study has not validated the completeness of the underlying Lifecycle Carbon Analysis assessments from which these datapoints originate, the findings should be interpreted with appropriate caution.

Retrofit Shell & Core + Cat A: A1-A5 Upfront Carbon for London Office Buildings



Source: Arup

Retrofit office

Whole Building

Key findings

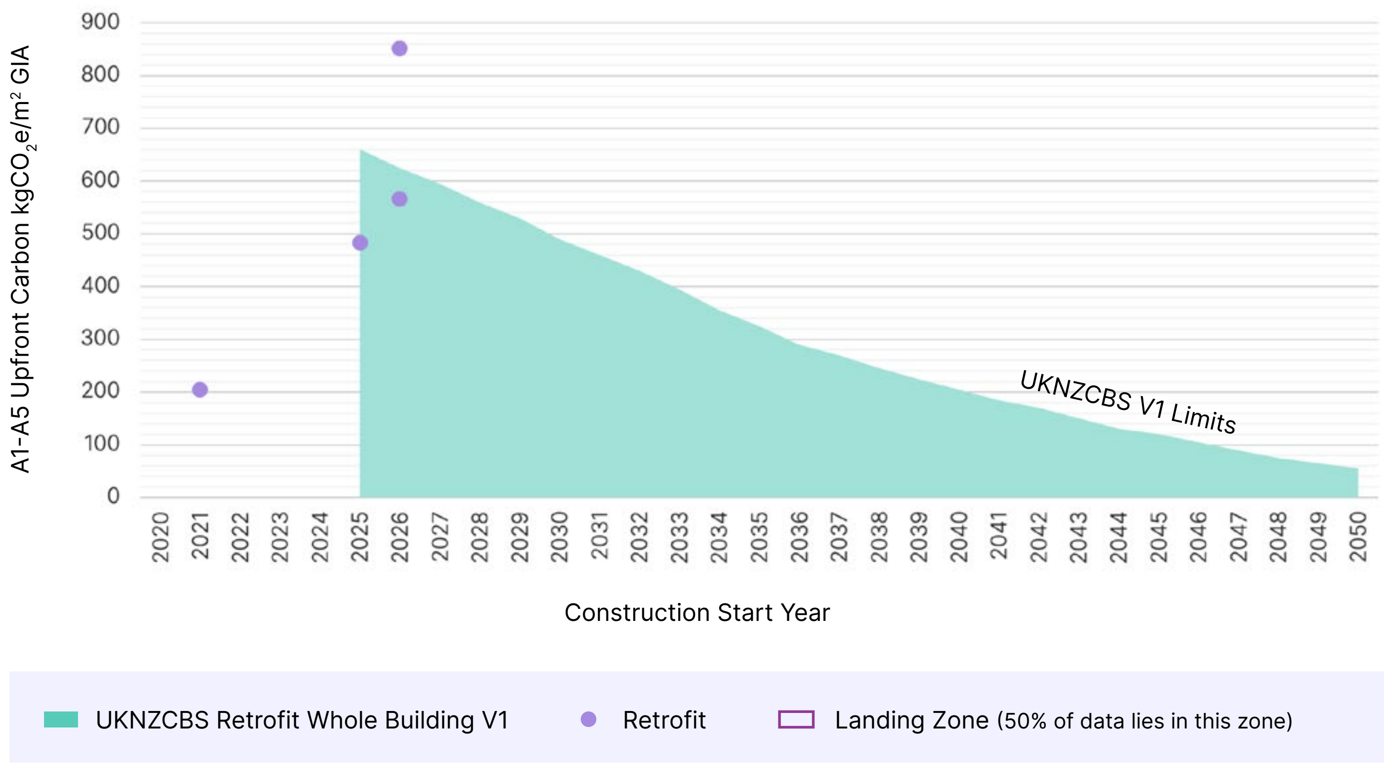
The retrofit dataset, much like the new-build dataset, contains very few whole-building datapoints, only four across 31 projects. As a result, any interpretation of whole-building trends for retrofits should be treated with caution.

The graph below illustrates the UKNZCBS whole-building limits for retrofit projects. However, given the small dataset size, no patterns can be extracted.

While Shell & Core and Cat A estimates are comparatively straightforward, estimating Cat B performance remains challenging due to tenant-specific fit-out choices. Encouragingly, the industry is moving towards more consistent fit-out carbon measurement, both for retrofits and new builds, supported by emerging benchmarks and new studies that continue to strengthen the evidence base.

Limited dataset, not enough datapoints to extract trends

Retrofit Whole Building: A1-A5 Upfront Carbon for London Office Buildings



Source: Arup

Embodied carbon & the UKNZCBS

Summary

The charts opposite present pass/fail outcomes for at least one UKNZCBS limit for both New Build and Retrofit projects, grouped by construction start year. Projects that commenced construction before 2025, the first year for which UKNZCBS limits are defined, have been assessed against the 2025 limits.

For New Builds, only 29% of the 45 projects align with at least one limit for their construction year, and no projects are projected to comply with the limits from 2027 onwards.

The relatively steep year-on-year reductions for the UKNZCBS limits point to an increasing gap year-on-year between what is achievable and the respective limit. The reality of this means that most New Build projects designed now, will not meet the UKNZCBS limits for their expected construction year (approx. 2031), despite many of these projects taking an industry-leading approach to minimising their embodied carbon impact.

The concentration of projects in the dataset with starts on site in 2025-2026 means that this dataset does not provide a reliable indication of the rate of decarbonisation of embodied impacts over time. This is further complicated by the fact that observable material decarbonisation in Lifecycle Carbon Analysis assessments will lag behind actual supply-chain improvements. This delay arises because Environmental Product Declarations (EPDs), the primary source of Lifecycle Carbon Analysis assessments, typically remain valid for up to five years, meaning that reductions in manufacturing emissions will take time to be reflected in published EPDs, applied in project Lifecycle Carbon Analysis assessments and subsequently captured in benchmark comparisons with UKNZCBS limits.

In contrast, retrofit projects display substantially stronger alignment, with 77% of the sample meeting at least one UKNZCBS limit, and all projects starting in 2025 passing at least one applicable limit.

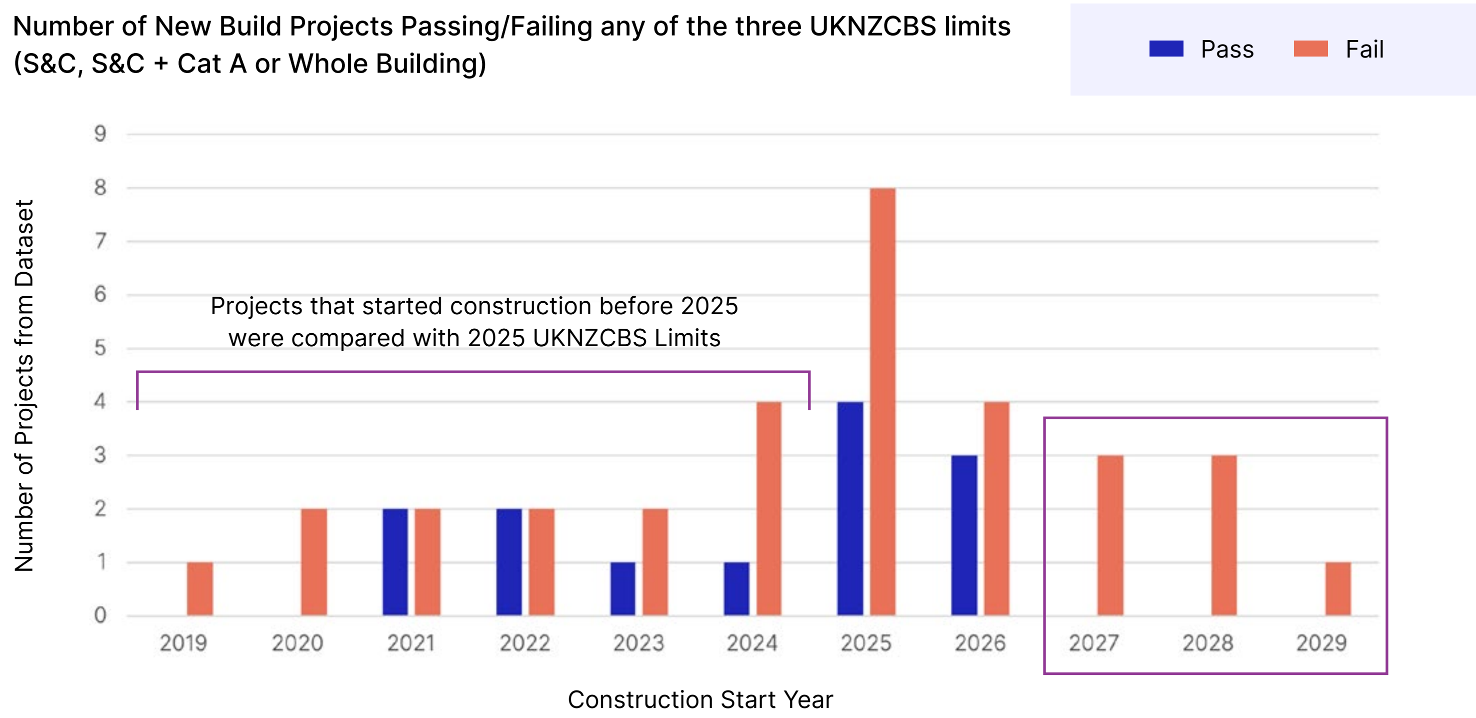
It should be noted that retrofit interventions vary substantially in scope - from light-touch refurbishments with limited material impacts to deep interventions involving extensive fabric, structural and building-services upgrades - and this variability can significantly influence a project's ability to meet the UKNZCBS limits.

Projects with larger structural interventions or complex façade works may face greater challenges in aligning with the tightening trajectory compared with those involving primarily cosmetic or low-intensity updates.

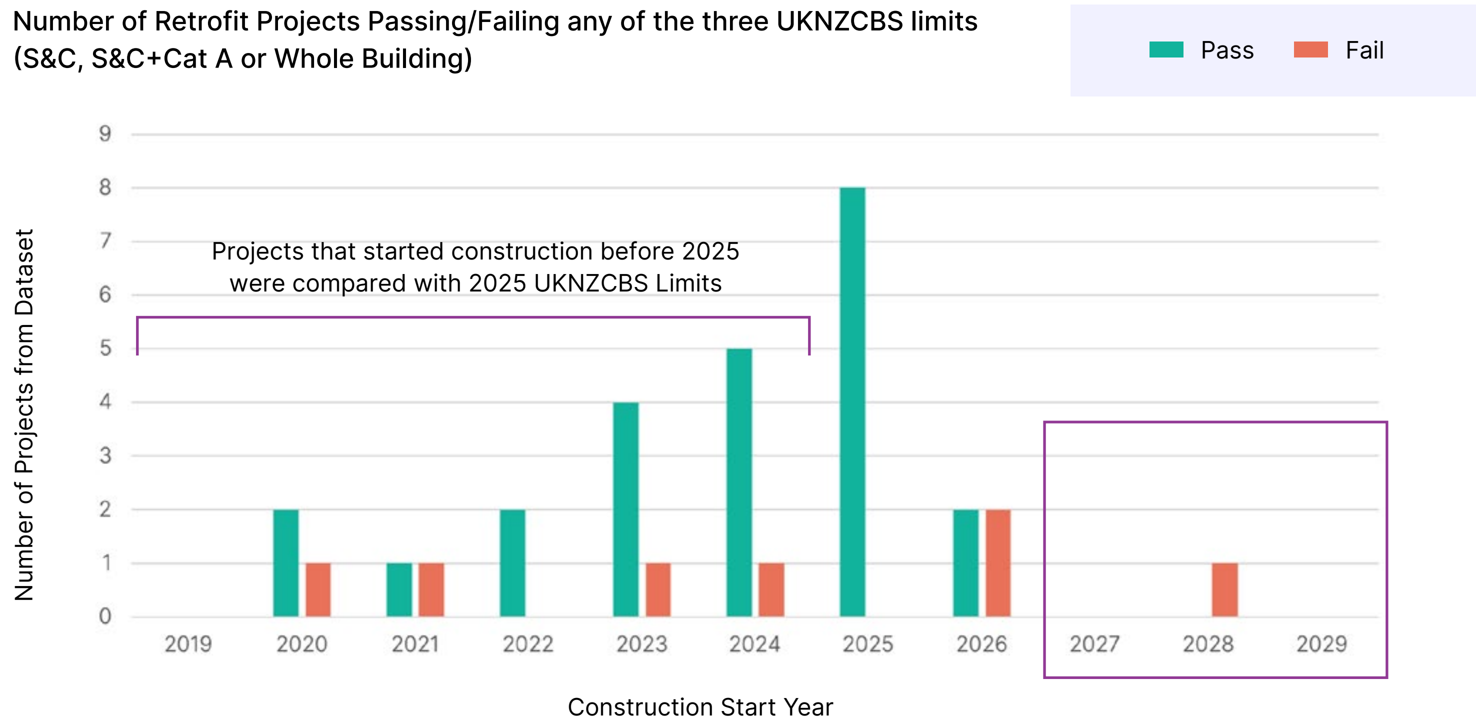
29%
New Build projects are meeting at least one UKNZCBS limit for their construction start year

77%
Retrofit projects are meeting at least one UKNZCBS limit for their construction start year

Number of New Build Projects Passing/Failing any of the three UKNZCBS limits (S&C, S&C + Cat A or Whole Building)



Number of Retrofit Projects Passing/Failing any of the three UKNZCBS limits (S&C, S&C+Cat A or Whole Building)



Source: Arup

Embodied carbon & tall buildings

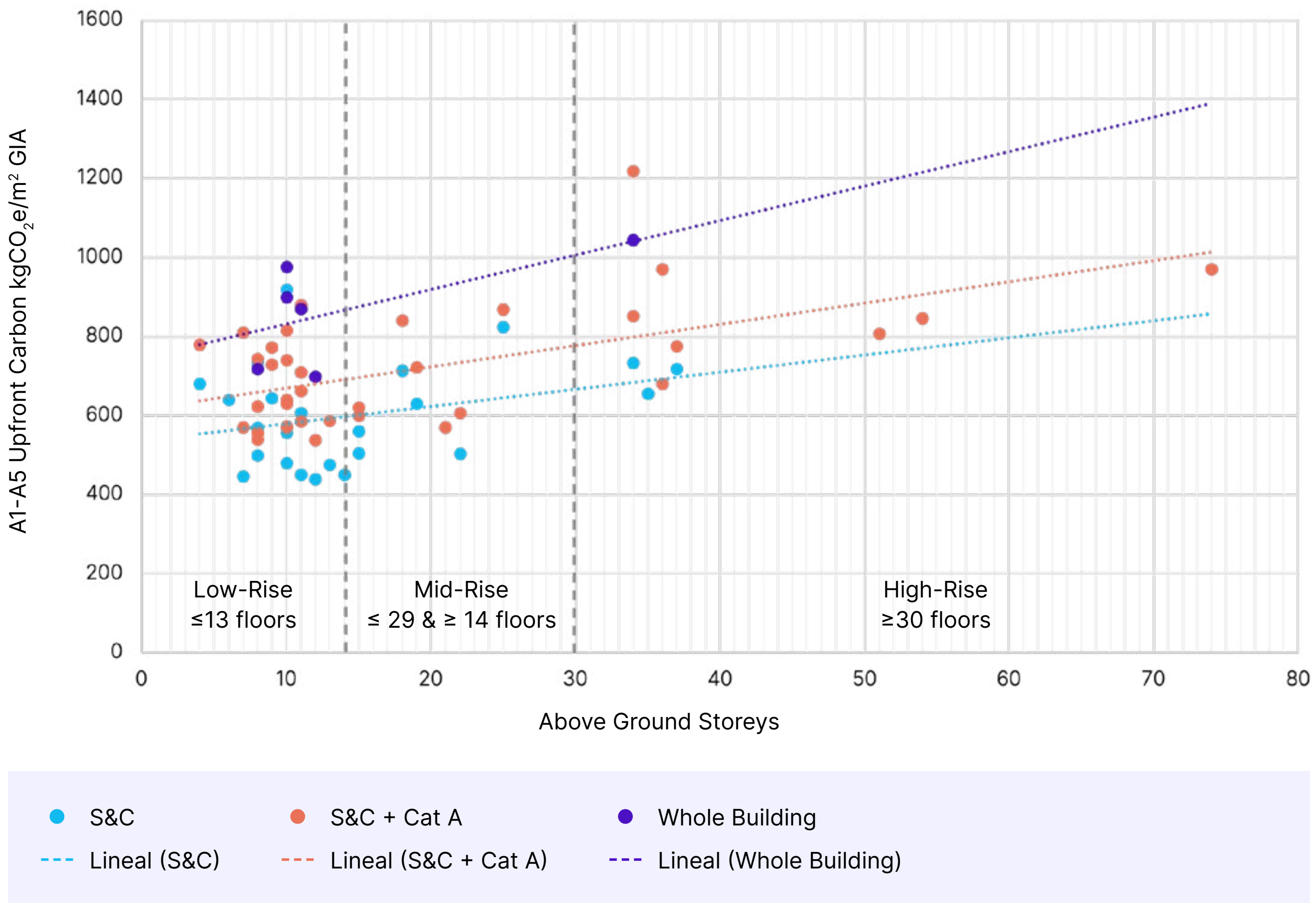
Massing & height

As part of the analysis, additional factors influencing embodied carbon performance beyond project scope were assessed, with this section examining building height as a key driver.

The dataset indicates a clear positive correlation between height and carbon intensity: the below graph shows that Shell & Core projects (blue) and Shell & Core + Cat A projects (orange) exhibit an average increase of approximately 5 kgCO₂e/m² GIA per storey, while Whole Building projects (purple) show an increase of around 9 kgCO₂e/m² GIA per storey, though the latter should be interpreted cautiously due to the small sample size.

This trend is expected, as taller buildings typically require proportionally more services, structural material and higher-strength systems to support greater loads over a relatively small footprint, leading to higher upfront embodied carbon intensities than mid- and low-rise buildings.

Office New Build Upfront Carbon vs No of Storeys vs Scope of Works



Source: Arup

The correlation between building height and upfront embodied carbon directly affects compliance with industry standards such as the UKNZCBS.

The chart below presents box plots illustrating the upfront carbon landing zones for low-, mid- and high-rise New Build projects, distinguished by scope of works.

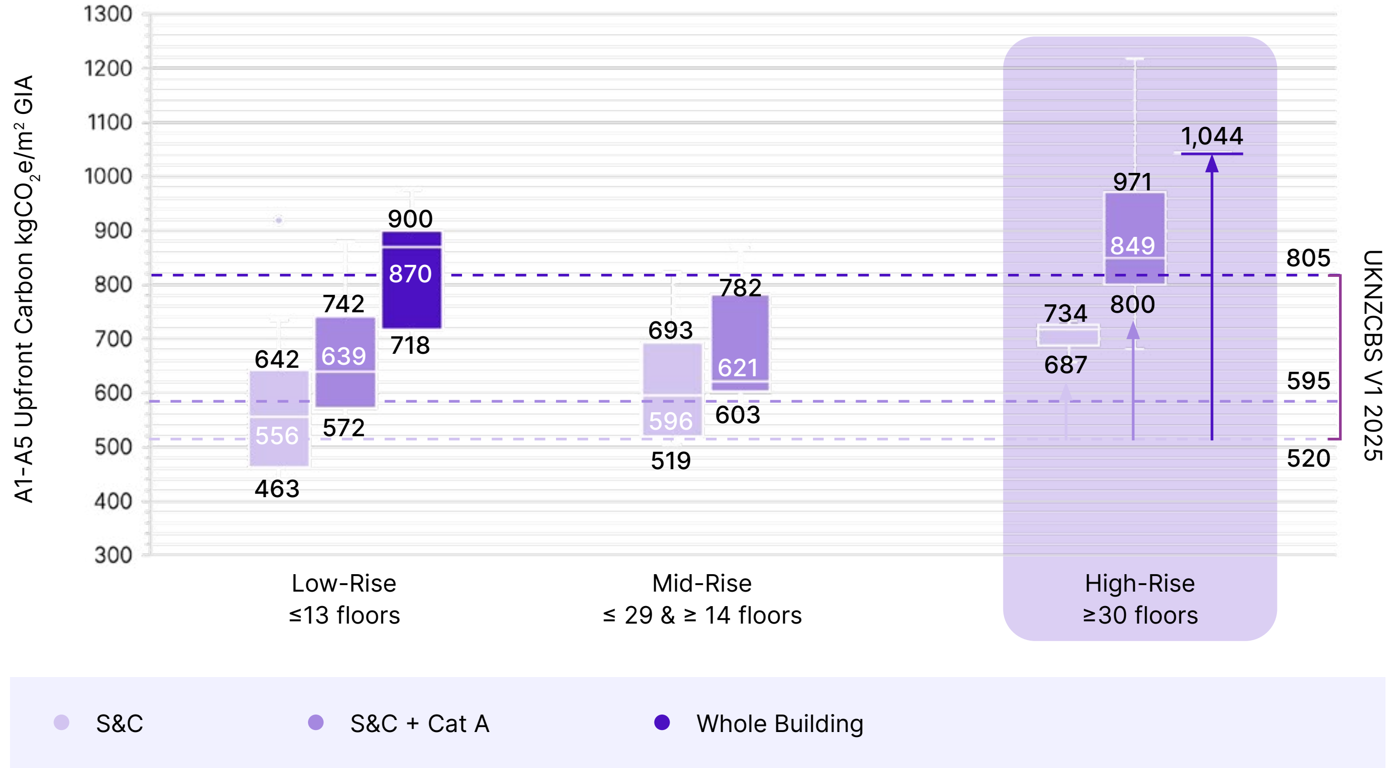
All projects that meet the UKNZCBS limits fall either within the low-rise (fewer than 13 storeys) or mid-rise (between 14 and 29 storeys) category. When compared with the 2025 UKNZCBS limit, the lower quartile of low- and mid-rise projects intersect the limit line, indicating that the best performing schemes up to 29 storeys are capable of achieving compliance.

High-rise buildings show the greatest divergence, with even the best performing projects exceeding the UKNZCBS limit by 150-240 kgCO₂e/m² GIA, indicating a substantial gap.

While the number of mid- and high-rise projects in the dataset is more limited, the trends are consistent with known market behaviour and are considered broadly representative of current industry performance.

The data sample for Whole Building assessments is particularly small for high-rise schemes and absent for mid-rise schemes.

A1-A5 Upfront Carbon for New Build Office Breakdown by Scope of Works & Building Height



Source: Arup

Embodied carbon & design

Building design solutions

The dataset also includes information on the predominant structural frame and floor systems used across the projects, where this information was available.

As illustrated in the charts opposite, the projects employ a range of floor typologies - including precast concrete, composite steel-concrete systems, and a small number of CLT solutions - yet no clear pattern emerges linking a specific system to improved Whole Building carbon performance. While reinforced concrete schemes in this dataset show marginally lower embodied carbon outcomes than other typologies, this is based on a small number of projects and the apparent trend should be treated with caution. The results are therefore considered coincidental rather than indicative of a causal relationship between floor system choice and overall embodied carbon outcomes.

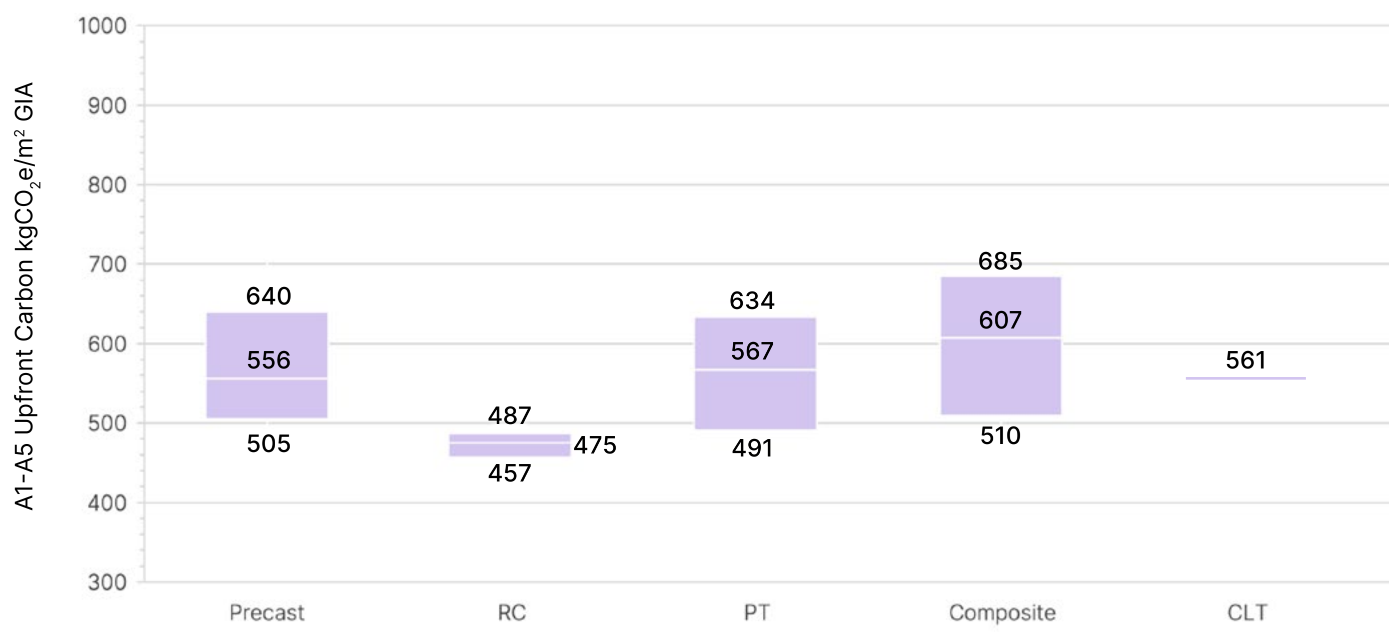
This is expected, as upfront embodied carbon reflects the cumulative impact of the entire building rather than the contribution of any single element. It points to the importance of an evidence-led decision-making approach at a project level, supported by robust embodied carbon analysis through from concept to detailed design.

Leading examples show that it is the integrated design approach, where structural, architectural and building-services strategies are optimised collectively, that most strongly influences overall carbon performance, rather than the choice of a particular frame or floor type in isolation. Still, this dataset is useful in understanding which frame and floor types may offer comparative savings over others when considered within a coordinated whole building design approach.

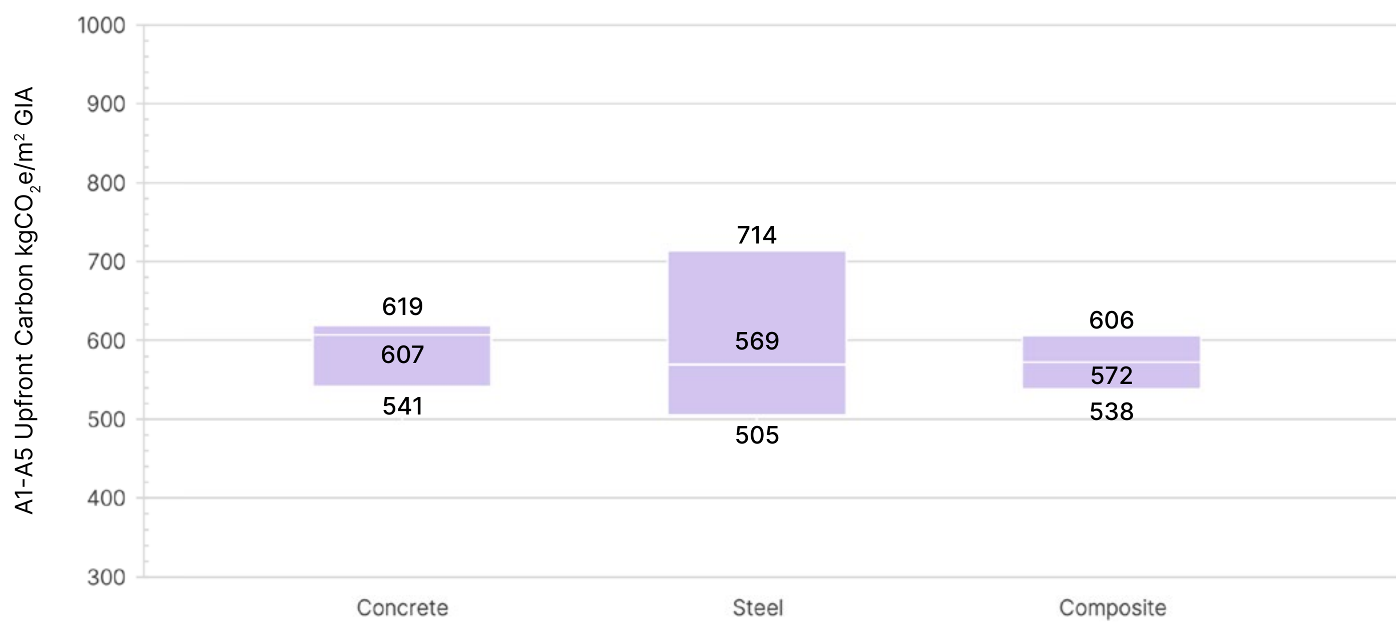
Collecting consistent data on façade, MEP and fit-out design proved more challenging than for structural systems. Unlike structural strategies, where projects typically adopt a single, clearly defined approach, façade and MEP solutions often comprise multiple systems or bespoke combinations, making categorisation less straightforward. Similarly, fit-out information varied considerably across submissions. Some Shell & Core + Cat A projects included full landlord fit-outs in areas such as receptions or end-of-trip facilities, while others adopted far more limited scopes. These differences in specification and extent of fit-out introduce variation in embodied carbon outcomes and make direct comparison between projects more difficult.

However, we believe there would be value in a wider collection of system-level data (substructure, superstructure, façade, etc.) in addition to whole-building data as presented here. This would support a deeper understanding of the relative importance of different elements, and potentially show more correlation between design solutions and embodied carbon outcomes than has been the case here.

S&C Upfront Carbon vs Structural Floor Systems



S&C Upfront Carbon vs Structural Frame Systems



Source: Arup

Embodied carbon & whole life measurement

Whole Life Carbon assessment boundary, maturity & quality

An accurate Whole Lifecycle Carbon Assessment is critical in supporting the evolution of efficient design. The RICS Whole Life Carbon Guidance provides a more consistent and robust methodology for undertaking Whole Lifecycle Carbon Assessments, helping to reduce variability across the industry. However, assessment maturity can still vary significantly between projects, driven largely by the quality and completeness of data available at each project stage. The way teams manage uncertainty, assumptions and data gaps can introduce further challenges when comparing WLC outcomes across projects or against industry benchmarks.

Assessment boundaries and scopes also differ across published benchmarks. As a result, Whole Life Carbon practitioners often need to generate several versions of the same assessment to align with multiple benchmark definitions, adding complexity and increasing the risk of inconsistency.

Additionally, the final quality of any Whole Lifecycle Carbon Assessment depends heavily on the competence and experience of the team carrying it out - not only in carbon quantification, but in understanding how carbon management integrates with wider project decision-making. Together, the assessment boundary, maturity and quality significantly influence how reliably datasets can be compared with one another and with industry benchmarks.

The results used in this study were derived from Whole Lifecycle Carbon Assessment that have not been peer-reviewed by Arup, and therefore their boundaries, maturity and quality have not been independently verified. However, given the size of the dataset and the study's focus on identifying overarching patterns in upfront carbon in London, the statistical analysis applied has allowed the removal of outliers and strengthened the reliability of the overall trends reported.

72 Upper Ground | *CO—RE & Cityscape*

50 Fenchurch Street

38-storey commercial tower
Eastern cluster, City of London

BY BNP PARIBAS ASSET MANAGEMENT ALTS & YARDNINE

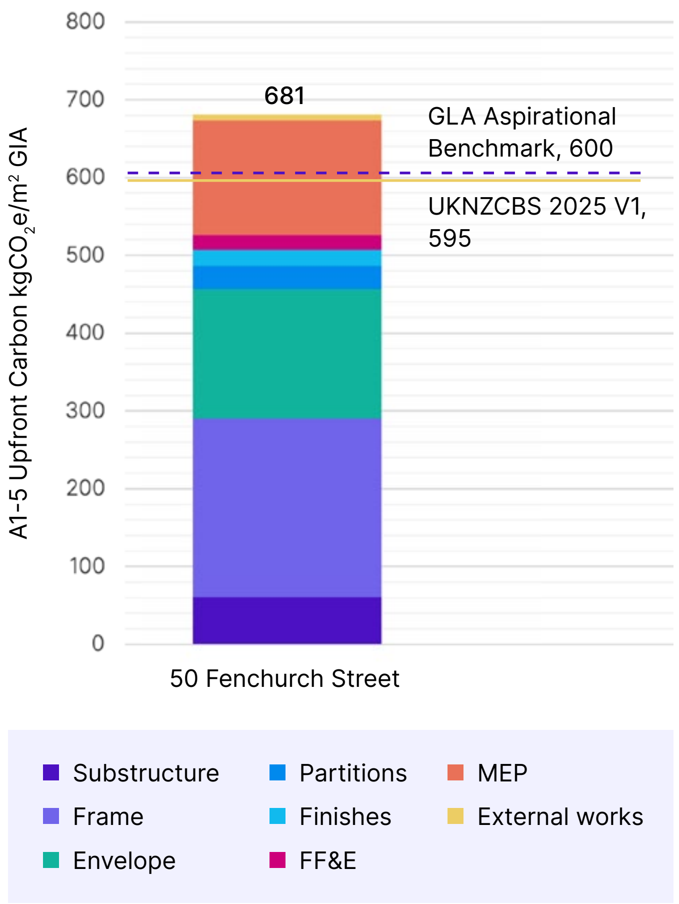
New Build - Technical Design
A1-A5 Upfront Carbon

681 $kgCO_2e/m^2$ GIA

+14% above UKNZCBS S&C + Cat A limit of 595

Best performing tall building in the data set

Upfront Carbon Comparison to New Build Office Benchmarks (Shell & Core + Cat A)



50 Fenchurch Street is a 38-storey, all-electric commercial tower designed to achieve exceptionally low embodied and operational carbon within a heavily constrained, historic part of London.

The project targets significantly lower upfront carbon than typical high-rise buildings, enabled by efficient sub- and superstructure solutions, an innovative underfloor air system and carefully selected low-carbon materials. The development integrates new public realm and preserves the Grade I-listed All Hallows Staining tower, demonstrating that ambitious carbon performance can be delivered alongside heritage protection and high-quality urban design.

Embodied Carbon Reduction Strategies

- **All-electric** tower targeting low embodied and operational carbon
- **Efficient structure** and low-carbon systems cut upfront carbon well below high-rise norms
- **Heritage-led design** with **substructure** performing **49% better** than **GLA Aspirational** Benchmark
- Optimised 9m x 9m grid
- **Piled raft** foundation
- Core-wall optimisation through **wind testing**
- No metal decking in precast floors
- Low carbon concrete with **high GGB content**
- Efficient steel frame using **S460 stee**l
- **Low carbon** steel using 70% EAF material
- **Low-GWP** refrigerants
- **Underfloor air** system with reduced plant and ductwork

1 Victoria Street

Nine-storey redevelopment with retained basement Victoria, Westminster

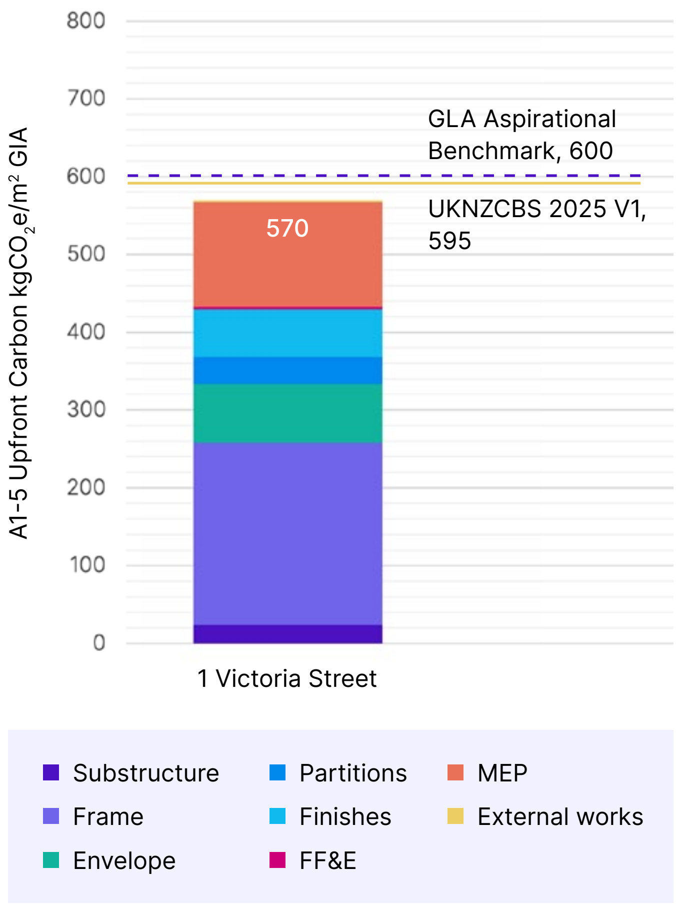
BY STANHOPE

New Build with Retention - Technical Design A1-A5 Upfront Carbon

570 $kgCO_2e/m^2$ GIA

-4% below UKNZCBS S&C + Cat A limit of 595

Upfront Carbon Comparison to New Build Office Benchmarks (Shell & Core + Cat A)



1 Victoria Street demonstrates how a major urban redevelopment can achieve strong embodied carbon performance even when technical constraints force a shift in strategy. The project began as a deep retrofit retaining the full basement and circa 60% of the existing superstructure. However, extensive corrosion uncovered during surveys of the existing superstructure forced a change to a new build approach above ground, while retaining the full basement, resulting in 52% retention of the existing structure.

This is a rare example of a project where a retrofit and new build solution have both been analysed in some detail for the same scheme. The surprising result was that the impact of the change to fully new construction above ground resulted in only a 3% increase in upfront carbon. The increase in new structure was offset by improvements in overall structural efficiency compared to the retrofit option, as well as a substantial reduction in the temporary works. The resulting building is also more spatially efficient, more flexible and with a longer design life than the original retrofit solution.

Throughout the project, the collaborative carbon management approach enabled the design team to identify efficiencies in the structure, façade and MEP systems, and to source innovative low carbon materials. This has allowed the project to stay on track to meet the quantitative planning limits set by Westminster City Council. The result showcases how resilient, data-driven decision-making can deliver high performance, lower carbon outcomes even when original reuse ambitions have evolved.

Embodied Carbon Reduction Strategies

- Shift from **deep retrofit** to **new build** due to poor state of existing concrete, with only **+3%** upfront carbon impact
- **Structural efficiency and reduced temporary works** offset loss of retention
- Basement retention drives substructure to **81% better** than GLA Aspirational Benchmark
- **Lean MEP design** including an optimised underfloor air system performing better than alternative strategies
- Partial **substructure and basement retention**
- **Structural optimisation** for maximised efficiency
- Minimised basement **temporary steel**
- Low carbon façade **aluminium extrusions**
- Low carbon façade **UHPC precast panels**
- Low carbon façade **glass**
- Low carbon **blockwork**
- Minimised **ceiling finishes**
- Concrete with **high cement replacement**
- **RAF panels** with a high recycled content

Holden House

Eight-storey redevelopment with partially retained listed façade Oxford Street, Westminster

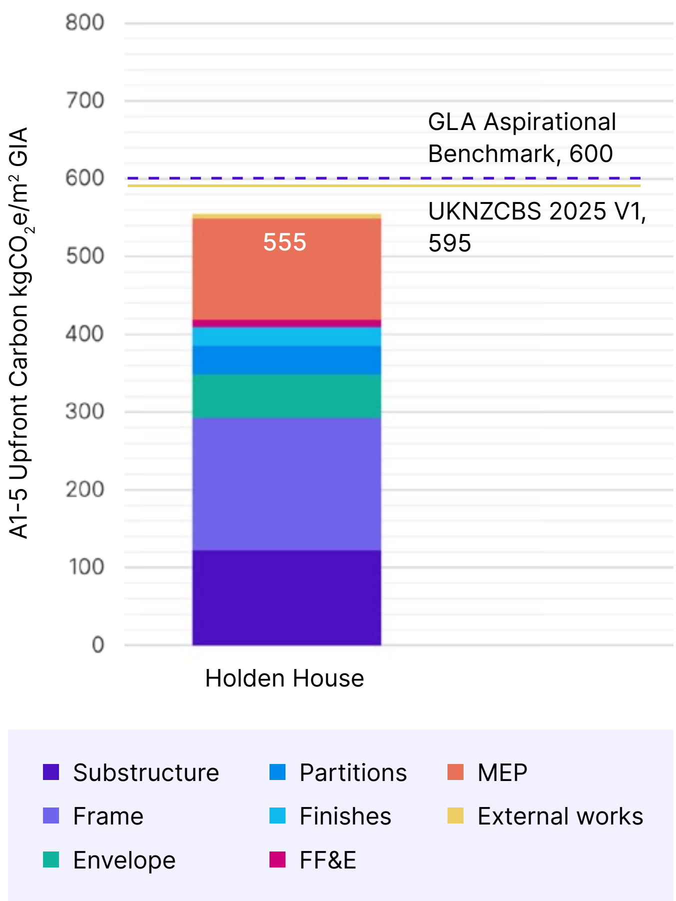
BY DERWENT LONDON

New Build with Retention - Technical Design A1-A5 Upfront Carbon

555 $kgCO_2e/m^2$ GIA

-7% below UKNZCBS S&C + Cat A limit of 595

Upfront Carbon Comparison to New Build Office Benchmarks (Shell & Core + Cat A)



Holden House exemplifies how high-quality urban redevelopment can be delivered while minimising embodied carbon impacts. Its embodied carbon journey was shaped by a fully-integrated, collaborative design process in which every discipline contributed to reducing whole life emissions. The retention of the listed façade delivered substantial carbon savings, demonstrating that high-performance, low-carbon outcomes are achievable even on complex historic sites. From the outset, the team prioritised efficient design and the procurement of low-carbon materials, supported by a rigorous carbon-management process that assessed every decision, large or small, through carbon and sustainability lenses.

Embodied Carbon Reduction Strategies

- Overall **façade** is performing **37%** better than the **GLA Aspirational Elemental Benchmark** thanks to the **retention of the listed elevations**
- **Rigorous carbon-management process** guiding material choices and design decisions using **technical/cost/programme/supply chain feasibility** studies
- **Partial façade retention**
- **Structural optimisation** for maximising efficiency
- 65% reclaimed façade **temporary steel**
- Low carbon façade **aluminium extrusions**
- Low carbon façade **precast panels**
- Precast panel **thickness optimisation**
- Concrete with **high cement replacement**
- (limestone fines), exploring alternatives to
- GGBS use
- Low carbon **reinforcement**
- 25% reclaimed permanent **primary steelwork**
- Reclaimed **RAF panels**

Minerva House

Riverside retrofit with vertical extension Southbank, Southwark

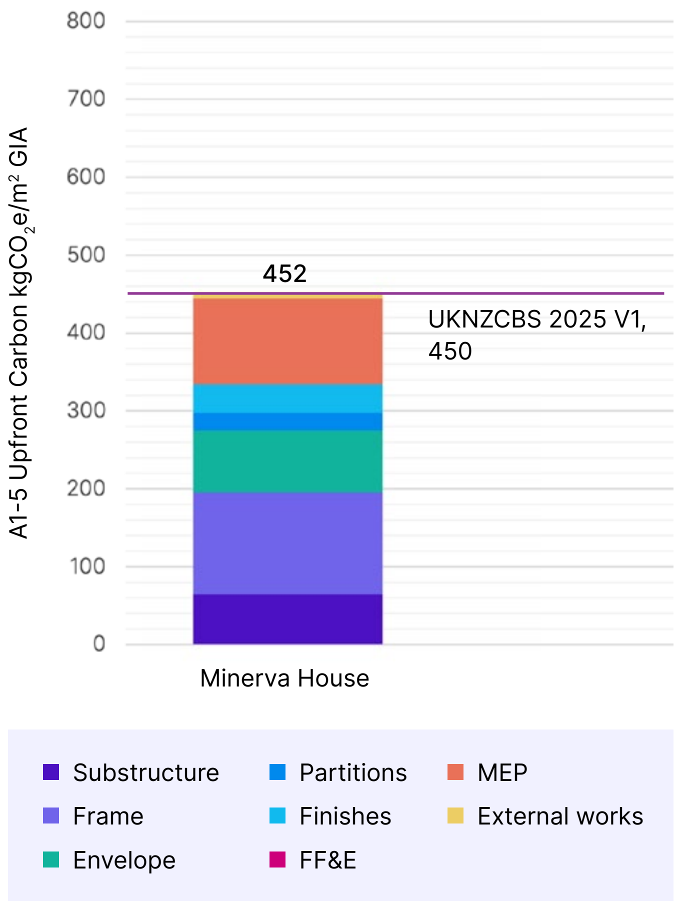
BY GPE

Retrofit - Technical Design A1-A5 Upfront Carbon

452 kgCO_2e/m² GIA

is aligned with UKNZCBS S&C + Cat A Limit of 595

Upfront Carbon Comparison to New Build Office Benchmarks (Shell & Core + Cat A)



Minerva House is a refurbishment project alongside the River Thames. The building will deliver best-in-class waterfront office space, embracing circular economy principles by retaining and reusing significant proportions of the existing foundations, frame and façade. The vertical extension will provide three extra storeys of space including terrace areas. Minerva House also offers retail space at ground level and an enhanced public realm.

Embodied Carbon Reduction Strategies

- **Refurbishment-first design** reusing over **70%** of the existing structure (including foundations and frame) and 50% of the existing façade
- **Vertical extension** adds three floors with riverside terraces + improved public realm
- **Structural reuse** drives substructure to **42% better** than **GLA Aspirational benchmark**
- **Post-tensioned structural slab** adopted as the primary structural solution
- Use of **river barge transport** as an alternative logistics method for demolition and construction material
- Updated MEP design to align with BCO 2023, leading to **reduced plant sizing** and associated embodied carbon
- **Optimised aluminium façade profiles** following supplier engagement
- **High GGBS content** used in new concrete structural elements
- Use of **low carbon glass**
- **30 tonnes of glass** was salvaged as part of the Saint Gobain Glass Forever Initiative for reuse offsite

Reflections on the London market

This ground-breaking analysis is the first of its kind, establishing, for the first time, a clear benchmark for what good embodied carbon performance looks like in office-led developments in central London. In this section, we explore the wider factors and key considerations that continue to shape this important and evolving agenda in London.

Urban & historic environments

Development in central London presents a unique set of challenges that have a significant impact on carbon outcomes. The city's dense urban fabric, combined with complex layers of historic infrastructure, including the London Underground network, creates constraints that are not typically encountered elsewhere. Whilst this analysis helps to establish what good performance looks like at a high level today, it is important that flexibility is applied at project level to reflect these site-specific conditions.

In particular, the scarcity of land in central London drives a greater reliance on high-density, vertical development. Whilst this supports efficient land use, it can also lead to higher embodied carbon outcomes. A nuanced, context-sensitive approach is therefore essential to ensure that carbon targets remain ambitious whilst still being relevant across a diverse range of development scenarios.

The importance of design

This analysis is grounded in data, helping us to understand where the market currently stands and where action is needed next. However, in the drive to decarbonise, it is important not to lose sight of why carbon is expended in the first place. The built environment is not only required to be low carbon and efficient, but also to support the wellbeing, experience, and enjoyment of those who use it.

An overly narrow focus on standardised design or low carbon material choices risks shaping our towns and cities in unintended ways. It is therefore essential to strike a balance, preserving the character of our urban environments, the quality of our buildings and the provision of amenities, whilst reducing carbon intensity. On this, our design and engineering teams will be critical in achieving this important balance.

London leads the way

London is a global leader in addressing embodied carbon. This analysis highlights the city's advanced position across measurement methodologies, low-carbon design practices, material innovation and policy frameworks. London's integrated approach, combining regulation, industry engagement and transparency, positions it as a reference point for other major international cities seeking to reduce lifecycle emissions in the built environment.

London, sustainability & growth

London's high levels of agglomeration, intensity of land use and integrated transport infrastructure make it the most carbon efficient place in the UK to grow the economy (lowest emissions per unit of economic output). The city's density enables more efficient use of land, energy and resources, resulting in the UK's lowest per-capita emissions.[15] Clusters of economic activity bring firms, talent and supply chains into close proximity, driving productivity whilst reducing the need for long-distance travel and logistics. This is reinforced by London's extensive public transport network, which provides high levels of accessibility without reliance on private vehicles. The concentration of jobs and services around well-connected transport nodes supports sustainable patterns of movement across the city. London's capacity for tall buildings and high-density development further strengthens these advantages, allowing more economic activity to be accommodated within a smaller footprint. Together, these characteristics make London the UK's most attractive location for low carbon investment and business activity.

Whole life vs embodied carbon

As discussed earlier in this paper, taking significant steps to reduce embodied carbon is essential, and the industry is committed to doing so. However, many members of the London Property Alliance are long-term building owners and investors, taking a whole life view of the performance, value and carbon impact of their buildings. This perspective requires careful consideration of factors such as adaptability and longevity, whether a building can be repurposed in 60 years' time, and whether materials are durable enough to support extended use. Whilst these decisions may result in higher embodied carbon in the short term, they can lead to a lower overall carbon footprint across the building's lifecycle. Owners must therefore balance embodied and operational carbon, recognising that trade-offs are often unavoidable. In some cases, materials or construction approaches that reduce upfront embodied carbon may lead to increased operational emissions over time, particularly in office developments. A balanced, whole life approach is therefore critical to achieving genuinely sustainable outcomes.

Action grounded in commercial realities

Effective carbon reduction strategies and policy must be grounded in commercial reality and reflect how buildings are actually financed, designed, delivered and used in practice. This means recognising the constraints and decision-making processes that shape development, from upfront capital considerations and construction timelines to operational performance and occupier needs. Policies that align with these realities are more likely to be adopted at scale, enabling consistent and meaningful emissions reductions across the built environment. By ensuring that low-carbon approaches are practical, deliverable and supported by a clear value proposition, whether through efficiency gains, risk reduction, or long-term asset resilience, policy can drive change in a way that is both ambitious and achievable.

[15] Consumption based greenhouse gas emissions for London and it's Boroughs. Sustainability Research Institute, University of Leeds, June 2024, https://www.londoncouncils.gov.uk/sites/default/files/2024-07/London%20CBA_2024_Technical%20report.pdf

Conclusion

This analysis clearly demonstrates the embodied-carbon emissions in the context of London's overall carbon footprint. It is essential that we take action collectively as an industry to minimise those emissions, and this analysis is very much intended to support that process.

The fact that we are able to produce this report at all is in part down to the requirements introduced in the GLA London Plan in 2021 requiring all referrable developments to calculate and report embodied-carbon impact. This has helped to support a competitive market between leading developers to reduce embodied carbon, which has had substantial benefits in emissions reductions.

Indeed, the industry has invested significantly in innovation to develop new low carbon materials and the implementation of circular economy principles in development. In plotting our route forward it is important not to forget the scale and pace of change to date.

This study demonstrates what is currently achievable in the market with regard to embodied carbon intensity for low-rise buildings. The 25th percentile values – 590 $kgCO_2e/m^2$ GIA for Cat A New Build and 295 $kgCO_2e/m^2$ GIA for retrofit – are a good approximation of current best practice. Embodied carbon intensities for high rise are significantly higher, circa 100 $kgCO_2e/m^2$ GIA higher for a 30 storey building over a 10 storey building. It should be noted that this is based on a limited number of high-rise data points.

The UKNZCBS has the potential to be a very important driver of change in the UK market. However, for the office sector the year-on-year reduction in the New Build embodied carbon limits mean that very few of the buildings in the dataset would be able to comply with the standard going forwards. This is despite the developers of these buildings being at the forefront of sustainable development in London. The rate at which those limits reduce annually mean that from 2029 none of the new buildings in the dataset would meet the limits, and the gap between the limit and what is achievable risks growing larger every year.

The embodied carbon performance demonstrated by schemes in the lower percentiles is the result of sustained marginal gains over time, driven by continual optimisation rather than step-change interventions. Many of the most impactful measures, such as structural efficiency, material substitution and design for reuse, have already been widely adopted by leading developers, particularly in more complex typologies such as high-rise buildings. As a result, while further reductions remain possible, these are likely to be incremental rather than transformative. This context is critical when considering the trajectory of future embodied carbon limits, as it helps to explain the growing divergence between policy expectations and what can realistically be achieved by even the best-performing projects in the market.

As a result, there is a real risk that the UKNZCBS is seen as unachievable by the market and fails to gain the broad appeal it needs to drive change and thus fails to have any real impact.

Timber Square | *Landsec and Bennetts Associates*

Final remarks

1

We have made significant strides in recent years in optimising embodied carbon outcomes, through a combination of lean design, re-use of existing materials and use of lower carbon products.

2

We have consumed much of the low hanging fruit. It is important as **we need to continue to innovate in this space.** Unlocking challenges such as fire safety of in particular bio-based materials and warranties for re-used products will require coordinated industry research initiatives, as these are beyond what can be overcome at an individual project level.

3

Demand for low carbon materials have had a significant impact on carbon reduction strategies, with the materials supply chain responding with innovative new materials and techniques. Where the business case is clear, supply chains are able to respond quickly. Re-used raised access floor tiles are selling like hot cakes and is a classic example of this. Other examples, such as re-use of structural steel for example, have more challenges associated with them, but that market is also starting to mature.

4

Supply chains have a significant role to play in building on the progress made so far. Coordinated engagement throughout the process will provide firms with the confidence **to invest in developing and scaling new products.**

5

This data reveals the levels the industry in London is achieving. **We now urgently need to better understand the likely rate of supply chain decarbonisation going forwards**, from which we will be able to understand the gap between what we can deliver and what we need to achieve.

6

Current data and the realities of commercial development show that going forward New Build projects designed today will struggle to meet the embodied carbon targets set by the UKNZCBS for their construction year. The Standard's year-on-year reductions are steep, particularly in the short term, making alignment more challenging year-on-year. **We recommend that to be effective, policies and certification schemes should be grounded in evidence and responsive to market realities.** Policymakers should actively engage with investors and developers to define a feasible, realistic pathway to net zero.

Data sources, analysis & accuracy

Whole Lifecycle Carbon Assessment methodology: RICS Whole Life Carbon Edition

All upfront carbon datapoints gathered for this study follow the RICS Whole Life Carbon Guidance. The first edition was released in 2017, followed by the second edition in 2024. Because the dataset spans projects completed between 2019-2029, it includes assessments prepared under both versions: 41 of the 76 projects are aligned with RICS Edition 1, while the remaining 35 follow Edition 2.

RICS Edition 2 provides updated industry guidance and revised default assumptions for early-stage Whole Lifecycle Carbon Assessments. These include changes to transport distances, service lives, wastage rates, site emissions and end-of-life assumptions. However, these updates generally have only a minimal effect on overall Whole Life Carbon results. The most significant methodological differences between the two editions relate to the treatment of pre-construction demolition and contingency. Under Edition 2, pre-construction demolition must be included within the main upfront carbon results, whereas Edition 1 requires it to be reported separately. Edition 2 also introduces a formal contingency requirement, which incorporates several uncertainty factors calculated according to assessment stage and data maturity.

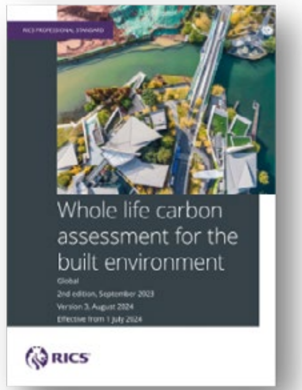
For the majority of projects in this study - most of which were assessed at later design stages - the practical differences between the two editions are relatively small, as assessments largely relied on detailed construction information. As a result, no distinction has been made between Edition 1 and Edition 2 projects within this specific dataset.

Industry benchmarks similarly vary in how they interpret or apply RICS guidance. Targets from the GLA, LETI and RIBA are based on RICS Edition 1. Westminster's Retrofit First benchmark draws on Edition 2 but excludes pre-construction demolition. The UKNZCBS aims to follow Edition 2 fully, however they exclude pre-construction demolition and facilitating works (module A5.1).

Together, these variations highlight both the rapid evolution of whole-life carbon methodology and the growing maturity of industry understanding. The sector has progressed significantly, from early alignment on principles to increasingly refined and consistent approaches, but it is still on a journey. Continued collaboration, clearer definitions and stronger alignment between standards will all be essential as the industry works towards more robust, comparable and transparent embodied carbon reporting.

41 RICS Edition 1 Projects

35 RICS Edition 2 Projects



20 Berkeley Square | *BEAM*
© *Jack Hobhouse*

This report has been prepared by Arup for and on behalf of the London Property Alliance (LPA) and considers the particular instructions and requirements agreed with LPA during the development of the project. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party. The embodied carbon data presented was provided by LPA members and has not been independently validated by Arup. Any duplication or use of this study (in parts or as a whole) must include this disclaimer.

The report and its contents are the views and copyright of the London Property Alliance©

Embodied Carbon in Central London

REPORT AUTHORS

London Property Alliance

WPA Westminster Property Association

CPA City Property Association

ARUP