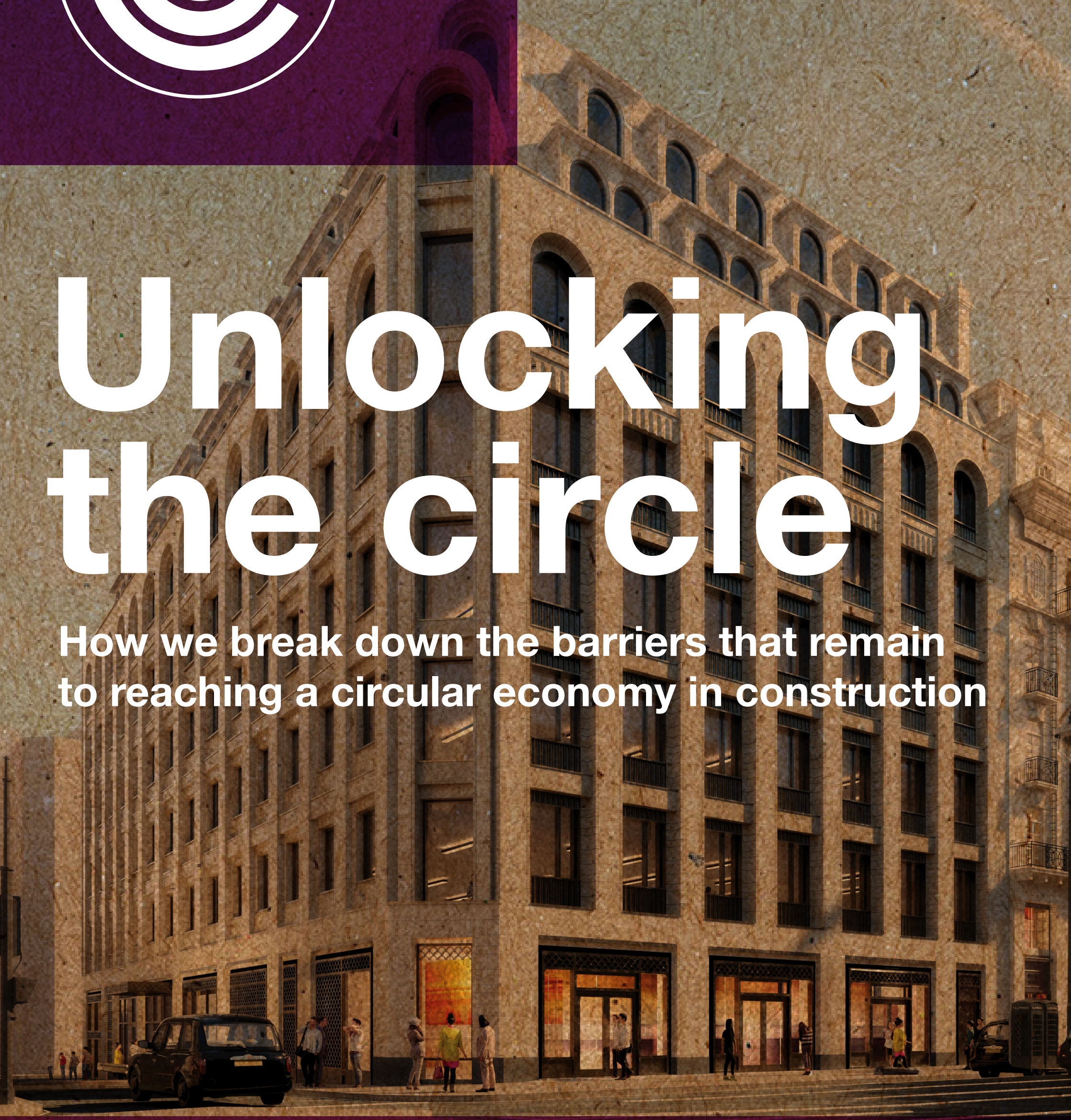
Unlocking the circle

How we break down the barriers that remain to reaching a circular economy in construction



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INTRODUCTION

Reducing embodied carbon in commercial office buildings is a significant challenge. According to the London Energy Transformation Initiative (LETI), almost half (48%) of a building's embodied carbon comes from the superstructure, with the substructure, façades and internal finishes contributing 17%, 16% and 4% respectively. Finding circular alternatives for these building components could address over 85% of the building's embodied carbon.

To tackle this issue, Mace hosted a Circularity workshop in October 2024, bringing together a range of industry experts to delve into the challenges and strategies to enhance circular practices across three areas: Structures & Demolition, Envelopes and Fit-out.

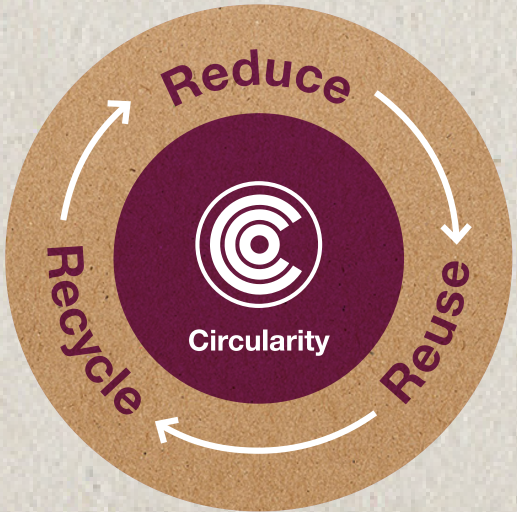
By focusing on these key areas, we explored how the current circular economy principles can be expanded and integrated throughout the building development cycle. From the initial brief and material selection to the end-of-life deconstruction and reuse, each stage presents unique opportunities to minimise waste and maximise resource efficiency.

This report provides a high-level overview of common challenges, best practices, and recommendations to drive the transition towards a more circular built environment.

Circularity

/ ***sur-kyuh-lar-i-tee*** / **noun** sustainably delivering and operating the built environment in a way that minimises the consumption of resources.

The circular economy in the built environment relies on three core principles:



Reduce

Reducing resource use in construction through improved design, avoiding new build, and using innovative construction approaches

Examples: Modern Methods of Construction (MMC), Design for Manufacture and Assembly (DfMA).

Reuse

Directly re-using construction products and materials so they don't become waste.

Examples: Retrofit, materials passports, urban mining, re-using steel frames.

Recycle

Taking construction waste materials and recycling them back into the industry, reducing the use of virgin materials.

Examples: Redirecting flooring materials or concrete waste into new products.

FOREWORD

Circularity remains one of the key issues our industry must advance to reduce our carbon footprint and address the growing shortage of raw materials.

As a leader in the construction industry, Mace is committed to championing the transition to a circular economy. We have made significant strides moving in the right direction.

At the end of last year, we brought together industry experts, clients, and consultants and discussed how together we can create a circular construction approach. This event followed the publication of Mace's 'Closing the Circle' report, which advocated for establishing a circular construction economy in London as a blueprint for other global cities.

The research revealed that in London alone, the economic value of materials not being reused in the past five years exceeds £1 billion. By adding 13.8 tonnes of materials to the supply chain through circularity, we could potentially save 11 million tonnes of carbon emissions.

Following this, we published a detailed breakdown of the circularity potential and measurement of various carbon-intensive construction materials, along with our partners Arup in our joint report, 'Closing Material Loops'.

Despite these reports showing what's possible, the industry is still struggling to fully adopt a circular economy in practice. Many barriers remain, and until these are unblocked, we won't be able to ever truly 'close the circle'.

Early engagement and collaboration are essential. We aim to move forward by identifying the real barriers and next steps to create an environment where investment in circularity options is encouraged.

While the importance of adopting a circular approach is widely recognised, widespread adoption remains limited. Design briefs are often inconsistent and not always developed with a circularity strategy in mind.

Our research has identified several factors contributing to this, including a lack of clear incentives and drivers, poor data, a misallocation of risk, higher relative costs, and skills gaps.

In this report, we discuss these barriers and offer recommendations on how they can be addressed to help us achieve a fully circular economy in construction and reduce our industry's environmental impact.

Improving circularity requires industry-wide collaboration at the early stages. A better understanding of buildings and materials, standardisation of components and systems, and a design for reuse rather than a complete deconstruction, will all increase opportunities for reuse.

Adopting a long-term perspective will shift the focus away from short-term projects to an industry-wide approach that rewards sustainable initiatives over the long-term.

Thank you to all those who attended our circularity workshop, whose ideas and discussions have informed this report.

Ged Simmonds
Managing Director – Private Sector, Mace

POLICY AND INCENTIVES

One of the primary challenges to creating a fully circular economy remains the lack of clear and standardised policy drivers at a national level, such as through legislation, tax and the planning system.

While there are local and regional level examples of excellence, particularly in London with the Greater London Authority (GLA), Westminster City Council and the City of London leading the way, national policy remains inconsistent. This lack of central coordination makes it difficult for asset owners with diverse portfolios to set consistent briefs across different regions.

New build and major refurbishment projects (referable buildings) must comply with the GLA circular economy requirements, but fit-out projects are not held to the same standards. Additionally, using reclaimed materials is often more costly than using virgin materials due to the extra time needed to carefully remove, store, survey, clean, test and warrant these materials, but there are no financial mechanisms to offset these costs.

The tax system incentivises new builds, through a zero-rated VAT rate, while repurposing existing assets, incurs the standard 20% rate. This disparity makes circularity more expensive.

Furthermore, material reuse within projects currently does not reward the donor project, with the new build gaining the carbon credits, disincentivising a closed-loop material reuse scheme between projects.

Recommendations

- **National planning policy**: Roll out planning policies like those in the City of London and GLA nationally and in the Devolved Nations to create a standardised framework for circularity. Consider fast-tracking applications that demonstrate high circularity.
- **Fit-out standards**: Develop circularity standards and guidance for fit-out projects to reduce waste, as these projects generally have a shorter lifespan than the materials used within them.
- **Embodied carbon limits**: Adopt the UK Net Zero Carbon Buildings Standard (pilot version) into planning policy or building regulations to force new build projects to adopt lower embodied carbon materials, including reclaimed and high recycled content. We recommend undertaking an impact assessment of this approach.
- **Tax incentives**: Use tax policy to drive change, similar to the impact the landfill tax had on reducing waste. Offer tax rebates similar to R&D tax credits on reclaimed or reused materials to offset higher costs.
- **Building regulations**: Update building regulations to include requirements for material reuse and recycling. Encourage renewable resources and mandate lifecycle impact assessments for buildings
- **Green building ratings**: Enhance BREEAM and LEED to incorporate and reward circularity.
- **Internal carbon trading**: Developers should adopt internal carbon trading schemes to incentivise circular designs across portfolios, not just individual projects.
- **Material donation incentives**: Introduce incentives like carbon credits for both donor and recipient projects to encourage material donations.
- **Contract clauses**: Develop contract clauses to promote circular economy principles on projects, such as those specified in a performance table (clause X29 NEC4) or Alex's Clause.

POLICY AND INCENTIVES

30 Duke Street St James's

Embracing a pioneering circular approach in the UK, over 78% of 30 Duke Street St James's structure will use reclaimed steel. This will be sourced from the former French Railway House building (which previously sat on the 30 Duke Street St James's site and is now demolished), a second donor building within GPE's portfolio, and the open market. This approach will generate a carbon saving of approximately 80 $kgCO_2e/m^2$.

The project also intends to reuse 33,645 kg (300m²) of the site's existing Portland stone (to form the new stone façade) and recycle approximately 30 tonnes of glass from the deconstruction of the French Railway House building.

DATA, METRICS AND PROCESSES

A major barrier to a fully circular economy in construction is the lack of consistent measurement standards. Without consensus on success metrics and benchmarks, improvement will be challenging.

Mace has developed its own circularity measurement tool to assess projects from a circular perspective and highlight the impact of reuse decisions. However, this is not standardised across the industry, with large contractors able to develop the tools, but smaller contractors unable to invest.

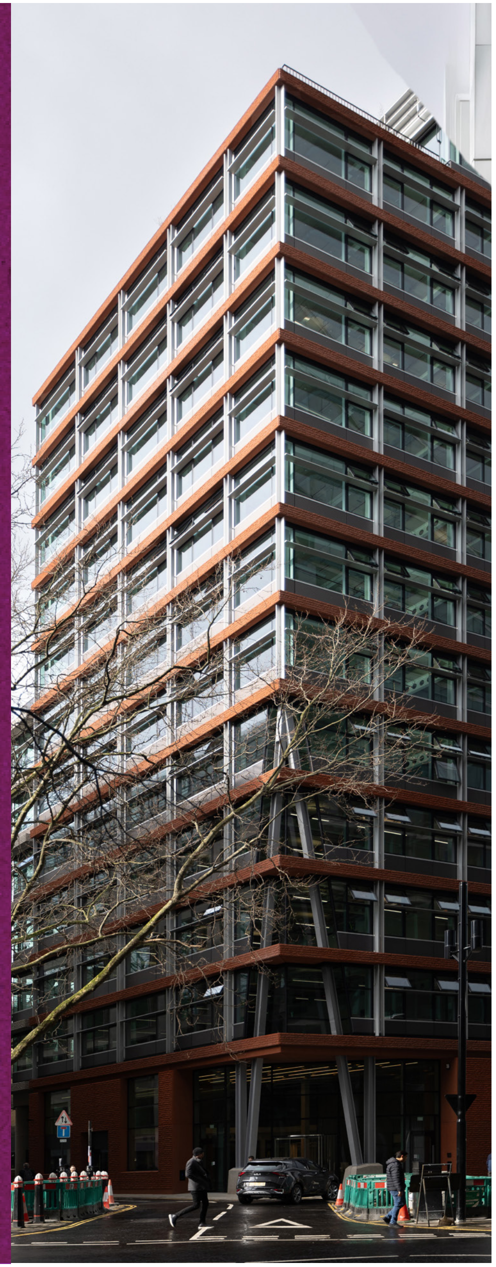
There is also limited understanding of buildings and materials at the demolition stage, often due to no digital records existing for older buildings. Prescriptive designer specifications restrict the flexibility of both constructors and manufacturers. Each project presents unique challenges, requiring tailored approaches for every reuse scenario.

Good quality data and better information will help to understand the value of materials and the potential to extend their lifespan. Implementing digital tools such as material tracking software and material banks will support future reuse.

Edenica

Edenica is the first project in the City of London designed as a 'material storage bank.' This 12-storey, 95,000 sq ft development is pioneering a Material Passport approach to significantly reduce whole-life carbon, paving the way for a circular economy in the built environment.

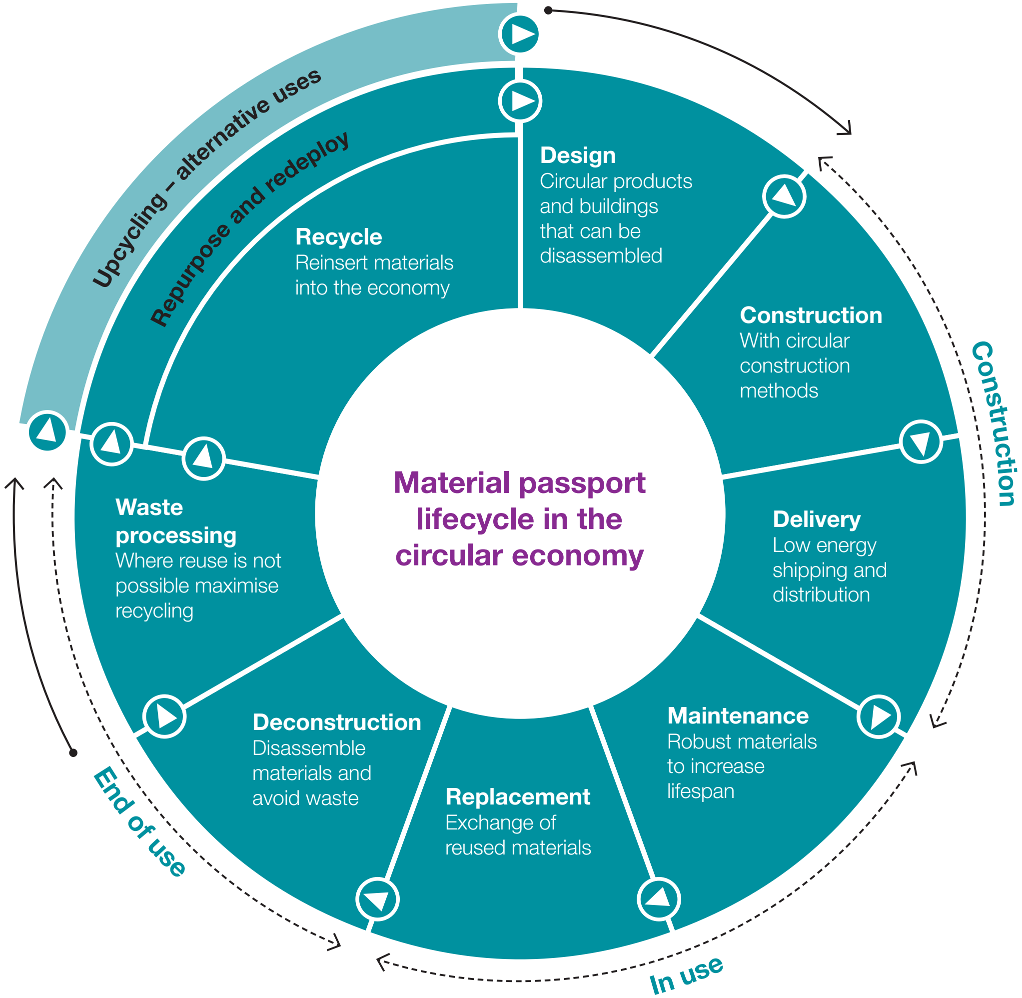
Digital datasets track each building component for future reuse, including comprehensive data on the building's carbon credentials, physical stamps, manufacturer and contractor information, products and components used, sourcing certificates, circularity capabilities, and carbon content. In total 80% of materials have been digitally recorded—capturing 4,817 products ready to be reused when the building is refitted or redeveloped instead of going to waste.



DATA, METRICS AND PROCESSES

Recommendations

- **Digital material databases:** Adopt standardised digital material databases, such as material passports, across the industry to reduce supply chain burdens and costs.
- **Digital tracking technologies:** Clients and contractors should adopt digital tracking technologies of materials, such as RFID tags, to monitor material usage and availability, and integrate modular storage units to provide flexibility as the requirements change.
- **Improved data access:** Contractors need better access to data at the demolition stage to make informed reuse decisions. This includes better records for new builds and detailed surveys of existing buildings at design and deconstruction stages.
- **Standardised audits:** Implement standardised and robust pre-development and pre-demolition audits to maximise circularity.
- **National register:** Establish a national register for historic building information to drive material reuse through detailed records.
- **Comprehensive waste data:** Collect comprehensive data on waste rates to assess the true value of a circular approach. Mandatory digital waste tracking due to come into force in the UK in April 2025 may assist with this.
- **Industry manual:** Develop an industry manual on how to dismantle buildings to provide much needed guidelines to promote greater industry wide adoption of circularity practices.
- **Material donation service:** Create a service that pairs asset owners and demolition contractors with suppliers and manufacturers to repurpose materials for the open market.



RISK AND COSTS

Using reused materials is still seen as riskier than using virgin materials, leading to challenges with warranties and insurance premiums which increase costs.

Project teams frequently lack sufficient information to understand the risk profile of reused components, resulting in contractual disputes and additional costs.

Reclaimed materials are often more expensive than new ones due to the extra time needed for removal, storage, surveying, and testing. Storage solutions for reused materials also present challenges.

Fixed budgets during design and specification, often overlook the balance between cost and upfront carbon savings. A holistic, whole life view isn't adopted, and circular materials are simply seen as the more expensive option. There is sometimes a conflict between embodied carbon savings and operational carbon savings.

The lack of a long-term vision for material reuse hampers investment and R&D. For example, current automated equipment used for manufacturing steel beams is not well-suited for working with recycled materials, and there is no incentive to invest in updating the equipment without confidence in the cost returns. This is a typical example where reuse is yet to become mainstream, and investment is new and suitable equipment only just emerging.

Standard building contracts are not always suited to the risks associated with material reuse, limiting trades willingness to embrace reuse due to the performance risk of the existing materials remaining with the contractors.

When material reuse is not feasible, the additional cost of new material often falls on the contractors.

Recommendations

- **Risk apportionment:** Implement fair and reasonable risk apportionment to facilitate reuse across all project tiers.
- **Extended warranties:** Extend warranties and safety considerations for reused materials, with industry-backed tests to mitigate perceived risks.
- **Innovative insurance schemes:** Develop instance-backed schemes for circular economy products and services to reduce and mitigate risk.
- **Contract incentives:** Incentivise circularity and encourage a fair balance of risk within contracts.
- **Cost and carbon models:** Cost consultants should expand and develop full cost and carbon models to support circularity.
- **Building code flexibility:** Increase flexibility in building codes, similar to recent changes in concrete standards, to allow for lower carbon cement replacement, and apply this to aluminium grading or glass appearance.

DESIGNING FOR CIRCULARITY

Design plays a pivotal role in achieving a circular economy in construction, particularly through designing for deconstruction.

This approach enables products to be easily disassembled, allowing components and materials to be reused, repaired, or recycled. This minimises waste, reduces resource consumption, and lowers greenhouse gas emissions, as opposed to traditional linear production models that often end in disposal.

However, several challenges currently limit the widespread adoption of circular design. Virgin materials are often preferred for their aesthetic qualities, with circular materials sometimes seen as inferior. Many designs have a short lifespan, often 30 years or less, leading to more material extraction. The most circular building is the one that already exists. Lack of uniformity in designs can lead to waste with buildings, as bespoke buildings miss out on the benefits of scale.

Construction products are generally not designed for dismantling, making disassembly complex and labour-intensive. Material combinations, such as adhesives and mixed plastics, can complicate recycling and reuse. Economic challenges arise as deconstruction processes often require more upfront design considerations and costs. Additionally, a lack of understanding and circular skillset often hinders the full potential of circular design.

Standardised guidelines and infrastructure for deconstruction are lacking, making it difficult for manufacturers to implement circular design principles at scale. Overcoming these challenges requires a shift in design thinking, policy support, and investment in recycling infrastructure to create a robust framework for sustainable deconstruction practices.

Recommendations

- **Standardised design protocols:** Develop industry-wide guidelines for product design to streamline deconstruction and recycling.
- **Simplified disassembly:** Specify materials and assembly methods that simplify disassembly, such as using fasteners instead of adhesives which allows for easier separation. Regulatory bodies and industry groups could collaborate to create and enforce such standards, encouraging more companies to design for deconstruction.
- **Incentives for manufacturers:** Provide support for companies that meet deconstruction design criteria, similar to the Industrial Transition Accelerator (ITA) a European initiative set up to support heavy industry to transition to a low carbon future.
- **Take-back schemes:** Suppliers should adopt take-back schemes for products after disassembly, offering contractors a rebate. Like the ones already in existence for SAS ceiling tiles, Saint-Gobain glass and HYDRO aluminium.
- **Uniform design:** Designers should consider greater uniformity in design to enable easier reuse in the future. For example, standardising floor to ceiling heights.
- **Mock-up floors:** Leasing agents should mock up only one floor to the highest fit-out category to avoid unnecessary waste.
- **Longevity in design:** Design for longevity in appearance and material use, with asset owners and operators focusing on good maintenance practices.
- **Circular mindset:** Encourage a circular mindset among the design community, through training programmes focused on circular economy principles and practices to improve the understanding of buildings and materials. This includes courses on sustainable design, material reuse, and deconstruction. Collaborate with universities and vocational schools to integrate circular economy concepts into all aspects of built environment studies, including engineering, architecture, and construction and property management.

DESIGNING FOR CIRCULARITY

Panorama St Paul’s, London

Adopting a circular economy approach was of paramount importance to the project to minimise embodied carbon in the façades, reduce the need for newly quarried material, and to exemplify the circular economy principles in the façade design on a scale that has never been seen before.

Working with specialist façade engineers, the team were able to reuse the stone cladding from the original building, modernising it to create a new, high-performance building envelope.

Retaining the existing structure achieved carbon savings of 254kg CO_2 per square metre. Over 1,500 tonnes of Portland stone and granite from the façade were redesigned and re-used.

DESIGNING FOR CIRCULARITY

25 Hanover Square, London

To ensure future flexibility and adaptability, 25 Hanover Square is utilising 1,500 square metres of magnetic flooring, eliminating the need for adhesives and reducing Volatile Organic Compound (VOC) emissions. This allows for easy replacement or removal of the flooring in the future, thereby saving carbon and reducing landfill waste.

DESIGNING FOR CIRCULARITY

100 New Bridge Street, London

The ambitious 167,000 sq ft redevelopment project prioritises circularity by preserving the original structure and targeting 95% reuse, recovery, and recycling of construction waste. It will retain 91% of the reinforced concrete lift cores and 85% of the reinforced concrete walls and reusing 81% of the existing steel work.

Through circular initiatives, the project is saving a total of 1,795.31 tCO_2e and 724 tCO_2e from onsite reuse.

Refurbished with the future in mind, the fully electric building is equipped with cutting-edge technology. The installation of new high-performance facades and solar panels significantly reduces operational energy demands.

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