
CIRCULAR
BUILDING A RENEWABLE CITY
LONDON

The Mayor has set ambitious targets for London to be a zero-carbon city by 2030. If we are to achieve carbon neutrality our priorities must include retaining buildings and infrastructure while making them more environmentally sustainable and replacing the end-of-life concept with re-use, re-purpose and recycle.

This NLA report looks at strategies, initiatives and projects that are pushing the boundaries to build a circular city.

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This NLA publication has been written in collaboration with a researcher, and guided by the NLA Expert Panel on Net Zero. It draws together interviews and call for actions from key stakeholders in the built environment community.

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“With around 40% of carbon emissions in the UK linked to the built environment, our cities are at the frontline of the transition to a circular economy. We must look to cities like London to pioneer and mainstream circular approaches through design strategies, material choices and upskilling. By asking how circular London is today, this report showcases the encouraging progress already underway. Crucially, it also builds a pathway for the further action needed if London is to continue being a circular economy pioneer.”

Sarah O'Carroll, Cities Lead, Ellen MacArthur Foundation

“Embracing circularity in the built environment will change how we measure success in architecture. It means celebrating refurbishments over new builds. Until relatively recently new structures were seen as the pinnacle of creativity, and dominated how we saw beauty in architecture and engineering. Reducing upfront carbon means embracing the repurposing and retrofit of buildings, and excelling in working with fewer new materials.”

Ashley Bateson, Director, Hoare Lea and Chair, NLA Expert Panel on Net Zero

FOREWORD

Peter Murray OBE, Co-Founder, NLA

The London Plan, with its focus on good growth, is committed to addressing the city's need to reduce its carbon footprint with sections on active travel targets, urban greening, sustainable drainage and the circular economy. The last is probably the most complex to deliver in an industry that has traditionally been heavily reliant on extracted resources. Now designers and contractors must ponder how demolition materials can be reused or recycled and how components and products can be disassembled and reused at the end of their useful life. They need to look at managing waste on site and consider storage space to support recycling and reuse.

But as yet, London has no functioning second-hand materials market that is easy to procure from. It requires a radical change in the way we think about constructing, equipping, using, maintaining, altering, and renewing our built environment. It needs a new economic model that moves away from our current linear economy, where materials are mined, manufactured, used, and thrown away, to an economy where resources are kept in use, and their value is retained.

But who takes the lead? Can existing suppliers and merchants adapt and change their business model? Will design teams respond?

This report features Danish architect Anders Lendager's Resource Rows housing scheme in Ørestad, Copenhagen, described as the world's first circular economy building. It uses upcycled bricks and waste wood, a recycled concrete beam as a bridge, and old windows and waste wood on rooftop community garden huts.

To deliver his circular projects, Lendager has set up several building materials companies re-making plastic, bricks, wood, and windows. Resource Rows did not cost more to build than traditional construction and is one of the most popular rental projects in Ørestad. In fact people rather like it: Lendager talks of a new aesthetic that celebrates upcycling and how the narratives of rescued materials connect with the occupiers. He believes that architects should be master builders, not color pickers.

In the UK, the Alliance for Sustainable Building Products has produced a toolkit for steel reuse and a number of featured projects are using second hand steel and raised flooring. Seratech, established by staff and researchers at Imperial College, is working on cement substitutes that capture industrial CO^2 emissions directly from flues and produce a carbon-negative cement replacement material. But it is not yet in commercial production. The idea that buildings and infrastructure should be designed to have long lifespans and be easily adaptable for future needs has been around for a long time. The concept of long life, loose fit was first promoted by RIBA President Alex Gordon back in 1974. It was popularised by Stewart Brand in his book 'How buildings learn.' If you google architects who use flexibility and adaptability in their lexicon, you get BIG, Renzo Piano, Foster + Partners, Diller Scofidio + Renfro, AHMM, Make, and Lifschutz Davidson Sandilands (Alex Lifschutz edited an excellent issue of Architectural Design on the

subject). However, it is still challenging to deliver unless developers, too, have bought into the concept.

Will the existing materials industry adapt, or will they feel it threatens their business? The circular economy could offer significant economic benefits to the construction industry. By embracing circular practices, companies can tap into new business models, such as leasing and sharing, to provide ongoing revenue streams. Moreover, it's a growth market, presenting opportunities for innovative companies to develop and offer sustainable solutions.

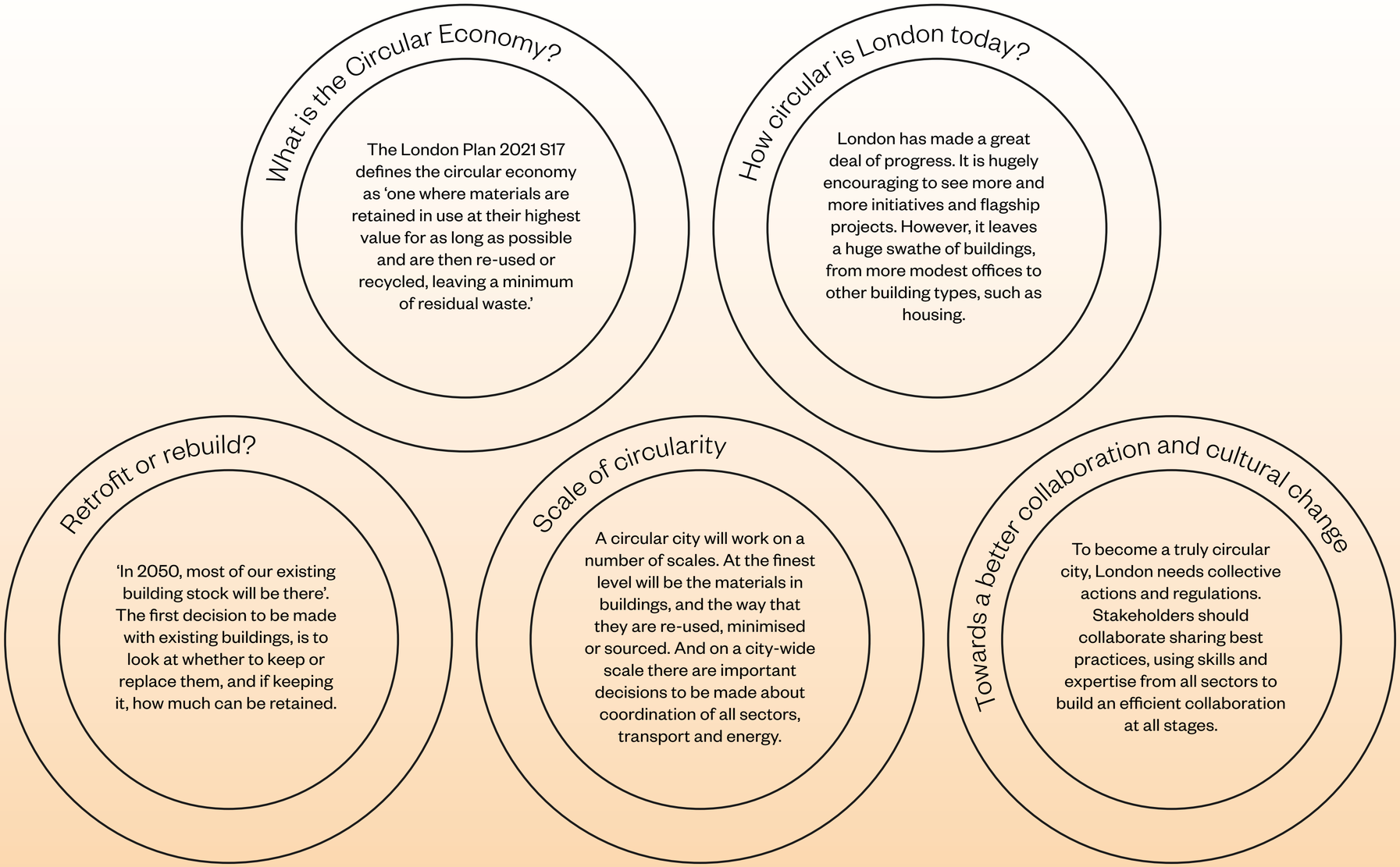
The circular economy should encourage collaboration among stakeholders — architects, contractors, developers, and material suppliers. Cities are the mines from which building resources can be gathered with materials from existing buildings deconstructed and recovered for reuse, materials that cannot be directly reused, recycled, or upcycled and converted into new products or materials. Procurement processes should prioritize selecting durable and recyclable materials, while BIM can enable better tracking, documentation, and information sharing about materials, components, and systems.

Resource Rows reuses brick facades from abandoned structures

EXECUTIVE SUMMARY

If we are to live in equilibrium with our planet, we will need a circular economy — one that re-uses the resources that are already in our system, rather than plundering new ones. Construction has a vital role to play in this since it is using 40 per cent of raw materials globally.

There have been important steps forward in London, including in the London Plan and there are individual projects and initiatives using circular economy principles, some included in this report. But this approach needs to become more widespread if we are to make a real change. This requires extra commitment from developers and design teams; changes in regulation such as the adoption of Part Z of the Building Regulations and the removal of VAT on refurbishment; and changes in the way that materials are used and supplied, as well as how buildings are demolished. Perhaps most importantly of all, we should think of demolition as a last resort.

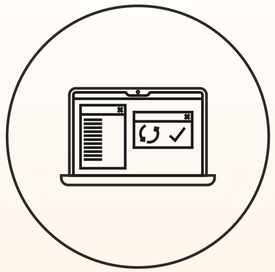


CALL TO ACTION

We need to take collective responsibility. Working in collaboration with industry leaders and the NLA Expert Panel on Net Zero, here we propose a series of actions that we should implement now to make London truly circular:

Reduce the VAT for retrofit to the same level as for new buildings.

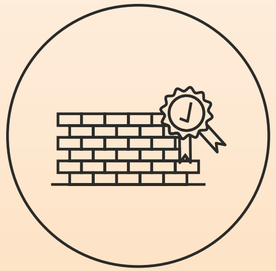
Implement a London-wide Carbon Review Panel (CRP) and Demolition Impact Assessment (DIA)



Include a pre-demolition audit in planning documents for existing buildings, to identify what can be re-used on site and elsewhere.

Implement a Demolition Impact Assessment (DIA) to compare the carbon impact of a retrofit option with a new build, and ensure that the lowest carbon solution is adopted.

Change Building Regulations to ensure mandatory assessments and reporting of whole life carbon, and set limits on embodied carbon.



Use more flexible and consistent approaches of certifying elements and materials for a second life.

Design a London-wide strategy for material storage and logistics. Set up hubs for re-use of materials. Standardise components and encourage material leasing.

Make publicly funded projects commit to using circular principles and become exemplars in circularity.

Share risk differently between developers, designers, contractors and building owners.

Promote a cultural and industry change in circular design education, re-skilling, manufacturing and deconstruction.

BUILDING A RENEWABLE LONDON

INTRODUCTION

What is the circular economy?

The circular economy is a crucial — probably the most important — concept in the move towards sustainable living.

The principle behind the circular economy is that we should use resources again and again rather than continually exploiting new resources which, at the end of their useful period are either discarded or re-used in a less valuable form. Therefore, we move from linear behaviour, where we need more and more, to circularity where waste is considered as a resource that can be used again and again. Since energy is used at all stages of producing, transporting and assembling goods, circularity will reduce the amount of carbon dioxide that we generate. Achieving zero carbon and achieving a circular economy are not the same thing, but it is hard to see how one could happen without the other.

If we want to create a circular economy within our cities, then the built environment needs to address this on every scale. On the largest scale, this means policies, infrastructure and management that promote and coordinate the re-use of energy and materials across the city. Urban planning should also ensure that not only people but also goods can reach key places by green transport — walking, cycling or public transport.

On a building level, it means retaining and repurposing as many buildings as possible, and within those retained buildings keeping as much of the original fabric as possible. Where new fabric is needed, materials should be chosen carefully and used as sparingly as possible. New buildings should also be designed so that they can be deconstructed and elements re-used as easily as possible at the end of their lifespan. This has implications not only for development, design and construction but also for maintenance and, eventually, for demolition — or deconstruction as one should consider it in the circular economy. On the material level, this means re-using, recycling or creating new materials, and questioning how they can be re-used, minimised or sourced.

Circularity, therefore, encompasses all aspects of life. Construction, by its nature uses so many resources (40 per cent of raw materials globally), has a vital part to play if we are going to achieve a circular economy. In terms of design, it means a crucial move from considering mainly operational carbon to thinking seriously about embodied carbon as well. And it demands frugality: questioning whether a new building is necessary; whether an existing building needs to be replaced; and whether each element in a building is necessary.

The Ellen MacArthur Foundation sets out the argument succinctly: ‘In our current economy, we take materials from the Earth, make products from them, and eventually throw them away as waste — the process is linear. In a circular economy, by contrast, we stop waste being produced in the first place.’[1]

38%

reduction of CO2 emissions could be achieved by 2050 with a circular economy[2]

17%

of the total carbon emissions in the UK come from buildings, the second highest emitting sector[3]

Ellen MacArthur Foundation principles of a circular economy [4]

It sets out three key principles of a circular economy:

1 **Eliminate waste and pollution**

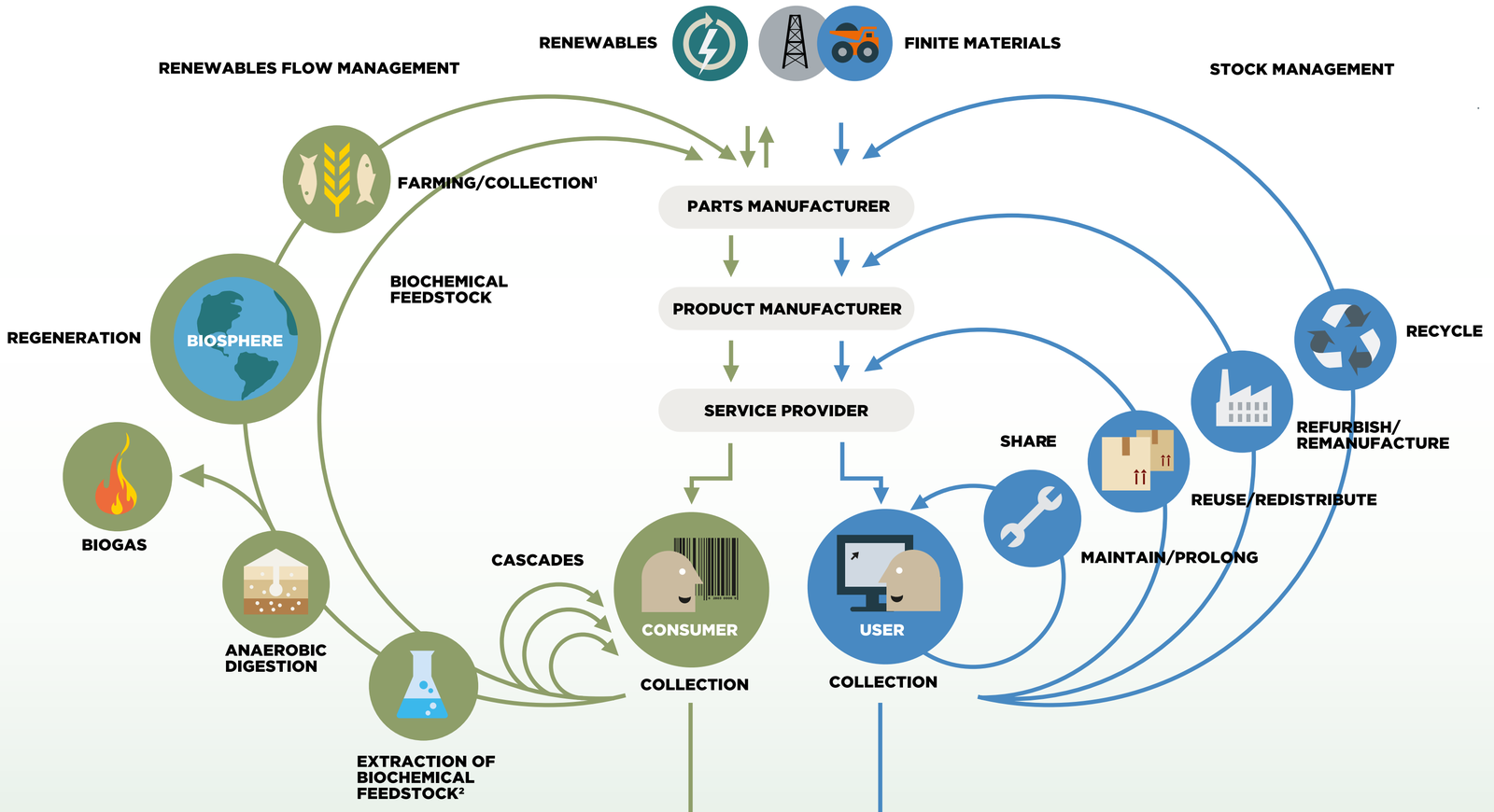
Currently, our economy works in a take-make-waste system. We take raw materials from the Earth, we make products from them, and eventually we throw them away as waste. Much of this waste ends up in landfills or incinerators and is lost. This system can not work in the long term because the resources on our planet are finite. In a circular economy, a specification for any design is that the materials re-enter the economy at the end of their use. By doing this, we take the linear take-make-waste system and make it circular.

2 **Circulate products and materials at their highest value**

This means keeping materials in use, either as a product or, when that can no longer be used, as components or raw materials. This way, nothing becomes waste and the intrinsic value of products and materials are retained.

3 **Regenerate nature**

By moving from a take-make-waste linear economy to a circular economy, we support natural processes and leave more room for nature to thrive.



1 Hunting and fishing
2 Can take both post-harvest and post-consumer waste as an input

SOURCE
Ellen MacArthur Foundation
Circular economy systems diagram (February 2019)
www.ellenmacarthurfoundation.org
Drawing based on Braungart & McDonough, Cradle to Cradle (C2C)

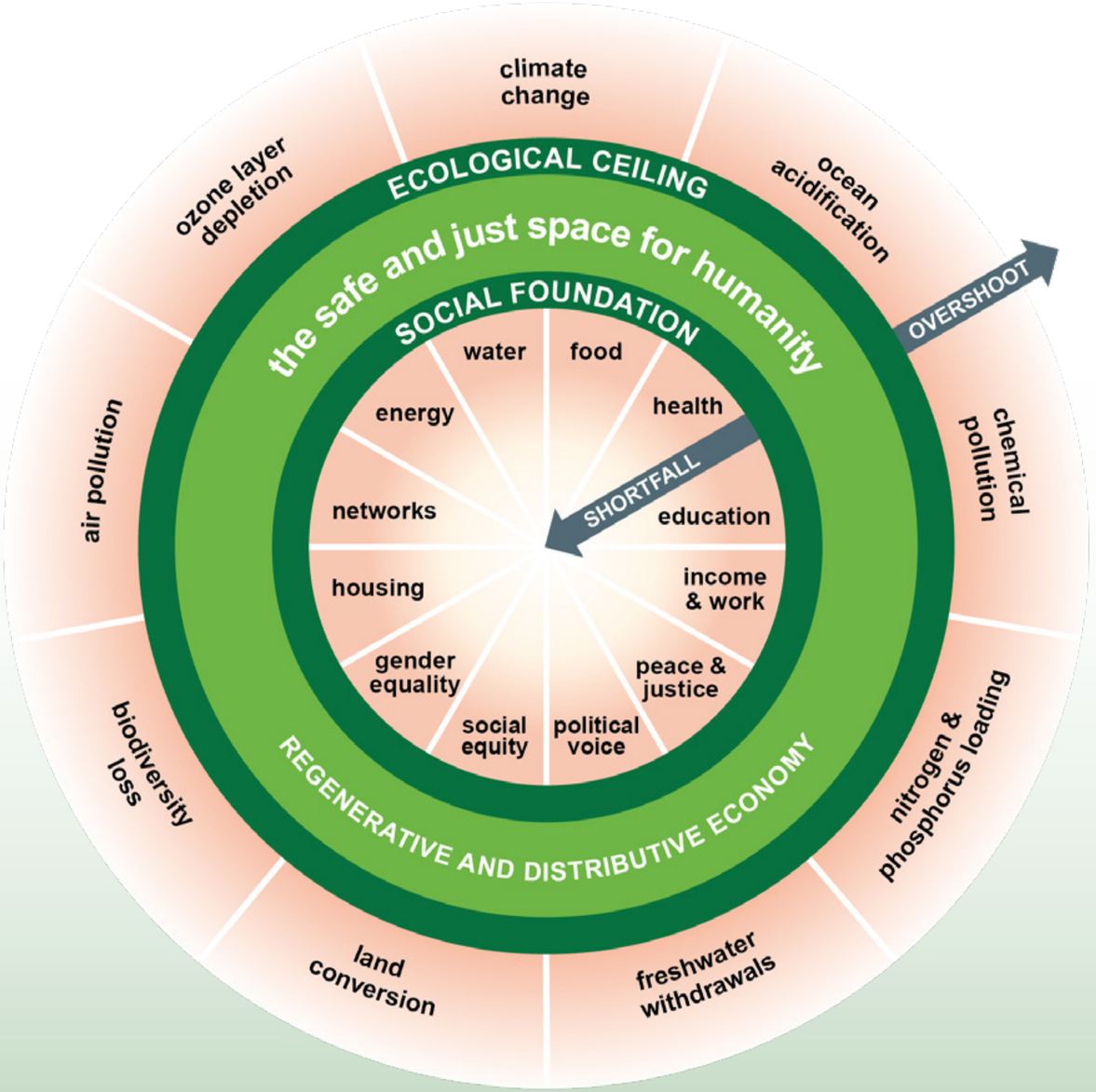
ELLEN MACARTHUR FOUNDATION

As we have realised the severity of the climate crisis over the last few years, so our aspirations have increased. Looking more specifically at construction, sustainability, net zero carbon and wellbeing, are some of the key drivers for the building industry. Then, how does the circular economy fit with all these? The circular economy looks for sustainability in all areas, it is the encompassing philosophy.

The London Plan 2021 S17 [5] defines the circular economy as 'one where materials are retained in use at their highest value for as long as possible and are then re-used or recycled, leaving a minimum of residual waste.'

To achieve circular economy in buildings, we need to address a range of issues: technical; organisational and cultural; and regulatory and legal. The technical are the most beguiling ones but in some senses the simplest to solve. After all, we have been re-using materials forever. The biggest challenge is to achieve a cultural change and ensure that there are incentives to preserve buildings wherever possible, in order for preservation to become the norm.

'Doughnut Economics' was developed in 2012 by University of Oxford economist Kate Raworth as a visual framework for sustainable development. The inner ring is the level below which individuals' lives should not fall — the outer ring is the level of resources that the world can offer sustainably. Below the inner ring will be individual suffering; beyond the outer ring we will continue to hurtle towards an unsustainable future. The ring of the doughnut includes the 'social foundation' for a safe space and a regenerative economy including circularity. Staying within that ring is vital.



The 'Doughnut Economics' concept developed by Kate Haworth © DoughnutEconomics

How circular is London today?

London has made a great deal of progress. The Greater London Authority now requires Circular Economy Statements for all major projects as set out in London Plan Guidance — Circular Economy Statements issued in March 2022 [6]. In their submissions, which consist of a table and a written statement, applicants are asked to outline the targets that they are committing to. The London Plan Policy SI 7(A) targets should be set as a minimum level of compliance with that part of the policy. Applicants should provide an explanation for the target that they are committing to and how they intend to meet these targets and monitor performance, including the metrics to be used.

ReLondon, a partnership of the Mayor of London and London's borough's has a route map for creating a circular economy [7]. This addresses five key areas: food, textiles, plastics, electricals, and built environment.

On the built environment, it echoes a hierarchy developed by David Cheshire, director at AECOM, in his book Building Revolutions [8]. This aims to maximise the retention of existing materials, moving from the retention of existing buildings (most desirable) through refurbishment and re-use down to the least preferable option of recycling materials produced by the building or demolition process.

The key principles supporting this hierarchy, presented in the London Plan's Circular Economy Statements Guidance, and used for the project showcase of this NLA report are:

+ Building in layers – ensuring that different parts of the building are accessible and can be maintained and replaced.
+ Designing out waste.
+ Designing for adaptability.
+ Designing for disassembly.
+ Selecting materials – for example, those that can be re-used and recycled.

318 Oxford Street, by PDP London for Publica Properties, retrofit of the old House of Fraser store as offices. 40 tonnes of 1930s steel beams from the old store are re-used on-site and on the TBC.London building, by Stiff + Trevillion for FORE Partnership.

In terms of the UK, London is leading, says Becci Taylor, director at Arup in charge of building re-use: ‘London has a policy and it’s driving change’. At a policy level, the City of London's ‘Whole Lifecycle Carbon Optioneering’ was recently adopted in their planning advice policy [9]. And there are some excellent initiatives and projects, largely led by pioneering developers, many are office buildings. In a first for a UK developer, Fabrix purchased 139 tonnes of steel, from a building being demolished in the City of London, for structural re-use across a number of projects, including 30 tonnes for the main structure at Roots in the Sky, designed by Sheppard Robson. Other developments involve the creation of a material passport, such as 55 Old Broad Street, where Landsec has created an extensive passport for all existing materials, allowing for their re-use.

In Canada Water, British Land is repurposing the former Harmsworth Printworks to create a mixed-use scheme that salvages as much existing material as possible. Schemes like these are developers’ showcases, and will appeal to potential tenants who are concerned about their ESG (environmental, social and governance) standards. Having buildings that are progressive in these terms may help to attract staff.

The Printworks in Canada Water by Hawkins\Brown for British Land, will retain the existing structure and fabric.

Challenges and barriers

It is hugely encouraging to see these initiatives and flagship projects. However, it leaves a huge swathe of buildings — more modest offices by less enlightened developers, but also other building types. Publicly funded buildings, in particular, are unlikely to follow these principles without legislative and regulatory change. While we are seeing a maturing market driving changes for commercial buildings, in the housing sector the incentive for circularity is not yet there. The commercial sector is going much further than the housing sector in meeting ESG requirements, including retrofit, and this is a major challenge: to retrofit all London's housing stock by 2050, it will require a workforce in the tens of thousands. It will need clear indicators and industry standards in order to have well-informed tenants, as we can see today in the commercial sector.

According to several stakeholders of the built environment, the main barriers and challenges for London to become a truly circular city are policy and regulations which are not fit for purpose, and an immature/inefficient supply chain. There is also a lack of incentives for retrofit, encouraging reused materials, and design for deconstruction. This needs to be addressed at a national, city, and local scales. 'Without regulatory requirements to design and build low embodied carbon projects, incorporating material reuse, there is a risk that only the most ambitious and ethical developers will engage with circular principles, others will be left behind.' said Rachael Owens, Head of Sustainability at Buckley Gray Yeoman

City collaboration

Looking abroad, the city of Brussels in Belgium is one of the leaders, with its 'Good Living' regulatory framework [10], which echoes the City of London 'Whole Lifecycle Carbon Optioneering' policies. This aims to address the future with a series of planning rules that will make the city more liveable and environmentally sustainable. Among these rules is one that states that renovation will be the starting point for every existing building. Demolition will only be allowed in exceptional circumstances, following an analysis of the carbon footprint of retention rather than re-use. Evidently, this will take into account issues such as structural stability or suitability for function, but the presumption will be strongly in favour of retention.

ReLondon is also a participant in the Circular Construction in Regenerative Cities (CIRCuIT) project [11]. This is a collaborative project funded by the EU's Horizon 2020 programme, bringing together 31 partners across the built environment chain in Copenhagen, Hamburg, Helsinki Region and Greater London. Each of the cities involved is carrying out nine demonstration projects, exploring three key areas: urban mining; extending building life; and designing for disassembly and flexible construction. CIRCuiT's stated aim is to move ideas about the circular economy in buildings beyond niche projects and to become part of the mainstream.

> 'Without regulatory requirements to design and build with circular processes only the most ambitious and ethical developers will engage with circular principles'
>
> *Rachael Owens,*
> *Head of Sustainability at*
> *Buckley Gray Yeoman*

SCALE OF CIRCULARITY

A circular city will work on a number of scales. At the finest level will be the materials in buildings, and the way that they are re-used, minimised or sourced. On a larger scale, the fate of individual buildings is important. And on a city-wide scale there are important decisions to be made about positioning of buildings, travel distances and biodiversity.

Rebuild or retrofit?

'In 2050, most of our existing building stock will be there', said Lord Deben at the Ecocity world Summit in June 2023. In the report 'London's dead spaces: bringing them back to life' [12], Sian Berry AM identifies '800 council-owned buildings, green spaces and facilities that are empty, neglected or not in their normal use across the city.' So the first decision to be made with existing buildings and neglected spaces, is to look at whether to keep or replace them, and if keeping them, how much can be retained. These decisions will be made on both technical and financial grounds. Technical reasons to demolish are likely to be where the building is not structurally sound. Extreme neglect will result in long-term water ingress that eventually will allow the reinforcing steel in concrete to rust, or even damage a structural steel frame. Fire, if it is severe enough to damage the structure, will be another technical reason for demolition. Financial reasons will be largely down to a lack of viability because of design. There may be a number of buildings and additions that have been lashed together in an unusable way, meaning that they will be expensive and unappealing to refurbish. Some floor to ceiling heights may be too low, or spans too small for practical use.

Arguments of this nature played a key part in Marks and Spencer's proposal to demolish its Oxford Street flagship. Architect Fred Pilbrow argued that the low ceilings and multiple columns would not allow the sort of space that the retailer wanted, and that the new building would improve the ground floor and public realm. In contrast, at the planning inquiry held in late 2022, SAVE, which was leading the opposition, argued that replacement would lead to the unnecessary release of 40,000 tonnes of embodied carbon. With the Inspector's decision expected in mid-July 2023, we are still to see the impact the decision on the Mark and Spencer Oxford Street case study will have on the built environment sector.

Time is also an important factor: speed and certainty may be more desirable to a developer. Retaining a building or using re-used elements may be a slower option than demolishing and starting again. But some developers, like Grosvenor, are calling for planning policies to prioritise climate change, and for financial incentives to be introduced.

In addition, argues Gerry O'Brien, Design Director at AKTII, there may still be occasions in which demolition and replacement is the most environmentally sound solution. He cited the theoretical example of a small, inefficient building in a position where it could be reached easily by zero-carbon transport. Replacing this with a

larger building would be more sustainable than siting a new building in a place that was only accessible by car.

However, Laura Batty, associate, research and innovation lead at Heyne Tillett Steel believes that often people create difficulties that are not there. ‘If you put a lot of designers in a room,’ she says, ‘they all will sound positive but will list barriers that are not their own. They will pass the buck. If you keep pushing the barrier it sometimes disappears.’

In order to make decisions it is important to have knowledge. Engineers Elliott Wood offer a pre-development survey to assess the viability of keeping a building. Gary Elliott, Chief Executive at Elliott Wood questions some of our fixed beliefs: ‘Do we need a 2.8m floor to ceiling height? Do we need a grid that is 9m by 9m? We need to ask these questions. We all want to live in buildings with character and refurbished buildings often provide this.

If we are talking about true sustainability, we must embrace a future that is not perfect.

Panorama St Paul’s, by KPF for Orion Capital Managers, retrofit of a 1980s office building in the City of London

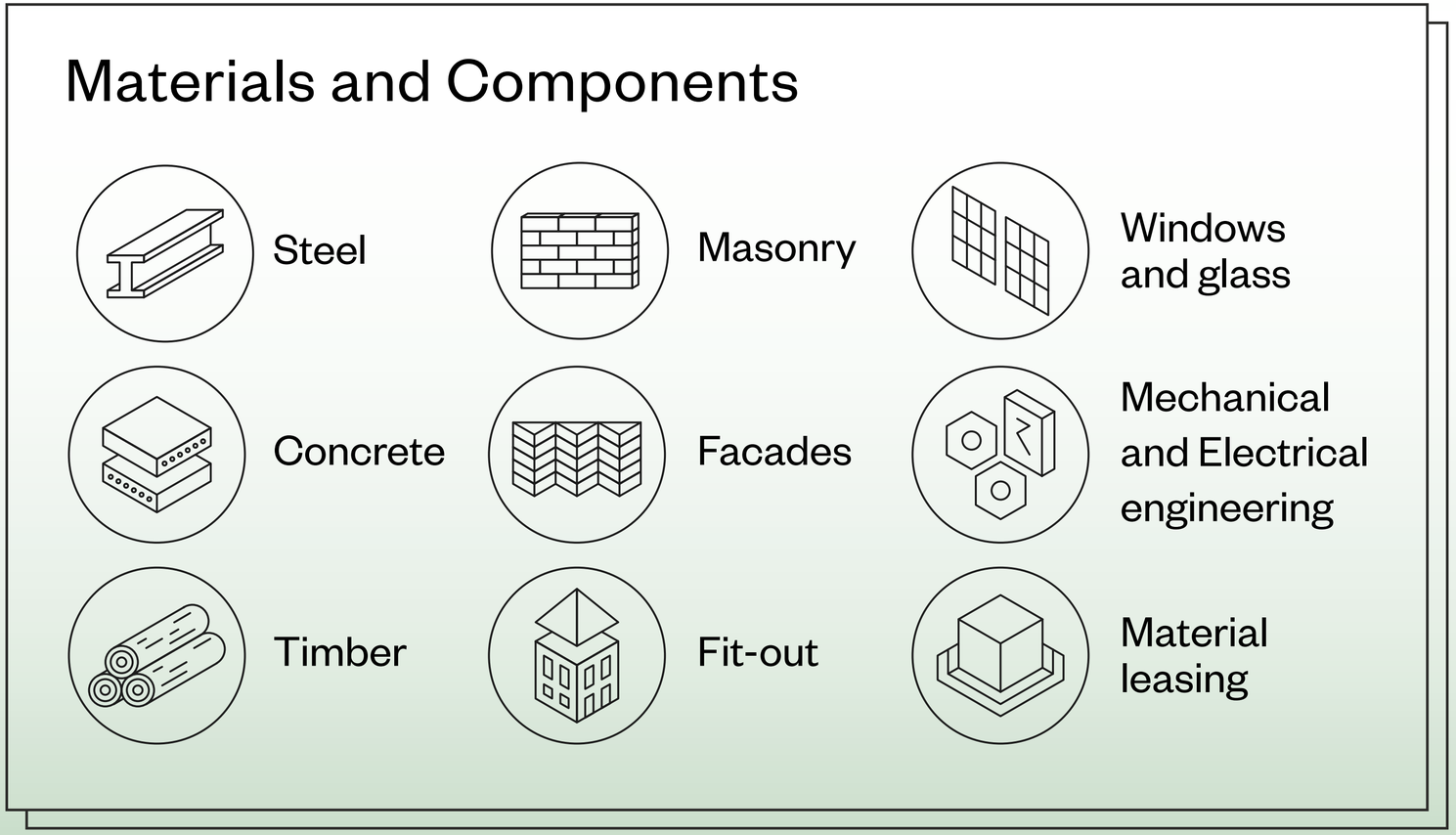
Re-using materials

Re-using elements of a building, ideally in as near to the original form as possible, is the best thing to do if a building is to be demolished. Elements that can't be re-used should, wherever possible, be downgraded to another use, or recycled. Whatever the approach, it is important to remember that both supplies of materials and of energy, even green energy, are finite. So, it is still important to be as frugal as possible. And where new materials are needed, regenerative materials are key to support biodiversity at a building and city-wide scale. Regenerative materials include bio-based materials such as bamboo, straw or wood, but also applies to recycled and upcycled buildings components.

At the moment, a lot of the re-use that is happening involves identifying materials on one building that can be used directly on another. In the longer term, if we are to make use of materials on a wider scale, there will have to be mechanisms for identifying the materials that are available, and for upgrading and exchanging them. Louisa Bowles, Partner and Sustainability Lead, at Hawkins\ Brown recognises that for now 'it is hard when working at scale to find materials that are re-used or recycled that are available in the right quantities, can be priced competitively and are certified for safe use against regulations or warranties.'

This knowledge will come from increasingly sophisticated information and also, it is to be hoped, from manufacturers changing their approaches. Just as the steel industry is moving towards becoming an important supplier of re-used steel so other manufacturers could develop similar specialisms. Some initiatives are already addressing this, and are described in the following section.

The most important materials to re-use are those in the building frame, which typically make up between 50 and 60 per cent of the embodied carbon in any building. Very different approaches are possible and are needed for the three principal structural materials — steel, concrete and timber.



Steel

Steel is in some ways the simplest element to re-use. In an ideal world, it should be possible to take structural elements out of a building, give them some minimal treatment and testing, and put them into a new building. And this, in some cases, is actually happening today. There are two companies that are currently set up to do this, Cleveland Steel and Tubes and EMR, both in the north of England.

Great Portland Estates (GPE) appointed Elliott Wood as their structural engineers to review the potential re-use of the steel frame from the deconstruction of City Place House, to another of GPE's London office developments within central London. The spans on the new building are slightly less than on the old one which allows, once end fixings have been removed, almost all of the steel to be re-used. Gary Elliott explained that whereas the average carbon dioxide production for each tonne of steel in the UK is 1740kg, the re-used steel works out at less than 50kg per tonne. 'We will be saving 700 tonnes of CO2 on our new building,' he said.

The Roots in the Sky project for developer Fabrix will re-use steel from the disassembled Broadgate 1 and 2 buildings. Engineer AKTII is involved in both projects and identified steel that would be suitable to use on the new smaller grid. The steel was taken apart carefully, and taken to Cleveland Steel and Tubes, where additional fixings were removed and it was tested. It will then be stored until the contract is let for construction.

Where steel can't be re-used directly, it can be scrapped and re-made into new steel. While the embodied carbon is greater in reprocessing, it is still a great deal less than making virgin steel — especially if the repurposing is done in an electric arc furnace. If long steel members are cut down to create shorter elements, there will be some redundancy of material because the element will be unnecessarily thick. Heyne Tillett Steel is working on a tool to allocate salvaged steel to projects, known as the HTS Stockmatcher 'If the excess material is more than 30 per cent', says the practice's Laura Batty, 'then it will be better to use the element elsewhere.'

Gerry O'Brian believes that the greatest barrier to the use of repurposed steel is not technical but organisational. Contractors, he says, are risk averse. 'For me that is the biggest hurdle, we need new ways of working, innovative processes. If we are working with old metrics, passing the project to the main contractor as a lump sum, we will be much less able to embrace opportunities.'

The idea of creating a market for re-used steel is appealing but Gary Elliott foresees one potential problem: 'You have to be really careful that people aren't taking down buildings in low-value areas such as in Eastern Europe and transporting the materials for re-use.'

Stock of steel to be re-used for the Holbein Gardens project, designed by Barr Gazetas for Grosvenor Property UK © Philip Vile

The DISRUPT project – Delivering Innovative Steel ReUse Project

By Dr Asselia Katenbayeva, Research Associate, The Association for Sustainable Building Products

Driven by low-carbon targets, leading construction companies have begun exploring the viability of steel re-use. To promote the mainstream adoption of this practice, the Alliance for Sustainable Building Products (ASBP) has developed a comprehensive and freely available steel re-use "toolkit" as part of the Innovate UK-funded DISRUPT project, in collaboration with Cleveland Steel and Tubes, ISG, the National Federation of Demolition Contractors (NFDC), and with support from the Grosvenor Group.

A key component of the toolkit is a set of business considerations and stakeholder checklists to facilitate steel re-use. These resources cater to various industry professionals, including demolition contractors, fabricators, stockholders, designers, and clients, covering technical, supply chain, and economic aspects.

The toolkit features 11 case studies that highlight the implementation or consideration of steel re-use across a wide range of project types and sizes. The case studies provide insights into the re-use process, drivers for adoption, achieved carbon savings, and lessons learned. Some notable case studies in London include:

+ 55 Great Suffolk Street and Holbein Gardens projects, which were the earliest projects to integrate steel re-use on such a scale.
+ Elephant and Castle town centre redevelopment, a current large-scale project.
+ Sloane Square House – a project where 100 per cent of the designed steel is re-used steel.
+ Brent Cross Town Primary Substation – a project that incorporated reclaimed steel as part of the public artwork.

ASBP continues its research in this area through two newly funded Innovate UK projects: DISRUPT II and E-TRACS. DISRUPT II focuses on the recovery of steel from buildings during the demolition phase, while E-TRACS explores the implementation of material tracking systems for structural steel to enable future re-use.

+ 45% of all structural steel in construction is being re-used
+ Steel re-use could save 250 000+ tonnes of embodied carbon per year
+ Construction projects could save £40m annually by using re-used steel

Concrete

The issues with concrete, the other main structural material, are very different. On buildings that are being retained, it may well be possible not only to re-use the existing concrete frame, but also to support additional floors. This is thanks to a number of factors: concrete continues to increase in strength throughout its life and many buildings are over-engineered.

In terms of re-use, elements such as precast concrete floor planks could be used again, and there has been work looking at re-using concrete cladding. For example, an article in the Journal of Cleaner Production [13] argues that examples have existed for some time and should be used more widely. It found examples going back to the 1980s. The only thing to do with structural concrete, if it can't be retained in place, is to crush it and use it for fill. Enfield Council is making the best of this at its Meridian Water development. On a former industrial building that forms part of the massive redevelopment, the team is crushing the concrete from demolition on site, and certifying it to a Type-1 and 6F2 standard. This allows it to be used on an access road just a few metres away. With a massive material like concrete, minimising travel distance is a clear win.

Heyne Tillett Steel carried out a research product, to see what could be re-used from a specific defunct concrete building. In particular, it looked at ways of repurposing the concrete cladding, which consisted of 100mm thick precast panels. Possibilities included cutting the cladding up to use as stair treads, or cutting it further to replace stone or brick in walling. Laura Batty said, 'When we pitched this to demolition contractors, they started seeing ideas that made it feasible for them.' Concrete is unavoidable in new construction, although the quantities should be reduced as far as possible. There are existing and proposed technologies that would reduce the embodied carbon, around 90 per cent of which is contained in the cement.

Existing cement replacement materials include pulverised fuel ash (PFA) and ground granulated blast furnace slag (GGBS). Both can replace considerable amounts of cement in concrete. But they are by-products of processes that we hope to eliminate or reduce drastically (coal-fired power stations and production of virgin steel) and are already in limited supply. There is also concern about where GGBS comes from today. Most of it is produced in Asia and it would be most sensible, to minimise transport-generated carbon, if it were used close to production. GGBS is most beneficial in deep pours, where its low heat of hydration minimises cracking. Gary Elliott warned however that it is being used indiscriminately. Contractors who are impatient with its relatively slow curing are tempted to add more cement — and then, because this no longer meets the specified proportions, more GGBS as well, negating the carbon savings.

There are other technologies developing that could produce very low carbon or even carbon neutral cement. These include Seratech which uses the mineral olivine with carbon dioxide. However none of these are in industrial production yet. The aim therefore must be to only use new concrete where it is absolutely necessary, and to use it as sparingly as possible — for example by making voided slabs.

Timber

Timber is a more challenging material to re- use but there are projects, such as one that looks at re-using timber from demolition to make 'cross-laminated secondary timber' (CLST). A pilot project, carried out by UCL in collaboration with housing association Poplar HARCA, architecture practice Seán & Stephen Ltd and the Remakery in Brixton, tested the cross-lamination process using secondary floorboards to create table tops. Dr Colin Rose, Strategic Advisor and Partnership Lead for the Built Environment at ReLondon, and a Senior Research Fellow at UCL, leads UCL's research investigating the structural potential of CLST. Similarly, in CIRCuIT, ReLondon along with partners Simple Works and Grimshaw ran a demonstrator project testing glulam made from secondary timber. While there are technical and cost challenges, Dr Colin Rose believes this kind of circular innovation will become increasingly important in construction, and has created a company, UK CLT, to produce the material commercially, backed by organisations including Ramboll, Waugh Thistleton, and the National Interdisciplinary Circular Economy Research Hub.

Masonry

Bricks are the materials that we are most used to re-using. Before the advent of cement-based mortars, it was easy to disassemble walls, and there is a long-established market for reclaimed bricks. The common wisdom is that bricks bound with cement mortar cannot be re-used but on the Meridian Water project, the team has managed to separate and clean 18,000 bricks of this type. They are now awaiting re-use.

Companies are currently thinking about using old concrete instead of masonry, or even cutting up blockwork panels. In Copenhagen, Lendager Group has created facades at Resources Rows from 3 sqm brick panels, cut out from old buildings. These panels include the mortar as well as the brick. The Netherlands company StoneCycling [14] makes bricks that incorporate at least 60 per cent waste material. In London, architect Buckley Gray Yeoman used these bricks on Technique, a former gin distillery in Clerkenwell that it converted into workspace for the developer General Projects.

Facades

On a retained building, the facade is usually the component that will be replaced. The first reason is that many of the buildings now considered for remodelling are from the 1970s and 1980s and replacing the facade may be the easiest way to refresh the image of the building. In addition, older facades are typically less efficient, and replacing the facade may improve the building's thermal performance so significantly that it justifies the additional embodied carbon investment.

Often, however, facades are replaced before they have reached the end of life because of elements, typically seals, that no longer work. This is a design issue, with many facades designed so that the seals cannot be removed without removing the entire unit.

Left: The Resource Rows by Lendager Group in Copenhagen, using upcycled wood and bricks and recycled concrete © Lendager, photography: Rasmus Hjortshøj |
Right: Technique by Buckley Gray Yeoman for General projects, is an adaptative re-used and retrofit of a former gin distillery and printwork, the external walls are constructed from StoneCycling waste-based bricks.

Fit-out

The embodied carbon in the fit-out of a building is significantly less than in the structure, but many feel that having a circular approach to fit-out is vital. This is because the time to fit-out is so much shorter. The amount that can be saved throughout the building's life is considerable. On a project at Air Street for The Crown Estate, ORMS was able to keep the existing raised floor and refurbished the ceiling panels. It also recovered a lot of the glass from the partitions for use on another project. The practice is offering it for re-use, helped by the fact that every panel has its ID marked on it.

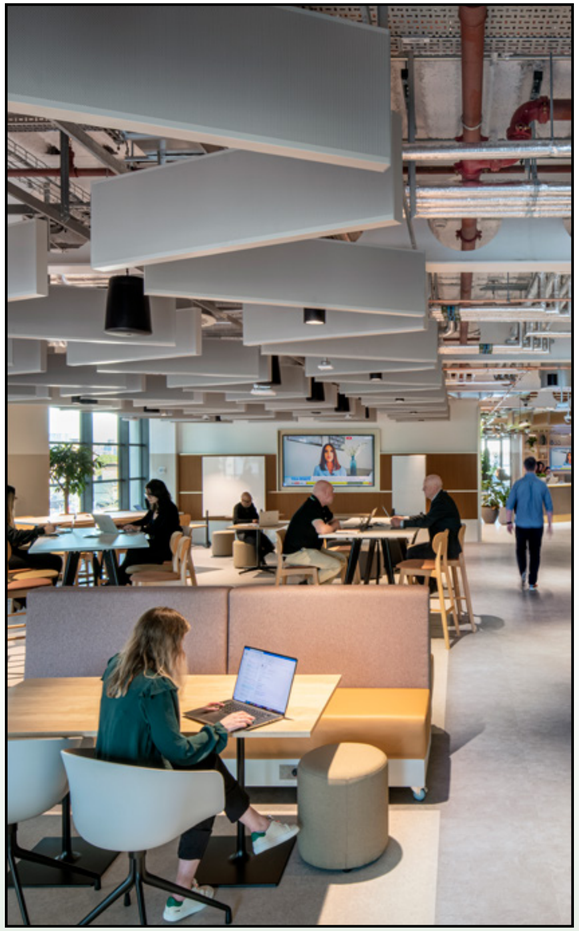
Part of the change that is needed will come from a change in aesthetic. Reconditioned ceiling tiles for example are unlikely to look brand new, but office workers may come to love a more distressed look, especially if it comes with green credentials.

Equally important is designing for flexibility. This can include, for example, having moveable pods in a building that can be reconfigured when needs change. And in new fit-outs, elements such as ceiling tiles can be eliminated.

Recycled furniture can offer a saving. For example, JLL, when refitting its own office in Manchester, bought second-hand furniture that had previously been in the offices of Goldman Sachs as part of an effort to reduce the embodied carbon. This was quite a complex operation since, in a commitment to creating a healthy environment, JLL decided to eliminate the volatile organic compounds in the upholstery. This meant that it all had to be removed and hand-stitched.

For The London Centre, NLA worked with innovative product manufacturers to retrofit our galleries in the Guildhall complex. The former carpet tiles have been recycled, and the new floor is Tarkett's linoleum which is made from 94 per cent natural raw materials (linseed oil, wood and cork flour, resins) and is the world's first to be certified Cradle to Cradle for its sustainable approach.

We also worked with FUTURE Designs to refurbish the existing large lanterns with the latest LED technology, in line with their carbon careful™ initiative, providing a cost saving and carbon reduction of 59 per cent.



JLL 20 Water Street, by Tetris Design x Build for JLL, acoustic soffit spray from recycled natural materials and recycled worktops support circularity. © Jonathan Banks

Windows and glass

It is possible to re-use windows or to use those that are in excess stock. This has been done at the Paper Garden Education Shed at Canada Water by Allies & Morrison and Waterman Group for British Land, where a mosaic of windows that happened to be available have been incorporated in a charmingly haphazard fashion. This is an indication both of the potential and the limitations of re-use. Paper Garden has some of the ad hoc nature seen in the projects that Rural Studio produces in poverty-stricken Alabama. These projects are outliers — if we are to re-use these materials in more conventional ways then there have to be stockists and suppliers.

Glass can be a problem for re-use. It is almost impossible to cut toughened glass. For the moment, melting down and repurposing is likely to be the most practical solution.

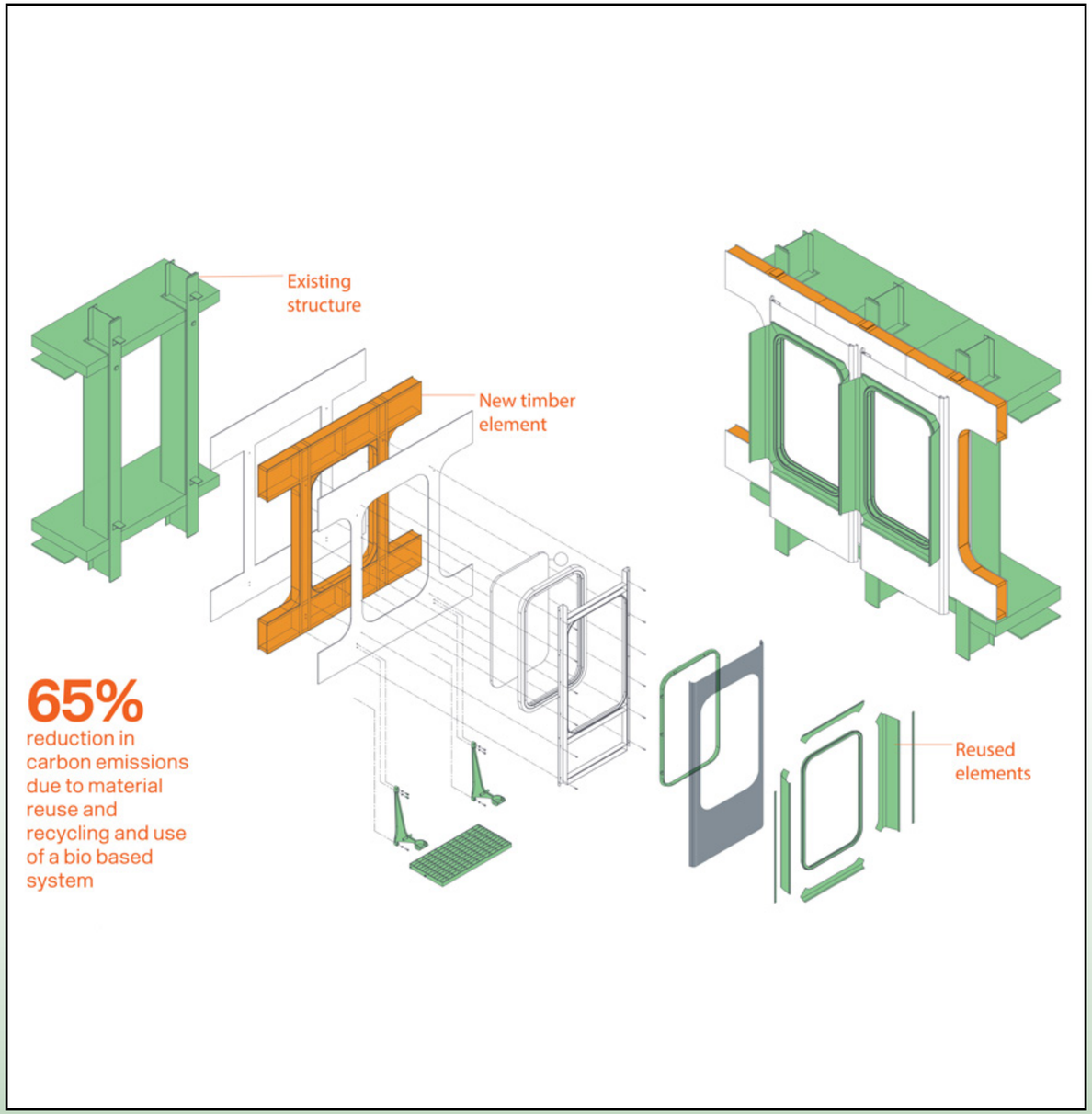
Mechanical and Electrical engineering

Re-using lighting is probably the most advanced area of circularity. Multi-disciplinary practice BDP has produced a report 'The Lighting Circular Economy' [15] which looks not only at re-use but at the entire hierarchy of the circular economy. This starts with daylight design, which can avoid the need for much lighting at all. Following this, is the idea of reducing the amount of light that is needed, both by excellent daylighting and by delivering high levels of light only where they are needed, rather than uniformly. Controls play a part in the energy usage, and some designers are innovating by using recycled or unusual materials to reduce the embodied carbon in their fittings. Demountable lighting elements can be moved around when needed.

'Many pieces of plant can be reconditioned and reused, as well as major elements that we have often replaced in the past like facades', says Becci Taylor, Director at Arup with special responsibility for re-using buildings.

Materials leasing

Kate Jackson, who leads Arup's circular economy team in the UKIMEA, argues that we need a fundamental change in the way that we see materials. This is not just a matter of changing what we use, including a move to bio-regenerative materials — but also how we use it. We need, she says, 'to see materials as a service. There needs to be less ownership and more service.' This would then mean that members of the supply chain would expect to take things back — and design their businesses accordingly. Allied with the imposition of carbon targets, this would incentivise them to refurbish and repurpose elements at the end of their rental period.



Retrofit of the UNESCO building in Paris, by Patriarche, recycling glass panels and creating a facade kit to support the re-use process.

Design for deconstruction

The industry is great at demolishing buildings efficiently and sending materials into waste management, but there is very little knowledge, experience and infrastructure for deconstructing and reselling components. We need to look at ‘grave to cradle’ infrastructure, as Dr Colin Rose describes it.

In new or refurbished buildings it is essential to make the right decisions about the components and to provide adequate information for the future, both for maintenance and, eventually, deconstruction. In contrast to the quirkiness of refurbished buildings, new build needs to be as standardised as possible in terms of grids, angles and dimensions of components. This will make deconstruction and re-use as simple as possible in the future.

Knowledge is key to the circular economy, and digital techniques are vital to gathering and storing information. The more material can be stored in usable form in a BIM model, the better.

Material passport

One way to do this is through the use of a materials passport. This is an issue that architects ORMS have addressed, launching its own materials passport at the start of 2021 because it felt that the tools that already existed were better suited to entirely new buildings. It worked with Elliott Wood, Arup and Heta Architects to produce the passport, which grew out of a project that ORMS was doing for Grosvenor and now, with the help of several tranches of research funding, has expanded into an open-source system that anybody can use. It gives information on materials under a number of headings: identity; dimensions, location; quantity; structural, architectural and MEP properties; circularity and operation. The passport interacts with a BIM model, and every element of the building can be tagged and scanned.

The need to create a material passport has also been addressed by other leading companies. Waterman Group aims to create the city’s first materials bank. The practice has taken this further by developing the Materials Passports Protocol Proof of Concept document, following research and collaboration with CIRCuIT and BRE. This document presents a standardised approach to creating materials passports which can be applied to any type or scale of construction, refurbishment or infrastructure scheme.

In London, a growing number of projects include a material passport such as 1 Broadgate, where British Land received an innovation credit from BRE, or Holbein Place where Grosvenor are using a material passport for the first time.

Arup, working with the Ellen MacArthur Foundation, has developed the Circular Building Toolkit [16], which consists of a set of practical strategies and measures, supported by a growing library of real-world examples. It identifies the changes that are needed, sets out a series of strategies and shows ways to use lower emissions materials. The toolkit also includes a number of case studies.

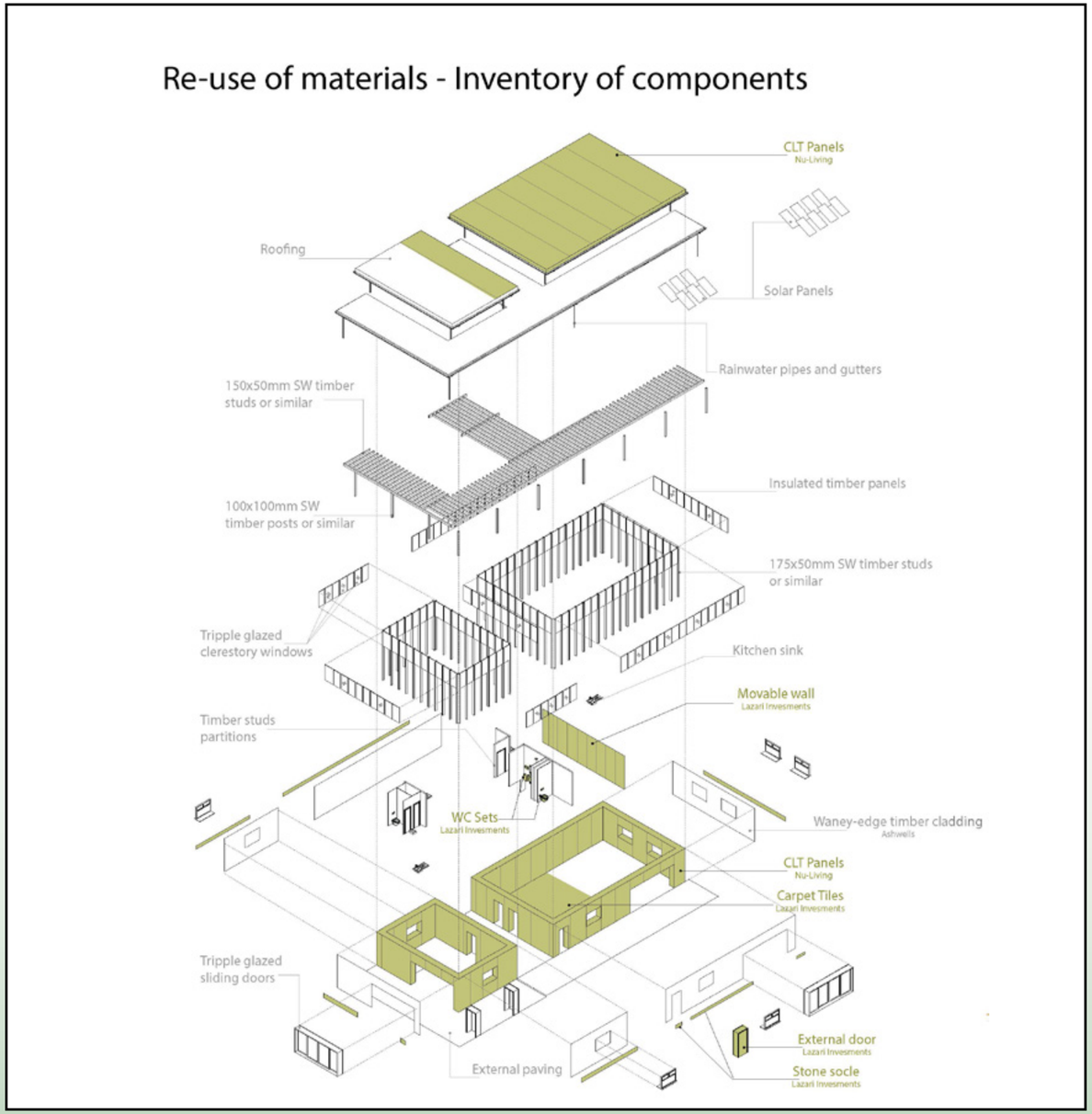
A new approach to design

Kate Jackson, associate at Arup, believes that we need a fundamental change in the way that we organise projects. We have to engage the supply chain much earlier. ‘Everything can be challenged against the time scale,’ she said. ‘What is the legacy that we are leaving?’, as Debbie Whitfield, director of impact at developer at Fabrix said, ‘Why have low carbon when you can have no carbon?’ This means, for instance, leaving soffits exposed. ‘Why put plasterboard, or even paint, on a concrete core.’

For the future, design for disassembly is key. So, for example, connections should ideally be bolted rather than welded. The more standardised building elements can be (not buildings themselves) the easier they should be to adapt, or it should be to substitute elements. And disassembly and re-use of elements should also be simplified. Oriel building, designed by Perkins&Will and AECOM will include ‘Deconstruction’ and ‘Disassembly’ manuals with an end-of-life strategy, and advices on materials.

Enfield Council worked at Meridian Water with Assael Architecture and AECOM to develop the RightSizer system. This is based on John Habraken’s Open Building movement from the 1960s which has an external ‘support’ system that can be disassembled and reassembled. The ‘stuff’ inside is non-structural and can be moved around and changed as needed. RightSizer has been conceived to extend a building’s life beyond 100 years, a longevity underpinned by the inherent system flexibility that can accommodate various use scenarios over the years.

Buildings that have been designed for meanwhile uses are the low-hanging fruit. It is easier to imagine a new use after a few years, or even months, than after decades. It is also more important because of the profligacy of throwing something away after a short period. BDP gave serious thought to this when designing the Nightingale Hospital established at the ExCel Centre in east London to accommodate patients during the Covid Pandemic. Many elements from this have now been used to fit out the NHS Diagnosis Centre at Dorset Health Village, occupying the top level of a former department store in Poole. ‘More than 70 per cent of the site reused equipment from the Nightingales, including desks, chairs, ducting, cabling and lighting’, said Golnaz Ighany director, sustainability at BDP.



Oasis Nature Garden project, by Marks Barfield Architects for Oasis Play, a circular economy between two buildings: a new building re-using materials and a retrofitted building used as a material donor

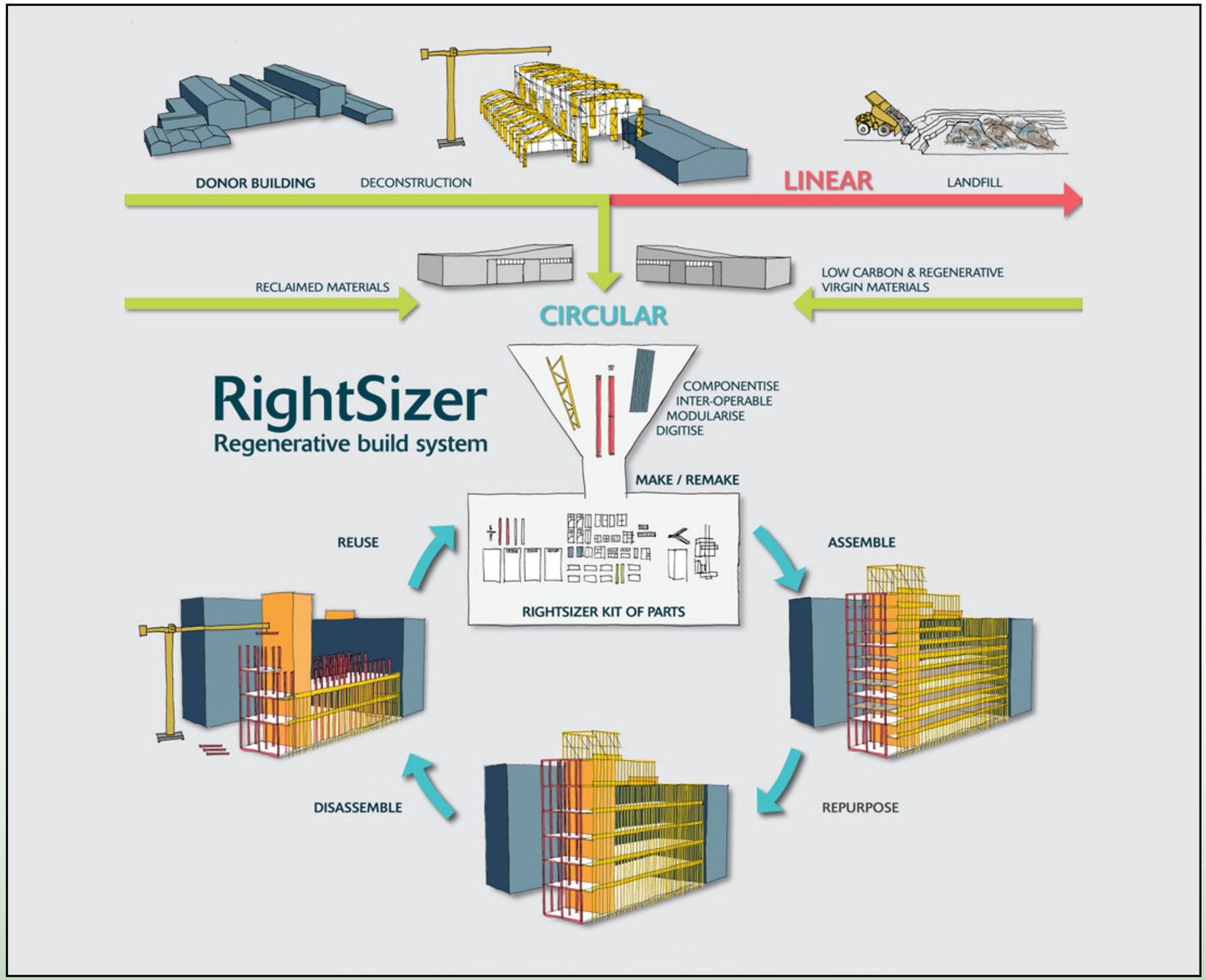
City-wide strategies

Infrastructure and biodiversity

The circular economy on a city scale is not just about buildings, but includes biodiversity, transport and energy. The transport of materials and a renewable energy strategy, re-using the energy from a building to another one for example, are key to support a regenerative city and reduce the pressure on natural resources and land. We need to maintain and ideally increase biodiversity, and look beyond the curtilage of buildings. It requires a city-wide infrastructure and collaboration between all sectors. 'We need better city-wide infrastructure to enable the procurement of re-used, re-processed and recycled materials for consideration at design stage', said Louisa Bowles, Partner and Sustainability Lead, Hawkins\Brown.

Biodiversity is the third of the principles set out by the Ellen MacArthur Foundation. Many older buildings provide habitats for species. Design should consider retaining some of these habitats, and also creating new ones within the new building elements. The GLA is also addressing this issue through the Biodiversity Net Gain (BNG) strategy for developers, land managers and local planning authorities to develop land and help regenerate nature.

The Better Buildings Partnership, a collaboration of property owners, has produced a checklist for biodiversity. It says, 'managing biodiversity is a central part of responsible property management. Legal obligations may exist in relation to preservation orders, protected specifies or valuable habitats. Well-managed biodiversity can also contribute towards positive community engagement and employee wellbeing.'



RightSizer at Meridian Water, Enfield, by Assael Architecture and AECOM, sets up a roadmap to circular economy.

Databases

Kate Jackson of Arup believes that 'we need to see our cities as manufacturing and re-manufacturing centres', taking elements that have been mined from buildings and repurposing them for use elsewhere. If we are to move beyond hero projects, we are going to need exchange mechanisms. Specialists in certain materials will need to acquire, recondition, catalogue and store components.

The first steps have been taken. ReLondon has produced, with Grosvenor, a document on sourcing materials as part of the CIRCuiT project. It looks at what is available, and whether an exchange platform exists. In addition to Cleveland Steel and Tubes for steel, it lists Globechain [17], and Community Wood Recycling [18], which is a nationwide network of wood recycling centres. ReLondon itself has set up a recycling portal which is currently in the Beta testing version. Looking at a different set of materials, Circular Economy Hub has a centre for mineral-based construction materials.

Another initiative, the Excess Materials Exchange [19], grew out of Enfield Council's Meridian Water project. A collaboration with Net Positive Solutions, it uses deconstruction and construction in Enfield as a pilot, offering donor materials to recipient projects. The ambition is to extend this to other councils, developers and eventually across the UK. At the moment, this is an information exchange with a small depot for physical materials as part of the Meridian Water site but 'crucially', explained Rafe Bertram, Sustainability Lead at Enfield Council, 'development audits and circular economy statements allow us to list materials in buildings that are still standing'.

One of the concerns is the cost of land, but Kai Liebetanz, senior sustainability advisor at the UK Green Building Council, believes that there is more available than we imagine at first sight. 'The local authorities own a lot of land,' he says. Obvious choices are landfill sites and waste processing sites.

Overseas, in Brussels, design practice Rotor, has set up Rotor DC [20] as a place to buy salvaged building components. In Germany, Austria and Switzerland, the Restado database [21] collects materials that come from deconstruction or oversupply, or are left over from projects. Typical materials include bricks, wood, tiles, windows, doors and façade elements. There are currently one million items worth more than €40 million in stock. One change that can help is adoption of the EU taxonomy. This is a classification framework to determine whether an economic activity is environmentally sustainable that requires reporting on eligibility and alignment against six environmental objectives. Done well, said Becci Taylor of Arup, 'this governance of investment level is powerful. It allows you to take a long-term view.' Funders are increasingly moving in the UK to adopt this approach.

Information on a city-wide scale is vital. A database of buildings that are due to be demolished and the materials that they contain would be a start. There are techniques just beginning that could make this feasible in future. For example, in France, APUR (the Paris Urbanism Agency) has created Demolition Database [22] which allows it to identify almost 16 million tonnes of waste from construction and public works waste produced by development operations, by 2030. This has allowed it to identify eight types of waste among this future source which represent over 11 million tonnes of material. It seems that this is mostly concerned with waste disposal but it is easy to see the concept extending to re-use of materials.

NEXT STEPS AND ACTIONS

If we are to move from our current situation, where there are a few exemplary projects to one where every building is designed to circular economy principles, then ‘we need to invoke deep, systemic change. To make this change, we need better policy, legislation, funding and incentives to drive practical action’ said Tim Danson, Circular Economy Lead, Sustainability and Climate Change, WSP. One can look at these changes in terms of those that could happen in the short, medium and long term. London has already made considerable progress but there is much more that could be done at both city and national level to benefit the circular economy.

This needs collective action. The following recommendations have been guided by the NLA Expert Panel on Net Zero, working in collaboration, and drawing together calls from other key stakeholders of the built environment industry: the Architects Climate Action Network (ACAN), The UK Green Building Council (UKGBC), the Low Energy Transformation initiative (LETI), Ellen MacArthur Foundation, and the Architects Journal.

> ‘We need to embrace a system change. I feel empowered by the challenge.’
>
> *Kate Jackson, Associate, Arup*

> ‘This is the biggest opportunity in the built environment since the industrial revolution.’
>
> *Gareth Atkinson, Director, Civic Engineers*

Short Term →

+ Changing the VAT regime

We are calling for a reduction in VAT for retrofit. At present, 20 per cent VAT is charged on most refurbishment and maintenance work, whereas new construction is exempt from VAT, which penalises refurbishment. This call follows the suggestion from UKGBC [23], ACAN [24] and the AJ's RetroFirst campaign [25] which proposes to cut VAT rate on refurbishment, repair and maintenance from 20 per cent to 5 per cent or below. If the government cannot afford to abolish VAT on refurbishment, then it needs to change the regime so that it charges the same level of VAT on all construction.

+ Implementing a pre-demolition audit

Planning deliverables should include the mandatory requirement for a pre-demolition audit when an application site involves an existing building. This will identify what can be re-used on site and what will be re-used elsewhere and diverted from landfill. It echoes the amendment introduced by Baroness Andrews to Levelling Up and Regeneration Bill on this regulation at Committee stage in the Lords in April 2023.

+ Publicly funded projects should use circular principles

Publicly funded projects should commit to using circular principles. They are well placed to push for circular economy principles and act as exemplars for the building industry. The Ellen MacArthur Foundation considers that they should be more ambitious without the need for further regulations.

Citing the longstanding example of Venlo city hall, local governments can lead by example and stimulate innovation to achieve better outcomes for all.

Mid-Term →

+ Implementing a London-wide Carbon Review Panel (CRP) and Demolition Impact Assessment (DIA)

We should implement a London-wide CRP and DIA to create a third party verification and to support the current Whole Life Carbon (WLC) and circular economy guidance in prioritising retrofit approaches.

This involves a Presumption for Refurbishment and Retrofit policy and a method of assessing and comparing the carbon impact of a retrofit option with a new build on the same site, to ensure that the lowest carbon solution is implemented. This policy should be applied to all existing buildings unless it is proven to be a carbon intensive solution or it is not possible to transform the existing building into a sustainable development project.

+ Bringing the proposed part Z into the building regulations

A number of industry stakeholders put together the proposal for creating a Part Z of the Building Regulations and its accompanying Proposed Document Z.

Part Z would cover embodied carbon, in the same way that Part L of the regulations covers occupational energy. If enacted Part Z would ensure that embodied carbon is assessed on all projects, as part of a comprehensive whole life carbon assessment. No new regulation is simple, but the proponents of Part Z have already done a lot of the work that would be needed.

+ Consistent approach of material certification

We need a more flexible and consistent approach to certifying elements and materials for a second life. There are currently multiple metrics and indicators. The built environment must work together to facilitate better and consistent metrics and build a database, according to UKGBC. LETI [26] propose using an easier indicator for the percentage of materials reused and another one for the carbon incorporated into renovations and new developments.

Industry restructure

Short-Term →

+ Collaboration between all sectors

All stakeholders should collaborate sharing best practice, using skills and expertise from all sectors to build an efficient collaboration at all stages. In the report 'System enablers for a Circular Economy', UKGBC recommend a collaboration at early engagement.

+ A new way to approach design

Architects and other members of the design team must think differently about materials. They must start by designing with buildings and materials that are available, rather than designing from scratch.

+ More local hubs for materials

More local authorities should set up hubs for re-use of materials.

Mid-Term →

+ Implementing a new design stage

Architects need to have a stage before initial design that considers the condition of a building and the potential for using all or part of it.

+ Sharing risks

Risk needs to be shared differently. Developers and owners of buildings need to take more of the risk. At present, contractors are responsible for most of it and so are worried about the uncertainty, particularly that to do with uncertain supply of refurbished materials.

+ Standardising components

Designers, working with manufacturers, need to adopt and accept more standardisation of elements of new buildings, both for flexibility and for disassembly. Building longevity depends not only on the durability of building elements but on their ability to remain useful in changing circumstances.

Long-Term →

+ A London-wide strategy for storage and logistics

We need a city-scale strategy to coordinate the storage of materials, and logistics issues.

+ Changing the demolition industry

The demolition industry needs to change, to be helped to see demolition as an opportunity and not just a cost. This may change the nature of demolition contracts. Instead of developers paying demolition contractors to take things away, the contractors may take the materials for nothing or even buy them with the prospect of re-selling.

+ Leasing materials

Building owners should move to leasing materials in buildings rather than purchasing them. This is already happening with lighting, but may be appropriate for longer-lasting elements as well.

Cultural change

Short-Term →

We all need to learn to love the less than perfect in our offices and public buildings. Not everything needs to be new and shiny. The quirky may not only be more sustainable but also more attractive.

In addition to specialist hubs, community groups could set up local hubs, collecting and re-supplying materials for use on a smaller scale. And we should build on what already exists, such as freecycle and sharing sheds.

Mid-Term →

Manufacturers need to think differently, and see themselves as specialised refurbishers with a side line in new materials.

Long-Term →

There could be new jobs and new ways of working associated with the move to circular principles.

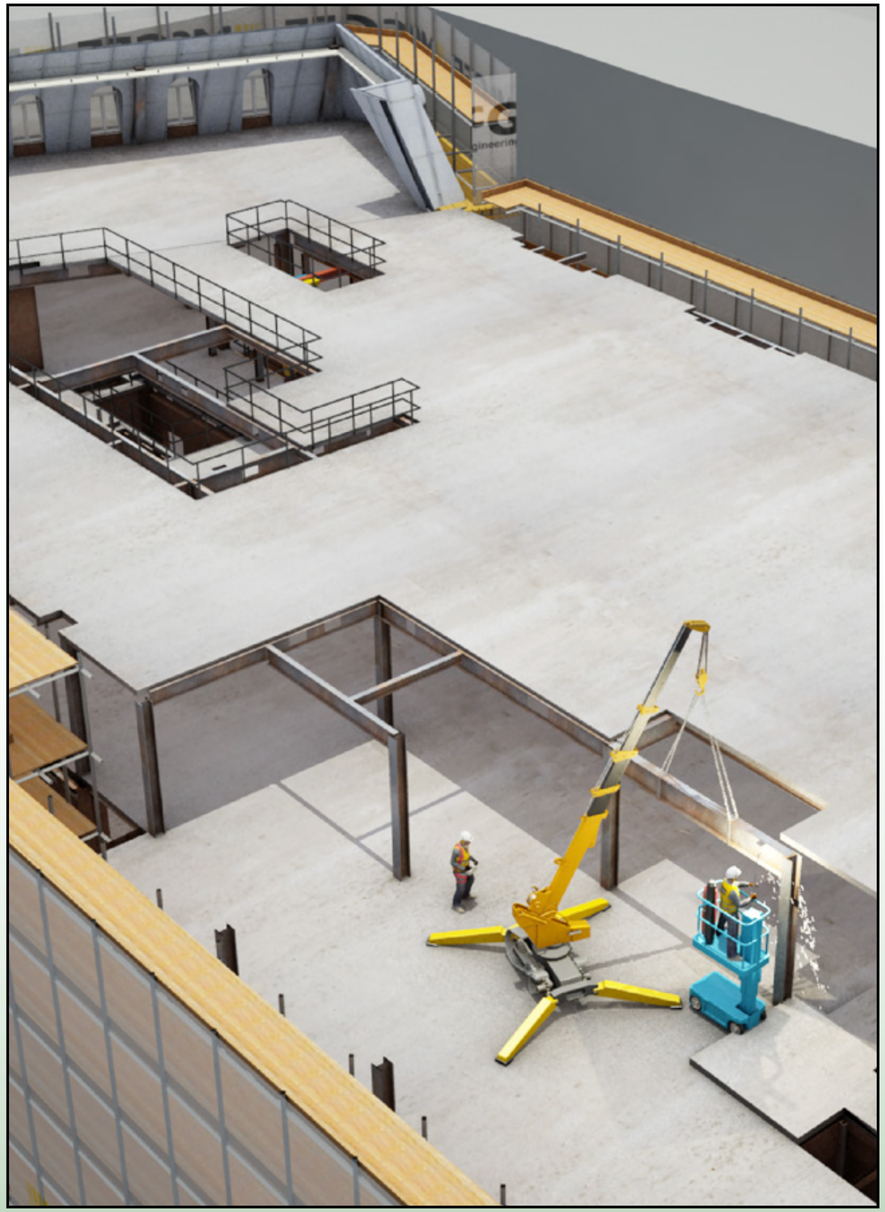
Education skills and training all need to reflect a new approach, new thinking and new work opportunities.

“The built environment as an industry is multidisciplinary, with each discipline anchored to its own professional body. These bodies must be overhauled to enable a circular economy and a sustainable future. For example, the RIBA work stages run from stage 0 to 7, with no stage addressing end of life. And module D in the RICS WLCA could be redefined to incentivise re-use across existing assets when carbon accounting.

There's currently no centralised methodology that's unilaterally agreed upon by all to measure circularity. We need to fast-track this standard into legislation.

It's not necessary to reinvent the wheel. However, we need multiple, simultaneous interventions to existing mechanisms to realise a circular built environment for all. The proposed Part Z Building regulations and the London Plan Guidance Circular Economy Statements are significant precedents in demonstrating what can be done by overhauling existing, outdated legislation and guidance. It shouldn't be hard!”

Matthew Morris, Architectural Technologist at Hawkins\Brown, and Coordinator at Architects Climate Action Network (ACAN)



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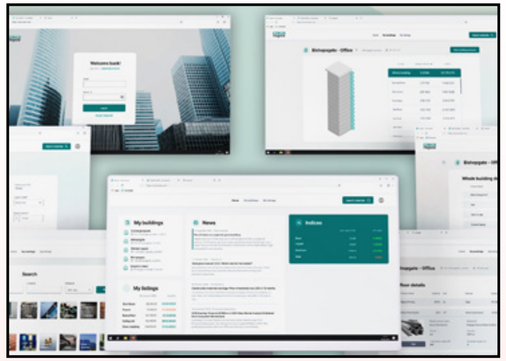


Futures trading – A way to scale-up the re-use of building materials

Tina Paillet,
Co-founder Circotrade and President Elect, RICS

Knocking nothing down

Clive Nichol,
CEO, Fabrix

How to design a circular built environment

Peter Swallow,
Sustainability Lead, Grimshaw

Policy and legislation: fostering the circular economy

Kai Liebetanz (he/him),
Senior Sustainability Advisor, UK Green Building Council

FUTURES TRADING – A WAY TO SCALE-UP THE RE-USE OF BUILDING MATERIALS

Tina Paillet,

Co-founder Circotrade and President Elect, RICS

The materials in existing buildings are full of untapped latent potential which is mostly overlooked and unrecognised. Standard industry practice puts a disproportionate value on new resources while disregarding the existing resources in buildings, seeing them as eventual waste and therefore a problem and a future expense.

Less than 1 per cent of a buildings materials are reused at the end of their useful life and the built environment has a profound impact on the planet:

+ The worldwide construction and building industry has an outsized impact on climate change (40 per cent of CO^2 emissions), our dwindling stock of finite resources (using 50 per cent of primary resources), and waste production (over a third of all waste streams).

+ Globally, we continue to build a city the size of Paris each week and will do so until 2040. Building anything costs embodied carbon.

+ Embodied carbon represents between 50–70 per cent of the Whole Life Cycle Carbon of a building. This portion of the carbon budget is used upfront and the climate clock is ticking.

Reusing the materials contained within existing buildings is key to decarbonization, but first building owners need the tools to unlock the potential in their portfolios to get them onto the path of the circular economy.

Circotrade is a B2B digital trading platform which is specifically developed to tackle the barriers to re-use in the construction and property industry and to attain critical mass for this new asset class.

We encourage the uptake of re-used materials in 3 steps :

+ Circoscan – Creation of a digital model listing an existing building's materials. We deploy market leading inventory technology and re-use inventory specialist teams;

+ Circopass – Valuing the building's circular & carbon footprint according to internationally recognized methodology. We provide third party certification to support extra financial reporting;

+ Circotrade - A technologically enabled marketplace to facilitate futures trading of a building's materials and embodied carbon via an innovative futures contract and matching service - long before any of these materials and products are actually slated for deconstruction.

Why a Futures Market? The benefits for both buyers and sellers are four-fold:

(1) Forward planning: buyers and sellers can plan ahead and lock in quantities and prices for future transactions. Development teams have access to an online "supermarket" of future reused materials allowing teams to design to specification and to scale with certainty.

2. Visibility: provides transparency and visibility into market trends, volumes and provenance of materials to be released in the future and price movements.

3. Supporting the financial burden: making it easier for companies to invest in the recovery, reconditioning, recertification of materials, as they can accurately predict their costs and revenues.

4. Market efficiency: By providing a platform for buyers and sellers to come together and trade in a standardized way, futures trading can help increase liquidity and reduce price disparities.

With Circotrade, the power of finance unlocks the hidden value laying dormant in existing buildings' materials and products.

Circotrade: Helping the built environment help the planet by extracting environmental, social and financial value from previously disregarded building materials by planning for their future re-use.

Circotrade is part of the Ellen MacArthur Foundation community.

KNOCKING NOTHING DOWN

Clive Nichol,

CEO, Fabrix

As a developer and investor with the modest ambition to help shape a more sustainable and equitable world, we have a number of pillars guiding the way we work. Chief amongst these is reducing our environmental impact — a big part of which is being mindful of opportunities to reuse and not wasting stuff. As an industry, our carbon emissions are a terrifying three times that of the aviation sector. We have an obligation to reduce our consumption and fast.

More often than not, for us that means reusing buildings rather than starting from scratch. But regardless of whether it's a retrofit project or ground-up development, we're always guided by the circular economy (or zero waste) design principles of 'rethink/ redesign; reduce; reuse; recycle/recover ' and the Circular Buildings Toolkit. Reusing materials as much as possible but almost more importantly, challenging the need for additional material at all unless it really is justified. Why specify a decorative material to apply over an already functional concrete core, even if it's low-carbon, for example?

Our Atelier Gardens project in Berlin is a good example of our approach to the circular economy. We're transforming the six acre-film studio site — one of the oldest in Europe — into a creative campus for global impact-led organisations, to sit alongside film and media pioneers. It's underpinned by a zero waste to landfill ethos and has become a test-bed for a lot of our thinking.

We're knocking nothing down — instead, sensitively repurposing listed studios and outdated office buildings, finding new uses for redundant structures, improving energy efficiency and adding new rooftop gardens, pavilions, cafes and sun-shading. What would commonly be treated as 'waste' materials, such as old window frames, insulation, doors and flooring are being reused on site or donated, rather than being discarded.

And the no-waste commitment extends to the regreening strategy too — we're reintroducing nature on a mammoth scale. It would have been tempting to rip out all the concrete and contaminated soil and start again. But we're taking a regenerative, longer-term approach — carefully specifying plants with the ability to not only thrive in harsh environments but gradually decontaminate the soil over time, whilst reusing crushed concrete on site to create hard landscaping, planting mediums and insect habitats, enhancing the biodiversity of the site.

We're also working hard to make the most of 'waste' closer to home. Our move at the back-end of 2021 to salvage 139 tonnes of steel from a building being demolished in Broadgate was a UK first for a developer at the time. And thankfully appears to have helped kickstart the wider adoption of a practice which had always appeared a total 'no-brainer' to us.

Currently almost no steel is disassembled, recertified and reused. The vast majority is sent abroad to be smelted and recycled, despite the fact it will still need to be tested and certified on its return to the UK. We figured why not just remove that massively carbon intensive travelling and smelting stage — a move that we understand reduces the carbon impact by up to 80% compared to using recycled steel.

In our experience, the barrier to this way of working hasn't been a lack of knowledge, creativity or innovation across the industry. The consultants we work with have jumped at the chance to put these

long-understood principles into practice.

The chief obstacles are of course inevitably interrelated. First, a lack of appetite for ‘risk’ from clients to try anything new that could disrupt project programmes. Second, the lack of a tech-enabled open marketplace to make the trading of used construction materials scalable (so we welcome the emergence of innovative platforms such as CircoTrade). And third, the distinct lack of regulation from government.

Europe certainly seems to be leading the way on regulating embodied carbon reduction currently. The UK urgently needs to do more so as not to fall behind. Cracking the adoption of the industry-initiated Part Z amendment to building regs would go a long way in giving the industry the confidence it needs to properly mobilise and innovate.

HOW TO DESIGN A CIRCULAR BUILT ENVIRONMENT

Peter Swallow,

Sustainability Lead, Grimshaw

Embracing circular design principles is key to transitioning the built environment towards a regenerative future, one that balances human needs without transgressing our planet's environmental boundaries. There are broadly three circular design principles; firstly, extending building lifecycles through transformation and refurbishment; secondly, reuse and recycling of material; and thirdly, flexible disassembly and adaptable construction.

Since Grimshaw's inception, the practice has been at the forefront of implementing these principles as part of its philosophy that buildings should be flexible and adaptable for the long term. The following case studies demonstrate the successful application of these principles across three of our recent projects.

Finding opportunities for the creative adaption of existing buildings is key to avoiding emissions associated with demolition and rebuilding. One notable example is the adaptive reuse of the Herman Miller Factory in Bath. Originally designed with loose-fit principles in 1976, the building was transformed to accommodate the Schools of Art and Design for Bath Spa University in 2019. The project focused on adaptability and disassembly. By reusing 90 per cent of the original facade and improving its thermal performance, emissions associated with demolition and rebuilding were avoided. The reuse of the existing building had a positive economic and environmental impact when compared to a new build equivalent.

As part of the EU grant-funded Circular Construction in Regenerative Cities (CIRCuIT) project, Grimshaw collaborated with Simple Works and Buckland Timber to run a demonstrator project focused on evidencing the viability of reclaiming timber from demolition sites for reuse in the fabrication of glue laminated timber. The timber was collected from a demolition site in South London, assessed for damage, removal of fixings and testing. The useable timber was fabricated into six glue laminated beams and mechanically tested at Napier University to confirm that their strength was equivalent to that of beams made from virgin timber.

Building on the lessons learnt from the practices experience delivering flexible and adaptable building, the Civil Engineering Building for the University of Cambridge, completed in 2019, incorporates a flexible spatial framework to maximise internal layout flexibility. Employing a regular planning module, zoning of heavy and light engineering activities to avoid operational disruption. The primary structure and facade systems were designed for deconstruction and reuse in mind to allow for future expansion and adaptation of the building as the masterplan for the wider engineering campus developed, with an estimated 80 per cent of the structural steel and façade components are recoverable.

Despite the existence of technologies, materials and strategies that support a circular built environment, there are still perceived barriers related to cost and programme holding back their wider adoption. Early consideration at project inception is key to their successful adoption as part of an integrated design solution that many cases can improve construction costs and delivery timelines.

In conclusion, the case studies highlighted exemplify the successful implementation of circular design principles. By extending building lifecycles, reusing materials, and embracing flexibility, we can create a sustainable and adaptable bult environment. Overcoming barriers and promoting early adoption are essential steps in accelerating the transition to a circular built environment.

Adaptive reuse of Grimshaw's original Herman Miller Factory in Bath to accommodate the Schools of Art and Design for Bath Spa University

POLICY AND LEGISLATION: FOSTERING THE CIRCULAR ECONOMY

Kai Liebetanz (he/him),

Senior Sustainability Advisor, UK Green Building Council

Our planet is at tipping point. Our current economic model and focus on growth is maintaining levels of carbon emissions and resource use that are exceeding our planetary boundaries, and the built environment has played a significant part in perpetuating that problem.

As we look ahead in the built environment industry and begin to define the future we want to see for our homes, towns and cities, and all those who inhabit them, it is clear that we must move away from a model of infinite extraction and a circular economy is a logical part of the equation. All levels of government, industry, and civil society will need to rally behind the common goal to shift from our current extractive and wasteful linear economy towards a regenerative, circular one.

Some leading businesses are already waking up to this. We are seeing an increasing amount of flagship circular projects, incorporating key concepts such as design for disassembly, carefully deconstructing and reusing existing buildings. However, the majority of industry has yet to embrace this concept as the default position.

This is where policies and legislation come into play. Government has the power to raise the bar for the entire industry, setting minimum requirements and a strategic direction of travel towards a circular economy. Tools at their disposal include rolling out circular economy statements nationally and introducing extended producer responsibility, putting enhanced onus on manufacturers to take back their products and materials at the end of their life cycle and explore opportunities to recycle and reuse.

Moving towards a circular economy will also require new business models which capture value differently. This requires being open to innovation and taking risks. Policy can create a climate for investment into new business models which are essential to deliver this transition at scale.

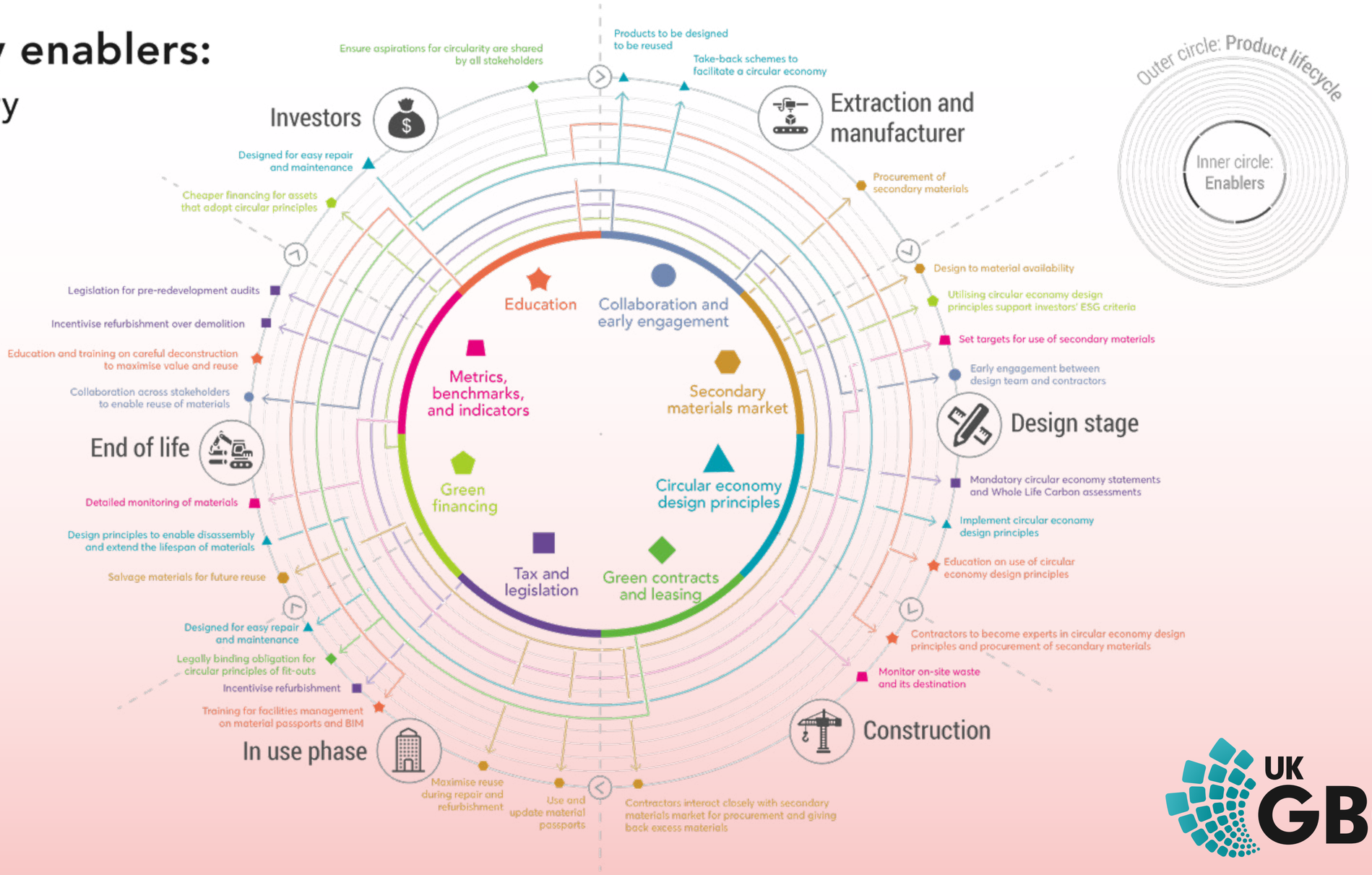
The transition to a circular economy requires us to address systemic issues and deliver concerted efforts. Policy and legislation are crucial for creating an environment that enables the transition towards a circular economy in the built environment, for example via taxation that favours refurbishment and reuse over new build. Currently, the opposite is the case with new buildings being exempt from tax, while refurbishments are taxed at the standard rate of 20 percent.

At UKGBC, our latest report System Enablers for a Circular Economy has identified eight enablers that can help make circularity the default way of operating in the built environment, and are supported by an extensive list of industry and policy action that are needed to deliver these.

In a world of finite resources, environmental destruction and pollution, shifting to a circular economy rapidly is a fundamental necessity. This is true especially for the built environment, the most resource intense sector of our economy. Policy and legislation play a critical role in realising the transition by setting minimum requirements, creating a climate for investment, and setting the direction of travel.

Industry enablers:

A summary



PROJECT SHOWCASE

The following showcase provides a snapshot of recently completed and planned projects in London that embrace circular economy principles. The showcase also includes a selection of international exemplars as well as a section including concepts, tools and research.

All projects featured in this showcase were submitted via a call for entries conducted by NLA in spring 2023. It included any scheme designed, planned or built following the Circular Economy Principles as defined in the London Plan's Circular Economy Statements Guidance.

+ **Building in layers**
+ **Designing out waste**
+ **Designing for longevity**
+ **Designing for adaptability or flexibility**
+ **Designing for disassembly**
+ **Using systems, elements or materials that can be reused and recycled**

SHOWCASE CONTENTS

BADGES

MU — Material re-use

R — Retrofit

RM — Recycled material

DD — Designed for disassembly

MP — Material Passport

PROJECT LIST

BUILDINGS & PUBLIC REALM

1 Broadgate

Broadgate, London
EC2M 2QS

Status:
Under Construction

Completion:
2025

Client: British Land

Architect: Allford Hall Monaghan Morris

Structural Engineer:
AKT II

Contractor:
Sir Robert McAlpine

MEP/ Sustainability Consultant:
Hilson Moran

Project Manager:
Gardiner & Theobald LLP

1 Broadgate comprises 546,000 sq ft of some of the highest quality, most sustainable mixed-use space in London, and includes the largest and most complex Material Passport in the UK, the first NABERS UK Design for Performance registered building, a BREEAM Outstanding and WELL Platinum target ratings.

"1 Broadgate is a stellar example of how a project team built on trust, honesty and collaboration can achieve best-in-class outcomes, be an industry leader on many fronts and overcome the challenge of staying relevant in a very fast-changing and demanding market."

Marie-Louise Schembri, Sustainability Director, Hilson Moran

16 Chart Street

Chart House, 16 Chart Street, London N1 6D

Status:
Under Construction

Completion:
2021

Client: CSI Investments

Architect:
Ian Chalk Architects

Structural and Civil Engineer:
Heyne Tillett Steel

MEP Engineer:
Peter Deer & Associates

Cost Consultant:
Exigere

Project Manager:
Stature

Interior Workplace Design: Spacelab

Contractor: Conamar

Timber Contractor:
B&K Structures

16 Chart Street is a carefully considered retrofit of an existing 1930s furniture warehouse in Hoxton. After two years of construction and refurbishment the building has been transformed from an unused building into a modern, interconnected studio space for structural engineers Heyne Tillett Steel.

The redevelopment takes design inspiration from what already exists, responding to the raw material palette of exposed steel, concrete and brickwork found throughout. Alterations to the existing fabric were limited to essential structural repairs with new finishes used sparingly, an approach that reduces carbon whilst celebrating the character of the existing building.

Sustainable structural timber has been used to form the building's new elements such as the north lit studio space on top and the vertical extension to the side; built using a combination of cross-laminated, glue-laminated and high-strength LVL timber, the new extensions avoids wet trades and composite materials and has reversible connections, showcasing the unique design potential of an all-timber solution and extending the life of the existing structure.

The project has received a number of awards including NLA Retrofit Award 2022, AJ Retrofit of Year 2022, Structural Timber Awards 2022 and has been shortlisted for the Wood Awards 2021, and the AJ Architecture Awards 2022.

"The key decisions to reuse and extend the building rather than demolishing saved a significant amount of embodied carbon over a new-build option and provided the 90-year-old warehouse, now office with 60 more years of life. There is a practical and "analogue" approach to circularity to the building. The repairs to fabric were done only for structural repairs, imperfections were celebrated, and new finishes were used sparingly. This minimises material use and maximises future adaptability. Keeping the structure and services exposed also allows for repairs, upgrades and alterations to be made with minimal waste. The new structure is mainly mass timber, in a panellised construction with exposed structure and reversible connections."

Laura Batty, Associate, Technical Research & Sustainability, Heyne Tillett Steel

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1 Golden Lane

Golden Lane,
London EC1Y 0RR

Status:
Planning Granted

Completion:
2025

Client:
Castleforge Partners

Architect:
Hawkins\Brown

Structural Engineer:
London Structures Lab

Specialist Engineering Contractor:
McGee

1 Golden Lane, an 8-storey steel framed office building constructed in the 1990s with its original, grade II listed facade from the 1890s is about to undergo a transformation. The work will see 96 per cent of the existing structure retained in its current form with the deconstruction allowing for extensions both vertically and laterally.

Castleforge's ambition is to create a cutting-edge office space, where the new floor areas will have 20 per cent lower embodied carbon relative to the London office benchmark. Steel reuse was found to be a viable approach. London Structures Lab developed a world-first concept to take existing steelwork from the building, ribbon cut it to increase the depth of the sections and give uniformity, then place it back in the new vertical extension.

Ribbon cutting enables a 40 per cent increase in the reusable tonnage over standard reuse techniques. The process also means that the structural zone across the floorplate could be regularised, giving a consistent service zone and ceiling line, producing the high-quality office space expected. Working with the client team, Castleforge, Hawkins Brown and G&T, London Structures Lab established the refabrication process, performance requirements and certifications needed for steel reuse.

McGee collaborated with the Client team and industry bodies, to demonstrate the viability of steelwork reuse in this scheme. Deriving a methodology to deconstruct the existing sections and demonstrate how testing and recertification could remove perceived blockers in reusing steelwork. McGee used its carbon engineering expertise to develop an approach to deliver certainty in removing the existing structural steelwork from the 1980s building, allowing it to be recertified, refabricated and reused in the new proposed structure. McGee removed the perceived risk points to create a procurement route to unlocking this opportunity. This pioneering approach enables the proposed extension of the building to emit less carbon than other structural solutions.

"This is the first time that any project in the UK is targeting exact steelwork sections to be deconstructed, de-fabricated, recertified and refabricated for use in the redevelopment of the same site. It is our hope that by successfully delivering this scheme it will demonstrate that technical solutions around steelwork reuse are commercially viable for future schemes in The Capital. I'm delighted that our client has put their trust in the experience of our team to deliver this UK first. We are committed to enabling lower carbon solutions through our high value engineering solutions."

Seb Fossey, Group Managing Director, McGee

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55 Great Suffolk Street

55 Great Suffolk St, London SE1 0BB

Status: Planning permission granted

Completion: 2024

Client: Fabrix

Architect: Hawkins Brown

Structural Engineer: Symmetrys

Cost Consultant: Exigere

Sustainability Consultant: CBRE

Project Manager: Opera

M&E Engineer: Max Fordham

Planning Consultant: Gerald Eve

Heritage Consultant: City Designer

This sensitive restoration and extension of a derelict, Grade II Listed warehouse into 15,000 sq ft of creative workspace in Bankside will breathe life back into a much-loved but neglected Southwark building.

One of the last surviving Victorian warehouses in the borough, 55 Great Suffolk Street has lain vacant and untouched for the last 50 years and is on Historic England's Heritage at Risk register. The remarkable utilitarian-style building is now being conserved, upgraded and extended; bringing it back into use for the first time in half a century. A new, distinctly-contemporary, external core structure will be almost entirely constructed using reclaimed steel. Connected by bridge-links, it will house essential modern services and amenities, such as WCs, a lift, bike store and showers, allowing the building's original uninterrupted floorplates to be uncompromised and retained.

In a first for a UK developer, Fabrix purchased 139 tonnes of steel, from a building being demolished, for structural reuse across a number of its projects. A total of 20.35 tonnes of reclaimed steel will be used for the new external core, saving approximately 50 tonnes of embodied carbon (based on a comparison to a generic A1-A3 carbon factor of 2.5kgCO2e/kg steel for 20 per cent recycled content steel sections). The upfront embodied carbon of the building (modules A1-A5) is estimated to be 386kgCO2e/m2 owing to both the steel reuse and the retention of the listed warehouse, representing a 36 pr cent reduction compared to the LETI 2020 design target of 600kgCO2e/m2. The project is on track to achieve a BREEAM 'Excellent' accreditation and Net Zero whole-life carbon.

Trap doors, which allowed goods to be moved between floors, will be left exposed with infill glazing, retaining visual connectivity. And corrugated cladding on the new external core references the building's use in the 19th century by Spicer Bros paper merchants.

"Guided by a bespoke project specific sustainability framework, ambitious sustainability intentions for the retrofit of this listed warehouse were set from the outset, ensuring that they remained at the fore throughout. The impact of early and ambitious client intentions should not be underestimated, as the advance procurement of structural steel from a donor site allowed known elements to be incorporated into the design; maximising the use of this circular material within the project. With 97% of the building's structural steel sourced though reuse pathways, 55 Great Suffolk Street is an excellent example of the possibilities that a well-planned approach to the circular economy can achieve, whilst demonstrating to the market a practical implementation of these important principles."

Matthew Ingham, Associate Director, CBRE

7 Holbein Place

1 Whittaker St, London SW1W 8JQ

Status: Built

Completion: 2023

Client:
Grosvenor Property UK

Architect: Barr Gazetas

Structural Engineer:
Heyne Tillett Steel

M&E / Sustainability Engineer:
Hurley Palmer Flatt

Project Manager:
Capital & Provincial

Quantity Surveyor:
Leslie Clark

Planning Consultant:
Gerald Eve

Landscape Architect:
Todd Longstaffe-Gowan Landscape Design

Holbein Gardens is a retained and extended 1980s commercial building, refurbished to create a modern workplace with increased floor area. Sustainability and circularity are at the heart of the development, reusing much of the existing building fabric paired with low carbon engineered timber extensions. The project is a pioneer for the direct reuse of structural steel in London, a first of many currently being developed and implemented across the Grosvenor portfolio. Grosvenor are committed to circularity and prioritising retention over demolition, re-use, recycling, trialling innovations such as material passports, and procurement and waste management. Holbein Gardens is the first project that champions this level of circularity.

93 per cent of the existing structure was retained, and a new vertical extension added to provide additional workspace and terrace area. The new structure is formed from a partially reused steel frame with cross-laminated timber (CLT) floor slabs. The steel being used is nine tonnes of reused steel from other Grosvenor projects and 16 tonnes reclaimed steelwork from other sites, with the remaining sourced from traditional (new) steel. This reused steel, alongside the use of CLT gives an overall embodied carbon for the structure of 65 kgCO2e/m2. The steels reused on Holbein Gardens were taken from low load applications, roofs or temporary works and so only steel primer needed to be removed. If steels are encased in concrete encasement or covered in intumescent/vermiculite fire protection, have shear studs etc. this would require further consideration as more de-fabrication and processing would be required for the steels to be reused, increasing energy consumption and embodied carbon. The steel frame was completed in Summer 2022 and practical completion is expected in April 2023.

Furthering our study into the reuse of structural steel, working with Grosvenor and with funding from Innovate UK, we are undertaking research into the re-use of pre-1970 steel and how concrete encasement removal may affect how steelwork can be reused. Results of this will be used to inform further work and is expected to be concluded in Summer 2023.

"Holbein Gardens is set to have just over 35 per cent of the new steel from reused sources and demonstrates how the challenges of using reclaimed steelwork can be overcome. With increased interest in reusing steel and incentives to get building owners to extract steel, this will help reuse of steel become a more economic, efficient and mainstream way to reduce carbon in the construction industry."

Rob Mills, Senior Associate, Heyne Tillett Steel

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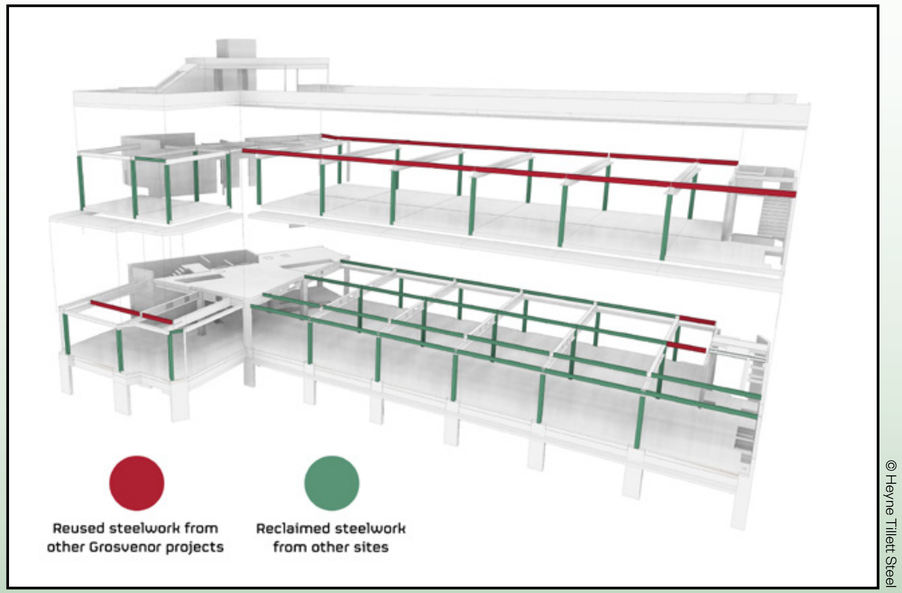

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318 Oxford Street

318 Oxford Street, W1C 1HF London

Status:
Under Construction

Completion: 2024

Client:
Publica Properties

Architect: PDP London

Engineers:
Civic Engineers

Reuse of existing materials in the construction sector is an essential step in the industry's transition to a net zero future. However, the reuse of steel is in its infancy. While a protocol exists for the reuse of steel manufactured in 1970 to current days, as yet this does not cover steel produced in earlier eras.

In a novel move, pre-war steel is being reused in a UK construction project, in the latest breakthrough in 'urban mining'. 40 tonnes of 1930s steel beams saved from the old House of Fraser store at 318 Oxford Street (now to be known as 'The Elephant') is being salvaged for reuse in a new London office scheme. A number of steel columns from the 5th floor are also being re-used on the new 8th floor extension, reducing the tonnage of new steel and embodied carbon of the scheme. The former department store is being designed and delivered as offices by PDP London and Civic Engineers. The steel beams will be used on FORE Partnership's Tower Bridge Court (TBC.London) scheme on the Thames. The columns being extracted will be used in the top floor signature restaurant of The Elephant. PDP and Civic Engineers worked closely together to ensure that the columns would fit into their allocated spaces and function structurally.

Together these moves will save an estimated 43 tonnes of carbon dioxide when compared with using new steelwork, equivalent to 11 family cars driving for a year or about 40 flights from London to New York. Civic Engineers liaised with McLaren, contractor on The Elephant refurbishment, to support the proposal. Webb Yates, the engineer appointed to TBC.London, ensured there was a smooth transition for using the recycled materials in the Thames-side design, and will work with TBC. London contractor Wilmott Dixon to incorporate the beams.

"Re-use of early 20th century steel from 318 Oxford Street is breaking new ground in the field of Urban Mining and delivering significant reductions in carbon emissions."

Andrew Davidson, Partner PDP London Architects

6–10 St Andrew Street

St Andrew St, London EC4A

Status:
Planning Granted

Completion: 2024

Client:
Great Portland Estates

Architect: Barr Gazetas

Building Services:
GDM Group

Project Manager:
Cogent Building Consultancy

MU R MP

6–10 St Andrew Street is the substantial refurbishment of an existing office building to create a sustainable, high quality and beautifully designed workspace, in line with Great Portland Estate's net zero carbon commitment. Located within the City of London, the existing building, constructed in 1999, consists of an eight-storey reinforced concrete frame over a single storey basement.

The proposed design utilises the full potential of the existing building, limiting the amount of demolition required by maximising the floorplate efficiency. A new single storey extension will be added to the top floor, alongside a new pavilion structure at Level 09, and the creation of additional external terrace space at Level 08. The design proposals maximise the reuse of the existing building, with 97 per cent of the structure being retained, including the foundations. However, this required a lightweight solution to be found for all new structures. The proposed extensions have been designed in steelwork and composite metal slabs, which will be exposed to the underside, as these materials are lightweight whilst giving the aesthetic the architect wanted.

Alongside the embodied carbon stored within the retained structure, the design minimises embodied carbon by sourcing the steelwork elements from re-used stock instead of virgin steel elements. Using HTS's internal Stockmatcher tool, 82 per cent of the new steelwork required has been matched with suitable re-used elements, avoiding 24 tonnes of new virgin steelwork needing to be procured.

"The HTS Stockmatcher gives a quick and considered solution to the current problem of how to best use reclaimed steel in buildings, maximising the efficient use of this low carbon material. The interface is simple, the inputs are flexible, and the results can be easily interrogated. HTS is looking forward to launching an open source version in June 2023."

Laura Batty, Associate, Technical Research & Sustainability, Heyne Tillett Steel

ANZ London

Savoy Place, London WC2N 6AT

Status: Built

Completion: 2019

Client: Australia & New Zealand Banking Group Limited

Interior Designer, Brief Consultant: tp bennett

Main Contractor: Overbury

Project Manager, Quantity Surveyor: JLL

M&E: Taylor Project Services

ANZ London is a new sustainable workspace that articulates the organisation's values, culture and identity. Located on the 12th floor of Canary Wharf's Cargo Building, tp bennett's approach centred around circular economy principles, reflecting ANZ's position as a leading environmentally sustainable bank.

With sustainability being a key priority, tp bennett tailored a bespoke and robust sustainability strategy with the client that focused on reducing embodied and operational carbon through all aspects of the design. Put into practice, this meant that 66 per cent of furnishings were directly refurbished or remanufactured and 55 different types of furniture were fully remanufactured. In addition, 7.5 tonnes of carbon dioxide equivalent (CO_2e), was avoided through remanufacturing 79 per cent of the task chairs used in their new office, which is the approximate annual footprint of one UK citizen. The worktops used for remanufactured desks were made locally in the UK from 85 per cent post-consumer recycled glass and aggregates.

A careful materiality strategy was implemented from the outset, focusing on 'design out', reuse, and maximising use of natural products. Similarly, most fixtures, fittings and services are demountable, enabling ongoing flexibility and maximising opportunity for future reuse. A biophilic design approach helps achieve excellent levels of indoor air quality through avoiding use of high-emitting, synthetic products, and prioritising mechanical fixings instead of adhesives. The fitout utilised tp bennett's award-winning approach to responsible sourcing, using its in-house database of sustainable materials and collaborating with suppliers to further reduce embodied carbon, increase circularity and achieve greater social value outcomes.

Altogether, the project avoided 19.3 tonnes of carbon emissions and prevented the creation of seven tonnes of furniture waste. The remanufacture of existing ANZ furniture supported 225 hours of London Real Living Wage employment for vulnerable workers.

"By employing biocentric design principles we have created a new UK & Europe head office that puts both people and the planet at its centre. We recognised that the materials our offices are constructed from can represent both our greatest socio-environmental impacts and opportunities, and we are proud of this project's recognition as one of the UK's most circular fitouts."

Tim Phillips, Head of Business Execution, Europe, ANZ

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Atelier Gardens

Oberlandstr. Mitte,
12099 Berlin, Germany

Status: Under Construction

Completion:
2022 – 2024

Client: Fabrix

Masterplanner: MVRDV

Architects: MVRDV, Studio Fabrix and Hirschmüller Schindele Architekten

Landscape Designers: Harris Bugg Studio

Project Manager: Drees & Sommer

M&E Engineer: Buro Happold

Water and Material Flow Management: Hati

Contractor: KPM3

Circular Construction Consultant: Concular

Partner: Dyce

Café Operating Partner: Roots Radicals

Atelier Gardens is a 110 year-old, six-acre film studio site in Berlin being transformed into a global campus for social and regenerative activism and entrepreneurship, alongside film and media. The project is underpinned by a 'zero-waste-to-landfill' ethos and a holistic approach to sustainability encapsulated by the motto 'Soil, Soul, Society & Celebration'.

The perception of film studios is often one of glamour and the site certainly has a rich history as the home of German cinema. The studio buildings once sat within a handsomely landscaped parkland, with water and green spaces between them. The more recent reality was very different — a mix of film studios and large sheds, built pragmatically over time with no thought for public realm, surrounded by tarmac and just seven trees.

The campus is being reconfigured as an inspiring and flexible home to a creative community of tenants devoted to social and environmental change. All existing buildings no longer used for film or post-production are being repurposed and brought back into use as a flexible mix of work and event space. Nature is being reintroduced via a radical biodiversity and regreening strategy, with green plazas, rooftop gardens and over 170 trees. Plants are being specified to decontaminate the soil and planted directly into broken hard paving, avoiding sending soil or concrete to landfill. Over 50 per cent of the site's paving is being dug up and reused on site, eliminating waste and vehicles, and adding water permeability.

A pioneering onsite water strategy will enable the site to become one of Berlin's first 'drainless' properties, with all rainwater being retained on site. Underground cisterns harvest rainwater for toilets and outdoor areas, and urine will be separated from solid human waste – the nutrients and faeces recovered and reused for fertiliser and as part of the campus' 'Terra Preta' composting system.

"Atelier Gardens for us is an opportunity to turn an established campus with more than 100 years of film history into a global home for sustainability and storytelling. And to do so in a way that goes beyond the limited aim of becoming carbon neutral by a certain date. We are, of course, taking important steps in reaching net zero, however, sustainability needs to also consider more holistic issues such as water use, the natural environment, waste and circularity.

Berlin is well-known for its rich and radical activist scene working to solve the most pressing issues of our time, from climate change to human rights and food production. We're harnessing a radical range of approaches to circularity on site, in partnership with our growing tenant community and incredible consultant team. All examples of pioneering solutions that London has a lot to learn from."

Clive Nichol, CEO, Fabrix

Gjuteriet

Västra hamnen, 211 19
Malmö, Sweden

Status: Built

Completion: 2023

Client: Varvsstaden

Contractor: PEAB

Tenant: Oatly

Architect: Kjellander Sjöberg

Landscape: Sted landskap

Engineer: BK Konsult

Advisor: Matter by Brix

Contractor: Martinsons

Focused on the intensive re-use of repurposed materials, the transformation of Gjuteriet in Malmö designed by Kjellander Sjöberg for Varvsstaden, demonstrates how existing buildings can be reimagined based on circular principles. Formerly a ruin, the distinctive building has been given a vibrant new life as an active and social new urban place telling a multifaceted story about the port's rich maritime heritage.

Varvsstaden is a major regeneration project in Malmö transforming the old shipyards into a sustainable new district. The historic Gjuteriet foundry building is a key landmark in the area representing Malmö's emergence as an industrial city. The project is both about the reinvention of the building and its wider environment. Kjellander Sjöberg have developed a program with maximum social, local and environmental benefits which bring to life an active new public realm along the adjacent quay, dry dock and inner basin. This new focal point in Malmö will kick start the regeneration of the Varvsstaden district which is fast evolving into an exciting new mixed-use neighbourhood with homes, workplaces and a new fine arts campus for the University of Lund.

Gjuteriet is a new inspiring and experiential company headquarters for Oatly. It's an informal, open, authentic workplace built around social meeting and communal spaces — it is also creative, collaborative and activity based — a reflection of the shared values of its users. The ground floor is a generous shared realm that will invite the public to a cafe, restaurant, foyer and exhibition space.

The overarching project ethos placed an acute emphasis on resource preservation and a minimal carbon footprint; what can be built within planetary boundaries, what materials were already available to achieve the most sustainable outcomes.

Kjellander Sjöberg began with what was already there: the imposing steel structure, the brick walls, the frail and broken collage-like character of the building we found — all these preserved stories and narratives that have accumulated over time.

© R Hjortshoj

Mayfield in Manchester

The Tavern, 75 Piccadilly, Manchester M1 2BU

Status: Built

Completion: 2022

Client: U+I

Architect:
Studio Egret West

Landscape architect:
Layer Studio

Engineer:
Civic Engineers

RM R MU

Mayfield Park, a 6.5-acre brownfield site, is Manchester's first city centre park in over 100 years. Packed with heritage, and with the River Medlock flowing through its core, it has an industrial history of innovation spanning back to the 1700s. In its former life, the site functioned as a parcel depot and relief railway station and textile mill. Left derelict for over 30 years, the existing industrial site has been repurposed into a public green space that celebrates the heritage of the area and exemplifies sustainable construction practices.

Alongside Studio Egret West, Layer Studio and with developers U+I, Civic Engineers worked on an approach that saw the site infrastructure reused to create moments of functional and aesthetic joy for the community. The recycling and reusing of materials during the entire construction saved around 553 tonnes of CO2 — the equivalent emissions of 651 London to New York flights. Salvaging and repurposing historic cast iron beams from the culvert which had covered the river, three new bridges were created on site. Additionally, two entrance ways and multiple ornamental beams were scattered throughout the site to create a visual effect. This not only saved cost and carbon but made sure the site heritage was not lost.

Creative thinking was also employed to retain the existing riverbank structure. Through detailed load balance analysis, Civic Engineers managed to remove one thousand cubic metres of concrete buttressing proposed by the previous park engineer. A delicate, targeted repair approach was employed instead, to breathe new life into the 1 km-long existing brick-and-stone masonry river wall.

"Mayfield has always been an industrious part of this great city. In Victorian times it was a city within a city, powering Manchester's role in the Industrial Revolution. As we look to the future it feels entirely appropriate that Mayfield will set a new blueprint for the creation of beautiful, progressive, sustainable neighbourhoods. Making the most of the heritage here at Mayfield just makes sense - there's a treasure trove of material from this rich past which we're celebrating across the site, which is so important from both a conservation and carbon point of view."

Martyn Evans, Creative Director, U+I

Millennium Mills

6 Barrier Point Rd,
London E16 2SB

Status: Proposed

Completion: 2030

Client:
The Silvertown Partnership

Architect: AHMM

Structural Engineer: AKT II

Sustainability Consultant: Buro Happold

MEP: HDR

Waste consultant: Arup

Fire engineer: OFR

Facade consultant: Meinhardt

Millennium Mills is an iconic industrial former flour mill that sits proud and civic as the centrepiece to the Royal Docks. The Mill is now due to be fully restored as part of The Silvertown Development brought forward by The Silvertown Partnership, which will create over 6,000 new homes, 1.8 million sq ft of next generation workplace, and a new space for cultural and community events.

Millennium Mills was originally built in 1905 but suffered extensive damage during World War One. It was rebuilt in 1933 and 1954 by Spillers and served London until 1981 where it fell derelict due to the decline of shipping trade.

The Millennium Mills refurbishment presents a full circular economy story that conserves the life of existing built fabric by ensuring longevity, adaptability, and reusability as part of a new chapter. The proposal plans to retain and refurbish the original mill building, adapting the industrial space to create 225,000 sq ft of flexible workspace. The façade will be sensitively preserved and celebrated by retaining the iconic Millennium Mills and Spillers signage. The internal load-bearing structure and foundations will be retained, as well as the original mill equipment, which will be repurposed and put back into the building as a key feature to highlight its industrial past.

New interior additions are minimised, promoting material efficiency and economy. The focus has been on specifying high-quality materials that support longer-life and adaptability of the building, as well as the wellbeing and modern lifestyle of occupants.

Embodied carbon is an essential part of the regeneration of The Mills, and the circular approach works to reduce carbon through the whole lifecycle of the building. The Silvertown development, including Millennium Mills, has a zero-carbon district heating system. Extensive studies have been undertaken to investigate the best solutions for facade retention, floor infills, and construction of the extension.

"With a shared passion and a wealth of expertise, AHMM, Lendlease, and Buro Happold are reimagining Millennium Mills into a dynamic and inspiring hub of innovation and creativity. The team's collaborative spirit is fuelling this transformation."

James Santer, Director, AHMM

© AHMM

© AHMM

Panorama St Paul’s

81 Newgate St, London EC1A 7AJ

Status: Under Construction

Completion: 2025

Client:
Orion Capital Managers

Architects:
Kohn Pedersen Fox Associates (KPF)

Structural Engineer:
AKT II

Development Manager:
Pella Real Estate Managers

MEP: Chapman BDSP

Planning Consultant:
Montagu Evans

Environmental Advisor:
Trium Environmental Consulting

Ecology:
Aspect Ecology

Landscape Designer:
Tom Stuart Smith

Stone Contractor: Grants

Contractor: Mace

R

81 Newgate Street is a high-profile redevelopment at the heart of the City of London. The outdated 1980s office is being transformed into a sustainable, mixed-use building that supports the City’s goal for 24/7 activity. The project will include flexible workplaces, retail units, public art, a rooftop restaurant and a new pedestrian route through the site.

Environmental performance and wellbeing are improved, with measures including mixed-mode ventilation and better daylight access. Additionally, renewable energy is provided through rooftop photovoltaics and there are more than 1,320 cycle spaces, with associated facilities. Extensive planting and a large public roof terrace, with a wildflower meadow, will improve biodiversity and make a significant contribution to the greening of this corner of the city. Through extensive retention of the existing structure, the project offers the lowest impact redevelopment for the site, saving up to three years of demolition/new construction and reducing the whole life carbon. The building’s original ashlar facades are used as a ‘quarry’, Portland stone and granite have been carefully removed and are being reused in a new high-performance facade.

With a target BREEAM rating of ‘outstanding’, 81 Newgate Street aspires to be part of a new generation of sustainable office developments in London. This includes minimising waste using modular construction, low carbon materials and a zero to landfill plan. The project will be air quality neutral, with a high urban greening factor. The project has been designed to be climate change resilient, with rainwater attenuation, material resilience and thermally comfortable adaptive environments.

“Creating a sustainable building is a relay race, with each team member passing the baton on to the next consultant. The end result is the cumulative effect of many decisions, not one grand gesture.

At Panorama St Paul’s we wanted to use the existing building as a ‘quarry’, removing original Portland stone and granite and reusing it in a new, high-performance façade. The stone consultant, Grants, were very engaged collaborators — their expertise and craftmanship were key to removing the original façade with minimum wastage.

The reclaimed masonry has been set into pre-fabricated panels, which can be demounted and refurbished — although the stone can’t be taken off as a single element again. There was a complex set of factors to consider to balance circularity, cost, and construction processes.”

John Bushell, Design Principal, Kohn Pedersen Fox Associates

Before © Miller Hare

After © Miller Hare

Roots in the Sky

1-15 Pocock Street, SE1 0BT

Status:
Under Construction

Developer: Fabrix

Architect:
Sheppard Robson

Structural Engineer:
AKT II

Landscape Design:
Harris Bugg Studio

Concept Design and Vision: Studio Fabrix and Studio RHE

Project Manager:
Gardiner & Theobald

MEP & Sustainability:
Atelier Ten

Cost Consultant:
Quantem

Planning Consultant:
Gerald Eve

Leasing Agent:
Knight Frank

Environmental Consultant:
Watermangroup

MU DD

Roots in the Sky is a net zero 430,000sq ft office building in Bankside which will be topped with the UK's first rooftop Urban Forest. 1.4 acres, 125 trees, 10,000 plants, 1,000 tonnes of soil and unprecedented community space, from potting sheds, community growing and seedbanks to a community barn. It will be the first of a new breed of next-gen HQ office buildings responding to the flight-to-quality across the post-pandemic office market, and the growing recognition that a company's headquarters should be a physical embodiment of its values.

Circular economy principles have been incorporated from the ground up. In a first for a UK developer, Fabrix purchased 139 tonnes of steel, from a building being demolished in the City of London, for structural reuse across a number of its projects. 30 tonnes will be used within the main structure at Roots the Sky, saving approximately 74 tonnes of carbon, compared to standard new steel members.

A pre-demolition audit was also undertaken to assess all materials that can be reclaimed and repurposed from the existing building, with a commitment established to reuse or recover at least 95 per cent of all construction waste. A steel portal frame housing the existing plant room, for example, will be carefully unbolted to form the structure of the 3,000 sq ft rooftop community barn, saving approximately 53 tonnes of carbon.

Working with Granby Workshop, aggregates from the demolition process will be remodelled with a sustainable resin to be used for finishes, such as decorative panels in the changing rooms. And the reception desk will be formed from a section of the existing concrete slab. Bolted structural connections that enable disassembly have been prioritised throughout the design. And waste energy will be captured from tenant server rooms to heat the rooftop swimming pool once the building is operational.

"When we started on Roots in the Sky, Fabrix made clear their mission to do things differently, pushing for the project to be truly sustainable and embed the reuse of existing building componentry through "urban mining". Serendipity perhaps but at the same time, AKT II were also engaged in deconstructing 1 Broadgate in the City of London — a perfect donor building for Roots in the Sky given the similarity of their structural grids.

Intensive partnership working was required to make this a reality — not least to circumvent the previously immovable barrier of CE marking. This was a huge step forward that effectively allowed the rest of the industry to gain the confidence that the idea of urban mining of structural steel is something that could be successfully implemented and in time scaled to make a real contribution towards tackling the climate emergency."

Gerry O'Brien, Director, AKT II

SEGRO Park, Courier Road

Courier Rd, Rainham RM13, UK

Status: Proposed

Completion: 2025

Developer: SEGRO

Architect: Michael Sparks Associates

Planning Consultant: Barton Willmore now Stantec

Sustainability and Circular Economy Consultant: Barton Willmore now Stantec

Whole Life Carbon Assessment: LCD Consulting

Carbon Consultant: TargetingZero

Energy Strategy & MEP: MBA Consultants

Joint Venture Partner: Greater London Authority

The development at Courier Road covers over eight hectares of contaminated brownfield land of a former landfill in the Borough of Havering. Developer SEGRO and their Development Partner, the Greater London Authority set a brief for the project based on the Responsible SEGRO framework that focusses on long-term priorities for low carbon growth, investment in local communities and environments, and nurturing talent.

SEGRO recognise that a Circular Economy is underpinned by a transition to renewable energy and materials. A holistic approach has been taken in order to support the creation of a Circular Economy which decouples economic activity from the consumption of finite resources. A Sustainability Lead was appointed at the start of the design process to embed sustainability principles into the scheme wherever possible exceeding minimum regulatory and policy compliance to achieve exemplary sustainability performance.

To embed Circular Economy into the development: non-structural internal walls will provide options in future for adaptability; reclaimed materials will be used, and will be specified to include a 'take back' recycling scheme to be reused again; office spaces and the building superstructures have been designed for disassembly and reuse at the end of their lives.

These measures improve the circularity of the development, and reduce waste generated from the construction, operation, and end of life phases of the buildings by encouraging the circulation of products and materials beyond the development's lifetime.

The development is targeting the BREEAM benchmark of 3.2 tonnes per 100m2 gross floor area for construction waste, and it is anticipated that 95 per cent of waste generated during construction will be reused or recycled offsite. Targets for operational waste arising from the units in use include an aim for 65 per cent of material to be recycled or composted on/off site.

"Embodied carbon from our developments made up 40 per cent of SEGRO's scopes one to three carbon emissions in 2022. This is therefore a very material issue for us and why we set an embodied carbon intensity reduction target in 2021 as part of our Responsible SEGRO framework. So far, our design teams and contractors have achieved a 12 per cent reduction against our 2020 baseline, which we intend to build on in coming years. There is significant scope for inaccuracies in LCA calculations, so structural engineering consultancy Elliott Wood verify all of our embodied carbon data across Europe. SEGRO are leading the way in setting corporate-level embodied carbon intensity targets, and we are pleased to be part of evolving this agenda."

Jack Shepherd, Group Sustainability Manager at SEGRO

Technique

140 Goswell Rd., London EC1V 7DY

Status: Built

Completion: 2022

Client: General Projects

Architects:
Buckley Gray Yeoman

Structural Engineers:
Heyne Tillett Steel

MEPH Engineers:
Chapman BDSP

Interior Designers:
Formafantasma

Technique is the adaptive reuse and retrofit of a former gin distillery and printworks to create 74,000 sq ft of best-in-class workspace over six storeys, with 5,000 sq ft dedicated to SMEs. Demolition of the existing structures was considered as part of the design process, however carbon analysis identified that 1,709 tonnes of CO2 could be saved by adapting the building fabric. The decision to retain the existing structure also prevented 2,560 tonnes of waste ending up in a landfill, with further waste avoided through the retention of the existing brickwork facades at ground, and first floor level.

A retrofit of the existing fabric, including internal wall insulation and new, high-performance glazing, helps reduce the operational energy use. The project team made a commitment to re-use as much of the existing building fabric as possible and where new materials were required, specified natural and/or low-carbon products: the external walls of the extension are constructed from StoneCycling waste-based bricks, manufactured from at least 60 per cent construction waste. At Technique, 21 tonnes of waste were diverted from landfill by using waste-based bricks alone.

At roof level we added a three-storey extension, with a structure of cross-laminated timber slabs and glulam beams and columns, sourced from sustainably managed forests. The structural elements of the mass-timber extensions were pre-fabricated off site and assembled on site, cutting site traffic by 70 per cent. The timber surfaces to the new floors, and pre-cast concrete soffits and columns to the existing floors have been left exposed across the office floors, celebrating the character of the structures, and avoiding unnecessary material use, by eliminating the suspended ceiling system. Track lights that can be easily adapted by future tenants are installed.

The embodied carbon emissions of the project were calculated by BGY after Stage 5 and are estimated as: 374 kg CO2e/m2 (Modules A1-A4, B4-B5, C1-C4).

"The essence of Technique has always been about making a statement - creating a new benchmark for our industry and showcasing a new way of sustainable building. We had three guiding principles we committed to at the outset:

+ *RE-SET - to re-set the expectations and the norms of how buildings can be repurposed and how sustainability can be approached.*
+ *RE-USE - a commitment to reusing and recycling as much of the existing building as possible.*
+ *RE-INVENT - finding ways of taking basic, ordinary building materials and reinventing these materials into the new building blocks of the building."*

Jacob Loftus, Founder & Ceo, General Projects

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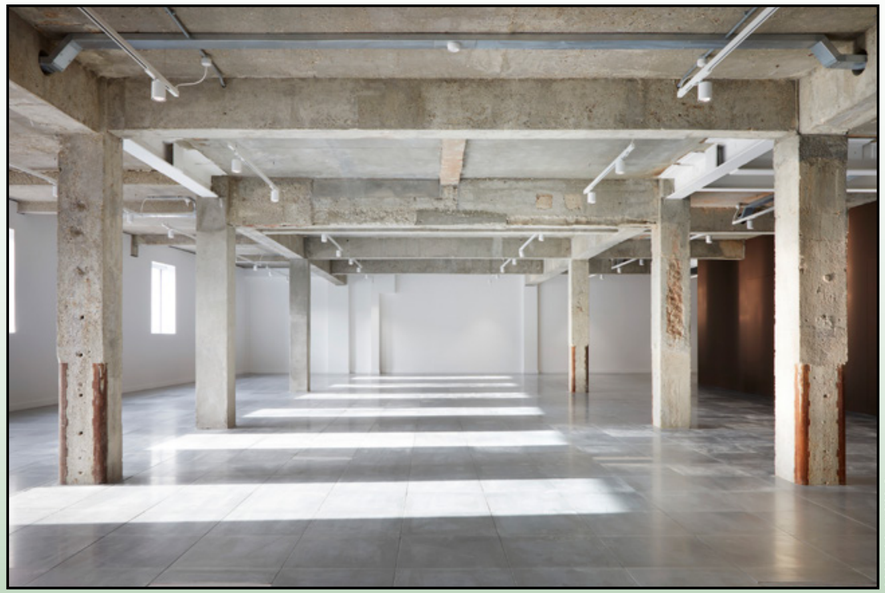


© Jack Hobhouse

150 Aldersgate

150 Aldersgate St,
Barbican, London
EC1A 4AB

Status:
Under Construction

Completion:
2024

Client: Topland

Architect:
Fletcher Priest Architects

Quantity Surveyor:
Leslie Clarke

Structural Consultant:
AKT II

© Socrates

© Fletcher Priest

This 140,000 sq ft workplace project reuses 80 per cent of the existing frame and substructure, saving time and a substantial amount of embodied carbon. The plan ensures flexibility and has 24 gardens and terraces spread over 5,650 sq ft. The replacement of existing services with modern and low-energy plant will reduce energy use by 43.5 per cent. A new facade featuring passive shading will substantially reduce the energy consumption of the existing building and provide occupants with enhanced daylight and openings for mixed ventilation.

R

155 Bishopsgate

155 Bishopsgate,
London EC2M 3TQ

Status:
Under Construction

Completion:
2020

Client: British Land

Architect:
Fletcher Priest Architects

Structural Engineers:
Meinhardt

Landscape Consultant:
Vogt

Services and Sustainability Consultant: Hoare Lea

Quantity Surveyor: Alinea

Contractor: Overbury

© Jack Hobhouse

A refurbishment of a 400,000 sq ft, 30-year-old building next to the UK's third busiest train station, occupied by multiple tenants. Refurbishment of high impact areas, including public realm, reception, and vacant office floors, was carried out with approximately 30 per cent of the workplace areas being occupied. 90 per cent of the structure was retained, leading to significantly reduced embodied carbon emissions. Light-touch interventions aimed to maximise impact through the re-use of high-quality existing materials including stone floor finishes, cladding and timber panelling.

R

Edenica – 100 Fetter Lane

100 Fetter Ln, London EC4A

Status: Under Construction

Completion: 2024

Client: BauMont Real Estate Capital

Developer: YardNine

Architect: Fletcher Priest Architects

Project Manager: Third London Wall

Multidisciplinary: Waterman Group

Planning Consultant: DP9

Quantity Surveyor: Arcadis

Contractor: Mace

© Fletcher Priest Architects

The 94,000 sq ft Edenica is a healthy, low-carbon, future-proof, net zero in operation workplace in the City of London. Embodied carbon will be 30 per cent lower than current GLA benchmark, achieved using recycled materials and implementing Waterman's new 'Materials Passports' process. Edenica will be a pilot project for passporting in the UK, giving materials a digital signature for present use, recovery, and future reuse. The project will be the City's first 'material bank', where used materials will become valuable resources instead of waste.

© Fletcher Priest Architects

RM MP

215 Mare Street

Roman Apartments, 215 Mare St, London E8 3QE

Status: Built

Completion: 2022

Client and Architect: Morris+Company

Services Engineer: Skelly&Couch

Structural Engineer: Heyne Tillett Steel

Contractor: EGG

© Jack Hobhouse

215 Mare Street was designed with sustainable strategies at its core, promoting re-use, recycling, and community interaction. To minimise carbon emissions a circular approach has been employed, re-using the building fabric and up-cycling existing partitions. Furniture and storage was reclaimed within a 10-mile radius, while low-carbon softwood was chosen for wall systems — demountable and reconfigurable for future use. Co-occupiers 'EDIT' are a plant-based / zero waste / seasonal restaurant / bar catering for Morris+Company, alongside the wider community.

© Jack Hobhouse

MU DD R

55 Old Broad Street

55 Old Broad Street,
London EC2M 1RX

Status: Proposed

Completion: 2028

Client: Landsec

Architect:
Fletcher Priest Architects

PM: Turner & Townsend

Structural Consultant:
Heyne Tillet Steel

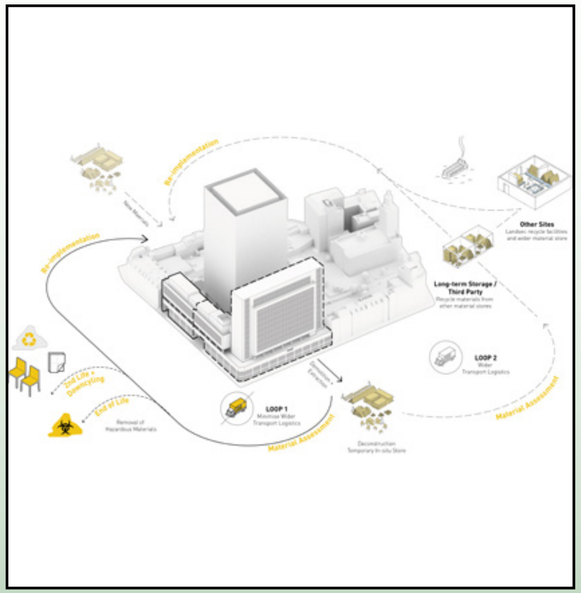
Services Consultant:
Long & Partners

Planning Consultant: DP9

MEP and Sustainability
Consultant: Atelier Ten

Landscape Consultant:
Vogt Landscape

The redevelopment of 55 Old Broad Street is a radical reimagining of City workspace for Landsec. The materials, components and furnishings in the existing building have been painstakingly catalogued, creating an extensive material passport database that will allow their reuse. Alongside retained and refurbished buildings, a new energy efficient workplace will rise from the retained basement featuring natural ventilation, passive solar shading and green amenity throughout.



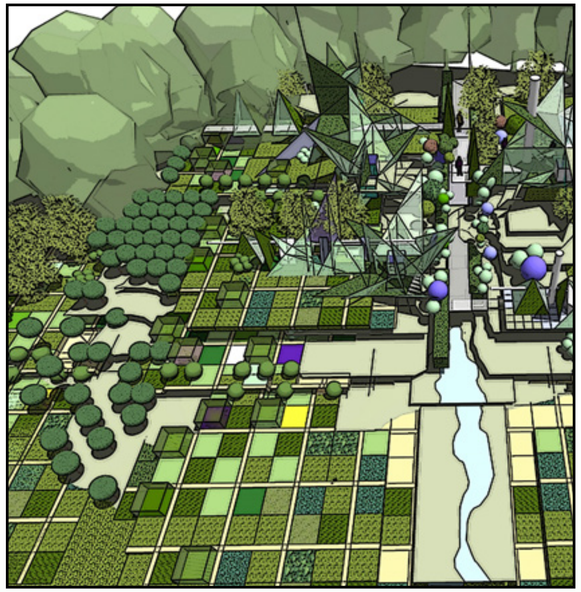
MP R

A Circular Lifestyle

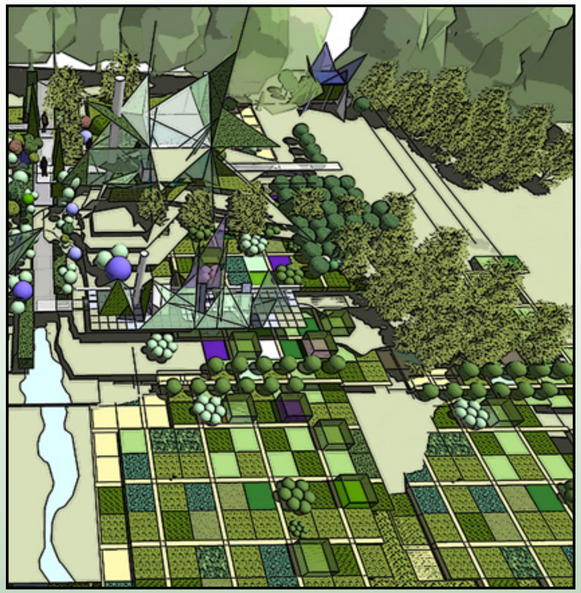
Status: Proposed

Completion: 2027

Architect:
Chetwoods Architects



The ground-breaking scheme's philosophy seeks to look beyond the circularity of building materials and develop an understanding of what the real circular economy methodology looks like in day-to-day life. The site has a history of experimentation — the original 1930s house was a timber kit building that evolved into Chetwoods Architects experimental Butterfly House in the early 2000s. We apply the six R principles: Rethink, Reduce, Reuse, Retain, Repair, Recycle, with associated key performance indicators and metrics building upon industry best practice guidance.



MU R

All Saints

13 Austral St, London SE11 4SJ, UK

Status: Built

Completion: 2022

Client: EPR Studio Ltd

Architect: EPR Architects

Main Contractor: McCue Crafted Fit

© Simon Kennedy

All Saints is a sustainable refurbishment. The use of embodied carbon was monitored and kept to a minimum through informed design choices, with new materials introduced to the building selected for their low carbon content. Existing features were sensitively reused wherever possible and poor-performing existing building elements were upgraded with new thermally efficient alternatives. This, combined with mixed-mode ventilation that allows passive cooling and an all-electric heating/cooling system, enables the building to be Net Zero Carbon in operation.

© Simon Kennedy

R

Brent Cross Town

Pennine Drive (Stop E), London NW2 1BW, UK

Status: Planning Granted

Completion: 2035

Client: Related Argent and Barnet Council

Architecture/art: IF_DO and Lakwena

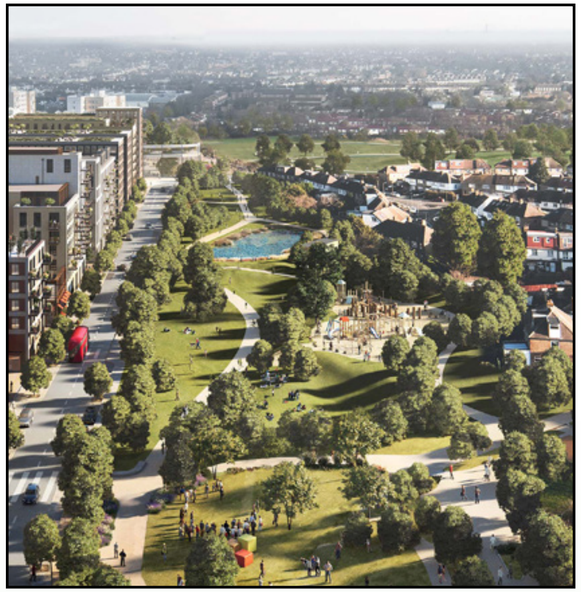
Engineer and lead design advisor: Arup

Infrastructure contractor: Galldris

Wrap contractor: Bourne Group

Landscape architect: Gillespies

Off-Site Re-Enforcement, PSS Fit-Out and Power Supplier: Power On



Located at Brent Cross Town, one of the largest net-zero regeneration projects in Europe, a new primary electrical substation has been wrapped with a 21-metre-high permanent public artwork. It embraces circular economy principles, using lower carbon products such as cement-free concrete for the foundations, and re-using steelwork for the construction of the wrap. Early engagement with steel suppliers was essential in the procurement of the project; with around 50 per cent of the structural steel salvaged from unused oil pipelines, reducing embodied carbon emissions of the steelwork by over 40 per cent.

MU

© John Sturrock

Broadwick Street

30 Broadwick Street,
London W1F 8JB

Status: Under Construction

Completion: 2023

Client: EQT

Global Architect: Studio Stockholm

Local Architect & Lead Designer: Barr Gazetas

Structural Engineer: Parmarbrook

Project Manager: Storey Project ltd

MEP: Cundall

Cost Manager: Quantem

Sustainability Consultant: Max Fordham

Principal Designer: Sweco

Landlord Team: Savills

© Studio Stockholm

Barr Gazetas and Studio Stockholm collaborated to bring the designs for EQT's UK offices into the local London context. The designs offer flexible office space that fosters community, collaboration and impact within each business line, with sustainability as a key driver, an embodied carbon target of <262kgCO2/m2 and WELL certification with material reuse, cradle-to-cradle certified natural materials made of recycled components and the support of Max Fordham as Sustainability advisor from the early stages of the project.

© Studio Stockholm

MU RM

Canada Water Modular Campus

Canada Water, London
SE16

Status: Under Construction

Completion: 2023

Client: British Land

Architect: Hawkins Brown

Contractor: Galldris

Modular construction: Premier Modular

© John Sturrock

Two new buildings are provided on the Canada Water Masterplan for TEDI-London's University campus, and life sciences purposes. The off-site manufactured, volumetric modular structure allowed rapid on-site assembly, lower vehicle movements, zero waste-to-landfill with decreased noise, dust and disruption to neighbours. The second phase utilised pre-loved modules, wall and window components. The buildings are built for intermediary use before disassembly to continue their life elsewhere. The entire front gate is made from 100 per cent recycled steel — salvaged from the Printworks site adjacent.

© Francesco Montaguti

MU DD

Dorset Health Village

64-68 Dolphin Centre,
Poole, BH15 1SQ

Status: Built

Completion: December, 2021

Client: University Hospital Dorset Trust

Architect: BDP

Building Services: BDP

Construction and facilities management: CFES

Material and healthcare equipment:
Innova Care Concepts

University Hospital Dorset Trust appointed BDP to design an outpatient clinic within a vacant department store of the Dolphin Shopping Centre in Poole, Dorset. The built design focused on a circular economy approach: over 70 per cent of the site was kitted out re-using equipment and materials from the Nightingale projects including plasterboard, doors, ironmongery, light fittings, and much more was salvaged and stored by Innova Design in a warehouse, reducing the project's cost and delivery time to a minimum.

MU

HYLO

105 Bunhill Row, London
EC1Y 8LZ, UK

Status: Built

Completion: 2021

Client: CIT Group

Architect: Horden Cherry Lee Architects

Structural Engineer: AKT II

M&E Engineer:
RHB Partnership

Contractor:
J Coffey Group & Mace

© AKT II

© AKT II

HYL — winner of the IStructE 2022 Supreme Award — absorbs London's formerly mid-rise Finsbury Tower within the delivery of a modern high-rise development. The existing 16-storey structure is now extended upwards, with 13 additional storeys, while re-using the existing frame and foundations in conjunction with just a minimum of targeted strengthening. Altogether, this design solution now doubles the site's leasable area (from 12,000 to 25,800 sqm) while saving 35 per cent in 'up-front' embodied carbon when compared with an equivalent new construction.

R

JLL 20 Water Street

20 Water St, London E14 9QG, UK

Status: Built

Completion: 2022

Occupier, Project Manager, Quantity Surveyor, Sustainability Consultant, Agent: JLL

Interior Designer: Tetris Design x Build

Contractor: Tetris Design x Build

M&E Consultant: Hilson Moran AV/IT

Consultant: Mix

Building Owner: Canary Wharf Group

© Jonathan Banks

The 100 per cent circular fit-out stipulated zero waste to landfill, an end-of-life plan for all assets and modular design. Circular design avoided new materials where possible and used innovative low carbon materials (e.g. post-industrial plastic waste worktops), while 1,244 refurbished/reused furniture items make up 79 per cent of the furniture installation. The project is on track to simultaneously achieve WELL Platinum, BREEAM Excellent and SKA Gold, the first London project and second in the UK to achieve this, following JLL's Manchester office fit-out.

© Jonathan Banks

MU DD

King's Mall

King St, London W6 9HW

Status: Built

Completion: 2021

Client: Schroders REIM and Ingka (IKEA)

Architect for Lyric Square: Stiff & Trevillion

Architect for retail areas: Woods Hardwick and Bell Associates

Structural Engineer: Expedition Engineering

Project Manager for LIDL/ IKEA works: Mace

Project Manager for office: MHBC (now Cumming Group)

© Stiff + Trevillion

King's Mall in Hammersmith is a 1970s, concrete frame shopping centre which was transformed between 2016 and 2021 by Schroders REIM and Ingka (IKEA). The project demonstrates the power of circular design to revitalise ageing buildings and make them fit for modern-day purposes. Expedition Engineering carefully tested and repaired the structural frame to extend the building lifespan. In the fit-out, finishes were stripped back and the structure exposed. New interventions focus on improving circulation, accessibility and flexibility within the mall.

© Expedition

R

London South Bank University – LSBU Hub

London South Bank Students' Union, 103 Borough Rd, London SE1 0AA

Status: Built

Completion: 2022

Client:
London South Bank University

Architect:
Wilkinson Eyre Architects

Structural + Facade Engineer:
Eckersley O'Callaghan

Principal Contractor: Wilmott Dixon Interiors

Fire Safety Consultant: Tenos

Landscape Architect:
Churchman Landscape Architects

Building Control Consultant:
JHAI Limited

Carbon Fibre Sub-Contractor:
CCUK Composites Construction

© Simon Yeung

This retrofit-first approach to sustainable building design, has transformed an outdated concrete building into a vibrant new student hub for London South Bank University — demonstrating how an existing building can be upgraded to achieve a contemporary look and extend its design life, while minimising its carbon footprint. By refurbishing and saving as much of the existing materials as possible, the A1-A3 (cradle-to-gate) embodied carbon component related to substructure and superstructure for the project is just 49 kgCO2e/m2 — under half of the LETI target for education buildings.

R

© Simon Yeung

Meridian Centre Havant

Elm Ln, Havant PO9, UK

Status: Proposed

Completion: 2028

Client: Havant Borough Council

Architect: RM_A

Public Realm & Landscape: Fabrik

Innovative ideas to address challenges faced by a local shopping centre by harnessing the benefits of re-use and re-purposing over demolition. Severing the existing frame recreates a historic throughfare, revealing a structure where new uses could flourish. Social value underpins a sustainable design for the whole community, inspiring 'ownership'. A day in the life shows its potential for inclusivity and accessibility to encourage this, a lifeline for social connections and a catalyst to reinvigorate wider regeneration and local economy.

R

Meridian Water

Meridian Water, London N18 3AH, UK

Status: Proposed

Completion: 2040

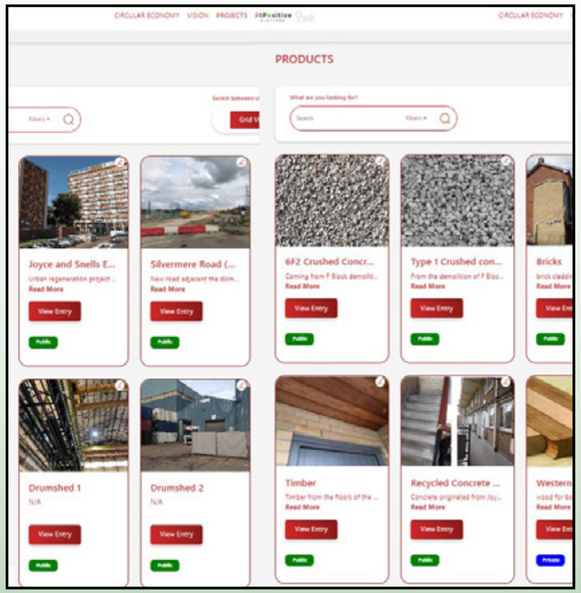
Client: Enfield Council's Meridian Water and Highways Team

Circular Economy Specialists: Net Positive Solutions (NPS), Excess Materials Exchange (EME), ReLondon, Grimshaw

Project Manager: Stace

Deconstruction Specialists: Clifford Devlin

Civil Engineering Contractor: Marlborough Highways



Making way for a new access road, a former industrial building's reinforced concrete frame was crushed on site and certified to a Type-1 and 6F2 standard, stored and used on the new access road a few meters away. 18,000 bricks, thought to be unsalvageable due to their cement mortar, were separated, cleaned and awaiting reuse. Materials are uploaded on the Excess Materials Exchange, and this project achieves a Material Value Retention (CE-MVR) of 50 per cent, a new metric developed with NPS, ReLondon and ACAN.

MU MP

Museum of London, West Smithfield

222 London Central Markets, Farringdon, London EC1A 9LH, UK

Status: Planning Granted

Completion: 2024

Client: Museum of London

Architect: Stanton Williams and Asif Khan

Structural and Civil Engineer: AKT II

Conservation Architect: Julian Harrap Architects

Landscape Architect: J&L Gibbons

Design Manager: Plan A

MEP, Sustainability& BREEAM, Security, Façade, Utility, VT: Arup

Quantity Surveyors: Gardiner & Theobald

Project Manager: Buro Four

Principal Designer: Bureau Veritas London

Planning Consultant: Gerald Eve

Environmental Consultant: Waterman Group

One of the largest and most significant cultural schemes currently underway across Europe, the new Museum of London at Smithfield transforms a group of historic market buildings into a world-class cultural destination and a democratic arena for public life. The project is a showcase for the adaptive reuse of heritage buildings and the application of the 'circular economy' principles — aiming to reuse and repair over 70 per cent of the existing fabric, recycle materials wherever possible and divert 95 per cent of construction waste from landfill.

R RM MU

© Secchi Smith

© Secchi Smith

Oasis Nature Garden Building and Project Jubilee

Oasis Nature Garden,
Larkhall Ln, London SW4
6SP, UK

Status: Proposed

Completion: 2025

Client: OasisPlay

Project Jubilee Client:
Lazari Investments

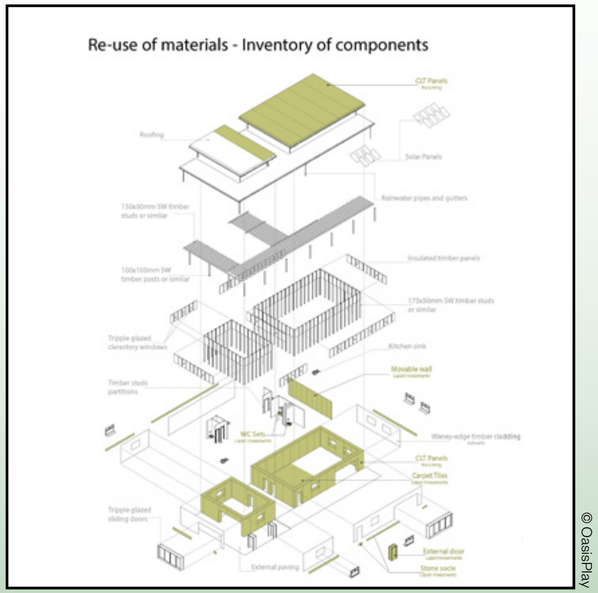
Architect: Marks Barfield
Architects (MBA)

Structural Engineer:
TERM Engineering

Quantity Surveyor:
Gardiner & Theobald

© OasisPlay

MBA has created a circular economy between two projects: Oasis Nature Garden and Project Jubilee. A forest nursery school, with a separate classroom for the nature garden, in Stockwell, is designed to be built entirely from waste or reused materials sourced from developments. Implementing Circular Economy principles, the Jubilee office retrofit acts as one material donor. 'Mining the Anthropocene' — materials are identified, deconstructed, protected, and stored for reuse. A further aim is to create a "circularity network", encouraging others to re-use in construction.



© OasisPlay

R MU

One Exchange Square

175 Bishopsgate, London
EC2M 3WA, UK

Status: Planning Granted

Completion: 2025

Client: La Salle

Architect:
Fletcher Priest Architects

Sustainability and
Engineering Consultant:
Sweco

Landscape Consultant:
Gillespies

Project Manager:
M3 Consulting

Planning Consultant: DP9

© Secchi Smith/Fletcher Priest Architects

Major refurbishment of 1980s post-modern City workplace. Transformation of public realm, envelope and massing deliver a building with the public and occupier experience at its heart and a focus on wellbeing with terraces at every level. Retaining over 90 per cent of the primary structure and significant elements of the façade leads to targets of BREEAM Outstanding, NABERS 5* and net zero operational carbon. Circularity approach includes repurposing materials for new flooring and reusing steelwork for a children's community centre in Lambeth.

R MU

© Secchi Smith/Fletcher Priest Architects

Oriel

4 St Pancras Way, London NW1 0PE, UK

Status: Planning Granted

Completion: 2025

Client: Moorfields Eye Hospital NHS Foundation Trust, UCL Institute of Ophthalmology, Moorfields Eye Charity

Architect: Perkins&Will (formerly Penoyre & Prasad)

Landscape Architect, Interior Designer: White Arkitekter

Project Lead: AECOM

© Perkins&Will

Oriel was designed with circularity at its heart. Adaptable floorplates provide flexibility for the organisation and location of its many current clinical functions, staff facilities, administrative and education spaces — adaptable for future commercial or residential uses. A unitised façade system enables reconfiguration without affecting structural integrity. 'Deconstruction' and 'Disassembly' manuals will include techniques to prolong the building's life, reducing operational, construction and demolition waste, 'end-of-life' strategies, advice on disassembly, and which materials or components can be reused, recycled or composted.

DD

© Perkins&Will

Park View

29 Rush Green Rd, Dagenham, Romford RM7 0PH, UK

Status: Built

Completion: 2021

Client: Thames Gateway Group

Architect: RSHP

Structural Engineer, Services Engineer, Planning Consultant, Project Manager, Environmental Consultant, Contractor: AECOM

Landscape Architect: Landform

Light Consultant: NRG

Manufacturer: @Home

©JoaoSouza

Park View provides move-on accommodation for YMCA residents, offering an affordable, stable transition to full independence. The 39 high-quality units with exceptional insulation, daylight and acoustics were achieved using rapid and cost-effective volumetric technology. The off-site manufacturing process benefits the Circular Economy due to its adaptability and flexibility. Modules are based on standard panel sizes with high tolerances minimising waste and components are widely accessible. Fixing methods are designed to allow to disassemble the building on the end-of-life phase of its lifecycle.

DD

©JoaoSouza

BRE’s Garston Campus

Bucknalls Ln, Watford
WD25, UK

Status: Built

Completion: 2022

Client: Building Research Establishment (BRE)
Architect: Feilden Clegg Bradley Studios
Structural Engineer: Alan Baxter
MEP Engineer: Cundall
Quantity Surveyor: Gardner & Theobald
Project Manager: Steam
CDM Advisor: CDRM
Approved Building Inspector: Harwood
Acoustic Consultant: Cundall
Fire Consultant: The Fire Surgery
Main Contractor: Logan Construction

© Luke Hayes

A repeatable and cost-effective approach to providing adaptable, healthy and low-carbon workspaces. The refurbishment prioritised low embodied carbon materials, local supply and reuse of existing materials where possible — carpets, ceiling tiles, lighting fixtures and timber partition studs — and the refurbishment of existing furniture. Taking a ‘long-life, loose-fit’ approach to fit-out allows the buildings to adapt to market-demand and alternative future uses. We calculated a saving of 31,768kgCO2e — a 34 per cent reduction in lifecycle embodied carbon for the refurbished items.

© Luke Hayes

MU R

Salutation Works

Status: Proposed

Completion: 2026

Architect:
Chetwoods Architects

A multi-storey mixed workspace and industrial concept. The existing building will be retrofitted and extended by introducing a new modular building. The scheme retains as much as possible of the current building. It repairs what can be reused, designs out unnecessary components, reuses most of the materials currently on-site as well as materials from site deconstruction and salvage yards nearby, and recycles the smaller portion that cannot be reused on-site or elsewhere. The construction will be used to educate about and showcase circular economy principles.

MU R

Shrewsbury Flaxmill Maltings

Shrewsbury Flaxmill Maltings, Spring Gardens, Shrewsbury SY1 2SZ

Status: Built

Completion: 2023

Client: Historic England

Architect:
Feilden Clegg Bradley Studios

Structural Engineer: AKT II

M&E Engineer: E3 Consulting Engineers

Contractor: Croft Building & Conservation

Cost Consultant: Gleeds

© Historic England

At the Georgian-era Shrewsbury Flaxmill Maltings site in western England, the existing Main Mill (Grade I) — the world's first iron-framed structure, and the genesis of all modern steel-framed buildings — and it's adjoined Kiln (Grade II) are now restored and returned into functional use. These are notably set amidst six further heritage-listed buildings. The Main Mill now rises out of the UK's 'Heritage at Risk Register' and, together with the Kiln, provides a mix of cultural and commercial spaces.

© Historic England

R

Soho Square

Soho Square, London, W1D 3PX

Status: Built

Completion: 2022

Client: Private

Architect:
Child Graddon Lewis

Structural Engineer:
Corbett + Tasker

MEP: Silver EMS

Heritage: Geoff Noble

© Jim Stephenson

Soho Square is the refurbishment and extension of a listed Georgian townhouse, located in the Soho Conservation Area. The scheme provides contemporary Grade A workspaces whilst restoring many of the building's original features. Whilst utilising sustainable materials, predominantly timber, the design protects the 'special architectural and historic interest of the Listed Building': fabric alterations, both internally and externally, were carried out in an authentic manner, to retain the existing built elements in their original form. The upgrade of the building was undertaken in order to maintain this heritage asset and make it efficient and usable into the future.

© Jim Stephenson

R

TBC.London

224 Tower Bridge Rd,
London SE1 2UP, UK

Status: Planning Granted

Completion: 2022

Client: FORE Partnership

Architect: Stiff + Trevillion

Engineer: Webb Yates

Contractor: Willmott Dixon

TBC.London reuses 60 per cent of the existing building's structure, with a low 265 kg CO2e / sqm GIA, below the LETI guidelines. We are saving 6,365 tonnes of embodied carbon, equivalent to 32 years of operational energy. 1930s steel beams salvaged from House of Fraser make up 10 per cent of the framing at TBC.London — the first time steel of this age has been reused in a UK construction project. The remaining 'new' steel contains more than 56 per cent of recycled content. 99 per cent of waste from construction has so far been recycled or reused, installing re-claimed floor tiles, and floor tiles made from waste materials.

MU R RM

The Forest Garden

625A High Rd
Leytonstone, London E11
4PA, UK

Status: Built

Completion: 2020

Client: London Borough of Waltham Forest

Architect: HUT

Landscape Designer, Contractors: HOS

Community Engagement: Moira Lascelles

© Samir Patel

HUT and HOS have transformed a traffic island into a vibrant community garden. HUT applied a circular approach to construction using innovative methods of utilising construction waste to revalue the connection with our lost natural habitats.
The idea of the garden is to be low-maintenance, visually appealing and to enhance biodiversity. Large areas of impermeable tarmac have been replaced with recycled building aggregate, sand, gravel and timber — allowing natural rainwater runoff to percolate the ground rather than running off into mains drains.

MU RM

© Samir Patel

The Hithe

Albion St, London SE16, UK

Status: Built

Completion: 2021

Client: Southwark Council and Meanwhile Space

Architect: IF_DO

Structural Engineer: Elliott Wood

Fabricator: Weber Industries

Circular Economy Partner: ReLondon

© Mike Massaro

The Hithe is low-cost business incubator space in Rotherhithe, South London, and is a prototype for a new generation of affordable, demountable and reusable meanwhile buildings that can utilise vacant sites for social good. It has been designed for disassembly and will be located on its current site for 11 years before being moved elsewhere. It sits on pre-existing foundations which eliminated the need for new concrete, and was built with part volumetric and part panelised construction.

© Mike Massaro

MU DD

The Loop

Pool St, London E20, UK

Status: Proposed

Completion: 2024

Client: Hackney Wick Community Development Trust and University College London

Architect: Turner Works

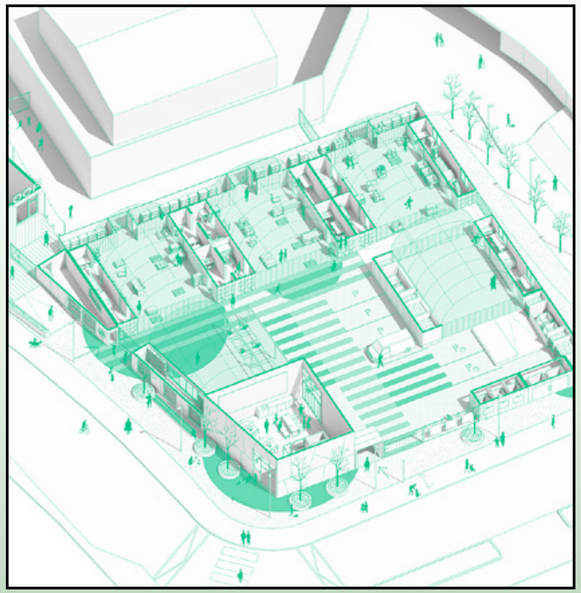
Structural Engineer: Structure Workshop

M&E Engineer: SGA

Cost Consultant: Stockdale

Project Manager: Workwild

The Loop is a new circular economy community, commercial and research cluster for innovative local businesses on the 2012 Olympic site. Designed to embody circular economy principles both in building design and site operation the project is designed as a kit of parts that will be easy to disassemble and relocate in the future. The site will incorporate full scale samples and excess materials from nearby UCL construction sites. The rain screen facade to the site perimeter will repurpose used materials to create an innovative building skin.



MU DD

The Old Vic Annex

103 The Cut, London SE1 8NB, UK

Status: Planning Granted

Completion: 2024

Client: The Old Vic

Architect: Haworth Tompkins

Theatre Consultant: Charcoalblue

Facade Consultant: EOC Engineers

Services Engineer: Skelly & Couch

Structural Engineer: Momentum

Cost Consultant: AECOM

Project Management: Bristow Consulting

BREEAM Consultant: Twin and Earth

Fire Consultant: The Fire Surgery

The Annex will be a new addition to the Grade II* listed Old Vic Theatre, containing a triple height street café, script library, Clore Learning Centre, green room and a rooftop event space. Circularity approach includes: a timber construction, demountable and re-usable at end of building life with an effective use of materials; re-purposing locally sourced theatre barndoor lights to create a colourful brise-soleil; and recycled internal finishes & furniture (100 per cent PET packaging waste, 100 per cent recyclable).

MU DD R RM

The Printworks

Canada Water, London SE16, UK

Status: Planning Granted

Completion: 2027

Client: British Land

Architect: Hawkins\Brown

Development management: AECOM

Multidisciplinary engineers: Arup

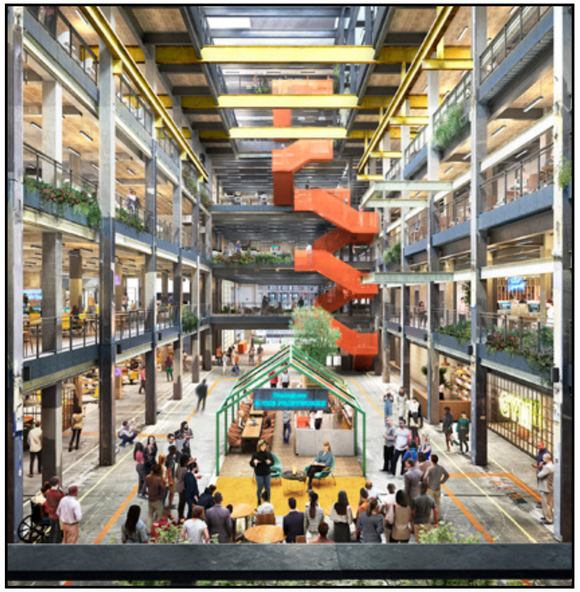
Structural Engineers: Waterman Group

Cost management: Gardiner & Theobald

Acoustic engineering: Sandy Brown

Fire consultants: QFR

Planning consultant: DP9



Part of British Land's Canada Water Masterplan, the project will re-purpose the Harmsworth Quay Printworks to provide an innovative mixed-use destination. Embodied carbon and waste is minimised by retaining existing structure and fabric. A salvage list identifies building elements for reuse. For example, some trusses are to be upcycled into a play structure while key fittings are to be stored and re-purposed around the new proposal. Design will be long life, loose fit and for future disassembly.

MU R DD

The Technical Services Room

4 Church Rd, London
SW19 5AL, UK

Status: Built

Completion: 2022

Client: The All England Lawn Tennis Club

Architect:
Langstaff Day Architects

Structural/Civil Engineer:
Thornton Tomasetti

Landscape Architect: ALD

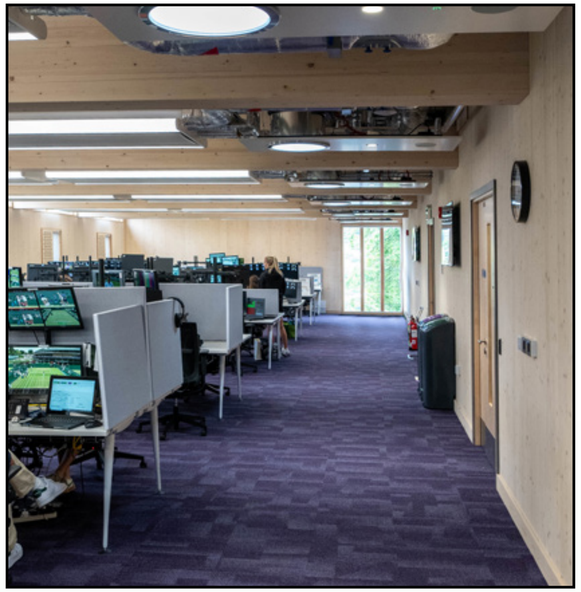
Mechanical Engineer:
ME Engineers

BREAAM: Cundall

Cost: Turner & Townsend

Contractor: Knight Harwood

Photography: Courtesy of The All England Lawn Tennis Club/ Ian Roman/ Joe Toth



The Technology Services Room is a flexible, sustainable hi-tech workspace, home to IT Services for The Championships during the Wimbledon Fortnight. Embodied carbon is reduced by using a lightweight, exposed engineered timber superstructure on reused foundations. Prefabricated panels are designed for disassembly, enabling future building extension or relocation. Long-life, loose-fit principles pervade. Exposed services provide future flexibility. Passive measures such as light-tubes and natural ventilation, minimise operational energy use. A green roof houses PVs, and log piles for creepy-crawlies.

MU DD

Timber Square

2a Southwark Bridge Rd,
London SE1 9HA, UK

Status: Under Construction

Completion: 2023

Client: Landsec

Architect:
Bennetts Associates

Structural Engineer:
Heyne Tillett Steel

Building Services:
Hoare Lea

Timber Square is a hybrid steel/timber office development which has focussed on circularity from the early stages of the project, with the retention of over 75 per cent of the existing structure. Beyond retention of the structure, an early audit was undertaken to target re-purposing on or off-site. New materials target higher than average recycled content (steel, aluminium etc.), with reversable structural connections where possible. Traditionally high carbon internal elements have either been designed out (ceilings) or use as remanufactured products (raised access floors).

R RM

Triangle House

Brook Lapping Productions Ltd, 6 Anglers Ln, London NW5 3DG, UK

Status: Built

Completion: 2020

Client: Private

Architect: Child Graddon Lewis

Structural Engineer: Conisbee

CDM Co-ordinator: Child Graddon Lewis

Approved building inspector: Salus

Main contractor: PG Building Services Ltd

CAD software used: Revit

Energy Assessor: ERS Consultants Ltd

Triangle House is the refurbishment and extension of a small infill site in a historic part of Kentish Town, transforming a disused small office into a 3-storey and 3-bedroom house. The design has been composed to embrace and utilise the triangular footprint and existing character of the site. The triangular site plot provided both the challenge and the opportunity to create a new modern home by reusing existing and neighbouring building fabric to enclose and create part of the proposed 3 storeys house; harnessing where possible the existing embodied carbon from the site context.

R

UNESCO – Building V

7 Pl. de Fontenoy, 75007 Paris, France

Status: Under Construction

Completion: 2025

Client: UNESCO

Architect: Patriarche

Structural + Facade Engineer: Eckersley O'Callaghan

After 55 years of operation, UNESCO's Building V is being transformed — maintaining the building's architectural heritage and reusing its existing facade. Piloting a pioneering approach to recycling flat glass, the existing glass panels will be removed, transported to a recycling factory, and remanufactured into internal glass partitions. Prefabrication in the workshop, an innovative block curtain wall system, and a facade kit of parts approach supports the reuse process — resulting in a reduction of 500 tCO2eq and saving 113 tonnes of existing glazing (equivalent to 34 tCO2eq).

R RM

Warwick Court

Paternoster Sq, London EC4M, UK

Status: Built

Completion: 2023

Clients:
Mitsubishi Estates London and Stanhope

Architect:
Fletcher Priest Architects

Sustainability and Engineering:
Waterman Group

Contractor: Mace

Quantity Surveyor: Alinea

Planning Consultant: DP9

© Selin Oktem

Retrofit of a building on Paternoster Square, with a focus on interventions that seek to revitalise the building include two new terraces, new reconfigured reception and entrance and a comprehensive office floor refurbishment. By retaining 90 per cent of the structure, including the façade, the project saved over 20,000 tonnes of embodied carbon (71 per cent reduction). 25 tennis courts worth of carpet tiles were reused elsewhere in the client's portfolio. Together with enhanced plant, Warwick Court achieved EPC A rating and received BREEAM Excellent certification.

© Stale Eriksen

R MU

Waterloo Hub

Kennington Rd, London, UK

Status: Planning Granted

Completion: 2025

Client: Palm Holdings
Architect: Studio Moren
Landscape Architect:
Phil Allen Design
Structural Engineer:
Heyne Tillet Steel
Transport Engineer:
TTP Consulting
Planning Consultant:
ROK Planning / DP9
Services, Fire, Acoustics,
Air Quality & Sustainability
Consultants: Elementa Consulting
Heritage, Townscape and
Archaeology Consultants:
Iceni Projects
Verified Views: AVR London
Community Engagement:
Local Dialogue

© Studio Moren

This proposal extends a building's life and revitalises a prominent intersection in London. A six-storey hotel will be refurbished and extended while introducing a fourteen-storey tower over an existing car park. The retention of the existing hotel on the site breathes new life into it and reduces carbon emissions from total demolition and rebuild. The old and new are linked through form, materiality and a glazed podium building creating a new place within the community to eat, drink and work.

R

Zodiac Pavilion

165 London Rd, Croydon, London CR0 2RJ

Status: Proposed

Completion: 2024

Client: Common Projects

Architect: shedkm

Structural Engineer: Whitby Wood

Original CLT Manufacturer: Egoin

Contractor: ConstructCLT

Previous client: Urban Splash

© Image credit

Broad Green Common at the Zodiac development in Croydon will see a timber marketing suite repurposed into a new community café and pavilion. The bold architecture of the pavilion will enliven the high street by creating a new, visible centre. The pavilion is constructed from cross laminated timber and is designed and engineered to produce zero fabrication waste. Structural components were prefabricated offsite and assembled in two days, and it can be disassembled and repurposed, making it fully recyclable.

R DD

GUIDANCE & TOOLS

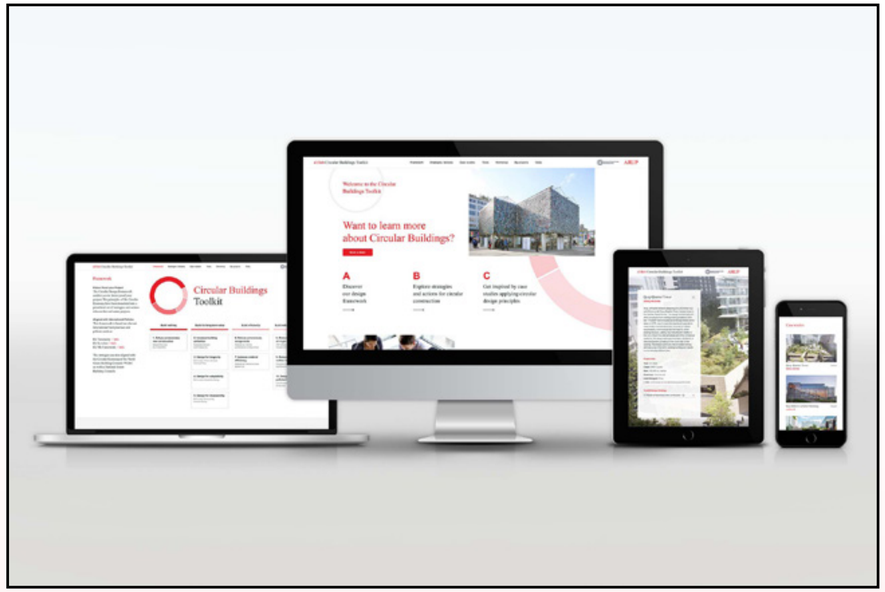
Circular Buildings Toolkit framework

Developed by Arup and the Ellen MacArthur Foundation

The Circular Buildings Toolkit framework, developed by Arup and the Ellen MacArthur Foundation enables you to futureproof your project. The principles of the circular economy have been translated into a prioritised set of strategies and actions relevant for real estate projects.

This framework is based on relevant international best practices and policies such as the EU Taxonomy. The strategies are also aligned with circular economy recommendations from the World Green Building Council as well as National Green Building Councils.

For more resources on circular economy in the built environment and cities, visit: ellenmacarthurfoundation.org



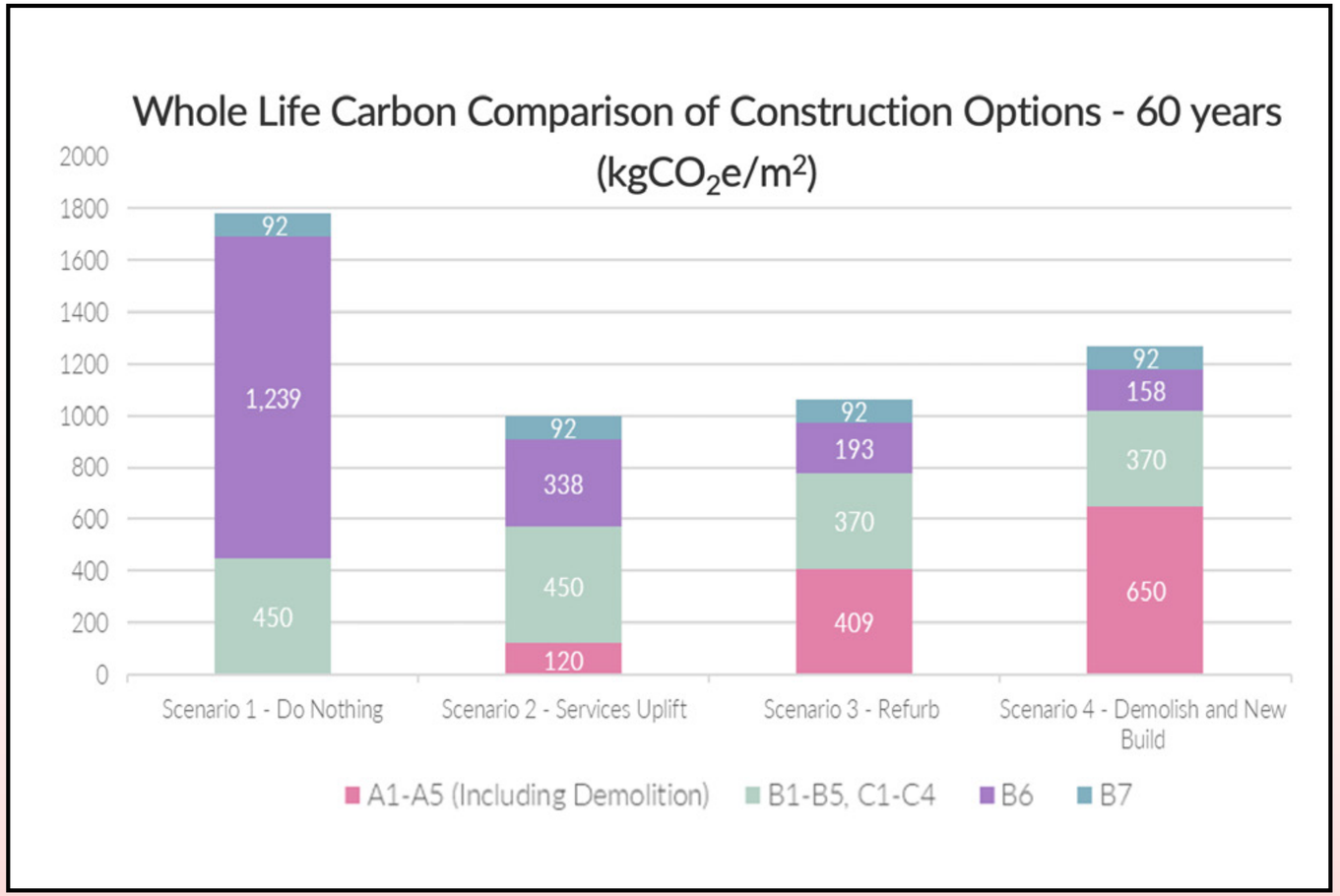
Circular Buildings Toolkit

ELLEN MACARTHUR FOUNDATION ARUP

Early Stage Whole Life Carbon Appraisal Tool

Author: Hoare Lea

At the business case appraisal stage, early decisions on the extent to which a refurbishment is a satisfactory alternative to new construction is a strong influence in whole life carbon (WLC). In refurbishment projects considering opportunities to retain building elements and maximise the use of reclaimed materials will help to avoid upfront carbon. To assist clients and project teams in early stage decisions Hoare Lea has developed a simple tool to evaluate whole life carbon outcomes of different retrofit and construction scenarios. The tool can be used to provide early estimates of WLC and allow clients and consultants to compare different design options.



HTS Reused Steel Stockmatcher

Heyne Tillett Steel

Heyne Tillett Steel Structural & Civil Engineers has built a tool to facilitate using reclaimed steel in new building projects. The HTS Reused Steel Stockmatcher is an innovative tool for fast and accurate stock matching of reused steel in new structures.

The system is based in Excel with Python-based functions to carry out the evaluation. It compares steel stock lists from reused stockholders with a design list to automatically find ideal pairings, where the section properties and the lengths are close matches. It has extra features to maximise efficiency: as stock beams are assigned, their offcuts are fed back into the stockpile and to be matched with other beams. It also optimises the process by repeating the exercise through automatically shuffled design lists and selects the cycle with the best overall material efficiency. The HTS Stockmatcher requires only Excel to run. It quickly solves the current problem of how to best use reclaimed steel in buildings, maximising the efficient use of this low carbon material. The interface is simple, the inputs are flexible, and the results can be easily interrogated.

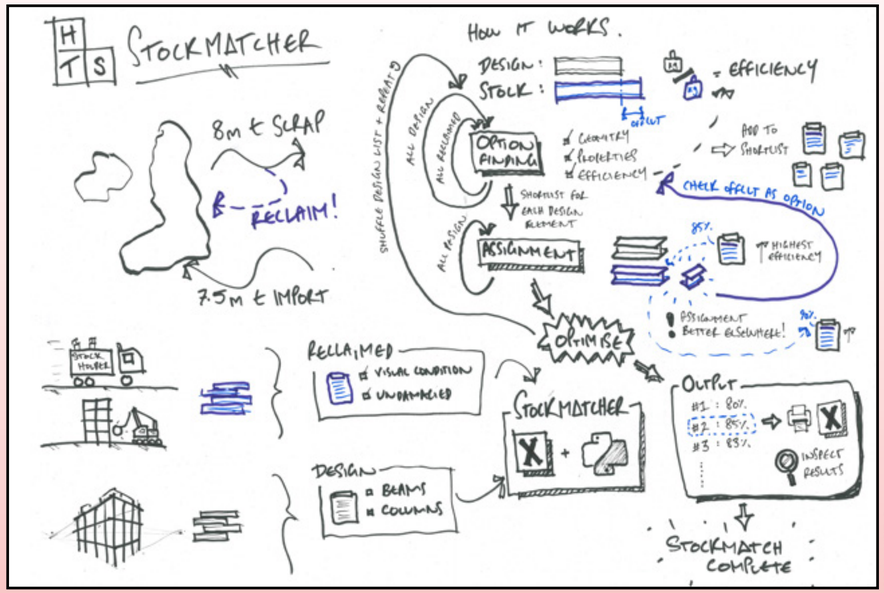
The HTS Stockmatcher will be released for free to the industry in June 2023.

"At its core the HTS Stockmatcher is a solution to a simple question: how can we best use reclaimed steel in new buildings? The key challenge is that the exact steel beams and columns you need are not likely to be in the pile. This forced us to make our own system.

The HTS Stockmatcher is based in Excel, it runs in seconds and provides outputs that are easy to interrogate. This means no design software is required to run it, making it accessible to all in the industry. We hope it encourages the exploration and uptake of reused steel in buildings across London."

Laura Batty, Associate, Technical Research & Sustainability, Heyne Tillett Steel

©Philip Vile



© Liam Ross

Waterman Materials Passports Framework

Lead Author:
Waterman Group

Contributor: BRE

Contributor: CIRCuIT

The re-use of materials has been identified as a crucial strategy for addressing the climate emergency and is central to our industry's plans for delivering a Net Zero built environment.

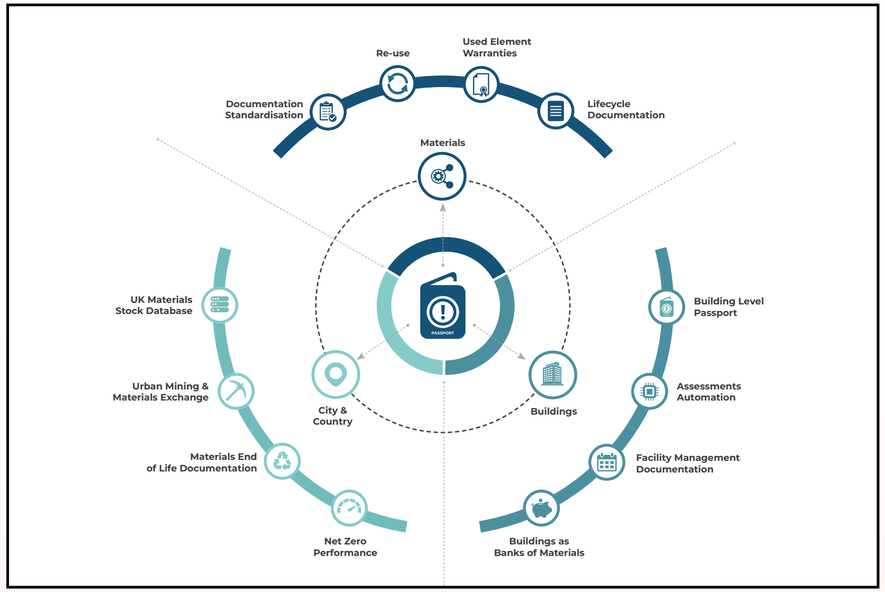
Waterman's innovative Materials Passports (MPs) initiative is helping maximise the circularity of construction materials by documenting their identity, specifications and performance throughout their lifecycle. MPs are currently being piloted at BauMont Real Estate Capital and YardNine's Edenica commercial development in the City of London, where they are helping to increase the material lifespan and whole life value of key structural elements.

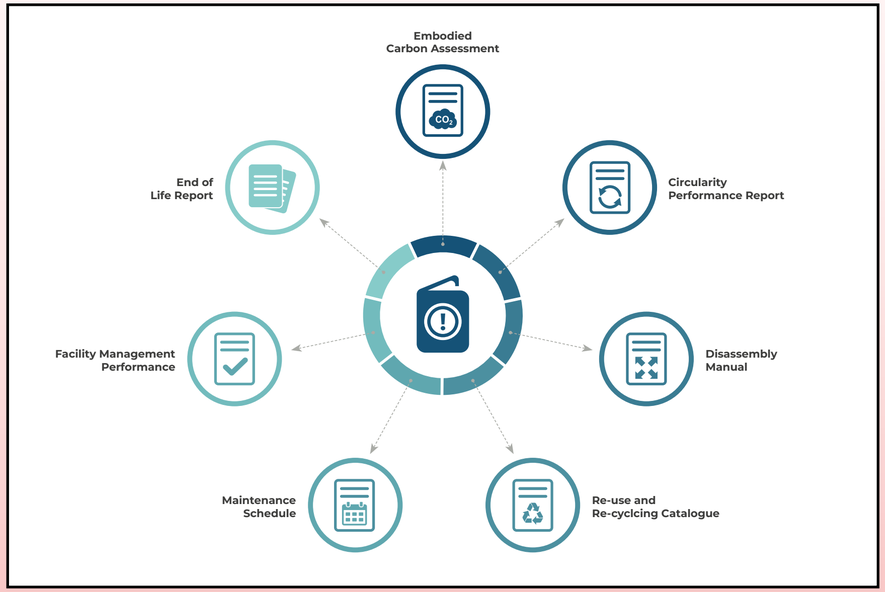
Representing the next step in bringing MPs to the wider industry, the Material Passport Framework document was developed by Waterman following detailed research and collaboration with CIRCuIT and BRE. This document presents a standardised approach to creating Materials Passports which can be applied to any type or scale of construction, refurbishment or infrastructure scheme, with the aim of kick-starting a thriving circular economy. The document will be presented to industry bodies and policy makers, with the aim of seeing Materials Passports adopted as part of their wider circular economy strategies.

The document defines what MPs are, outlines their scope and explains the benefits of the different levels. It also details the content and structure for each level, providing clarity on the data structure of MPs and identifying links between the building level and product level passports, which can result in automating the process of producing MPs for whole buildings. In addition, the Framework provides clarity on how BIM models can support the production of MPs, and offers recommendations for their implementation, detailing the required steps and outlining key roles and responsibilities. Finally, the document summaries the 'next steps' needed to establish the production of MPs as industry standard practice.

"The Materials Passports Framework is a new initiative for our industry. We started from a blank canvas, so this document acts as a baseline to set out the key attributes, levels and processes which underpin the production of Materials Passports. This initiative has the potential to re-shape our sector's approach to design, seeing circularity designed-in from the outset. We believe this document will provide the foundation to help maximise the impact of Materials Passports, establishing a new benchmark for recording and formalising circularity within our industry with the ultimate aim of driving a thriving circular economy."

Mark Terndrup, Waterman's Managing Director of Building Services – South





Circular Economy and Reuse: Guidance for Designers

Authors: Elliott Wood and Grosvenor Britain and Ireland

Contributors: GBG, Orms, LWARB (Now ReLondon), Rotor, HETA, Arup

This forthcoming publication from the IStructE, co-authored by Elliott Wood's Head of Sustainability, Penny Gowler, provides actionable guidance for incorporating circular principles on engineering projects, enabling structural engineers to lead clients and project teams through the process.

MU R DD RM MP

Hierarchy of Responsible Retrofit

Author: Laura Baron, Head of Sustainability, Purcell

Purcell developed a Hierarchy of Responsible Retrofit which is based on a 'whole building' approach, which considers a building as a system of interconnected materials, functions and users, and founded on the principle that the greenest (and cheapest) energy, is the energy you don't use. Much can be achieved by changing behaviour, avoiding waste, using efficient controls, equipment and materials.

MU R

The ‘Full Circle to Reuse’ Guide

Authors:
Elliott Wood, Grosvenor Britain and Ireland

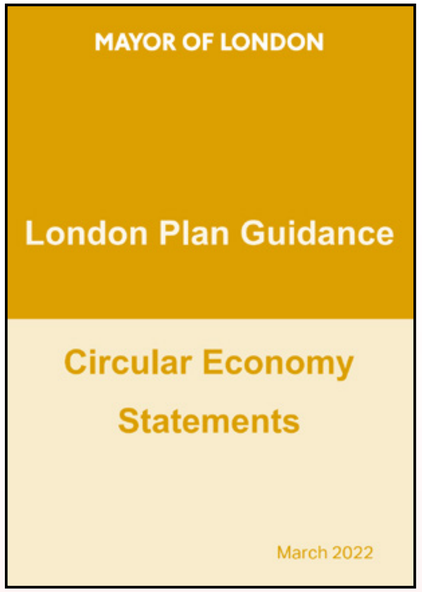
Working with Grosvenor, Elliott Wood’s 12-step ‘Full Circle to Reuse’ guide sets out an actionable framework to help architects, developers, construction, contractor and demolition firms take steps to implement reuse on their schemes. It is mapped against the RIBA Plan of Work 2020 and available to download on Elliott Wood’s website.

MU

The Mayors’ London Plan Guidance: Circular Economy Statements

Greater London Authority

Contributors:
Built environment stakeholders including developers, architects, contractors, technical consultants, the public sector and academia.

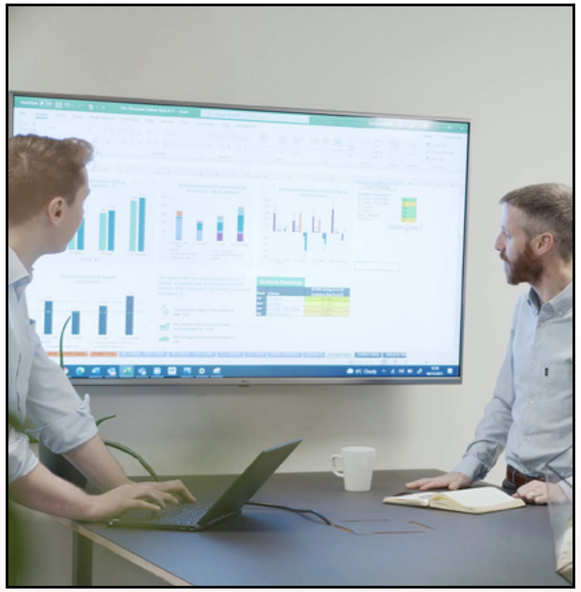


London consumes 400 million tonnes of material each year and accounts for 48 per cent of waste. The first of its kind, the Mayors’ London Plan Guidance on Circular Economy Statements will help reduce construction waste and associated emissions through incorporation of circular principles into the design, construction and operation of a development — supporting London’s transition to circular economy.

MU R DD RM MP

The Structural Carbon Tool

Author: Elliott Wood,
Institution of Structural Engineers



Developed by Elliott Wood in conjunction with IStructE, this carbon estimator was donated to the industry to empower all engineering firms to reduce the embodied carbon in their designs — regardless of the firm's size or resources. Downloaded over 7,000 times worldwide, the tool won Best Sustainability Initiative at the Memcom Excellence Awards 2022.

RESEARCH & CONCEPTS

Afterlife

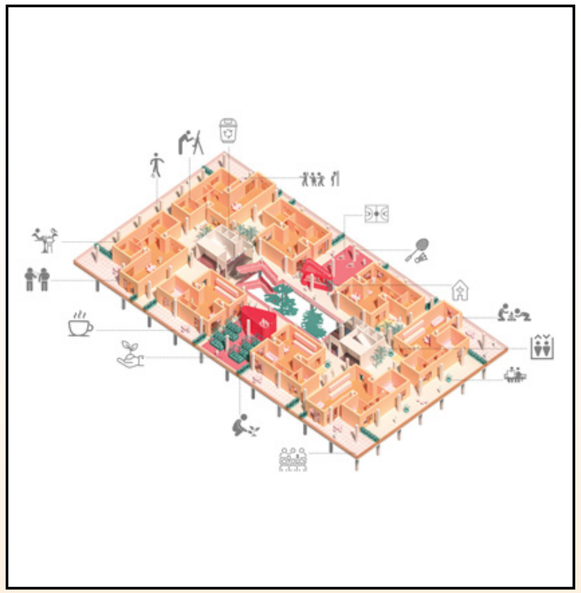
Architect:
NAME Architecture

Structural Consultant:
Engineeria

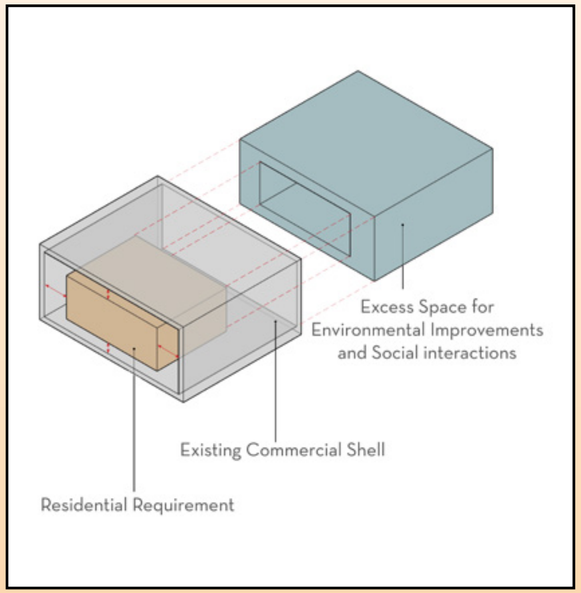
Environmental Consultant:
XCO2

Fire Consultant: AURA Fire

QS: CAST consultancy



Afterlife is a design concept that works with existing structures and retrofits them for new, greener uses with pre-fabricated dwelling units and communal amenities. Sustainable materials or those that sequester carbon are used for the new insertions. Designed with pre-fabricated dwelling units made using natural and innovative biomaterials, this project aims to achieve enhanced environmental sustainability. The proposal aspires to be net zero or carbon positive over its lifetime. The proposal was developed as a generic concept to be tested on several sites — this is currently being undertaken both in the UK and France, confronting the idea to the various regulations and site conditions.



R

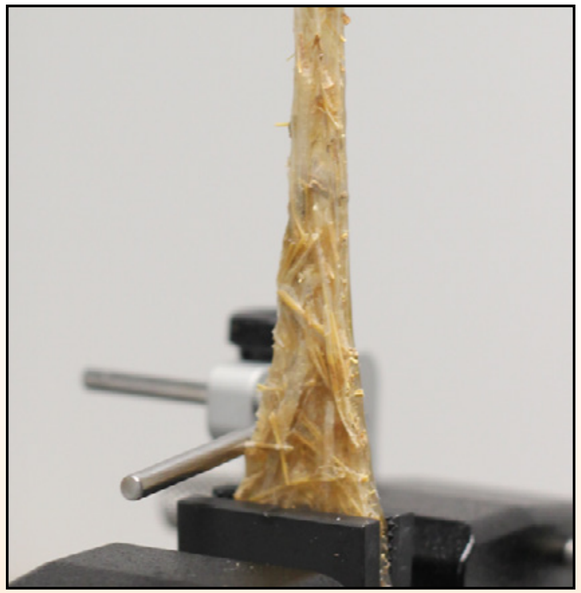
Babassu Fibre-Reinforced Natural Rubber Bio-composite

Author: Tropisms

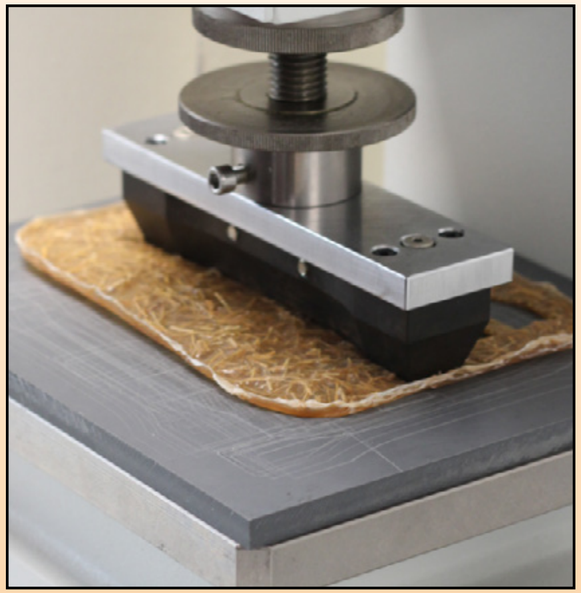
Research Development:
Bio-ID (University College London)

Material Test:
Bangor Biocomposite Centre (Bangor University)

Material Provider:
Associação de Emprendedores Rurais de Boa Vista



The research concentrates on how the largely disposed by-products from the babassu palm tree industry and the liquid natural rubber latex extracted from rubber trees can help produce local construction material on-demand to substitute the use of plastic sheets in rural projects in Brazil. Rubber and babassu occurrence overlap in several regions, hence the relevance of the study to local economies.



RM

Crinkle-Crankle Concrete

AKT II, White Collar Factory, 1 Old Street Yard, London EC1Y 2AS

Status: Built

Completion: 2022

Client:
Seratech & London Design Festival

Designer: AKT II

Contractor: Byrne Bros

© Mark Harrington / AKT II

This architectural installation — for the 2022 London Design Festival (LDF) — leverages an Ancient Egyptian wall-building technique for the first public showcase of Seratech's novel carbon-neutral concrete. The blocks together tell Seratech's story; each one shows a unique step in the material's development from traditional Portland cement through to Seratech's novel cement-replacement.

© Mark Harrington / AKT II

RightSizer at Meridian Water

Pickett's Lock Ln, London N9 0BA, UK

Status: Proposed

Completion: 2025

Client:
London Borough of Enfield

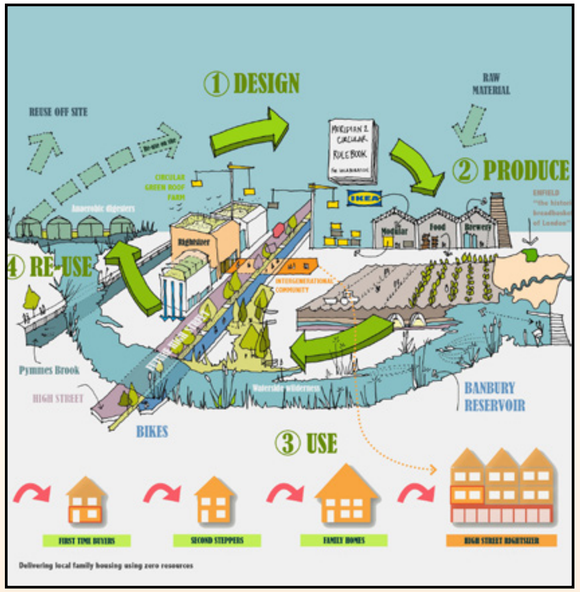
Architect:
Assael Architecture

Structural Engineer, M&E / Sustainability Engineer, Cost Consultant: AECOM

Landscape Architect:
Exterior Architecture

Collaborating Architect:
ArchitectureDoingPlace

Social Value:
Hatch Regeneris



A collaborative project with the UKGBC, CIRCuIT and Futureground, RightSizer sets a roadmap to circular MMC on large-scale developments and targets whole lifecycle embodied carbon emissions of 300kgCO2e/m2, closely aligning with LETI 2030 guidance. This is achieved through a structure designed entirely for disassembly and reuse, with standardised components, interoperable connections and digital passports to enable buildings to be reconfigured for many uses long into the future, and is maximised by locally manufactured components and new recycling technologies such as low-carbon cement.

MU MP DD

ENDNOTES AND FURTHER READING

ENDNOTES

1 https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview#principles

2 https://ellenmacarthurfoundation.org/topics/built-environment/overview

3 (Climate Change Committee: Report 'Progress in reducing emissions – 2023 report to Parliament')

4 https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview#principles

5 https://relondon.gov.uk/wp-content/uploads/2021/06/ReLondon-Sourcing-reclaimed-construction-materials-May-2021.pdf

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7 https://relondon.gov.uk/wp-content/uploads/2021/03/LWARB-Londons-CE-route-map_16.6.17a_singlepages_sml.pdf

8 https://www.routledge.com/Building-Revolutions-Applying-the-Circular-Economy-to-the-Built-Environment/Cheshire/p/book/9781859466452

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25 https://www.architectsjournal.co.uk/news/introducing-retrofirst-a-new-aj-campaign-championing-reuse-in-the-built-environment

26 https://www.leti.uk/_files/ugd/252d09_ecec993000bf4cf9acba953b845eb9af.pdf

FURTHER READING

+ Sourcing reclaimed construction materials – ReLondon ↗
+ Circular Economy playbook – the Danish Design Centre ↗
+ The Full Circle to Reuse Guide – Elliott Wood and Grosvenor Britain & Ireland ↗
+ London Plan Guidance: Circular Economy Statements – The Mayor of London ↗
+ The Handbook to building a circular economy – David Cheshire ↗
+ Circular Buildings toolkit – Arup ↗
+ Retrofit First, Not Retrofit Only: A focus on the retrofit and redevelopment of 20th century buildings – London Property Alliance ↗
+ FCRBE: Facilitating the circulation of reclaimed building elements in Northwestern Europe ↗
+ Reuse toolkit – Rotor ↗

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ACKNOWLEDGEMENTS

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NLA is London’s built environment community; a membership organisation for everyone with an interest in London’s built environment. Its purpose is to help make London a better place to live, work and visit. Its mission is to engage with professionals, politicians and the public to deliver positive change in the city.

NLA's activities include events, exhibitions, tours, research, publications, learning, websites and social media, awards and competitions, as well as the London Festival of Architecture. NLA's public gallery and event space, the London Centre, is based in the City of London and hosts its London Models.

Join our community today ↗

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