UK GBC
Together for a better built environment

ADVANCING NET ZERO

Unlocking the Delivery of Net Zero Carbon Buildings

NOVEMBER 2020

Advancing Net Zero Programme Partners

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JLL

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Project supporter

JLL

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- AECOM
- EPR Architects
- JLL
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- Lendlease
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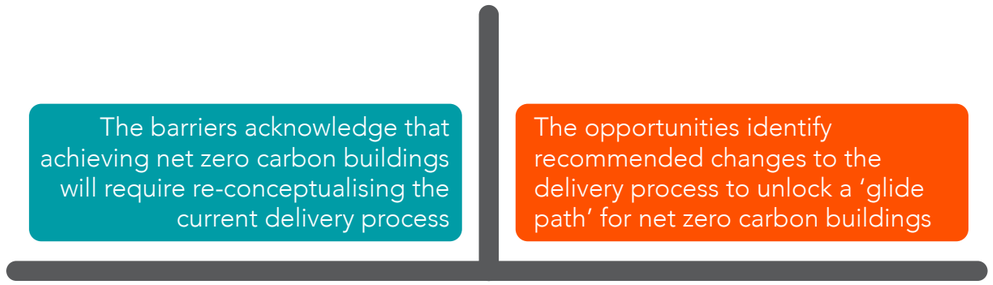
Contents

Executive Summary

UKGBC's Advancing Net Zero programme is helping drive the transition to net zero carbon buildings, including through its publication of the Net Zero Carbon Buildings Framework.[1] In September 2020, UKGBC published Building the Case for Net Zero[2] to provide the industry with an evidence base on the design changes needed to achieve net zero performance targets and the effect this has on capital cost. The study found that, in addition to design and cost changes, achieving net zero buildings requires rethinking the typical delivery process.

This guidance document is intended to help developers and project teams set strategies at the outset of any project to streamline the delivery of net zero carbon buildings. It identifies barriers that are likely to emerge through RIBA Stages 0-7 and provides associated opportunities for how these can be overcome.



A total of 17 barriers and associated opportunities have been identified in this document and grouped into four key themes:

Design – ways to integrate net zero carbon into the building design or design process. This includes setting net zero carbon outcomes early in the project's strategy which can inspire design teams to think innovatively.

Cost – ways to finance net zero carbon buildings. This includes accounting for future 'brown discounts' and 'green premiums' and a shift in perspective to whole life investment rather than just immediate capital expenditure.

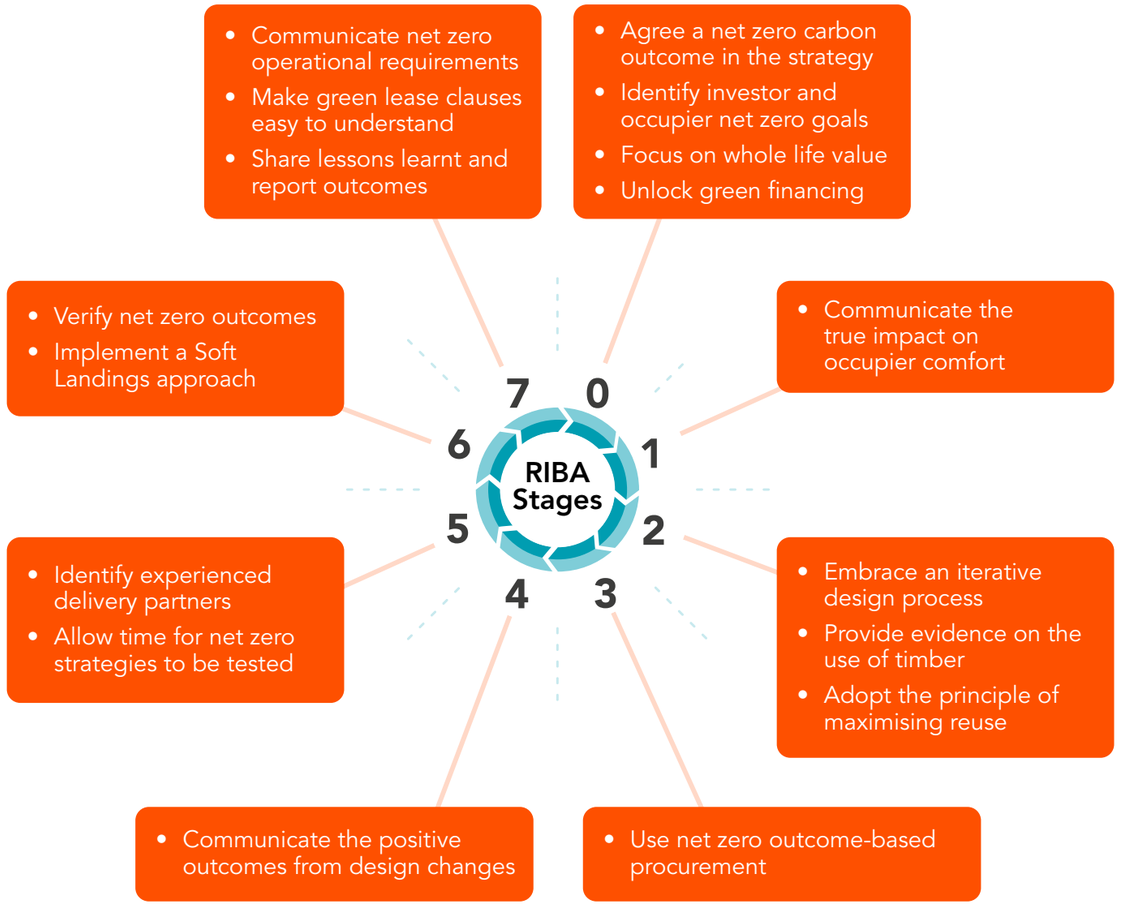
Stakeholder engagement – ways to integrate net zero carbon into the decision-making process of all stakeholders. This includes identifying growing investor and occupier net zero ambitions.

Innovation – ways of capitalising on new processes, mechanisms, and technologies to achieve net zero buildings. This includes using new financing mechanisms and alternative building materials.

The guidance in this document embraces the market shift towards net zero and, through practical resources and case studies, demonstrates that net zero buildings can be delivered today. Whilst barriers are likely to be encountered across all delivery stages, the guidance provides associated opportunities for how these can be overcome.

We hope this guidance helps developers and their project teams unlock the delivery of more net zero buildings. However, it is not able to provide all the answers and UKGBC intends to build on this work as new knowledge is gained and solutions uncovered.

Figure 1: Summary of 17 opportunities for unlocking net zero carbon buildings



Introduction

The UK's 2050 net zero carbon target, corporate ESG drivers, and increased occupier interest in net zero are just three reasons why developers and investors are becoming acutely aware of the need to deliver net zero carbon buildings. By better understanding the practical implications of delivering net zero buildings, developers and project teams can be made more resilient to future operating conditions and pivot to embrace the upcoming change.

In the UK, the operation of buildings accounts for around 30% of carbon emissions, mainly from heating, cooling and electricity use.[3] For new buildings, the embodied emissions from construction can account for up to half of the carbon impacts associated with the building over its lifecycle.[4] UKGBC's Advancing Net Zero programme is helping to drive the transition to net zero carbon buildings, including through its publication of the *Net Zero Carbon Buildings Framework Definition* [1] in 2019.

In September 2020, UKGBC published *Building the Case for Net Zero: A feasibility study into the design, delivery and cost of new net zero carbon buildings*.[5] It provides the industry with an evidence base on the design changes needed to achieve net zero performance targets and the effect this has on capital cost. The study found that, in addition to design and cost changes, net zero buildings require changes to the typical delivery process.

This guidance is intended to help developers and project teams identify and respond to likely barriers throughout the process of delivering net zero carbon buildings. Each barrier is accompanied by a corresponding opportunity that explores how to overcome it. These are mapped across the RIBA Stages (0-7), which allows the guidance to be considered in tandem with a project's plan of works, and integrated with other pieces of guidance, including UKGBC's *Circular economy guidance for construction clients*[6] and LETI's *Client Guide for Net Zero Buildings*,[7] which will be published in 2021.

The 17 opportunities identified are approaches that we believe will assist developers and project teams to plan, design, construct and handover net zero carbon buildings. However, they are opportunities only and each project team will need to turn them into real-world solutions. Importantly, these opportunities need to be explored early in the project's delivery to set strategies that avoid the associated barrier entirely – this guidance should be read in full during RIBA Stage 0.

The list of barriers and opportunities that will be encountered is not considered exhaustive for developments, and as the market gains greater knowledge and experience in delivering new net zero buildings, UKGBC hopes to expand on this guidance.

Figure 2: This guidance builds on and supports other outputs from UKGBC's Advancing Net Zero Programme

KEY

The nature of each barrier and associated opportunity has been tagged with one or more of the icons listed below, to give readers a better understanding of what each relates to. Practical resources and case studies are also highlighted to provide further insight on relevant opportunities.

Design
How to integrate net zero carbon into the building design or design process.

Cost
How to finance net zero buildings.

Stakeholder engagement
How to integrate net zero carbon into the decision-making process.

Innovation
How to use new processes, mechanisms, and technologies to achieve net zero buildings.

This guidance was initially developed with insights from the project teams working on the *Building the Case for Net Zero* report, combined with views from a cross-section of teams led by JLL, plus feedback from a number of UK signatories to WorldGBC's Net Zero Carbon Buildings Commitment.[8]

Whilst the guidance has been developed in response to a commercial office development and a build-to-rent housing scheme, it has been generalised and can be considered relevant for a range of other new development and major refurbishment projects.

Table 1: Summary of barriers and opportunities for unlocking net zero carbon buildings

	Design	Cost	Stakeholder Engagement	Innovation	Barrier	Opportunity
RIBA Stage 0: Strategic Definition						
1			●		Net zero carbon is not part of the strategy	Agree a net zero carbon outcome in the strategy
2	●		●		Organisational net zero targets are not reflected in the building design	Identify investor and occupier net zero goals
3	●	●			Capital expenditure is king	Focus on whole life value
4		●		●	Requirement for additional capital expenditure	Unlock green financing
RIBA Stage 1: Preparation and Brief						
5	●		●		Perceived impact on occupier comfort	Communicate the true impact on occupier comfort
RIBA Stage 2: Concept Design						
6	●			●	Linear design process	Embrace an iterative design process
7			●	●	Limited use of timber in construction	Provide evidence on the use of timber
8	●			●	Limited reuse of existing buildings and materials	Adopt the principle of maximising reuse
RIBA Stage 3: Spatial Coordination						
9	●		●		Value engineering net zero specifications	Use net zero outcome-based procurement
RIBA Stage 4: Technical Design						
10	●		●		Prevailing market expectations	Communicate the positive outcomes from design changes
RIBA Stage 5: Manufacturing and Construction						
11			●	●	Limited capability and capacity in the supply chain	Identify experienced delivery partners
12		●		●	Compressed timelines leading to inefficient outcomes	Allow time for net zero strategies to be tested
RIBA Stage 6: Handover						
13			●	●	Limited market recognition of net zero buildings	Verify net zero outcomes
14			●		As-built outcomes fall short of design	Implement a Soft Landings approach
RIBA Stage 7: Use						
15			●		Net zero aspirations not translated into operation	Communicate net zero operational requirements
16		●	●		Minimal green lease uptake	Make green lease clauses easy to understand
17			●		Minimal post-project evaluation	Share lessons learnt and report outcomes

Delivery Guidance (RIBA Stages 0-7)

STAGE 0: STRATEGIC DEFINITION

Barrier: Net zero carbon is not part of the strategy

Traditionally, the individuals responsible for the carbon and broader environmental strategy for a building are not involved until RIBA Stage 2 or later. This can result in the agreed strategic outcomes and financial appraisals not accounting for the delivery of a net zero carbon building. This also increases the risk of net zero carbon design strategies being 'value engineered' out later in the delivery process.

Opportunity: Agree a net zero carbon outcome in the strategy

The vision can be high-level, though it should set out key elements of the building's desired outcome. For example, does the client want the building to achieve net zero? Does the net zero scope include 'construction' and/or 'operational energy' as per UKGBC's net zero framework,[1] or some variation of that? Additional technical expertise may need to be brought on early in the process to supplement the knowledge of the agent, development/ project manager, and client.

This vision can then be developed into a strategy which should include a robust framework for achieving the outcomes, a well-coordinated design team, and a process for auditing the design to ensure that targets are being met along the way. Awareness at the outset that the project is to be ambitious in its approach should foster a sense of commitment and an innovative approach by the design team.

BSRIA's *Soft Landings Core Principles*[9] should be adopted from the outset to define a Soft Landings approach which will help deliver performance-driven, net zero carbon outcomes. BBP's *Net Zero Carbon Pathway Framework*[10] can also be used by owners and investors to help this process, by setting organisational net zero strategies which can inform project level strategies. Specifically, Table 2 in the framework provides guidance on setting delivery strategies for new developments.

Developers can also develop their own net zero design briefs and specifications to bridge the disconnect between net zero aspirations and the decision-making that follows.

0
Stategic
Definition

Barrier: Organisational net zero targets are not reflected in the building design

More and more investors, developers, and occupiers are setting 'net zero' targets, but this is often not reflected in the decision-making process when developing and acquiring buildings.

Opportunity: Identify investor and occupier net zero goals

Developers could link their investors' and occupiers' organisational net zero goals with the buildings they invest in and occupy. Similarly, property agents should engage with occupier clients on their sustainability ambitions to better understand and promote these. This should include challenging whether a new building is required or whether more efficient use of existing space or a retrofit is a better solution.

More than 30 companies in the UK have now signed up to the *Net Zero Carbon Buildings Commitment*,[11] and through 2019 there was a doubling in the number of companies with a central London presence who signed up to science-based targets.[12] For these companies, moving to a low carbon or net zero building is one of the easiest ways to decarbonise their footprint.

Similarly, investors who are setting science-based targets or committing to net zero, via mechanisms such as *Science Based Targets*[13] and *UN Net Zero Asset Owner Alliance*,[14] are becoming increasingly aware of the impact of a new acquisition or disposal on their emissions footprint. Net zero carbon buildings provide an attractive investment to de-risk portfolios and align with strong corporate drivers.

From a legislative perspective, it will be mandatory for many large companies in the UK to report their carbon emissions and exposure to climate risks from 2025,[15] in line with the recommendations of the *Taskforce on Climate-related Financial Disclosures*.[16] Businesses are pivoting to align with these economic trends, and recently published net zero trajectories, such as the *Carbon Risk Real Estate Monitor*[17] and *UKGBC's energy performance targets for offices*,[18] indicate the level of performance expected from buildings to align with a net zero carbon economy.

Barrier: Capital expenditure is king

UKGBC's *Building the Case for Net Zero* report identified that there is an increase in capital costs in order to deliver net zero buildings. If the financial decisions only account for capital expenditure and not the broader returns through the whole life of the building and changing market expectations (see above) then delivering a net zero building could be deemed financially unviable.

Opportunity: Focus on whole life value

UKGBC's *Building the Case for Net Zero* report identified that the increase in capital costs is relatively marginal and can be recouped when taking a longer-term, whole life investment perspective, including the value uplift.

As an example, the report found that a switch from a gas boiler to air source heat pump in the office study not only significantly reduced energy, but also resulted in a cost saving of 30-40% over a 30 year period (see 'Whole life costing' section of the report). Buyers will ultimately underwrite these lower operating costs upon acquisition, helping to make the value case.

Other examples of whole life cost savings from designing to net zero include:

- Reduced energy spend due to finely tuned and highly-efficient building systems.
- Reduced maintenance costs due to optimised provision and operation of mechanical systems.
- Reduced fitout costs due to dematerialisation of end finishes.
- Reduced future costs for carbon offsetting and requirements for retrofit, which are both likely to increase.

There is increasing evidence that low to net zero carbon buildings command a value premium. JLL's *Impact of Sustainability on Value*[12] report shows that sustainable office buildings can result in an increased rental value of 6-11% and lower void periods which could potentially outweigh increases in capital costs for new net zero buildings.

0
Stategic Definition

Barrier: Requirement for additional capital expenditure

UKGBC's *Building the Case for Net Zero* report calculated the additional capital expenditure to make the office and high-rise residential development net zero in the order of 6.2% to 17% and 3.5% to 5.3%, respectively. See *Stage 1: Preparation and Brief* for further detail.

Opportunity: Unlock green financing

A growing number of initiatives exist to mobilise capital and debt for financing zero carbon solutions, including built assets.[19] An increasing amount of investment capital is being allocated to sustainable buildings[20] and transferring assets through innovative approaches, such as service models, rather than an upfront capital cost to owners.

Some lenders are offering preferential borrowing rates for low to zero carbon developments and initiatives that support this. Two current examples are NatWest Group's green mortgages for residential buildings[21] and the revolving credit facility for Derwent London from HSBC UK, Barclays and NatWest.[22] See case studies below.

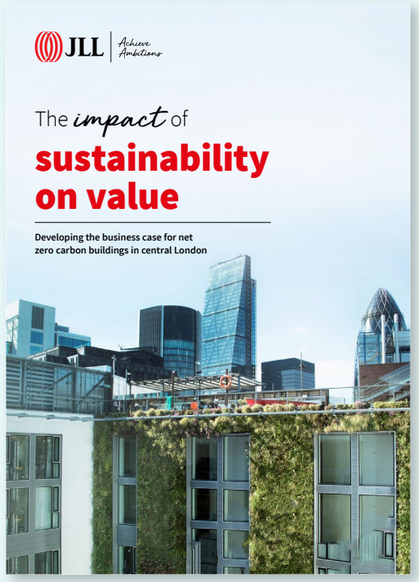
Where green financing can be secured, the development will need to verify it meets low carbon or net zero standards at completion, ideally via a recognised third-party scheme (see *Stage 6: Handover*). This can help reinforce the project's vision by ensuring outcomes set early on are verified at completion, reducing risks of 'value engineering' net zero carbon design strategies.

RESOURCE: JLL Impact of Sustainability on Value

JLL's report examines trends in the performance of sustainable office buildings in central London, in terms of rental values and leasing velocity. It focuses on space that has a BREEAM rating or EPC certificate and sets out to quantify to what extent demand for sustainable offices is increasing.

The research reveals that sustainable buildings in central London have a rental premium in range of 6% and 11%; and that at both 12 months and 24 months after completion, vacancy was lower in buildings with an Outstanding/Excellent BREEAM rating compared to those that were rated Very Good.

The report concludes that there will be a rental premium for net zero carbon buildings in central London for those that can deliver effectively and fast. Even with a potential increase in construction costs, JLL estimates that the rental premium and yield compression could take a typical scheme from 15% profit on cost to over 20% profit on cost.



0
Stategic Definition

CASE STUDY: Green Finance

NatWest Green Mortgages

The Green Mortgage offers a discounted interest rate to customers purchasing a property with an Energy Efficiency Rating of A or B. Every home must have an Energy Performance Certificate (EPC) when it is built, sold or rented – this gives the property an energy efficiency rating from A or 100 (most efficient) to G or 0 (least efficient) and is valid for 10 years. The Green Mortgage supports the bank's pledge to help customers become more energy efficient with an ambition that 50% of the bank's mortgage book is at or above EPC C or equivalent rating of C by 2030.

Revolving Credit Facility for Derwent London (with HSBC UK, Barclays and NatWest)

Derwent London, the largest London-focused Real Estate Investment Trust (REIT), has agreed and signed a new five-year £450 million revolving credit facility (RCF) from HSBC UK, Barclays and NatWest. The financing includes a 'green' tranche of £300 million, making it the first revolving credit facility provided to a UK REIT that meets the LMA Green Loan Principles. The green tranche is available to fund activities that satisfy the criteria set out in Derwent's newly established 'Green Finance Framework'. This describes the Group's sustainability objectives and outlines how Derwent intends to fund projects that will deliver first-class working, amenity and outdoor spaces, improved energy efficiency and reduced consumption of natural resources.

STAGE 1: PREPARATION AND BRIEF

Barrier: Perceived impact on occupier comfort

There may be a perception by occupiers that a net zero carbon building is only possible at the expense of indoor comfort (e.g. lower ventilation rates, less lighting, poor thermal comfort, limited system flexibility).

Opportunity: Communicate the true impact on occupier comfort

Owners, developers, project teams and property advisors need to understand that net zero can be achieved through better building design with no discernible negative impact on internal comfort, and this information needs to be communicated to occupiers. Training for how to get the right balance between comfort levels and energy efficiency is also critical (see *Stage 6: Handover*).

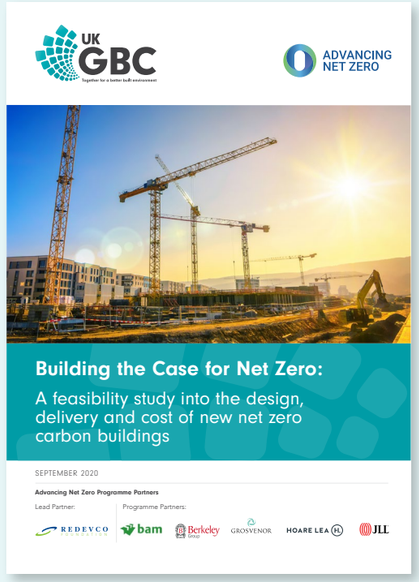
This shift in market perception can only be achieved with an interrogation of current design standards. For example, UKGBC's *Building the Case for Net Zero* report found achieving high levels of energy efficiency for the office project meant BCO comfort requirements had to be relaxed. Thermal comfort bands were widened, provision for occupiers' small power loads was reduced, and blanket lighting levels were also reduced. These changes meant the office achieved future net zero energy performance targets, with modelled outcomes finding no discernible difference to occupant comfort.

Case studies where such benefits have been delivered can be a useful tool for swaying end-user perceptions, including *UKGBC's case study library*[23] of projects applying net zero carbon principles.

1
Preparation
and Briefing

RESOURCE: UKGBC Building the Case for Net Zero

UKGBC's report presents the findings of a feasibility study that shines a light on the real-world implications for achieving new net zero buildings. It illustrates how new buildings can be designed to reach net zero performance targets and the effect this has on cost.



The study looked at two real-life buildings at design stage, one residential block and one office building. The team considered the base designs and produced two further design iterations for each, one 'intermediate' scenario, aiming to meet 2025 net zero performance targets and one 'stretch' scenario with 2030 targets in mind. The targets used were drawn from work undertaken by RIBA, LETI and UKGBC, covering embodied and operational carbon.

The cost analysis found that in the 'intermediate' scenario, for the residential building, the cost uplift was only 3.5% and for the office building it was 6.2%. These costs are relatively marginal and more than likely to be at least recouped through associated increases in rental and capital value, plus reduced operational costs. Unsurprisingly, for the 'stretch' scenario the analysis for the residential building found a cost uplift of 5.3%, while for the office building the study found the uplift could be as low as 8% or as high as 17%. These findings highlight the need for supply chain innovation and investment early on to scale the market for low carbon solutions, thereby bringing down costs over time.

STAGE 2: CONCEPT DESIGN

Barrier: Linear design process

Currently, the process for designing a building is linear and often short on time. However, to achieve net zero buildings, baseline designs will likely need to be iterated multiple times to maximise operational energy efficiency and reduce embodied carbon.

This will be particularly likely for design teams with limited experience designing beyond Building Regulations and/or working with low carbon design strategies. The linear design process is additionally challenging when having to balance other project objectives, such as cost and climate resilience, while changes to aesthetics and space uses may also require reconsideration.

Opportunity: Embrace an iterative design process

Designing to net zero requires an evidence-based approach, using a whole life carbon assessment and accurate energy modelling to inform decisions about where carbon savings can be made and any resulting trade-offs.

Design teams need to be given the autonomy and liberty to iterate the building's design to achieve the overarching environmental vision. Net zero carbon outcomes should sit alongside the design specification in the brief, to empower design teams to reiterate designs multiple times in order to meet as many of their objectives as possible. The range of KPIs set should be monitored across these different iterations.

This enables teams to think innovatively to adjust project parameters and be granted consent by the client for doing so. Experienced design team members may be needed at this stage to manage design requirements which might conflict with net zero carbon outcomes. Additional time should also be allowed for feasibility studies to take place, which will need to be factored into the appointments, fees and programme.

An example of this is design stage carbon reduction targets detailed in the brief. This could help inform the overall massing and form of the building (e.g. avoidance of complex structures, designing façades to optimise glazing), along with types and quantities of construction materials to meet the design targets.

2
Concept
Design

Barrier: Limited use of timber in construction

Current UK fire regulations restricting the construction of timber buildings to 11 metres is a significant barrier to the use of this low carbon product. Even if there is a future relaxation in the UK's regulatory environment that promotes the construction of tall timber buildings, it will take some time to address market perceptions and insurance/ investor concerns of fire risk.

This includes residents gaining a greater sense of ease living in tall timber buildings, and the insurance market appropriately pricing the cost of timber buildings with no discernible difference due to fire safety.

Opportunity: Provide evidence on the use of timber

Achieving net zero targets for embodied carbon will be challenging without at least a partial shift towards timber construction, in addition to utilising low carbon concrete and steel. The implications of using a timber structure must be identified in the concept and technical design stages to ensure realistic expectations are set and that project briefs can still be adjusted. For example, full timber or hybrid timber structures can have additional impacts on the design of buildings that designers need to be aware of, including larger sized structural zones which can reduce useable floor area.

Case studies can be used to present the benefits of timber, including the ability to sequester carbon and meet net zero embodied carbon targets. Timber-steel hybrid structures can also be proposed as viable interim solution, particularly if there is an opportunity for steel reuse.

International case studies – for example from Scandinavia, the US and Canada – help to demonstrate how other markets are embracing tall timber buildings and studies are showing that their fire performance can be as good as conventional steel and concrete buildings.[24,25] Additional UK studies into the fire safety of timber buildings may also help to improve the market perception of tall timber buildings and promote their uptake.

Barrier: Limited reuse of existing buildings and materials

Over 50,000 buildings are demolished in the UK every year; while 90% of the waste is recovered, much is recycled into less valuable products or materials rather than being reused.[26]

If the reuse of existing buildings, or parts thereof (e.g. structure, other building elements), and the prioritisation of circular economy principles are not explored early in the project, significant carbon savings can be missed and there will be limited opportunities to reduce embodied carbon further on in the delivery process.

Opportunity: Adopt the principle of maximising reuse

Significant embodied carbon savings can be made from the reuse of existing buildings and by recovering materials and products for reuse. This is one of the five 'Circular Economy Principles for Construction' identified by UKGBC and specific guidance is available in the *How-to Guide: Reusing products and materials in built assets*.[27]

The reuse of building and materials also has the potential to significantly reduce costs.[28] One study looking at the recycling and reuse of steel at the end of life of two buildings found that clients could realise cost savings of up to 16% or 25% per tonne of steel compared to conventional construction, in addition to embodied carbon savings of 6–27% for a warehouse, 9–43% for an office and 2–10% for a whole building.[29]

There are additional wider benefits to retrofitting buildings for reuse, such as maintaining heritage value, avoiding disruptive new construction, and retaining the natural capital of greenfield sites. These benefits can help with achieving wider sustainability KPIs and company goals, and with gaining planning permission.

2
Concept Design

CASE STUDY: Maximising Reuse

1 Triton Square is a commercial office property owned by British Land that was due to be adapted for today's working lifestyles, twenty years after its initial development in the 1990s. Instead of demolishing the building and starting anew, British Land took a circular economy approach by choosing to retain and reuse as much of the existing structure as possible. This approach had several significant positive impacts:

- 3,300 m² of limestone, 35,000 tonnes of concrete and 1,900 tonnes of steel were reused.
- As much of the façades and superstructure was retained as possible, while adding three floors and doubling the net office area, all without increasing the amount of plant space. For the façade, 3,500 m² of panels (equivalent to over a dozen tennis courts) were removed and transported to a pop-up factory less than 30 miles away. Here, each one was inspected, deep cleaned, refurbished and new gaskets fitted before reinstallation. It was initially proposed to send the panels to Germany for refurbishment, but establishing a pop-up factory nearby saved 25,000 transport miles, cutting carbon and supporting UK jobs.
- A BREEAM Outstanding sustainability rating for the design stage was achieved with very little cost for upgrading from BREEAM Excellent: roughly 0.3% of capital expenditure, compared to a perceived industry norm of around 5%.
- Overall, a 44% carbon saving in construction and operation was achieved versus a typical new build alternative. This exceeds the reduction curve for the UK's current carbon target, set out in the Climate Change Act to meet our commitment to the Paris Agreement.

STAGE 3: SPATIAL COORDINATION

Barrier: Value engineering net zero specifications

Environmental design strategies are sometimes lost or downgraded at the tender stage with limited value placed on achieving their outcomes, including net zero carbon. This can lead to the required design components being value engineered out of the project for reasons of cost and risk reduction.

Opportunity: Use net zero outcome-based procurement

Net zero carbon design strategies, such as material specifications and building systems, should be inherently linked to the project's outcomes and considered as non-negotiables throughout the tender stage. Where these direct links are made, project teams will understand the prioritisation of net zero carbon outcomes and consider embracing these, rather than simply value engineering them out.

Outcome-based procurement can be used alongside third-party verification or certification (see *Stage 6: Handover*) as a means of encouraging project teams to work towards a single, clearly defined outcome. Project requirements can be set against clear deliverables (e.g. to achieve a particular credit, or carbon saving), allowing delivery partners to take greater responsibility and ownership in achieving net zero carbon outcomes.

3
Spatial Coordination

CASE STUDY: Outcome-based Procurement

At *80 Charlotte Street*, Derwent London challenged the design team to create a building that would accelerate progress to a low carbon future. As the Group's first all-electric building, it will use air source heat pumps for all heating and cooling needs. To ensure the building is net zero carbon, it will be powered by renewable electricity and optimise energy efficiency in operation; embodied carbon was also reduced during development and Derwent London will offset residual carbon emissions that cannot be eliminated.

Arup carried out a detailed embodied carbon study early on, which has been tracked throughout the project. To further reduce embodied carbon, the Sustainable Procurement Policy focused on use of responsibly sourced materials, materials with a high recycled content and regional materials, along with waste minimisation and recycling. Informed by this project, all future Derwent London projects will undergo carbon appraisals, as well as financial appraisals. The Group is now targeting all-electric heating and cooling systems for new development projects, as part of its net zero carbon ambition.

STAGE 4: TECHNICAL DESIGN

Barrier: Prevailing market expectations

Prevailing market expectations and perceived standards for certain features of new buildings may conflict with the design changes needed to achieve net zero performance targets. These can range from aesthetic changes to how the building is operated.

A clear example is the expectation that city office buildings will be completed with a BCO Category A fitout to maximise appeal during the leasing stages. This can result in the overprovision of building systems (increased operational carbon) and fitout finishes that are typically removed by the incoming occupier (increased embodied carbon).

Opportunity: Communicate the positive outcomes from design changes

Developers need to adjust the expectations of investors, owners and occupiers throughout the delivery process to balance the final building product with the project's net zero carbon aspirations. These expectations should be set early in the development's narrative and can instead be used to positively market the development as superior in other aspects, such as mitigating climate change.

Below are some examples from UKGBC's *Building the Case for Net Zero* report where standard market expectations for offices had to be adjusted in order to meet net zero performance targets:

- Avoidance of suspended ceilings and minimal interior fitout complexity to reduce embodied carbon and allow the incoming occupier the opportunity to have greater influence.
- Automatic shutdown of building systems at evenings and weekend (e.g. HVAC, lighting, IT shut down at 7pm) to encourage manual occupant control for specific out-of-hours use, if necessary.
- Reduction of occupier lighting, small power and IT loads (e.g. removal of occupier server room), using advanced energy modelling, to reduce the overprovision of building systems.

Occupiers will rarely ask for such specifications and instead focus on other considerations, for example, access to green space, increasing productivity, and space efficiency. It is up to the developer to ensure they are comfortable working with clients to adjust pre-existing market expectations in order to meet net zero carbon goals.

4
Technical Design

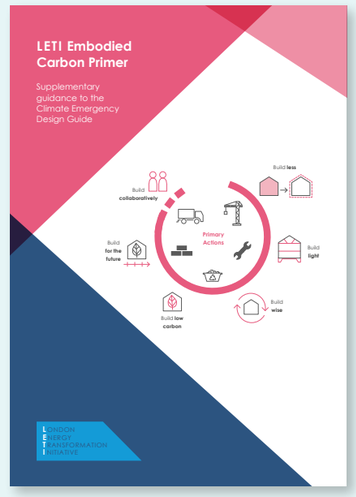
RESOURCE: LETI Climate Emergency Design Guide & Embodied Carbon Primer

LETI's Climate Emergency Design Guide outlines the requirements of new buildings to ensure the UK's climate change targets are met - setting out a definitive journey, beyond climate emergency declarations, into a net zero carbon future. It aims to help to define 'good' and to set clear and achievable targets. The guide includes requirements for four key building archetypes: small scale residential, medium/large scale residential, commercial offices, and schools.

The guide seeks to:

- Aid clients and developers in setting briefs and strategies both at organisational and project levels, which are required to develop net zero carbon buildings.
- Support design teams with easy-to-follow best practice guidance on delivering net zero.
- Outline to planners, policymakers, local and central government what to expect for the delivery and hence the policy framework needed for net zero carbon new buildings.

LETI's Embodied Carbon Primer provides designers including architects, engineers, interior designers and urban designers with easy-to-follow best practice guidance and toolkits for reducing embodied carbon in buildings. The document can also aid planners to be aware of strategies available to designers to reduce embodied carbon in building design, and how planning recommendations on materials, massing and treatment of sites may affect embodied carbon.



Both guides set out key actions for reducing whole life carbon by RIBA stage, allowing the guidance to be easily layered onto UKGBC's Unlocking the Delivery of Net Zero Carbon Buildings.

STAGE 5: MANUFACTURING AND CONSTRUCTION

Barrier: Limited capability and capacity in the supply chain

Constructing net zero buildings can be challenging as developers and the wider industry are only beginning to implement low carbon strategies at scale.

Opportunity: Identify experienced delivery partners

Developers should work with suppliers and contractors who have proven experience in delivering low carbon and/or net zero buildings, by identifying at the tender stage the net zero ambitions of the development.

Building elements where this expertise is particularly relevant include:

- Airtight construction (requiring a Clerk of Works for greater site supervision).
- Installation of heat pump systems (rather than conventional gas boilers).
- Installation of modular building components (Design for Manufacture, Assembly and Disassembly).
- Commissioning (ensuring a Soft Landings approach).

Developers can proactively strengthen their value chain to help build capacity. This can include:

- Explicitly communicating net zero design ambitions to existing suppliers and contractors, and working with them to uncover solutions (new or existing).
- Requiring contractors and suppliers to consider low carbon solutions first and provide justifications for why materials and products are chosen.
- Simplifying building designs to include already existing low carbon opportunities (e.g. switching to air source heat pumps), rather than always defaulting to new and untested solutions.
- Including embodied carbon requirements in the tender pack and requiring a whole life carbon assessment for the main contractor to assess where the most significant impacts in the value chain lie.

5
Manufacturing and Construction

Barrier: Compressed timelines leading to inefficient outcomes

Compressed construction timelines can often lead to poor performance outcomes. The pre-handover stage can be especially rushed as delivery teams are liable to meet strict deadlines for completion or otherwise face financial penalties. This can lead to overlooking responsibilities that may be considered non-critical at the time but result in carbon inefficient outcomes.

Opportunity: Allow time for net zero strategies to be tested

Sufficient time should be allocated in the programme, beyond completion and into occupation, to allow for proper building commissioning, tuning and handover. This can include, for example:

- Structural piling tests.
- HVAC and control system tests.
- Building air tightness tests.

Undertaking this testing for net zero design strategies can potentially mean allowing additional time in the construction programme, early in the planning stages. However, in some instances, using innovative construction methods can actually achieve both carbon and time savings (e.g. using DfMA, modular or timber construction)[30] freeing up time elsewhere in the construction programme.

Bearing these considerations in mind, it is important for developers and project teams to set realistic time projections early on for how they will deliver high-quality, net zero carbon outcomes in order to avoid unexpected impacts to the construction programme.

CASE STUDY: Construction Innovation

The *Brock Commons Tallwood House* is a student dormitory on the University of British Columbia's campus. One of Canada's tallest timber buildings, the 18-storey residential development provides accommodation for 400 students.

The hybrid structure of the building is composed of:

- Prefabricated cross-laminated timber (CLT) floor panels, supported on glue-laminated timber (GLT) and parallel strand lumber (PSL) columns;
- Cast-in-place concrete foundations, ground floor, and elevator/stair cores;
- Steel connections and roof structure.

Some additional benefits included:

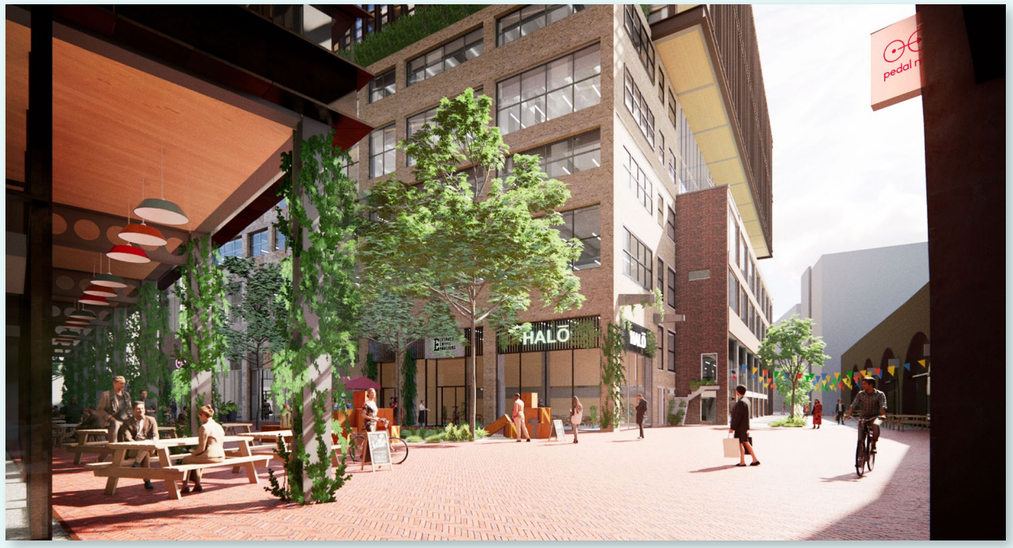
- A shortened construction time due to the use of prefabricated elements. The construction was completed less than 70 days after the prefabricated components arrived on site, with a 9-person onsite team. This was approximately two months faster than a typical project of this size.
- A reduction in on-site waste by about two thirds with the use of pre-fabricated elements.
- Less traffic around the construction site.
- Reduced noise impact on neighbours.

5
Manufacturing
and Construction

CASE STUDY: Construction Innovation

Timber Square is a 370,000 sq ft mixed use scheme in central London. The developer Landsec and architect Bennetts Associates vision is for a development that is net zero carbon with healthy, flexible and inspirational spaces. Located in Bankside, the ambition for the former printworks responds to the existing vibrancy of the area while accounting for the evolving nature of workplace, all whilst keeping sustainability at the heart of the project.

Operational, embodied and construction transport emissions will be about half those of a typical new office building. This will be achieved by reusing large parts of the existing structure and by using cross laminated timber (CLT) alongside steel as an innovative construction technique. Using timber overtly in the design, and maximising daylight and outside views offer an additional emphasis on wellbeing, alongside the sustainability benefits.



STAGE 6: HANDOVER

Barrier: Limited market recognition of net zero buildings

Currently, there is no recognised certification scheme or other metric to demonstrate that a building is net zero carbon in terms of construction, operation, or whole life. Without this, developers and owners can be reluctant to invest in delivering a net zero building as they feel it will not be recognised within the market and, therefore, achieve enhanced value.

Opportunity: Verify net zero outcomes

Verification of as-built outcomes via market recognised schemes is crucial to gaining greater uptake for new zero carbon buildings. This can help in securing green financing from investors seeking assurance in reported outcomes and avoid 'greenwashing' by providing the market with confidence on what has been achieved, often in non-technical terms.

NABERS UK[31] can be used for new office developments using a 'Design for Performance Agreement' whereby energy performance is targeted and simulated throughout design and verified once the building is fully occupied. This significantly reduces the risk of a 'performance gap' and guarantees in-use energy performance for investors. The metering and monitoring requirements for NABERS UK is additionally favourable with asset managers as the measurement of in-use energy becomes a key issue, over design initiatives alone.

Other recognised schemes that measure actual building performance include *BREEAM In-Use*,[32] *Display Energy Certificates*[33] and, for residential buildings, the *Home Quality Mark*.[34] These schemes can also be utilised to clearly demonstrate the operational cost benefits of low carbon buildings to investors and occupiers, rather than design certifications alone.

Currently, building developers, owners or occupiers can use UKGBC's *Net Zero Carbon Buildings Framework*[35] to demonstrate how a building, tenancy or portfolio of buildings has achieved net zero carbon, either for construction or operational energy. UKGBC is now exploring the options for developing an explicit net zero 'badge' for buildings. This could potentially utilise the certification schemes listed above as routes to demonstrating actual building performance, in addition to any other steps to achieving a net zero carbon balance.

6
Handover

Barrier: As-built outcomes fall short of design

The 'performance gap' in buildings is a significant barrier to achieving highly efficient, low energy and/or low carbon buildings. This can often be attributed to issues such as: ineffective transfer of knowledge from design and construction teams to building operators; minimal post-occupancy energy monitoring; occupiers not operating the space as expected; and a lack of procedures for accessing in-use energy data.

Opportunity: Implement a Soft Landings approach

BSRIA's *Soft Landings*[36] approach is a "building delivery process which runs through the project, from inception to completion and beyond, to ensure all decisions made during the project are based on improving operational performance of the building and meeting the client's expectations."

Developers should adopt a Soft Landings approach at the beginning of their project. This will enable them to clearly set their desired success criteria/performance targets for the building at the outset and bring the project team together to focus more on achieving these targets.

A Soft Landings approach places greater emphasis on building readiness, by giving the designer and constructor greater involvement during the pre-handover and commissioning stages. This includes ensuring there is support and training for FM teams and occupiers during initial handover and occupation.

This approach can also be used to provide clients with guarantees on net zero carbon building performance and any associated cost savings, such as reduced energy spend. This level of assurance can help justify any upfront increases in cost for low carbon design features, such as improved building fabric.

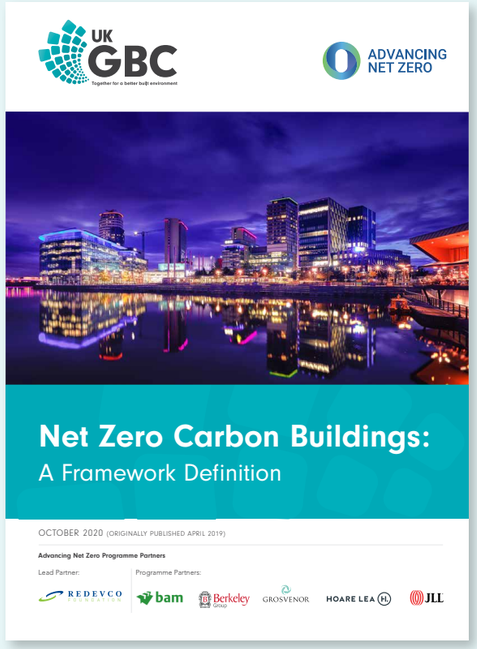
These guarantees could evolve into the more ambitious approach of 'performance contracting' where developers or contractors are paid based on the energy savings achieved from actual building performance. This innovative approach is being used in home retrofits under the European *EnergieSprong*[37] scheme and can be extended to other building types also.

RESOURCE: UKGBC Net Zero Carbon Buildings: A Framework Definition

UKGBC's framework provides clarity on the definition of net zero carbon buildings in the UK. It sets out a path to achieving net zero carbon buildings, both for construction and operation (in-use energy consumption), whilst beginning to provide direction for addressing whole life carbon.

As a freely available resource, the framework definition is intended to provide a route for building developers, owners or occupiers to demonstrate how a building, tenancy or portfolio of buildings has achieved net zero carbon via third-party verification.

A minimum level of information is required to be publicly disclosed through an easily accessible publication, such as an organisation's annual sustainability report or clearly presented on a website. The minimum reporting templates are available from UKGBC's *website*.



This approach is intended to encourage a culture of transparency in the industry and to openly share the approaches used to achieve net zero carbon. Additionally, it ensures any net zero claims are robust and stand up to public scrutiny.

UKGBC is now exploring the options for developing an explicit net zero 'badge' for buildings. This could potentially use existing certification schemes as routes to demonstrating actual building performance, in addition to any other steps to achieving a net zero carbon balance.

6
Handover

RESOURCE: BSRIA Soft Landings Framework

Soft Landings helps to solve the performance gap between design intentions and operational outcomes. This performance gap can emerge at any stage in a project:

- At inception and briefing, where ambitions and requirements are set but may not be informed by experience and feedback from other projects..
- At design, where specific performance targets are set and regulatory compliance achieved, but those targets are neither re-visited nor reality-checked during detailed design
- During construction, where budget shortfalls may compromise the best of intentions, and variations are made to the building and its technical systems that change how the building will be used.
- During handover, when commissioning and end-user training may be rushed or abandoned to meet deadlines.
- During initial occupation, where not enough support is available to occupants and the managers to ensure the building is set up for the long-term.

Soft Landings provides a step-by-step process for clients and their project teams to follow in order to avoid these pitfalls and deliver a better-performing product. It aims to create virtuous circles for all.

The Soft Landings approach is designed to give clients and their project teams a process to follow that will lead to a better chance of success. It is a change of culture as much as it is a change of process. Everyone involved has to share the ambition, and share roles and responsibilities, to make buildings tread more lightly on the earth and provide the right internal environment to foster occupant wellbeing and productivity.

STAGE 7: USE

Barrier: Net zero aspirations not translated into operation

If a Soft Landings approach has not been used it is unlikely that the teams responsible for operating the building will be aware of the procedures required to meet in-use net zero ambitions.

This can negatively impact both operational energy performance and embodied carbon during the use stage, which can be significant. For example, embodied carbon from the use stage which covers maintenance and replacement (LCA modules B1-B5) can make up 45% of an office building's whole life carbon impact.[38]

Opportunity: Communicate net zero operational requirements

Owners, managing agents, facilities managers and occupiers should be made aware of what is required to make a building operate at net zero carbon. This can include the operational and maintenance benefits that can be realised through relevant contracts and operational mandates.

BBP's *Responsible Fit-Out Toolkit for Offices*[39] is a useful guide for owners and occupiers to incorporate net zero principles into the fit out process. Other approaches can include implementing an appropriate management systems, such as *ISO 50001*[40] for energy management; adopting continuous building monitoring systems; and implementing planned maintenance programmes, to ensure in-use performance is as 'hands off' as possible.

Including recommendations for these systems and programmes during handover can help ensure owners and occupiers are aware of the benefits of maintaining the net zero vision. Integrating energy metrics within the computerized maintenance management system (CMMS) and real estate management tools can also lead to decision-making that favours the longer-term payoffs of net zero design.

7
Use

Barrier: Minimal green lease uptake

Despite their prevalence in other developed markets, such as Australia, green leases are not widespread in the UK. This can be attributed to many reasons including their complexity, limited occupant awareness, and split incentives.

Additionally, where developers divest of a new building, they may be reluctant to make binding commitments in their leases, for example, for the purchase of green energy, in case it has a negative impact on value and/or reduces the pool of potential purchasers.

Opportunity: Make green lease clauses easy to understand

Green lease clauses can help ensure building systems are used effectively after handover if they specify sustainable operational requirements for owners and/or occupiers. Owners can take the first step in promoting the uptake of green leases by clearly establishing how they will work together with occupiers to ensure that the lease benefits all parties involved.

For the owner, green leases can reduce their scope 3 emissions and potentially help lease the asset at a higher value. Occupiers benefit from lower energy bills while maintaining occupant comfort with minimal interventions on their part. As occupier emissions are increasingly incorporated within owners' net zero carbon scopes and more occupiers demand net zero spaces, achieving these targets will be impossible without greater occupier/owner collaboration.

If green leases are not feasible, alternative financing arrangements can also be explored, such as the establishment of low carbon funds by owners to assist occupiers in making improvements to their space. This could potentially be more cost-effective than having to purchase carbon offsets to account for scope 3 emissions or play catch up with more stringent regulations over time.

Barrier: Minimal post-project evaluation

While every project uncovers new learnings that can be taken forward to improve future projects, capturing this knowledge continues to be a weak spot in many project teams. Even when there is a post-project feedback session, this information needs to be taken up in practice to have an impact.

Opportunity: Share lessons learnt and report outcomes

There are existing guidelines for capturing lessons learnt and knowledge developed during or at the end of projects, such as the RICS Lessons Learned Guide,[41] which can be used as a template. Setting expectations for required project assessment can help ensure teams are capturing their learnings as they progress through the project. Long-term projects have the benefit of incorporating feedback at checkpoints during project delivery. Any lessons learnt must be incorporated during the development of future projects.

Taking time at the beginning of each new project to assess the outcomes and learnings from comparable projects can help the new project run more efficiently. Developers who invest into expanding their net zero carbon knowledge and capabilities now will benefit in the future.

7
Use

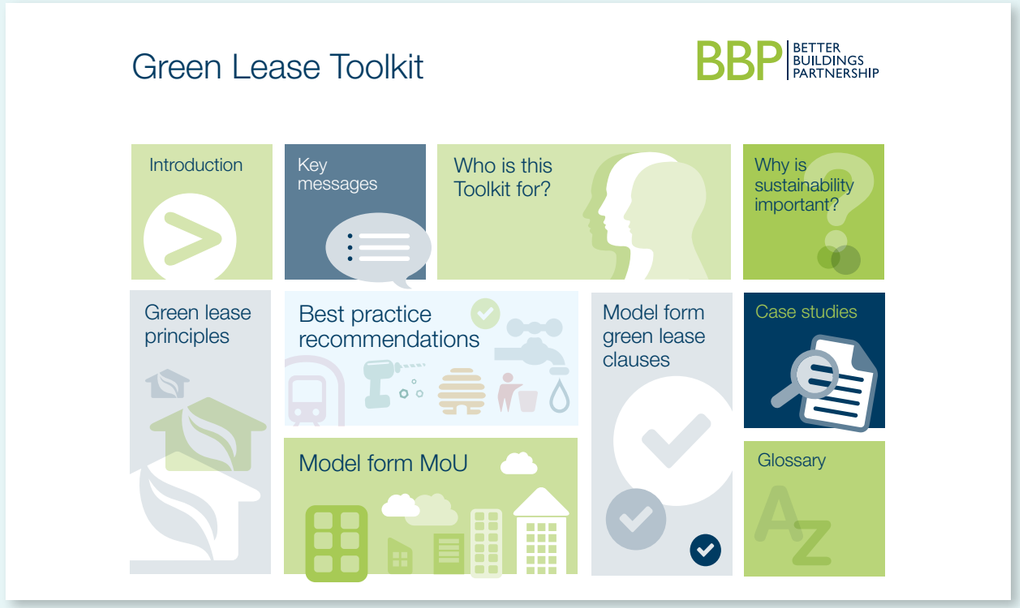
RESOURCE: BBP Green Lease Toolkit

The BBP has produced a comprehensive *Toolkit* for green leases to enable owners and occupiers of commercial buildings to work together to reduce the environmental impact of their buildings.

This guidance is non-prescriptive, helping owners and occupiers to agree carbon, energy, waste and water reduction strategies which best fit with the circumstances of individual properties. With the help of this Toolkit it is possible for any owner or occupier to positively engage in developing practical ways to effect significant positive change, ultimately accelerating the process of making the UK's existing commercial properties more sustainable.

The Toolkit includes the following:

- Non-prescriptive best practice recommendations by which, through a partnership approach, owners and occupiers can agree appropriate arrangements to best fit with the circumstances of individual properties.
- A model Memorandum of Understanding which can be used in full or in part and which parties can enter into at any stage of a lease.
- Model Form Green Lease Clauses which the BBP believes should be included in new and renewal leases as a minimum as best practice. The extent to which these clauses are used will depend on the parties' ambitions and what is appropriate for individual circumstances.



Conclusion

Current market trends stemming from investor pressure, stranded asset risks, corporate sustainability drivers, and legislation mean that the demand for, and value of, net zero buildings is set to increase. Whilst the property and construction sector is increasingly improving its knowledge of how to design net zero carbon buildings, significant changes are needed throughout the delivery stages to ensure outcomes meet the initial aspirations.

This report sets out opportunities for how to overcome existing barriers, and we hope it helps unlock the delivery of more net zero buildings. However, it is not able to provide all the answers and UKGBC intends to build on this work as new knowledge is gained and solutions uncovered.

UKGBC's Advancing Net Zero programme will continue to work with the industry to refine the scope of net zero buildings, provide guidance on how to achieve such buildings, and the business case for doing so. In 2021, we expect the outputs to include a cost evaluation of a net zero large-scale housing development and a study into the financial value of low and zero carbon buildings. Meanwhile, we will also be leading the development of a Whole Life Carbon Roadmap for the built environment, to be unveiled at COP26, the international climate conference in November 2021.

We hope that owners, investors, developers, contractors, designers, and others in the supply chain, find this guidance useful on their journey to net zero carbon, that they continue to collaborate on this shared challenge, and that as they gain new insights they share them for the collective benefit of all.

References

1 UKGBC (2019), Net Zero Carbon Buildings: A framework definition: *https://www.ukgbc.org/ukgbc-work/net-zero-carbon-buildings-a-framework-definition*

2 UKGBC (2020), Building the Case for Net Zero: A feasibility study into the design, delivery and cost of new net zero carbon buildings: *https://www.ukgbc.org/ukgbc-work/building-the-case-for-net-zero/*

3 Committee on Climate Change (2020), Reducing UK emissions: 2020 Progress Report to Parliament: *https://www.theccc.org.uk/publication/reducing-uk-emissions-2020-progress-report-to-parliament*

4 Royal Institution of Chartered Surveyors (2017), Whole life carbon assessment for the built environment: *https://www.rics.org/uk/upholding-professional-standards/sector-standards/building-surveying/whole-life-carbon-assessment-for-the-built-environment*

5 UKGBC (2020), Building the Case for Net Zero: A feasibility study into the design, delivery and cost of new net zero carbon buildings: *https://www.ukgbc.org/ukgbc-work/building-the-case-for-net-zero/*

6 UKGBC (2019), Circular economy guidance for construction clients: How to practically apply circular economy principles at the project brief stage: *https://www.ukgbc.org/ukgbc-work/circular-economy-guidance-for-construction-clients-how-to-practically-apply-circular-economy-principles-at-the-project-brief-stage/*

7 London Energy Transformation Initiative (2019), LETI 2020 Workstreams: *https://www.leti.london/*

8 UKGBC (2019), WorldGBC Net Zero Carbon Buildings Commitment: *https://www.ukgbc.org/ukgbc-work/thecommitment/*

9 Building Services Research and Information Association (2018), Soft Landings Core Principles 2nd edition: *https://www.bsria.com/uk/product/BxP8EB/soft_landings_core_principles_2nd_edition*

10 Better Buildings Partnership (2020), Net Zero Carbon Pathway Framework: *https://www.betterbuildingspartnership.co.uk/net-zero-carbon-pathway-framework*

11 World Green Building Council (2020), The Net Zero Carbon Buildings Commitment: *https://www.worldgbc.org/thecommitment*

12 JLL (2020), The Impact of Sustainability on Value: *https://www.jll.co.uk/en/trends-and-insights/research/the-impact-of-sustainability-on-value*

13 Science Based Targets Initiative (2020): *https://sciencebasedtargets.org/*

14 UNEP Finance Initiative (2020), Institutional investors transitioning their portfolios to net zero GHG emissions by 2050: *https://www.unepfi.org/net-zero-alliance/*

15 The Guardian (2020), UK to make climate risk reports mandatory for large companies: *https://www.theguardian.com/environment/2020/nov/09/uk-to-make-climate-risk-reports-mandatory-for-large-companies*

16 Task Force on Climate-related Financial Disclosures (2020): *https://www.fsb-tcfd.org/*

17 Carbon Risk Real Estate Monitor (2020): *https://www.crrem.eu/tool/*

18 UKGBC (2020), Net zero carbon: energy performance targets for offices: *https://www.ukgbc.org/ukgbc-work/net-zero-carbon-energy-performance-targets-for-offices/*

19 UK Government (2019), Green Finance Strategy: *https://www.gov.uk/government/publications/green-finance-strategy*

20 UNEPFI (2019), Global ESG Real Estate Investment Survey Results: *https://www.unepfi.org/wordpress/wp-content/uploads/2019/03/Global-ESG-Real-Estate-Investment-Survey-Results.pdf*

21 NatWest Group (2020), NatWest launches Green Mortgages: *https://www.natwestgroup.com/news/2020/11/natwest-launches-green-mortgages.html*

22 Derwent London (2019), Derwent London first UK REIT to sign Green Revolving Credit Facility: *https://www.derwentlondon.com/media/news/article/derwent-london-first-uk-reit-to-sign-green-revolving-credit-facility*

23 UKGBC (2020), Case study library: *https://www.ukgbc.org/our-work/case-studies/*

24 Department for Communities and Local Government (2012), Analysis of fires in buildings of timber framed construction, England, 2009-10 to 2011-12: *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/66062/Timber_frame_analysis_17_Jan.pdf*

25 Structural Timber Association (2017), Structural Timber Buildings Fire Safety in Use Guidance Volumes 1 and 2 (requires registration): *http://www.structuraltimber.co.uk/links/research-documents*

26 Architects Journal (2019). Introducing RetroFirst: a new AJ campaign championing reuse in the built environment. Available at: *https://www.architectsjournal.co.uk/news/introducing-retrofirst-a-new-aj-campaign-championing-reuse-in-the-built-environment/10044359.article*

27 UKGBC (2020), How-to Guide: Reusing products and materials in built assets: *https://www.ukgbc.org/ukgbc-work/circular-economy-implementation-packs/*

28 Patrizia Ghisellini, Maddalena Ripa, and Sergio Ulgati (2018), Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector. A literature review, Journal of Cleaner Production, 178:618-643. DOI: *https://doi-org.ludwig.lub.lu.se/10.1016/j.jclepro.2017.11.207*

29 Arup (2016), The Circular Economy in the Built Environment: *https://www.arup.com/perspectives/publications/research/section/circular-economy-in-the-built-environment*

30 Capital Projects & Infrastructure (2019), Modular construction: From projects to products: *https://www.mckinsey.com/~/media/mckinsey/industries/capital%20projects%20and%20infrastructure/our%20insights/modular%20construction%20from%20projects%20to%20products%20new/modular-construction-from-projects-to-products-full-report-new.ashx*

31 National Australian Built Environment Rating System (2020), NABERS UK: *www.nabers.gov.au/nabers-uk*

32 Building Research Establishment (2020), BREEAM In-Use: *https://www.breeam.com/discover/technical-standards/breeam-in-use/*

33 UK Government (2020), Check a public building's Display Energy Certificate: *https://www.gov.uk/check-energy-performance-public-building*

34 Home Quality Mark (2020): *https://www.homequalitymark.com/*

35 UKGBC (2020), Verifying net zero carbon buildings: *https://www.ukgbc.org/ukgbc-work/verifying-net-zero-carbon-buildings/*

36 Building Services Research and Information Association (2020), Soft Landings: *https://www.bsria.com/uk/consultancy/project-improvement/soft-landings/*

37 EnergieSprong (2020): *https://energiesprong.org/*

38 LETI (2020), Climate Emergency Design Guide: *https://www.leti.london/cedg*

39 Better Buildings Partnership (2018), Responsible Fit-Out Toolkit: *https://www.betterbuildingspartnership.co.uk/responsible-fit-out-toolkit-offices*

40 International Organization for Standardisation (2018), ISO 50001 Energy Management Systems: *https://www.iso.org/iso-50001-energy-management.html*

41 Royal Institute of Chartered Surveyors (2016), Lessons Learnt: *https://www.rics.org/uk/upholding-professional-standards/sector-standards/construction/lessons-learned/*

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QUESTIONS & FEEDBACK

This guidance aims to enable the delivery of net zero carbon buildings. We welcome input from any interested stakeholders on the content and other follow up resources.

If you have any questions on the guidance or would like to provide feedback, please email *ANZ@ukgbc.org*.

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